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Climate Change Hearings [2]

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S	21	4	11	3

Responses to Senator Chafee's Questions

1. The President, Members of the Cabinet and Senior White House officials have meeting with with a wide range of parties interested in the issue of global climate change. We have been consulting with representatives from business and labor, environmental groups, scientists, economists and others about the best, most cost-effective way to reduce greenhouse gas emissions. On October 6, the White House will hold a conference to discuss the scientific evidence, the economic impact and the international implications of global climate change. These discussions are intended to inform the Administration's decision-making process, which will culminate in a U.S. policy position for the international negotiations in Kyoto in December of this year.

With the lessons we have learned so far, the Administration has established a broad framework within which this policy position will be developed. For example, we support the use of flexible approaches, such ~~as joint implementation and~~ international emissions trading. We support the requirement that non-Annex I countries, as they become wealthier, abide to binding emissions goals. And, for domestic implementation, we support the use of flexible, market based approaches.

Draw on Q1 from Txt JF's

2. No one model, or even a small set of models, can give a definite estimate of the effects of a policy on the economy 20 or 30 years into the future. There are a vast array of economic tools that provide us with a basis for informed judgment about the likely effects of different climate policies. For example, we know that a market based approach to reducing carbon emissions will be less costly than a command and control approach.

In developing a climate change policy, the Administration intends to bring to bear many analytic tools and perspectives found in the economics literature. Some of these may have strengths on issues where the models used in the IAT analysis were weak. I am confident that the analytic tools and perspectives available to the Administration can provide us with sufficient information to generate ranges of economic effects so that the Administration can make informed policy decisions.

3. At this time, the Administration has not settled on a particular set of policies. The Administration is considering an array of market based approaches to implement climate policy.

4. Tradeable emissions permits and energy taxes share several important characteristics. First, they both send a price signal to markets that would stimulate the development and adoption of energy efficient technologies. Second, they both provide flexibility to achieve emissions goals. In the case of tradeable permits, firms that find it very costly to reduce emissions may purchase permits from firms that find it less costly. In the case of taxes, firms would reduce their energy use until it became more costly than the tax. These both achieve emissions reductions at substantially lower costs than through command and control approaches.

Tradeable emissions permits would provide greater certainty than energy taxes of attaining a specified emissions cap. By specifying a number of permits and allowing firms to trade these permits, the country can ensure that it is meeting an agreed upon carbon emissions goal. A tax, on the other hand, would provide greater certainty than a cap-and-trade approach of limiting costs, since the increase in unit costs would be determined by the tax.

5. For international emissions trading, all countries participating in the trading scheme will need to have their emissions capped.

International emissions trading can significantly decrease the costs of meeting an emissions goal. It would provide greater opportunities to reduce emissions at low costs. If some of the emissions reductions necessary to achieve the U.S. goal can be undertaken in other countries at lower costs, then U.S. emissions control costs will fall. Various modeling efforts have shown that the costs of achieving a variety of emissions goals could decrease by more than half.

incorporate CH from T+T

For joint implementation, all countries may participate, regardless of when their emissions will be capped. Lower cost abatement opportunities abroad again suggest substantial savings to the United States could result if U.S. companies could receive credit for incremental abatement efforts in other counties.

6. Some innovation surely occurs in the absence of a price signal. Many studies suggest that energy use relative to GDP falls each year regardless of the price signal by 0.5 to 1.25 percent. To the extent that energy use is associated with climate change effects, and this causes damages not reflected in market prices, this innovation is unlikely to be sufficient. Additional incentives to innovation, such as price signals, or support for R&D may be needed.

Composition shift

7. Some observers of the climate change issue have suggested that capping only developed countries' emission will result in "leakage": the escape of jobs, capital, and polluting activity to developing countries. However, the economic evidence does not support the argument that climate policy will adversely affect U.S. economic competitiveness.

First, non-tradeable sectors account for a substantial share of carbon emissions. Transportation and residential and commercial buildings account for approximately two-thirds of U.S. carbon emissions. For these sectors, the "competitiveness" argument does not appear applicable. Second, energy costs comprise only a small percentage of total manufacturing costs. According to the 1995 Annual Census of Manufactures, energy costs for manufacturing industries averaged just 2.2% of total costs. Given the small share of energy in total costs, differential shifts in existing energy prices are unlikely to have substantial effects on location decisions and trade flows. Third, our experience in this country with environmental regulation has ~~been~~ that it does not cause significant leakage. Firms that decide to relocate to other countries do so because of international differences in labor costs, capital costs, material costs, and exchange rate changes that all swamp the costs of complying with environmental regulations.

To address the possibility of leakage occurring, we should do climate policy smart. If we do it dumb, it will cost our economy a lot. By doing it smart, through flexible, market-based approaches, we will make the costs of complying with an emissions goal much lower. In addition to using market-based approaches domestically, joint implementation and international emissions trading would also lower the costs of climate policy. These lower costs associated with a smart climate policy would decrease the economic rationale for industries to move to developing countries.

Responses to Senator Boxer's Questions

1. Some observers of the climate change issue have suggested that capping only developed countries' emissions will result in "leakage": the escape of jobs, capital, and polluting activity to developing countries. However, the economic evidence does not support the argument that climate policy will adversely affect U.S. economic competitiveness.

First, non-tradeable sectors account for a substantial share of carbon emissions. Transportation and residential and commercial buildings account for approximately two-thirds of U.S. carbon emissions. For these sectors, the "competitiveness" argument does not appear applicable. Second, energy costs comprise only a small percentage of total manufacturing costs. According to the 1995 Annual Census of Manufacturers, energy costs for manufacturing industries averaged just 2.2% of total costs. Given the small share of energy in total costs, differential shifts in existing energy prices are unlikely to have substantial effects on location decisions and trade flows. Third, our experience in this country with environmental regulation has been that it does not cause significant leakage. Firms that decide to relocate to other countries do so because of international differences in labor costs, capital costs, material costs, and exchange rate changes that all swamp the costs of complying with environmental regulations.

To ensure that climate change policy does not damage U.S. competitiveness, we need a smart climate change policy. If we do it dumb, it could cost our economy a lot. By doing it smart, through flexible, market-based approaches, we will make the costs of complying with an emissions goal much lower. In addition to using market-based approaches domestically, joint implementation and international emissions trading would also lower the costs of climate policy. These lower costs associated with a smart climate policy would decrease the economic rationale for industries to move to developing countries.

2. The costs of reducing emissions in the U.S., and in Europe and Japan depend on how all of these countries implement their policies. If the U.S. employs a market based approach, the costs will not be that high relative to Europe and Japan. Regardless of the implementation approaches used in these countries, the costs of emissions reductions are not likely to affect U.S. competitiveness. As noted above, energy costs comprise a small share of total manufacturing costs (2.2%). Further, two-thirds of carbon emissions occur in non-tradeable sectors. The

evidence on energy price differentials across countries suggests that they are not sufficient to spur firm relocation to other countries.

3. The IAT report did not focus on the benefits of reducing greenhouse gas emissions. avoid IAT
Without a benefits assessment, the IAT could not provide estimates of the positive effects on human health and the environment. In addition, the IAT did not study the effects of the risks of climate change on economic activity. However, the report did assess the impacts of climate policy on the economy. The IAT analysis confirms other economic research (for example, the recent report by the World Resources Institute) that smart climate policy can actually lead to net benefits in the long term. For example, the IAT analysis found that auctioning off tradeable permits and using the proceeds of the auction to lower income and corporate taxes would help the economy grow faster in the future than without climate policy.

4. The longer we wait to take any action can adversely affect the economic and environmental outcomes of climate policy. rewrite 1st sentence
However, we do know that more gradual efforts to reduce our carbon emissions can lower the economic costs relative to very aggressive reductions efforts while still achieving the same carbon dioxide concentration goal. For example, some international proposals to reduce carbon emissions would have Annex I countries cutting emissions to 20% below 1990 levels by 2005. Such a target would have very substantial economic costs because it does not provide enough time for the capital stock to turn over. It is very expensive to scrap the existing capital stock, while much of it is in the prime of its life, and replace it with carbon-free technology. Further, such a target would require the economy to employ existing low-carbon and carbon-free technologies while longer-term targets would provide more lead time to develop and implement superior technologies. Given that it is the stock of carbon dioxide, not the annual emissions of carbon dioxide, that drive global warming, there is an opportunity to be flexible in the timing of emissions reductions. Less aggressive paths that 1990 -20% emissions level by 2005 could achieve the same carbon dioxide concentration stabilization goal in the year 2100 by increasing carbon reductions in the future when they are less costly to the economy.

5. It is very difficult to assess the nature of the economy, and especially specific industries, 20 or 30 years into the future. If the country embarked on a policy of reducing carbon emissions, obviously the firms and industries that can creatively and cost-effectively reduce their emissions will benefit relative to their competitors. To reduce carbon emissions, it is reasonable to envision that the products and services of industries that develop energy efficient technologies and industries that develop low-carbon based energy (such as renewable energy sources including wind, solar, and biomass) would be in greater demand.

Responses to Senator Lieberman's Questions

1. The Administration's analysis on the issue of climate policy has not occurred in a vacuum. In fact, climate change has been one of the more active areas of research in economics this decade. The economic literature on climate change, complemented by the IAT report, has already done quite a lot to inform the policy development process. Based on the economic research, we have identified some of the important characteristics of the climate policy we will develop: joint implementation, international emissions trading, developing country participation, emissions budgets, and market-based, flexible domestic implementation. My interpretation of the role of economics differs -- I believe economics has informed the process, and I am confident that it will continue to play an important role in our country's deliberations over a climate policy position.

2. No one model, or even a small set of models, can give a definite estimate of the effects of a policy on the economy 20 or 30 years into the future. However, a vast array of economic tools exists to provide us with a basis for informed judgment about the likely effects of different climate policies. For example, we know that a market based approach to reducing carbon emissions will be less costly than a command and control approach. The Administration intends to bring to bear on the climate issue many analytic tools and perspectives. Some of these may have strengths on issues where the models used in the IAT analysis were weak. I am confident that the analytic tools and perspectives available to the Administration can provide us with sufficient information to generate ranges of economic effects so that the Administration can make informed policy decisions.

Responses to Senator Chafee's Questions

1. The President and his Administration are in the process of discussing the issue of climate change with all interested parties, including representatives from business and labor, environmental groups, economists and others. This process will culminate with a White House Conference on climate change in October. 6

It's not more specific on purpose?

The Administration has established a framework. For example, we support the use of flexible approaches, such as joint implementation and international emissions trading. We support the requirement that non-~~Annex I~~ countries, as they become wealthier, abide ~~to~~ by binding emissions goals. And, for domestic implementation, we support the use of flexible, market based approaches.

in international treaty negotiations

of "agree to"

See my para. pointed out, for more language

2. No one model, or even a small set of models, can give a definite estimate of the effects of a policy on the economy 20 or 30 years into the future. There are a vast array of economic tools that provide us with a basis for informed judgment about the likely effects of different climate policies. For example, we know that a market based approach to reducing carbon emissions will be less costly than a command and control approach. The Administration intends to bring to bear on the climate issue many analytic tools and perspectives. Some of these may have strengths on issues where the models used in the IAT analysis were weak. I am confident that the analytic tools and perspectives available to the Administration can provide us with sufficient information to generate ranges of economic effects so that the Administration can make informed policy decisions.

is bringing

3. At this time, the Administration has not settled on a particular set of policies. The Administration is considering an array of market based approaches to implement climate policy.

4. Tradeable emissions permits and energy taxes share several important characteristics. First, they both send a price signal to markets that would stimulate the development and adoption of energy efficient technologies, Second, they both provide flexibility to achieve emissions goals. In the case of tradeable permits, firms that find it very costly to reduce emissions ~~may~~ can purchase permits from firms that find it less costly. In the case of taxes, firms would reduce their energy use until it became more costly than the tax. These both achieve emissions reductions at substantially lower costs than through command and control approaches.

as well as conservation of energy use

Tradeable emissions permits would provide greater certainty than energy taxes of attaining a specified emissions cap. By specifying a number of permits and allowing firms to trade these permits, the country can ensure that it is meeting an agreed upon carbon emissions goal. A tax, on the other hand, would provide greater certainty than a cap-and-trade approach of limiting costs, since the increase ~~in~~ unit costs would be determined by the tax.

There might also be difference in administrative costs and transactions costs, and ease of enforcement, depending on how a permit trading system was implemented.

For Q2

JF

The existence of modeling difficulties does not mean that we can abandon rigorous economic analysis. Rather, we must employ a broad set of economic tools to analyze the policy options. The tools employed ~~in this paper~~ include results from models of the energy sector and economy over the next 25 years, including but not limited to the models that were used by the Interagency Analytical Team (IAT) earlier in this year. The survey also includes models that are designed to operate on the longer time frame that is relevant for thinking about climatological effects. Other tools include simple relevant statistics, "meta-analyses" of existing models, historical and sectoral examples, and basic economic reasoning. Drawing on this broad array of analytical tools allows an intelligent evaluation of the policy alternatives.

5. For international emissions trading, all countries participating in the trading scheme will need to have their emissions capped.

International emissions trading can significantly decrease the costs of meeting an emissions goal. It would provide greater opportunities to reduce emissions at low costs. If some of the emissions reductions necessary to achieve the U.S. goal can be undertaken in other countries at lower costs, then U.S. emissions control costs will fall. In both the IAT analysis and some other modeling efforts, the costs of achieving a variety of emissions goals could decrease by more than half. Yes but see my p. 2)

Too positive! For joint implementation, all countries may participate, regardless of when their emissions will be capped. Lower cost abatement opportunities abroad again suggest substantial savings to the U.S. could result if U.S. companies could receive credit for incremental abatement efforts in other counties.

6. Some innovation surely occurs in the absence of a price signal. Many studies suggest that energy use relative to GDP falls each year regardless of the price signal by 0.5 to 1.25 percent. (some is due to changing composition of economy To the extent that energy use is associated with climate change effects, and this causes damages not reflected in market prices, this innovation is unlikely to be sufficient. Additional incentives to innovation, such as price signals, or support for R&D may be needed.

Too sanguine! 7. Some observers of the climate change issue have suggested that capping only developed countries' emissions will result in "leakage": the escape of jobs, capital, and polluting activity to developing countries. Any time countries negotiate international treaties that would apply different rules to different countries, there is a concern about some countries gaining a competitive advantage. However, the economic evidence does not support the argument that climate policy will adversely affect overall U.S. economic competitiveness. First, non-tradeable sectors account for a substantial share of carbon emissions. Transportation and residential and commercial buildings account for approximately two-thirds of U.S. carbon emissions. For these sectors, the "competitiveness" argument does not appear applicable. Second, energy costs comprise only a small percentage of total manufacturing costs. According to the 1995 Annual Census of Manufactures, energy costs for manufacturing industries averaged just 2.2% of total costs. Given the small share of energy in total costs, differential shifts in existing energy prices are unlikely to have substantial effects on location decisions and trade flows. Third, our experience in this country with environmental regulation has been that it does not cause significant leakage. Firms that decide to relocate to other countries do so because of international differences in labor costs, capital costs, material costs, and exchange rate changes that all swamp the costs of complying with environmental regulations.

To address the possibility of leakage occurring, we should "do climate policy smart." If we do it "dumb," it will cost our economy a lot. By doing it smart, through flexible, market-based approaches, we will make the costs of complying with an emissions goal much lower. In addition to using market-based approaches domestically, joint implementation and international emissions trading would also lower the costs of climate policy. These lower costs associated with a smart climate policy would decrease the economic rationale for industries to move to developing countries.

Need to say (1) Absence of opportunity to buy low-cost emissions from participating LDCs would raise costs to us ($\approx$ 50%)
(2) free-riding + large LDC share of emissions ⇒ global emissions would continue to rise, despite Annex I sacrifices.
(3) Leakage makes it worse

For Q 5 JF

What if there is no international trading?

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

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

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

It is important also to note that the gains from international trading are highly uncertain. In the case where developing countries do not participate, the extent to which Russia and Eastern Europe are a source of low-cost emission reductions depends heavily on the extent to which they fail in the future to recover from their recent contractions in output. Discussion usually presupposes that the United States will be a net buyer of permits, and several models confirm this. (The SGM shows "1990 by 2010" leading to $8 ½ billion in U.S. permit purchases in 2010, rising to $54 billion in 2050. This is why Annex I trading reduces the permit price in the table.) The U.S., however, is the next lowest-cost major emitter among Annex I countries, after the former Communist bloc. (Europe and Japan already conserve on energy, largely via already-high energy taxes on petroleum products, so they have less scope for further reductions.) If Russia and Eastern Europe begin to grow strongly, the U..S. could become a net *seller* of permits before long. If so, international trading will result in a higher price, not a lower price. McKibbin and Wilcoxen ( ) have built the G-cubed model to explore the international dimensions of climate change policy. They find that the U.S. turns into a net seller of permits by 2020 (to the tune of $38 billion, as opposed to purchases of $2-3 billion in 2010). If this result is right, then the high prediction for the carbon price is the right one, regardless whether there is trading among Annex I countries or not (though trade in permits is still beneficial).

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Comments on Schaefer Q&As

1. Insert period after "meetings".

3. Change "accumulate" to "account for".

7. Rewrite second sentence to read: "However, the IAT process was unsuccessful in providing a definitive answer on the economic effects to support the Administration's overall decision-making process." The range of results, as specified in the draft, are less of a concern (especially since the range is in part a function of the different trading, AEEI, and revenue recycling assumptions). Of more importance are the flaws raised by the peer reviewers.

8. Rewrite second sentence to read: "As the work done by the IAT proceeded, the concerns raised by the peer reviewers called into question the benefits of continued IAT work on these economic models, given the many other competing claims on agency resources."

8. Delete from the last sentence: "given the many other competing claims on agency resources."

9. Change "models" after "situations" to "modeled".

9. The range of the IAT results are incorrect. If the context is all permit prices for all runs reported, the highest permit price is $207 in the year 2020 with Markal Macro under the 1990 - 10% case. If the context is the highest 1990 permit price, then the highest permit price is $200 with DRI under the 1990 -10% case. The $145 value only applies to the 1990 in 2010 case.

9. The third sentence should be rewritten to read: "The IAT found that the estimates of the costs to the U.S. economy of a carbon emissions reduction policy depended on several factors, including targets and timetables, the use of market based incentives, technology assumptions, implementation of international emissions permit trading, and revenue recycling."

9. Delete from the last sentence: "and indeed could produce net benefits in the long run."

10. Delete "wide" in first sentence.

11. Rewrite first sentence to read: "The IAT's analysis focused on a standard emissions target widely used in the academic literature for comparing model results."

12. Replace "or" with "and" in first sentence.

14. Delete from the last sentence: "to changed price levels."

15. Rewrite answer based on revised answer 9 (permit price range, inserting factors affecting costs).

18. Make "it" possessive in last sentence.

18. Switch "fully" and "implement" in last sentence.

25. Do we want to state that a "full assessment of the costs and benefits of action would be taken prior to committing the United States to any new legal obligation" at the end of the first paragraph?

28. Should our discussion of international emissions trading be couched in more uncertainty, given that under some targets and timetables, we are actually a net seller of permits? Further, any JI might affect the conclusion drawn at the end of this answer.

Question 7 Substitute for entire answer

Economic models cannot give definitive answers on the economic impacts of climate policy, only ranges of possible outcomes. The IAT effort provided much useful information, and reinforced how all economic modeling results - both inside and outside the government - depend critically on underlying assumptions about how the economy works and how policies are implemented.

The Administration continues to believe that climate policies can be crafted which will preserve the environment, meet our international responsibilities, meet our responsibilities to our children and grow the economy at the same time. As part of the ongoing Administration decision process, we are drawing on a number of different economic, engineering and other analyses to gauge the likely effects of policies to reduce greenhouse gas emissions.

Question 8

Substitute for second sentence:

The dependence of economic outcomes on modeling assumptions called into question the benefits of continued IAT work on economic models, given the many other competing claims on agency resources.

DRAFT --May 30, 1997

Economic Effects of

Global Climate Change Policies

Results of the Research Efforts of the

Interagency Analytical Team

June 1997

Executive Summary

Using a group of economic models with different strengths and weaknesses, the Administration's Interagency Analytic Team has analyzed the economic effects of policies to limit emissions that lead to changes in global climate.

The starting point for this analysis was a scenario in which carbon emissions in the year 2010 were reduced to their 1990 levels. This starting point was selected because it was presented in previous Administration analyses of the issue and because it has been the subject of numerous analyses by academic researchers. Cross-border trading of emissions rights (or permits) was then allowed to reduce transitional economic losses created by such a policy. This is particularly true in the short term. A dramatic acceleration of technological progress also has made the potential to reduce further economic losses, if it can be achieved, but over a longer time period. The economic losses are also reduced by policies that use any resulting revenues for the Federal budget deficit reduction or other policies, which favor investment and long-term growth.

The starting point scenario would raise the implicit price of carbon in the economy by about $100 per ton of carbon. (Actual household burdens would be somewhat offset by conservation and presumed subsequent efficiency improvements.) These higher energy costs would produce GDP losses, at peak, between 0.2 percent and 1.0 percent of GDP. The economy would thereafter bounce back, or in the worst case stabilize, so that it would soon reach its pre-policy growth path. Thus, the losses of economic output resulting from such a policy are real, but relatively small and transient. These losses are disproportionately greater for stricter targets and disproportionately smaller for more lenient ones. However, if international permit trading were established it would moderate the losses to GDP. The maximum effect on GDP under international permit trading is about half of that under no trading.

While the economy-wide losses are small, some sectors bear large burdens, particularly energy producers. Energy-intensive industries also face greater losses. But there is no evidence of a wholesale "capital flight" from the United States resulting from an emissions reduction policy. Moreover, some industries expand as the economy undergoes the adjustment to a world with fewer carbon emissions.

Introduction

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

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

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

Model Selection

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

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

The DRI model is a large disequilibrium model of the domestic economy that is particularly well suited to identify transition issues based on short-run behavior embedded into a long-run model. The DRI macroeconomic model is linked to energy, regional, and industry sub-models so that macroeconomic effects of policies are translated into the effects on specific industries and regions of the country. The link to energy sub-models provides specific detailed information about the interaction of the energy sector with the rest of the economy.[1] The DRI model also includes the interaction of the financial markets with markets for goods and services and enables the analysis of the interaction of fiscal and monetary policy with the rest of the economy.

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

The DRI model and SGM can be thought of as lying at opposite ends of an axis that measures time horizons. A second dimension of the climate change problem concerns the role of technology. Both DRI and SGM allow technological progress to move forward in response to the parameters of their models. But given the unpredictable character of innovation, the IAT concluded that a second approach would be helpful. The Markal-Macro model consists of an integrated energy supply and demand modeling system (Markal) and a macroeconomic model (Macro) useful for translating technological assumptions into economic outcomes.

The Markal-Macro model is particularly useful in answering the question, "How do we get there from here?" Markal-Macro identifies optimal, under perfect foresight, for achieving and quantified goal. Markal-Macro allows the user to control technology innovation and diffusion and its cost to the user in order to determine the levels of energy efficiencies that might be expected from a long-term policy announcement. This model also allows us to understand the implications of technology and its interaction with the economy, and helps us determine whether expected energy efficient technologies hold the key to continued economic growth.

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

[1] The majority of the DRI results reported by the IAT use DRI's own Energy sub-model. In a limited number of cases, DOE's National Energy Modeling System (NEMS) has been also used been used in conjunction with the DRI model to analyze various sensitivities.

The Base Case

The domestic energy and emissions baseline forecasts were taken from the Energy Information Administration's 1997 Annual Energy Outlook (AEO97). The DRI baseline is DRI's own October 1996 long-term forecast, adjusted in part for the Climate Change Action Plan (CCAP). It is very similar to the AEO97 forecast, but not specifically calibrated to it. The international baseline forecast was taken from the International Energy Agency's World Energy Outlook, except for the baseline forecast of the Former Soviet Union (FSU), which came from World Bank projections. The IAT then imposed, as best possible, consistency across the models with regard to projections of baseline GDP, total energy consumption, and carbon emissions. Once these were calibrated into the 3 models, the models solved for energy prices by fuel type. Thus, the baselines of the three models are consistent, but not identical.

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

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

Table 1: IAT Domestic Baseline

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

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

Table 2: IAT International Baseline
Average Annual Growth Rates (percent)

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

The Analytical "Starting Point"

The IAT began its analysis of emissions reductions policies by examining one core emissions reduction scenario. Then we explored the economic effect of changes to this scenario. The central policy modeled -- the "starting point" scenario -- is aimed at reducing carbon and other greenhouse gas emissions by stabilizing them at 1990 levels. The "starting point" scenario pursues those reductions by issuing tradable emission permits at the earliest point of energy production or when imported into the United States. The policy is announced in 2000 and its restrictions are phased-in over a ten year period, so that the policy takes full effect in 2010. The permits are initially auctioned so that all revenues generated through permits would be recycled through the economy through deficit reduction. The initial discussion of the "starting point" scenario assumes no international cooperation. An option incorporating international trading is discussed once the dynamics of the no trading "starting point" scenario have been established.

Estimates of reductions of non-carbon emissions, such as methane and forest carbon sinks, are obtained from engineering estimates outside the models. Early in the process, the IAT estimated a strike-price for these sources of $70 per ton (which turned out to be low). Appendix Table A shows baselines for, and the quantities of emissions obtained from, these non-carbon sources at this price. These carbon tons were subtracted from the emissions targets being modeled. But the cost of obtaining them was not factored back into the models ~~and~~, is therefore missing. While the engineering estimates are uncertain, the cost of abating non-carbon sources could increase the estimates of economic effects by as much as 14 percent.

The "starting point" scenario was employed as an analytical starting point for this analysis primarily because it has already been the subject of much attention within the analytical literature. Most analysts of climate change policies have used an emissions freeze in the year

2010 at 1990 levels as their framework. The IAT, therefore, used this scenario in order to facilitate comparisons of its work to that of other researchers.

Industry and regional effects, as presented here, show only the effects of the climate change policy on the industry's output (shipments plus inventory change). We considered this our first step in understanding the likely sectoral consequences of emissions reductions.

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

Unless otherwise stated, the tables and figures that follow were derived using the DRI model and using the "starting point" scenario, which does not incorporate international emissions trading. These estimates, therefore, will be at the high end of the likely range, due to both model structure and the absence of trading.

"Starting Point" Results

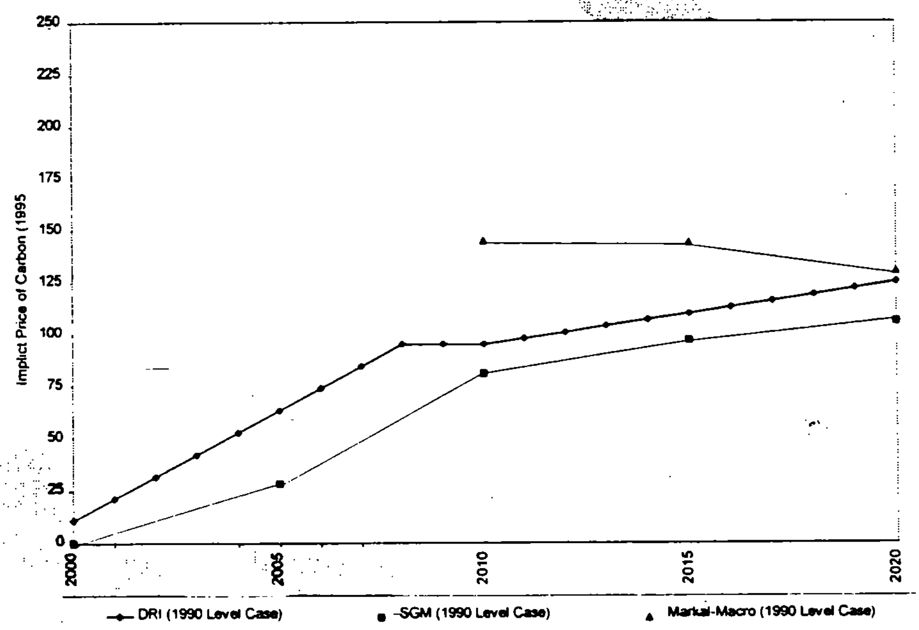
Estimates of permit prices are around $100 per ton of carbon in 2010 and rising slightly thereafter, and are consistent across models. While the three models used for this analysis vary in structure and often in terms of macroeconomic outcomes, they generate fairly consistent results as to the implicit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

Table 3: The Implicit Price of Carbon (1995$) in 2010 and 2020
1990 Level Case, No International Trading

	2010	2020
DRI-DRI Energy	95	125
SGM	81	106
Markal-Macro	145	130
NEMS	n/a	n/a

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

Figure 1: Price Path of the Implicit Price of Carbon (1995$)
1990 Level Case, No International Trading



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

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

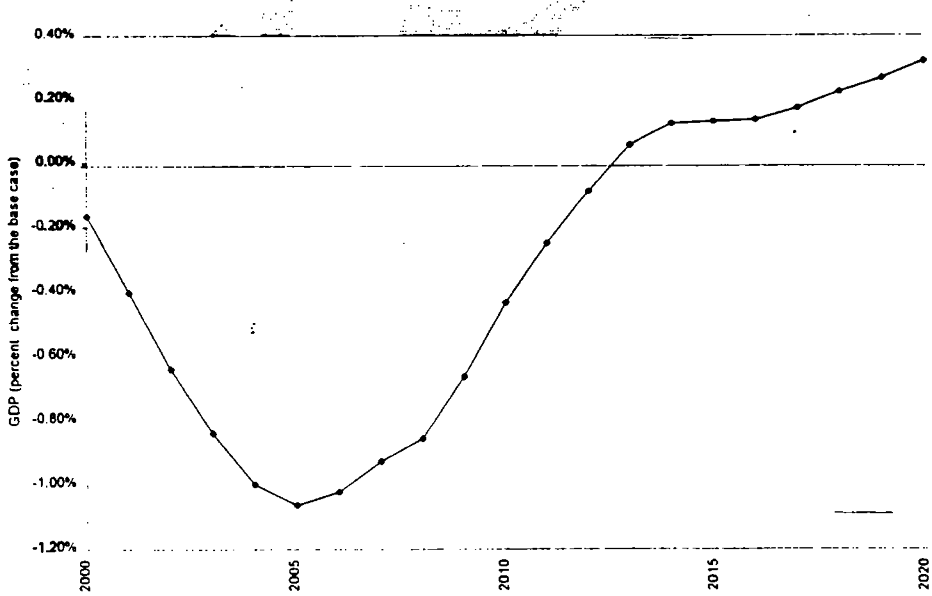
[2] The higher permit price from the Markal-Macro model reflects, in part, differences in model structure, but results mostly from differences in the calibrations of baseline emissions.

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

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

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

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

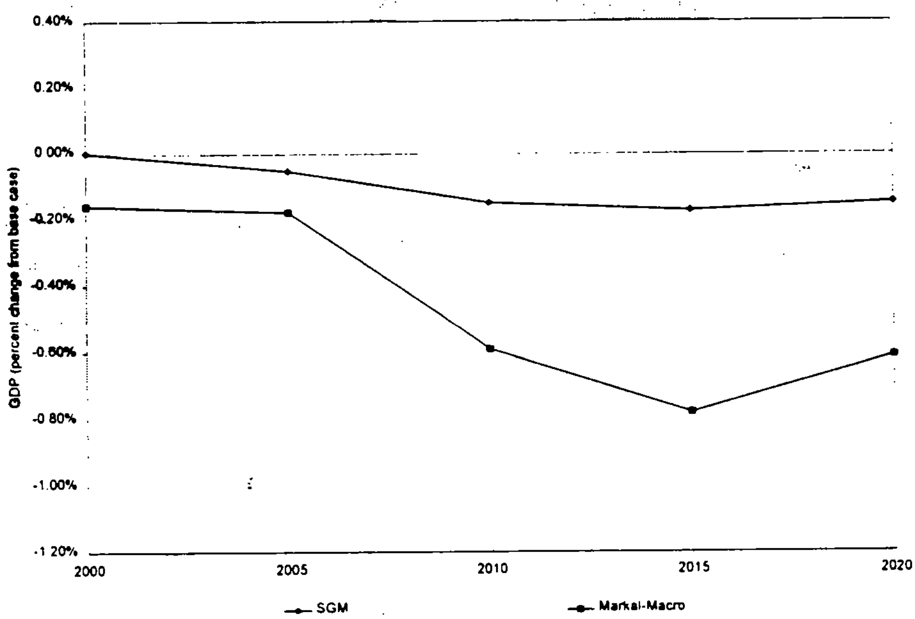


Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues used for Federal deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

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

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

Figure 3: SGM and Markal-Macro 1990 Level Case
No International Trading, Gross Domestic Product



Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues used for Federal deficit reduction and assuming a 1.25 percent annual decrease in C/GDP.

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

The models used by the IAT offer a similar picture in some regards--all show initial losses in aggregate economic output that are not very large (even the DRI peak loss is spread over five years). But they also differ in predictable ways, given their structure. A recent analysis by Dr. Robert Repetto and Dr. Dunkin Austin of the World Resources Institute examined 162 analyses of climate change policy and found that model structure can account for two-thirds of the difference in results, if environmental benefits are ignored.[3]

Disequilibrium macro models, such as DRI, tend to identify deeper transitional losses and steeper transitional rebounds. Computable general equilibrium models, such as SGM, see more sanguine short-term effects and see the economy stabilizing after a more frictionless adjustment. The SGM model, however, is less flexible than some computable general equilibrium model because it does not allow instantaneous shifts in capital. The SGM model maintains vintaged capital stock in the electricity sector and retires old electricity related capital only when it cannot cover operating expenses or reaches its fixed lifetime. This feature allows the analysis to incorporate the costs of reallocating capital stock.

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

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

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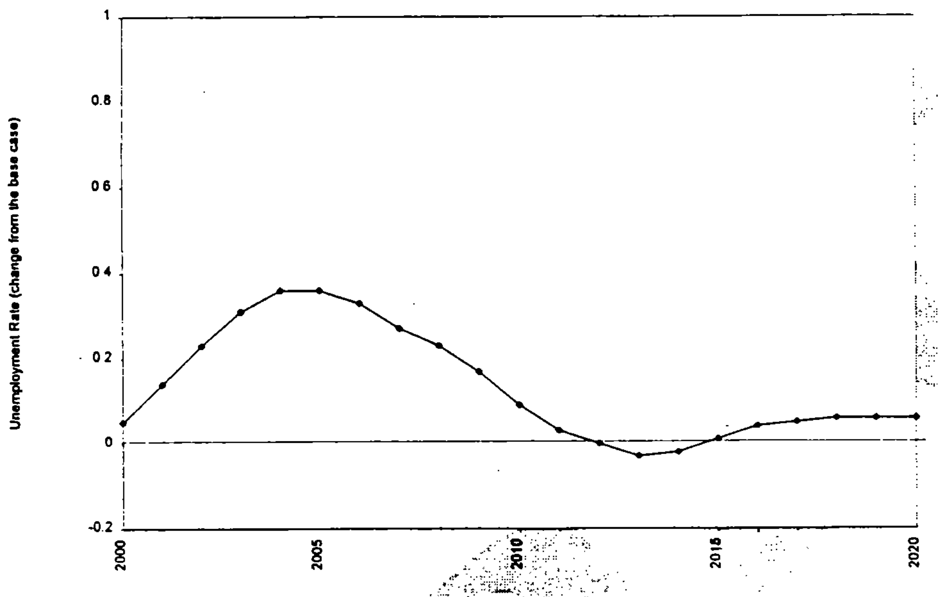
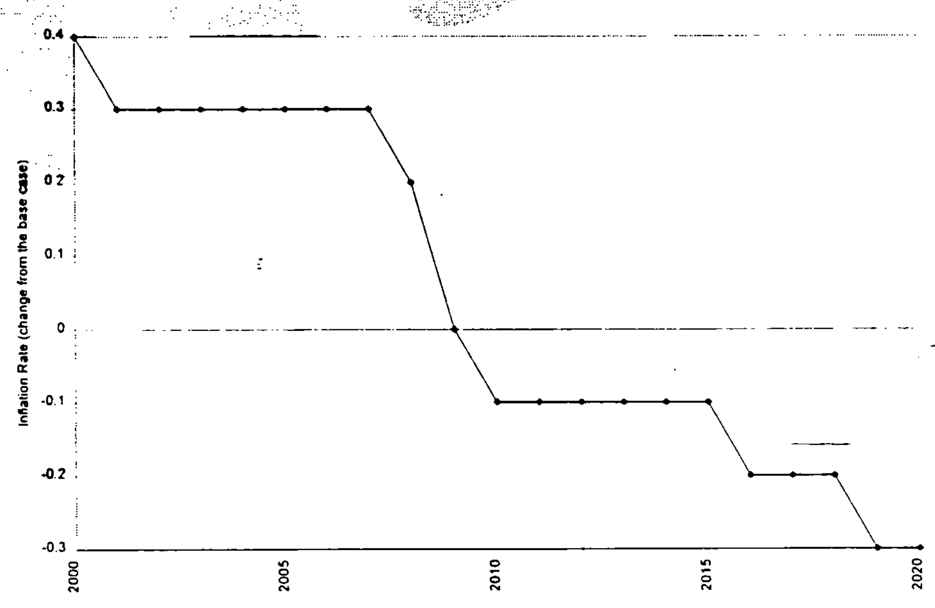
[3] Repetto, Robert and Dunkin Austin. "The Cost of Controlling CO2 Emissions: A Guide for the Perplexed." *World Resources Institute* (Forthcoming).

Figure 4: DRI-DRI Energy 1990 Level Case, No International Trading--Unemployment Rate



Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues used for Federal deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

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

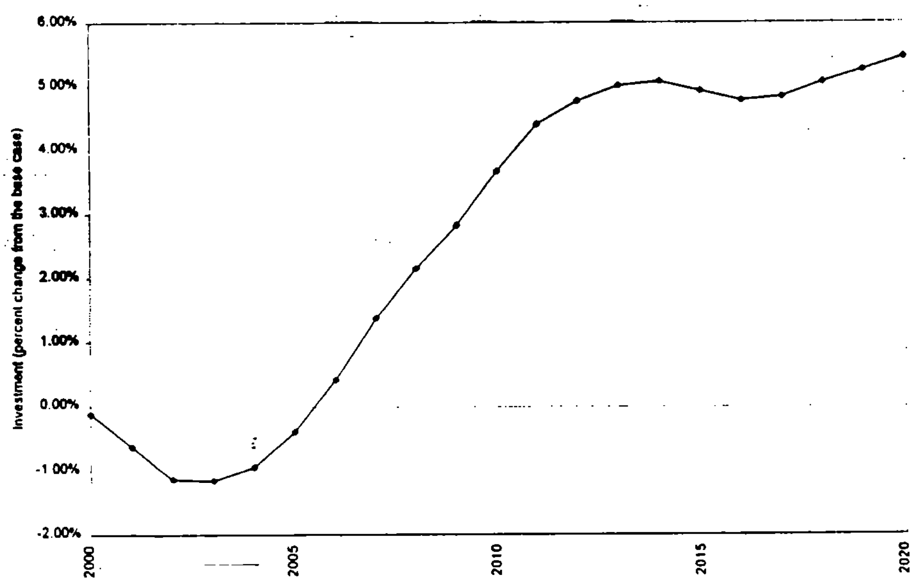


Note. Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in Revenues used for Federal deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

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

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

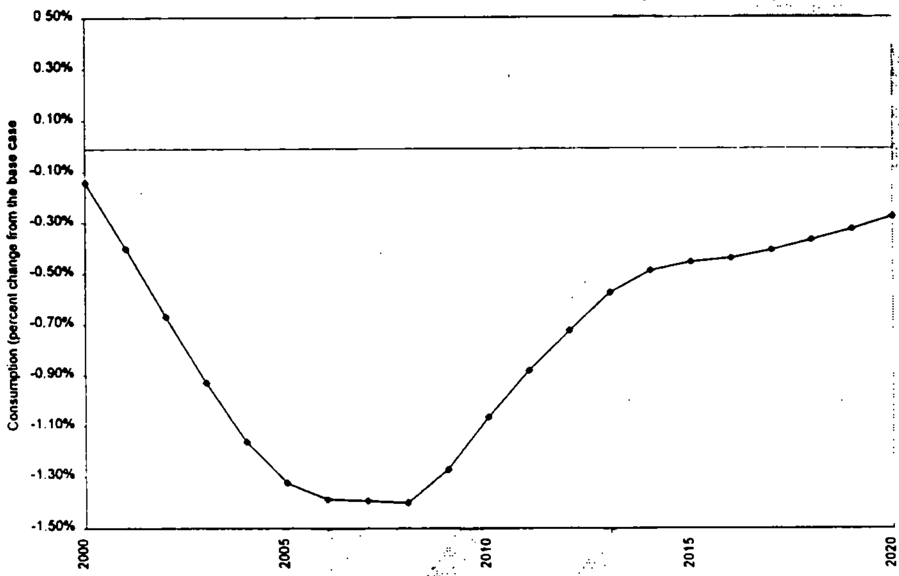
Figure 6: DRI-DRI Energy 1990 Level Case, No International Trading--Investment



Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues used for Federal deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

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

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



Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues used for Federal deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

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

Among fuels, demand for coal bears the brunt of greenhouse gas stabilization The reduction in energy-related greenhouse emissions in the 2010 time frame will require a combination of three types of energy system changes: increased end-use efficiency, reduced end-use activity, or fuel-switching towards an increased market share of low- and no-carbon fuels in the energy mix. Increased end-use efficiency or reduced end-use activity tends to lower the demand for all fuels, while fuel-switching favors low- and no-carbon fuels, such as natural gas and renewable energy, relative to coal. The three models used by the IAT place different emphasis on these three strategies, with corresponding differences in projected fossil fuel impacts.

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

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

	1990	2010		2020	
	Actual	Base case	1990 Level Case, No International Trading	Base case	1990 Level Case, No International Trading
DRI-DRI Energy					
Total U.S. Energy Consumption	84.3	105.3	88.2	108.9	86.7
Natural Gas	19.3	27.4	22.9	29.8	24.9
Oil	33.6	41.1	35.6	44.1	37.4
Coal	19.0	24.3	17.2	25.8	15.2
SGM					
Total U.S. Energy Consumption	84.3	107.0	91.4	113.0	90.0
Natural Gas	19.3	33.2	33.1	37.7	36.7
Oil	33.6	36.5	33.1	39.0	34.0
Coal	19.0	23.9	11.3	25.8	8.5
Markal-Macro[1]					
Total U.S. Energy Consumption	84.3	107.8	92.6	115.6	96.7
Natural Gas	19.3	29.0	30.7	35.1	36.7
Oil	33.6	43.4	37.9	45.0	40.1
Coal	19.0	22.5	9.4	24.6	4.7
NEMS					
Total U.S. Energy Consumption	n/a	n/a	n/a	n/a	n/a
Natural Gas	n/a	n/a	n/a	n/a	n/a
Oil	n/a	n/a	n/a	n/a	n/a
Coal	n/a	n/a	n/a	n/a	n/a

Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues used for Federal deficit reduction and assuming a 1.25 percent annual decrease in E/GDP. SGM uses a similar rate of change in C/GDP. 1. Under the Markal-Macro results, the increase in the use of renewable energy sources, such as wind, account for the difference the total U.S. energy consumption and the sum of the component fuels. NEMS estimates are forthcoming.

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

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

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

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

Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues used for Federal deficit reduction and assuming a 1.25 percent annual decrease in E/GDP. NEMS estimates are forthcoming.

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

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

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

Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues used for Federal deficit reduction and assuming a 1.25 percent annual decrease in E/GDP. SGM uses a similar rate of change in C/GDP. SGM does not generate data by demand sector. NEMS estimates are forthcoming.

Thus, across models and when viewed from different perspectives, the majority of reductions in emissions obtained under the broadest strategies comes from reducing utility consumption of coal. Reducing coal use under utility boilers is generally the largest, cheapest option to reduce carbon emissions in the economy. This is accomplished through better operating rates and through the substitution of gas-fired combined-cycle units for coal-fired units. The implicit price of carbon obtained in most model runs is usually the one that accomplishes this transition in electricity baseload. The range of carbon values -- generally about $100 per ton in the no trading cases-- is as high as it is because most coal-fired units are fairly old and already fully amortized. Thus, their product costs mainly consist of fuel and operating and maintenance expenses but not capital costs. The price of coal, therefore, must rise considerably to make coal-fired electricity more expensive on the margin than electricity generated b~~y a~~ new gas-fired plant that entails new capital costs.

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

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

Using the SGM model, the IAT modeled two international trading scenarios. In the first, it examined the affects of establishing a permit market among the United States, Canada, Western Europe, Eastern Europe, Japan, the Former Soviet Union (FSU), and Australia (collectively known as Annex I countries under the Climate Convention). In the second scenario, it examined the effects of Joint Implementation, that is, establishing a wider permit market that includes the rest of the world. These scenarios are compared to a scenario in which each of the Annex I countries independently implemented our "starting point" scenario for stabilizing carbon emissions; that is, stabilizing emissions at 1990 levels in 2010 with a ten year phase in, where revenues are used to reduce the deficit, and under the assumption of moderate technological change (i.e., a 0.25 percent increase over the baseline in the annual increase in energy or carbon efficiency).

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

The IAT performed its analysis both with and without "corresponding reductions." The case without "corresponding reductions" allows the FSU to sell emissions rights up to its 1990 base. The case with "corresponding reductions" does not allow these trades. Instead the IAT specified that if a nation's emissions were below their 1990 level in the base case, its baseline for the purposes of trading was shifted down from the 1990 level to whatever the nation's actual emissions would be. For example, the FSU had carbon emissions of 1050 million metric tons (MMT) in 1990, and is projected to have emissions of 836 MMT in 2010. Their baseline in

2010, therefore, is 836 MMT, even though it is lower than the 1990 level. Thus, any tons "sold" from the FSU in these simulations represent actual emissions reductions. The results obtained using the SGM model appear in Tables 7a and 7b.

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

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

	No Trading					Annex I Trading (With Corresponding Reductions)				
	2000	2005	2010	2015	2020	2000	2005	2010	2015	2020
Australia	0.0%	-0.2%	-0.5%	-0.4%	-0.2%	0.0%	-0.1%	-0.3%	-0.2%	-0.1%
Canada	0.0%	-0.4%	-1.1%	-1.1%	-1.1%	0.0%	-0.1%	-0.4%	-0.3%	-0.2%
Eastern Europe	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.3%	0.3%
Former Soviet Union	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.5%	0.6%	0.5%
Japan	0.0%	-0.2%	-0.6%	-0.4%	-0.3%	0.0%	-0.1%	-0.2%	-0.1%	-0.1%
Western Europe	0.0%	-0.2%	-0.7%	-0.4%	-0.2%	0.0%	-0.1%	-0.3%	-0.2%	-0.1%
United States	0.0%	-0.1%	-0.2%	-0.2%	-0.2%	0.0%	-0.1%	-0.1%	-0.1%	-0.1%

Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues used for Federal deficit reduction and assuming a 1.25 percent annual decrease in C/GDP.

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

	No Trading					Annex I Trading (With out Corresponding Reductions)				
	2000	2005	2010	2015	2020	2000	2005	2010	2015	2020
Australia	0.0%	-0.2%	-0.5%	-0.4%	-0.2%	0.0%	0.0%	-0.1%	-0.2%	-0.1%
Canada	0.0%	-0.4%	-1.1%	-1.1%	-1.1%	0.0%	0.0%	-0.2%	-0.2%	-0.2%
Eastern Europe	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.7%	0.7%	0.5%
Former Soviet Union	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	0.5%	0.5%
Japan	0.0%	-0.2%	-0.6%	-0.4%	-0.3%	0.0%	0.0%	-0.1%	-0.1%	-0.1%
Western Europe	0.0%	-0.2%	-0.7%	-0.4%	-0.2%	0.0%	0.0%	-0.2%	-0.2%	-0.1%
United States	0.0%	-0.1%	-0.2%	-0.2%	-0.2%	0.0%	0.0%	-0.1%	-0.1%	-0.1%

Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues used for Federal deficit reduction and assuming a 1.25 percent annual decrease in C/GDP

GDP losses in Canada are the most severe among the Annex I countries. Canada is already less carbon intensive, but not as energy efficient as other Annex I countries. For example, Canada's carbon to population ratio is about 17 percent below that of the United States, while its energy to GDP ratio is about 46 percent higher. Canada also relies more heavily on non-carbon sources of energy, such as hydroelectrical generation, making emissions reductions more difficult to come by.

Table 8 shows the implicit price of carbon by country without trading, trading with Annex I countries, and with Joint Implementation with the developing countries. The United States shows smaller output losses than Japan or Western Europe predominantly because it has more "cheap" carbon-abating opportunities. Thus, it is somewhat easier for the United States to reach emission targets than other regions, which have already "picked the low fruit."

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

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

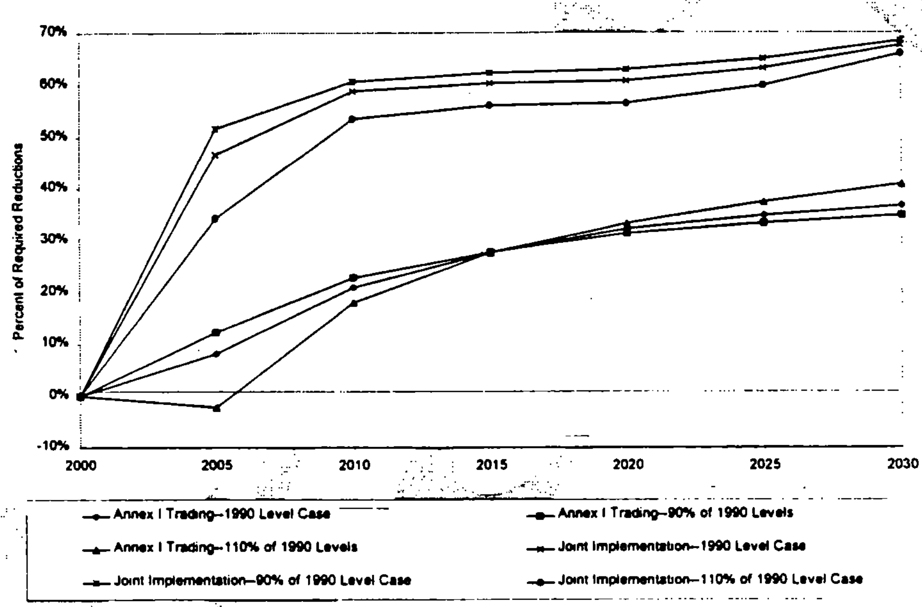
Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues used for Federal deficit reduction and assuming a 1.25 percent annual decrease in C/GDP. * indicates the cell is blank because the country is a non-Annex I country. CR=corresponding reductions.

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

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

Joint Implementation with developing countries reduce the costs of permit prices even further. Joint implementation -- emissions trading on a global scale -- reduces the permit price further, to $20 in 2010 and $16 in 2020 (with corresponding reductions). If corresponding reductions are not required the implicit price of carbon falls to $9 in 2010 and $12 in 2020. Under this broader market for tradeable emissions permits the FSU and Eastern Europe lose their monopoly on permit sales. Specifically, Joint Implementation encourages China and India to reduce their use of coal and enter the market as emissions permit sellers. As shown in Figure 8, imports of carbon permits are greater under Joint Implementation than under Annex I trading.

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

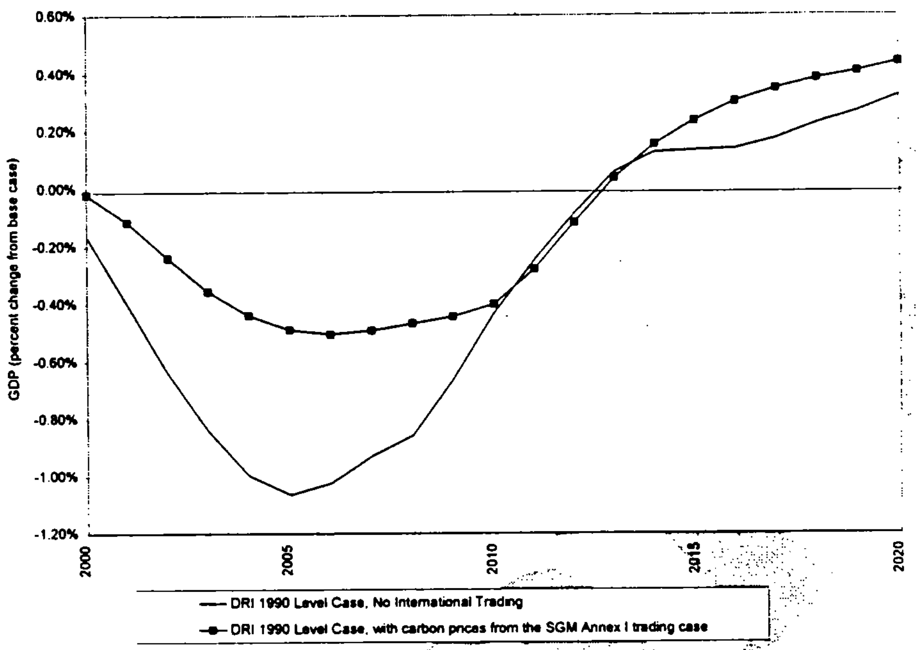


Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues used for Federal deficit reduction and assuming a 1.25 percent annual decrease in C/GDP.

Using the SGM implicit carbon prices from Annex I trading to simulate macroeconomic conditions for the DRI Model moderates the short-term economic effects of emissions reductions. The IAT incorporate Annex I implied permit prices estimated by the SGM model under permit trading, with corresponding reductions into the DRI model. For ~~in~~ 2010 SGM's Annex I trading implicit price of carbon estimate ($56) was incorporated into the DRI model.

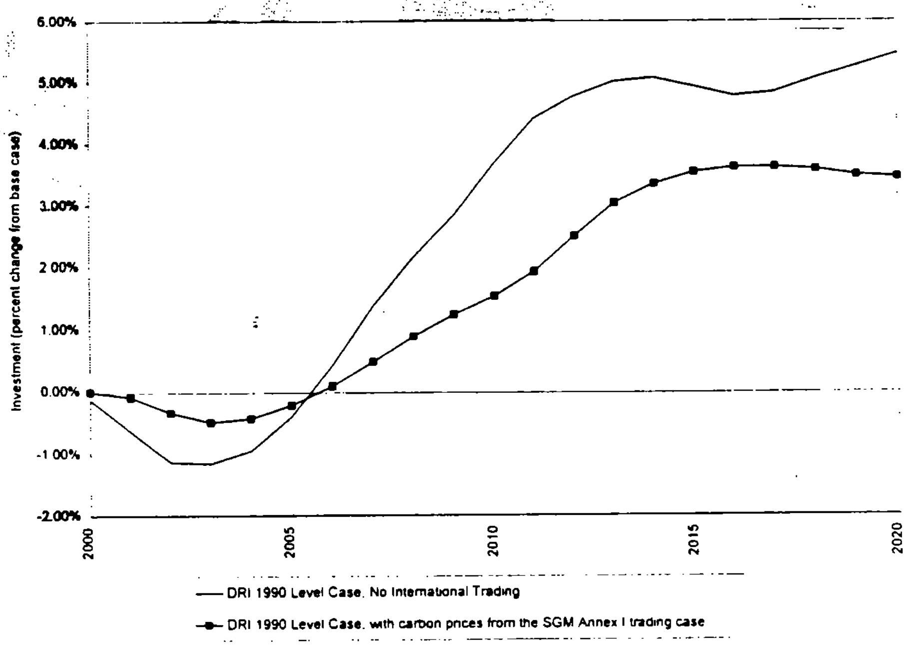
The results from the DRI model using the SGM ~~permit trading~~ implied permit prices are represented in Figures 9, 10, and 11. As shown in Figure 9, the maximum effect on GDP is less than half, 0.5 percent less than the baseline in 2006 compared with about one percent in 2005. The lower permit prices also has a somewhat dampening effect on the increase in investment under the no trading case, but shows a much improved effect on the impact on consumption, a -0.7 percent change in 2010 compared with a -1.4 percent change in 2008, and reaches the baseline consumption estimates in 2018.

Figure 9: DRI-DRI Energy 1990 Level Case with and without Annex I Trading--GDP



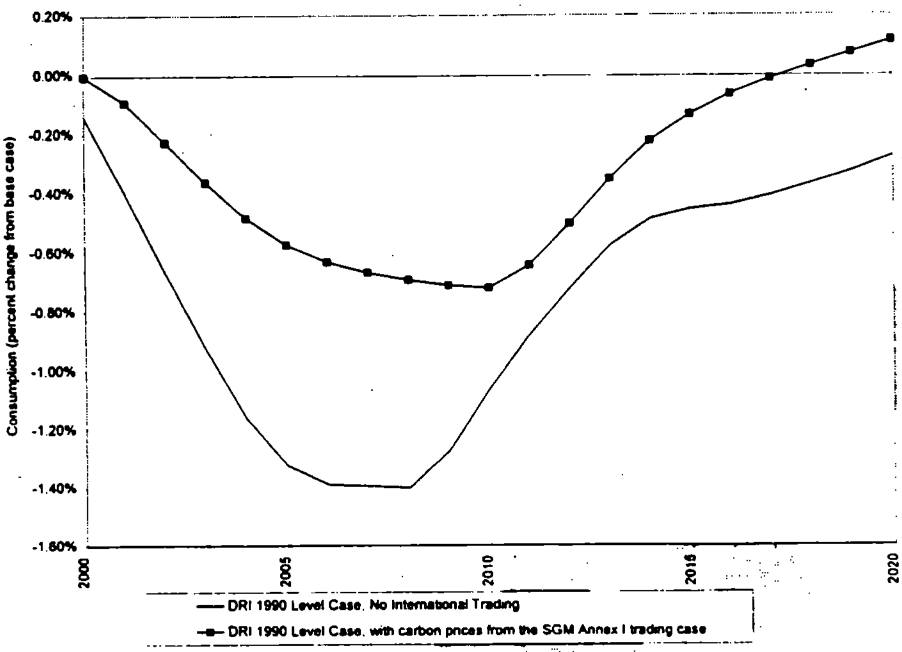
Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues used for Federal deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

Figure 10: DRI-DRI Energy 1990 Level Case with and without Annex I Trading--Investment



Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues used for Federal deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

Figure 11: DRI-DRI Energy 1990 Level Case with and without Annex I Trading--Consumption



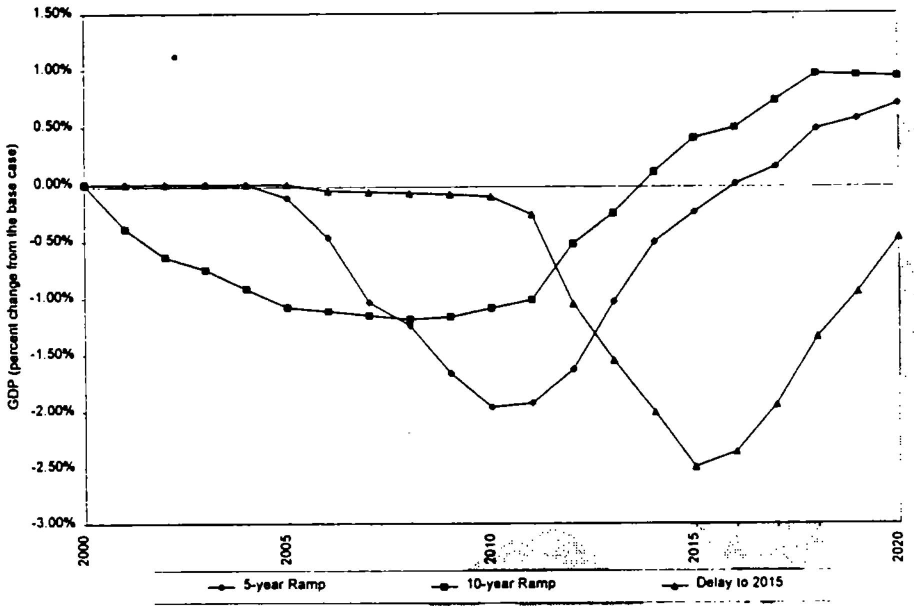
Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues used for Federal deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

Important Sensitivities

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

Increasing the implementation period from 5 to 10 years dampens the negative effects on GDP. Delaying implementation until 2015 does little to improve GDP effects. The IAT examined differing effects on GDP of a 5-year and a 10-year implementation period for the "starting point" scenario with the NEMS model. These results are shown in Figure 12. A 5-year ramp-up between 2005 and 2010 results in a maximum output loss in 2010 that is 65 percent greater than that associated with a ten year ramp-up and a return to the baseline two years later. Thus, shorter transition periods result in a more pronounced economic cycle in response to policy--a sharper downturn and deferred recovery.

Figure 12: NEMS 1990 Level Case, No International Trading--Sensitivity to the Length of the Implementation Period and to Implementation Timing



Note: These simulations were conducted using DRI and the NEMS Energy Model and they do not conform in detail to those conducted using DRI and the DRI Energy Model. 5-Year and 10-Year Ramp to 1990 Levels in 2010; 1990 Levels in 2015 using a 5-Year ramp-up. Revenues are used for Federal deficit reduction, assuming 1.25 percent annual decrease in E/GDP.

Figure 12 also shows the result of delaying the implementation by 5 years, to 2015 combined with the shorter 5-year ramp-up period. GDP effects for the delayed case are less severe in the initial period, but become greater than either the 5-year or 10-year ramp-up to stabilization in 2010.

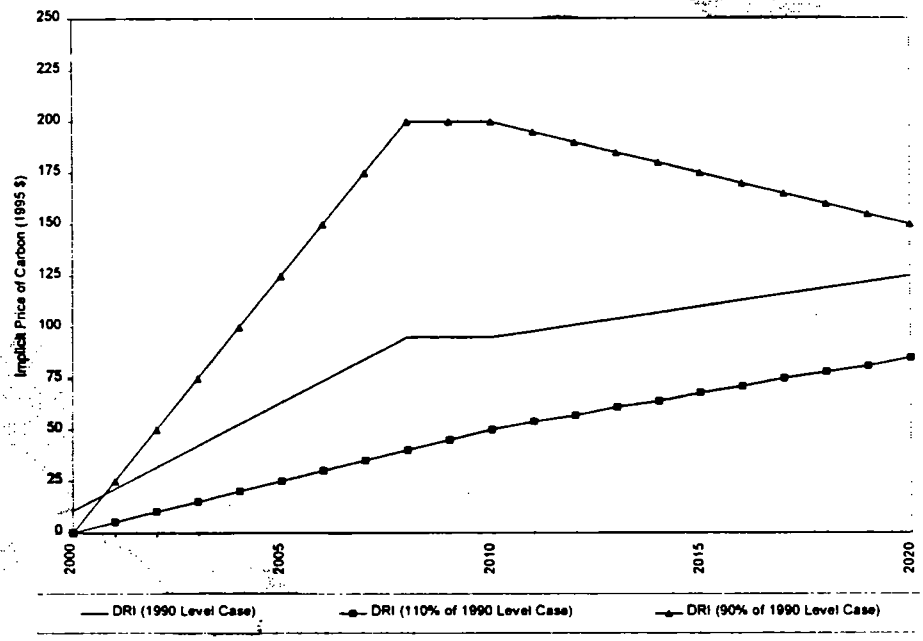
Raising or lowering emission targets lead to obvious results--more stringent emission targets lead to greater economic losses while less stringent ones have less severe impacts The three models were used to analyze how changes in the level of emissions affect the implicit price of carbon. If the emission target for the year 2010 and beyond is raised (made less severe) to a level equal to 110 percent of the 1990 emissions level (that is, to a target of 1,472 million tons as opposed to 1,338 million tons), then the DRI model estimated that the implicit price of carbon drop almost by half -- to about $50 per ton of carbon, while the SGM model dropped from $81 to $37. The very large decline in the implicit price of carbon reflects the fact that additional emissions reductions are progressively harder to ~~find~~. On the other hand, a more stringent target, one that freezes emissions at 90 percent of their 1990 level in the year 2010 and beyond, leads to an implicit price of carbon of $200 per ton in 2010 and $150 per ton in 2020, according to the DRI model. The SGM model estimated that the implicit price of carbon would be $145 and $183 in 2010 and 2020, respectively. The implicit price of carbon generated by Markal-Macro for the 90 percent of the 1990 level case with no international trading would be $187 and $207 in 2010 and 2020, respectively. Table 9 and Figures 13 and 14 describe the sensitivity of these results using DRI, SGM, and Markal-Macro.

Table 9: Sensitivity of the Implicit Price of Carbon to the Stringency of the Emissions Target No International Trading

	2010	2020
DRI-DRI Energy		
Carbon Emissions 90% of 1990 Level Case	200	150
Carbon Emissions 110% of 1990 Level Case	50	85
SGM		
Carbon Emissions 90% of 1990 Level Case	145	183
Carbon Emissions 110% of 1990 Level Case	37	56
Markal-Macro		
Carbon Emissions 90% of 1990 Level Case	187	207
Carbon Emissions 110% of 1990 Level Case	101	93

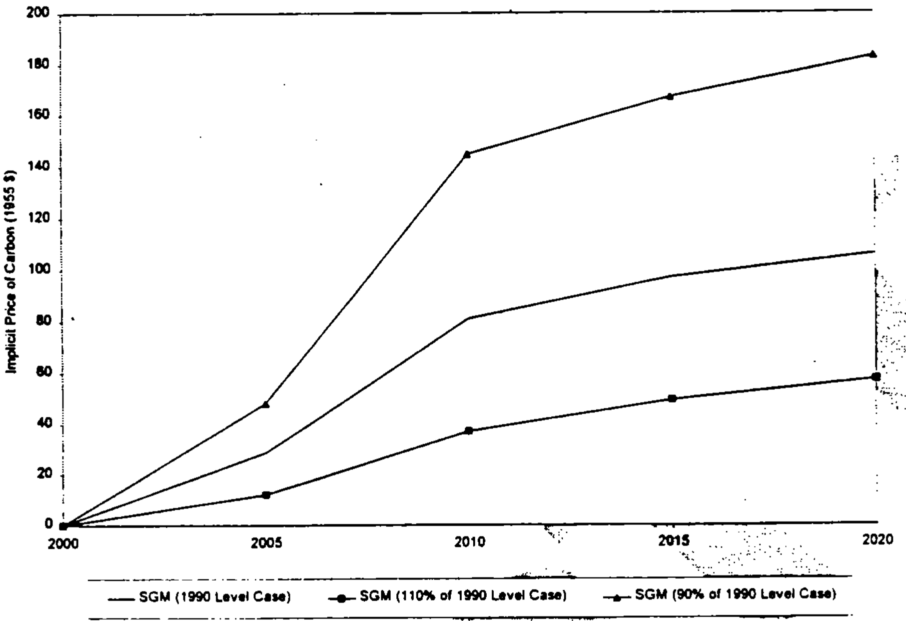
Note: 10 year phase-in with revenues used for Federal deficit reduction and assuming a 1.25 percent annual decrease in E/GDP. SGM uses a similar rate of change in C/GDP.

Figure 13: DRI-DRI Energy No International Trading--Sensitivity of the Implicit Price of Carbon to the Stringency of the Emissions Target



Note: 10 year phase-in with revenues used for Federal deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

Figure 14: SGM No International Trading--Sensitivity of the Implicit Price of Carbon to the Stringency of the Emissions Target



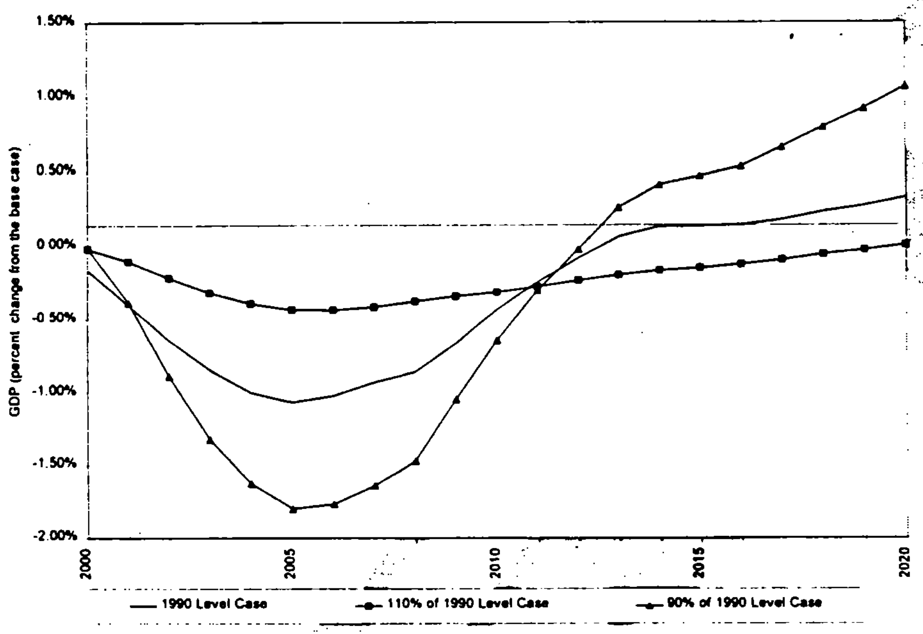
Note: 10 year phase-in with revenues used for Federal deficit reduction and assuming a 1.25 percent annual decrease in C/GDP.

In 2020, permit prices rise to about $85 compared with the $125 permit price under stabilization. Using the DRI model, an emissions target of 90 percent of 1990 level results in an implicit price of carbon of $200 per ton in 2010 and $150 in 2020. Unlike in the other cases, the implicit price of carbon falls after 2010. This is because the initial price increase is large enough to set in motion a series of capital stock improvements, particularly in utilities, that reduce the ongoing level of emissions by enough to allow the implicit price to fall in the future. Thus, this result is predicated on the idea that future price expectations could be wrong. In fact, if decision makers had perfect price expectations, the implicit price of carbon would lie somewhere between these two values over the period.

It is no surprise that the 90 percent of 1990 emissions case results in a more severe decline of GDP in the transition period. But what is surprising, and questionable, is that this scenario also has a greater long-term potential for economic recovery. As shown in Figure 15, GDP declines to a peak loss of 1.9 percent below the base case in 2005. It recovers to the base case level in 2013 and increases to 1.0 percent above the base case in 2020. The long-term rebound effect results from a greater amount of revenue used for deficit reduction (or debt retirement), which pushes interest rates down substantially and drives up investment. The magnitude of this result is questionable.

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

Figure 15: DRI-DRI Energy No International Trading--Sensitivity of GDP to the Stringency of the Emissions Target



Note: 10 year phase-in with revenues used for Federal deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

The portion of total emission reductions from coal and oil in both the 90 percent and 110 percent of 1990 Level Case, No International Trading, increases only slightly--about 5 percentage points--while total emission reductions from natural gas change significantly. In 2010, under stabilization, about 13 percent of total emission reductions are from natural gas. Under a 10 percent increase in the target (that is, a target of 90 percent of 1990 emissions), about 9 percent of total emission reductions are from natural gas. This occurs because the substitution of gas for coal in electric utilities is not enough to achieve the bulk of the 90 percent (more stringent) target. Additional emissions reductions must be found, which forces the burden to be spread more evenly among fuel types and sectors.

Adopting a revenue recycling option that favors capital formation leads to less impact on the economy during the transition and greater returns to the economy in the long term. The IAT looked at a number of revenue recycling policies in addition to the deficit reduction case. These options are depicted in Figure 16. These include:

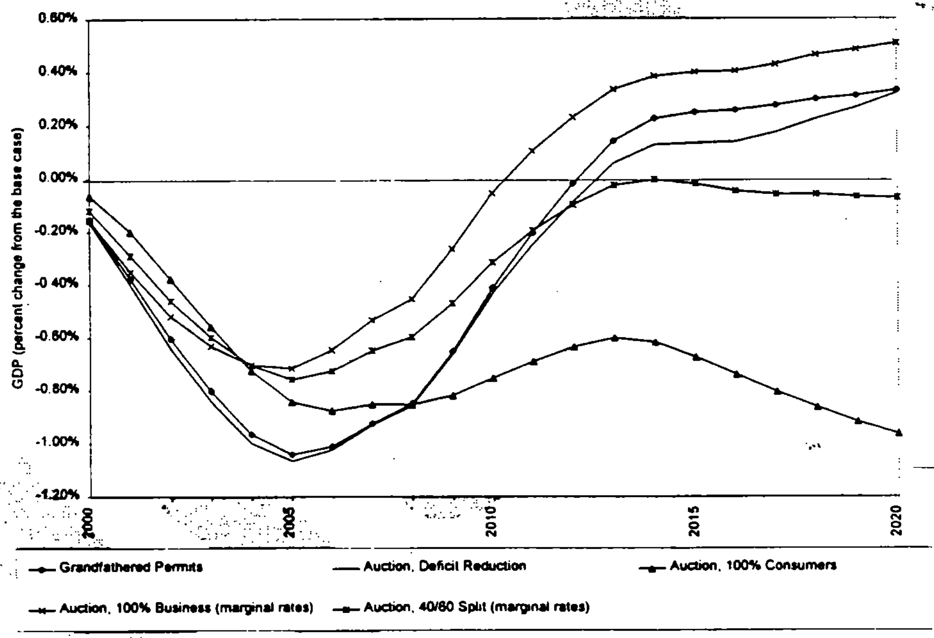
- "grandfathering" permits to producers, meaning that every carbon-emitter would be given sufficient permits to allow them to emit at their 1990 level. The permits allowing them to do so would then be traded freely, allowing a least-cost response to the problem to emerge;

- a 100 percent recycling of any revenues from permit auctions to consumers through a reduction in the personal income tax;

- a 100 percent return to business through a reduction in the marginal rates of the corporate income tax; or

- a 40/60 split to consumers and businesses, in proportion to their shares of energy use, through tax rate reductions.

Figure 16: DRI-DRI Energy 1990 Level Case, No International Trading--Sensitivity of GDP to Revenue Recycling Options



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

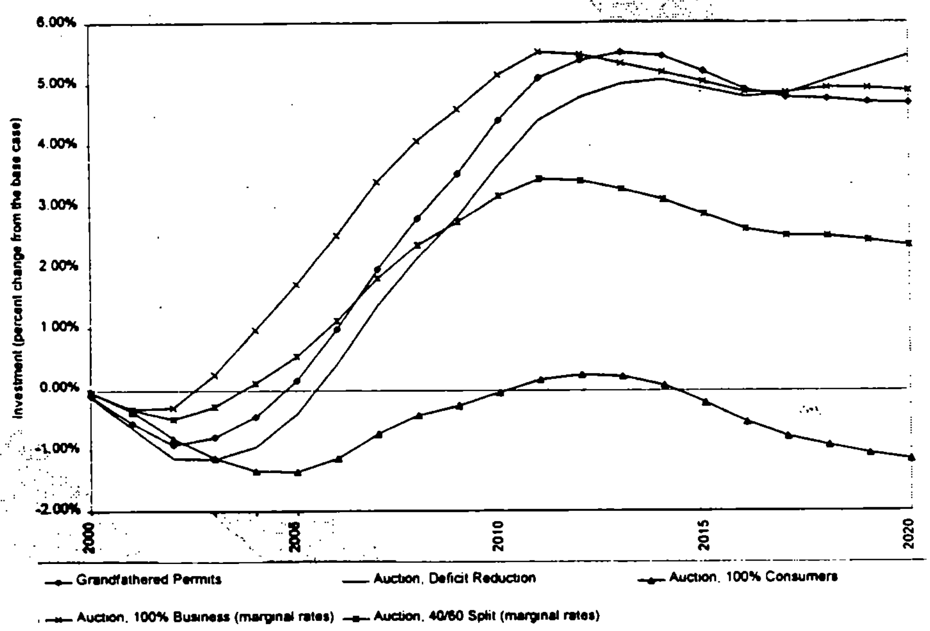
According to the IAT analysis, the revenues generated from the implementation of this policy have the most positive effect when returned through either the deficit reduction plan, grandfathered permits, or to business through lower taxes. Revenue recycled to consumers, in either case, result in a greater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

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

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

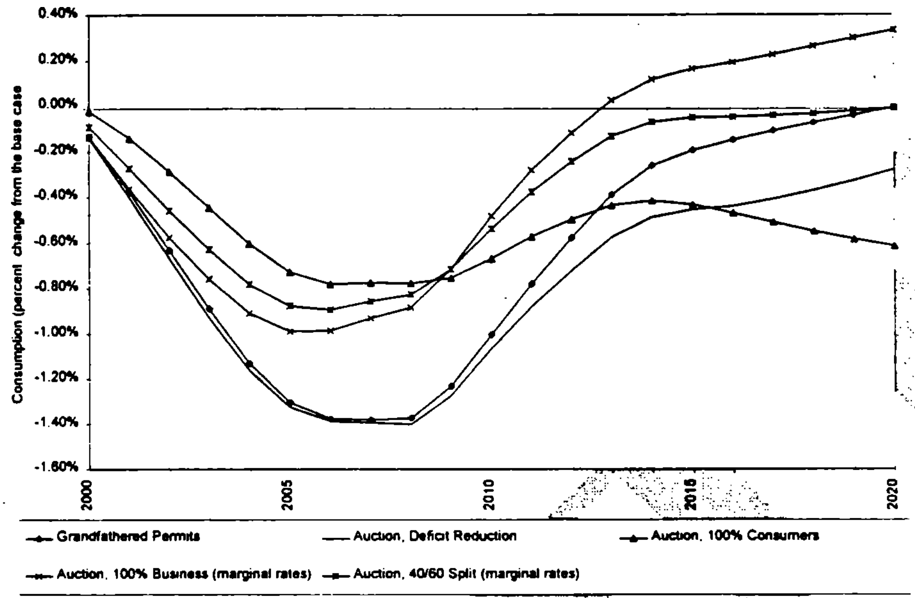
Figures 17 and 18 demonstrate the effects of revenue recycling on investment and consumption, in relation to the effect on GDP, as shown in the previous figure. As these figures show, the key to economic recovery among the revenue recycling options is to improve investment in the economy.

Figure 17: DRI 1990 Level Case, No International Trading--Sensitivity of Investment to Revenue Recycling Options



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

Figure 18: DRI-DRI Energy 1990 Level Case, No International Trading-- Sensitivity of Consumption to Revenue Recycling Options

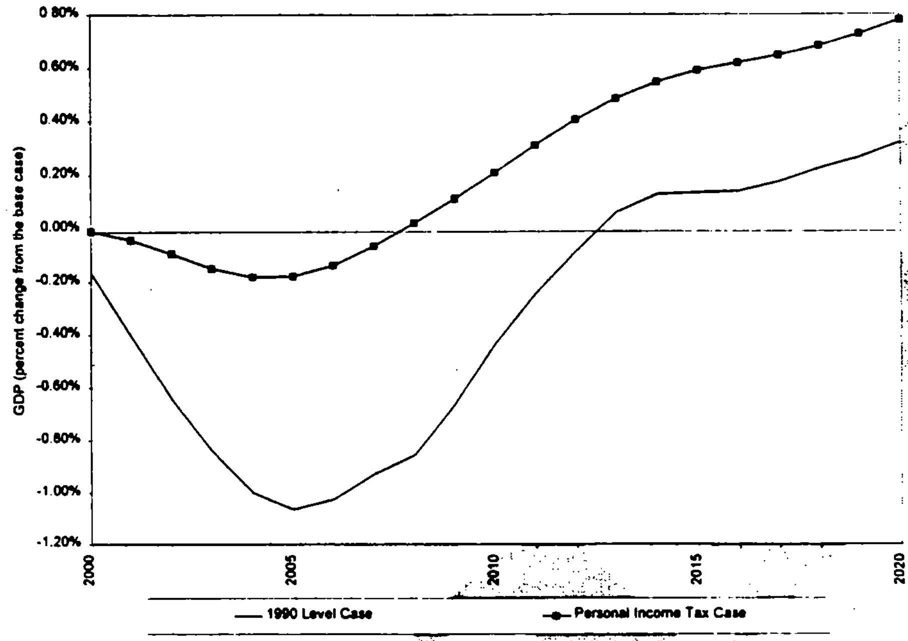


Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Assuming a 1.25 percent annual decrease in E/GDP.

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

An increase in the personal income tax results in smaller economic losses and a more prompt economic rebound than a "deficit-equivalent" carbon reduction policy, as shown in Figure 19. Thus, while revenue recycling options can affect significantly the outcome of a carbon-reduction policy, the gains they create are unrelated to carbon reduction itself.

Figure 19: DRI-DRI Energy, No International Trading--Comparison of GDP, Recycling Revenue Recycling through Deficit Reduction and a Personal Income Tax Increase



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

Technological progress can be very helpful, especially in the long term. In its analysis of technology, the Markal-Macro model was used to determine whether higher levels of energy to GDP (E/GDP) savings are realistic. This analysis assumed two benchmarks for technological progress. In the first, the annual steady-state improvement in the economy's efficient use of energy was increased from the level of 1.0 percent in the AEO97 projections (found in the "no policy" base case) to a level of 1.25 percent. In the second case, this improvement in energy efficiency was increased to 1.75 percent. These two benchmark levels were obtained by examining the historical record and engineering estimates of potential technical progress. The point of the analysis was then to determine not only what effect technical progress might have on the economic effects of climate change policy, but also whether these rates were themselves technically feasible.

According to results from the Markal-Macro model, an improvement in the energy intensity of 0.25 percent annually, or a total annual decline of 1.25 in energy per unit of real output, can be achieved without great difficulty using both off the shelf technologies as well as new technologies that are near commercial viability. For example, such an improvement can be produced if the "hurdle rates" -- that is, the premium that households and firms appear to place in their discount rate when considering energy-efficiency investments -- declines by 81 percent. (For example, the discount rate households use when considering installing better insulation would have to fall from 46 percent to 23 percent). Thus, this improvement can be achieved through diffusion practices even without assuming a higher rate of innovation and technological progress. In fact, some analysts believe that the enactment of the CCAP gets us to the 1.25 annual reduction.

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

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

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

Table 10 summarizes the effects of higher technological progress (that is, the 1.75 percent annual rate versus the 1.25 annual rate) on the economic effects of carbon-limiting policies. As seen, higher rates of technological progress can dramatically cut the implicit price of carbon and the associated transitional GDP losses. In the IAT "starting point" case (assuming 1.25 percent annual efficiency improvements), the implicit price of carbon in the three models is \$95, \$81 and \$145 per ton in 2010 and \$125, \$106 and \$130 per ton in 2020, for DRI, SGM, and Markal-Macro respectively. In the more advanced technology case, the implicit price of carbon is \$88, \$53, and \$77 per ton in 2010 and \$30, \$51, and \$35 per ton in 2020, for DRI, SGM and Markal-Macro respectively.[4]

[4] SGM applied the rate of carbon-efficiency for purposes of modeling technological improvement in energy-efficiency because it is easier for SGM to manage C/GDP than E/GDP. Carbon to GDP is an equally appropriate target and the differences in the results of the two specifications is not large.

Table 10: Sensitivity of Implicit Price of Carbon (1995$) to Rate of Technological Change --1990 Level Case, No International Trading

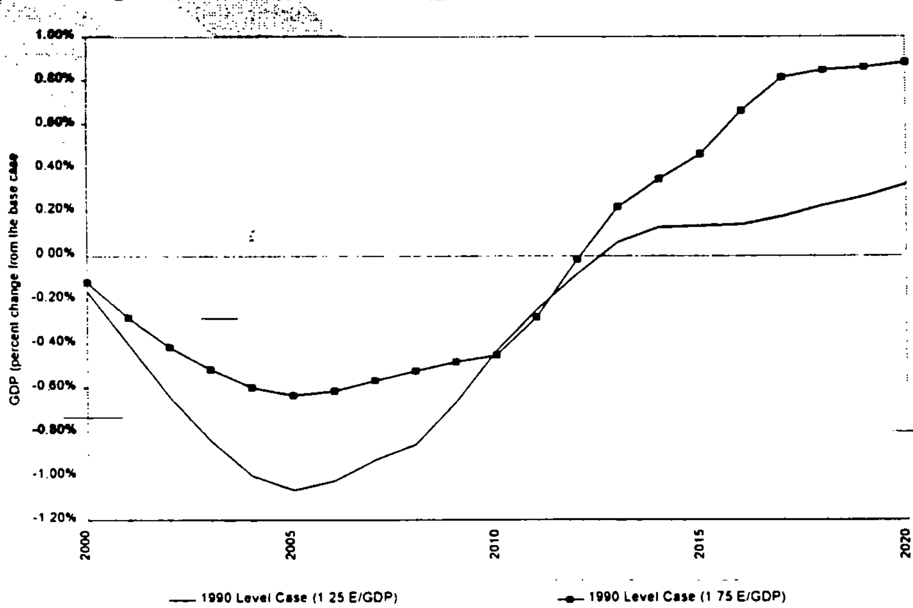
	2010		2020	
	1.25 Case	1.75 Case	1.25 Case	1.75 Case
DRI-DRI Energy	95	88	125	30
SGM	81	53	106	51
Markal-Macro	145	77	130	35

Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues used for deficit reduction. DRI permit prices are generated using the annual rate of change in E/GDP. SGM uses a similar rate of change in C/GDP.

The peak GDP losses change accordingly, as shown in Figure 20. Using the DRI model, the peak output loss of -0.6 percent occurs in 2005, and the economy reaches its pre-policy growth path by 2012. The economy's shift to a higher growth path is also more pronounced, but here the result is more believable, because it is achieved through technological progress rather than revenue recycling that raises savings and fosters investment (in fact, the level of revenue recycling falls dramatically along with the implicit price of carbon).

The risk, however, is that these output gains may be somewhat overstated, because they do not account for the cost of the investments needed to reach the higher rate of technological progress. For example, firms will have to perform R&D that might distract them from other R&D tasks. If other R&D in the economy fell as energy- and carbon-related R&D was performed, overall productivity could drop and offset the economy's potential growth elsewhere. Alternatively, firms might increase total R&D effort, but leave the economy with fewer resources to do other things. While it is likely that these effects are second-order when compared to the effects of the improvement in carbon-related efficiency, they are still absent from the analysis.

Figure 20: DRI-DRI Energy 1990 Level Case, No International Trading--Sensitivity of GDP to the Rate of Technological Progress



Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues used for deficit reduction.

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

Reducing carbon emissions would also reduce other pollutants leading to direct economic benefit. The release of CO_2 is inherent in the activity of burning fossil fuel under current technologies. When CO_2 emissions in the utility, industrial boiler, and transportation sectors are reduced--either by using less fuel or by altering the mix of fuels--emissions of nitrogen oxides (NO_X) and sulfur dioxide (SO_2) are also reduced. In the atmosphere, NO_x and SO_2 react with ammonia to form ammonium nitrate and ammonium sulfate--significant components of fine particulate matter ($PM_{2.5}$), which may cause significant respiratory health problems and mortality.[5]
To investigate this effect, the NEMS model was used to estimate SO_2 and No_x emissions from electricity generation. When emissions are frozen at 1990 levels without trading, NEMS estimates decreases in utility NO_x and SO_2 emissions of 60 percent 47 percent, respectively in 2010.

The NEMS model provided emissions for each of the thirteen NERC regions. These results were then translated into disaggregated county level emissions by calibrating the NEMS results to the county specific data from EPA's National Particulate Inventory. The results were then fed through EPA's climatological regional dispersion model, which calculates the resulting air quality changes for each county. Finally, these results were used to estimate health and welfare effects of air pollution using EPA methodology developed under Section 812 of the Clean Air Act Amendments and reviewed and endorsed by EPA's Science Advisory Board.

Health benefits from reducing utility NO_x and SO_2 emissions in the "starting point" stabilization case include avoided mortality, avoided cases of chronic bronchitis, reduced acute bronchitis, fewer upper and lower respiratory symptoms, and a decline in lost work days. The results are very sensitive to the value attributed to avoided mortality, here estimated at $5 million per episode. When monetized these benefits could have a mean value of over $4 billion per quad of coal based energy generation. Assuming the estimated 7 quad reduction found by DRI (in Table 4), this would yield benefits of about $30 billion.

NOTE TO READERS: The IAT has not yet quantified the NO_x and SO_2 emission reductions from the industrial and transportation sectors or estimated the reduction in emissions of other criteria air pollutants--e.g., carbon monoxide and volatile organic compounds.

[5] This analysis assumes that no new regulations to control criteria air pollutants would be implemented at the Federal or state level. It is important to note that actions are being considered at the Federal and state levels, including proposed new National Ambient Air Quality Standards, the Clean Air Policy Initiative, and new State Implementation Plans, that could reduce NO_x and SO_2 emissions from utilities over the next decade independently of controlling CO_2 emissions.

<u>*The losses experienced by the United States by handicapping energy-intensive industries in international trade need not be large*</u>. There is widespread and legitimate concern that forcing an implicit energy price increase on U.S. producers will disadvantage them substantially through trade, particularly with those countries outside of Annex I that might not be subject to the same emissions limits. The IAT used the DRI model to examine the overall trade implications of such a possible energy price differential. Industry trade results are discussed in the Industry Results section of this report.

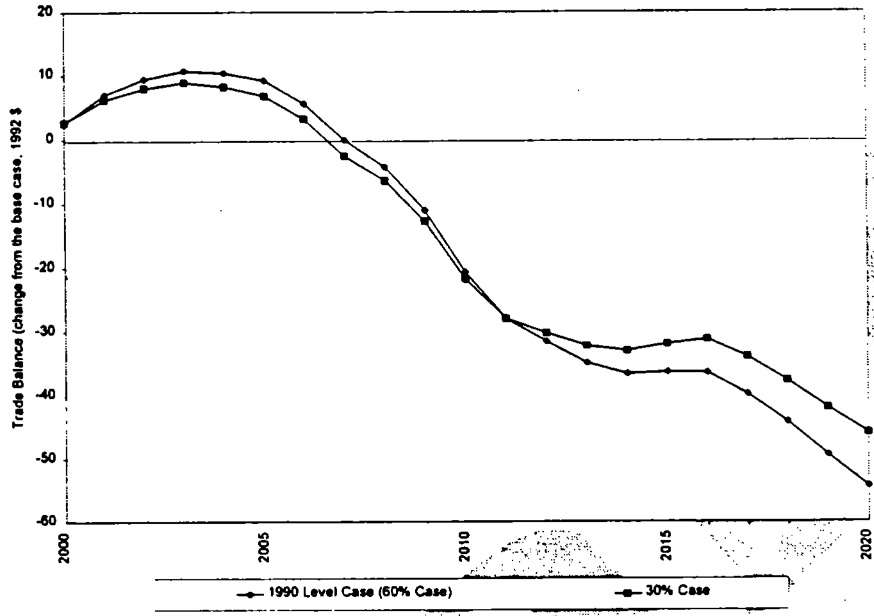
The DRI model examines overall trade effects by assuming a rate at which producers who export to the U.S. experience cost increases. In the aggregate, about 60 percent of imports of manufactured goods come from Annex I countries that will also experience higher implicit carbon prices (and, therefore,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

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

Figure 21 presents the results under these two cases. The effect of the carbon-limiting policy on trade is depicted in these runs as surprisingly small. Some of the change in trade flows is reconciled in the DRI model by allowing the exchange rate to move, but as seen in Figure 22, the anticipated changes in the exchange rate themselves are not large and do not vary between the two assumptions. The small differences are not necessarily counterintuitive. There are already substantial energy price differences and differing environmental restrictions among trading nations that are larger than the price increase that results from the policies considered here.

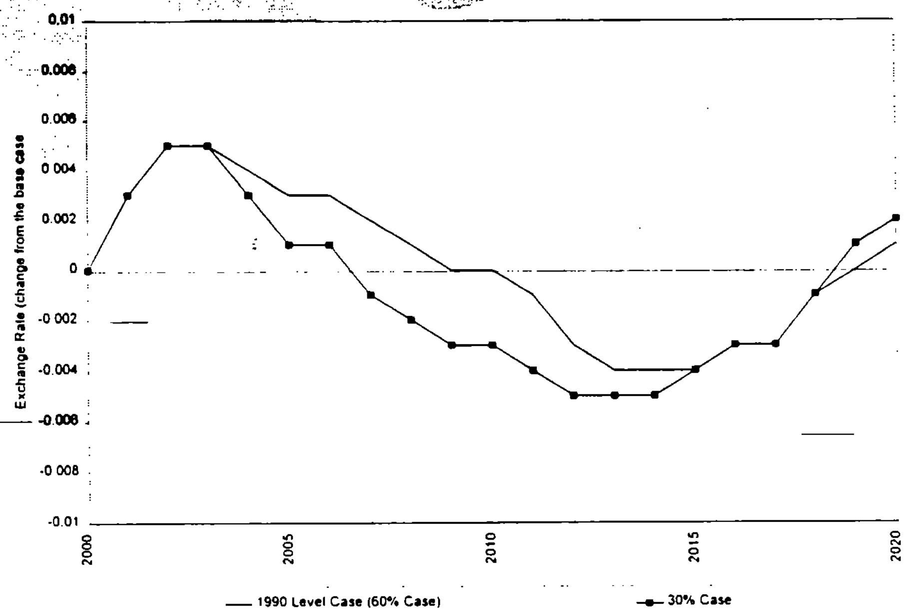
This aggregate treatment does not capture the effects that <u>might</u> be borne by specific industries due to their varying energy intensities. This more detailed examination is presented in Table 13, in the section on industry effects

Figure 21: DRI-DRI Energy 1990 Level Case, No International Trading--Sensitivity of the Trade Balance to International Price Ratio Assumptions



Note: Emissions stabilized at 1990 levels in 2010. Revenues used for deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

Figure 22: DRI-DRI Energy 1990 Level Case, No International Trading--Sensitivity of the Exchange Rate to International Price Ratio Assumptions



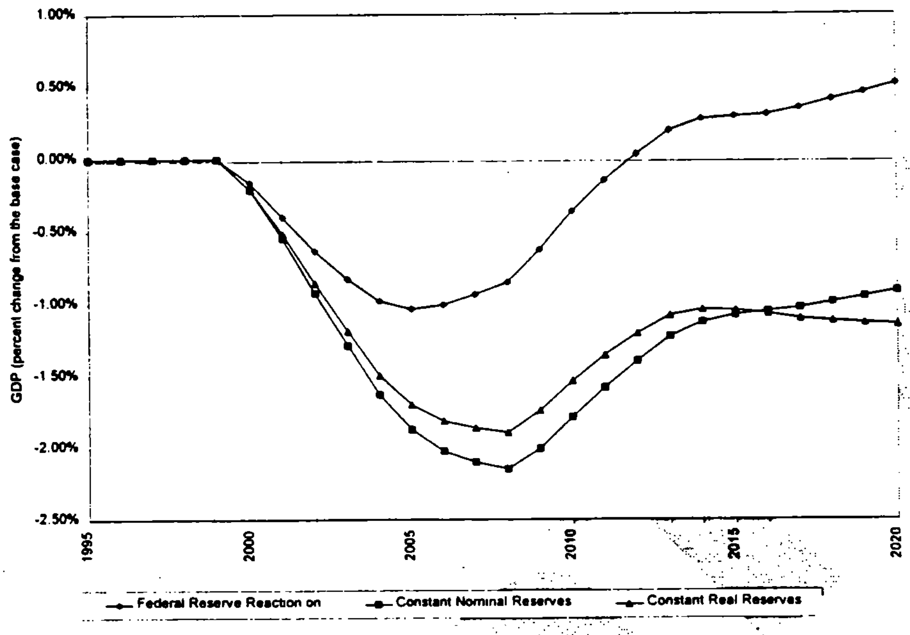
Note: Emissions stabilized at 1990 levels in 2010. Revenues used deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

Alternative views about Federal Reserve policy can yield significantly different results. The Federal Reserve reaction function in the DRI model is an empirically derived estimation of likely Federal Reserve policy responses to changes in price inflation and the unemployment rate, among other variables. It is seen by DRI as the best proxy for Fed decisions in the model simulations. In essence, the reaction function will abate unemployment unless doing so would lead to high rates of inflation. This reaction function was used in the analysis as the default setting for the assessment of the alternative target profiles and implementation strategies. This section reports on a set of sensitivity analyses which consider different Federal Reserve actions: maintaining *nominal* non-borrowed reserves at baseline levels, and a case where *real* non-borrowed reserves are held at baseline. As can be seen from Figure 23, the effects of the alternative monetary policy assumptions are substantial.

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

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

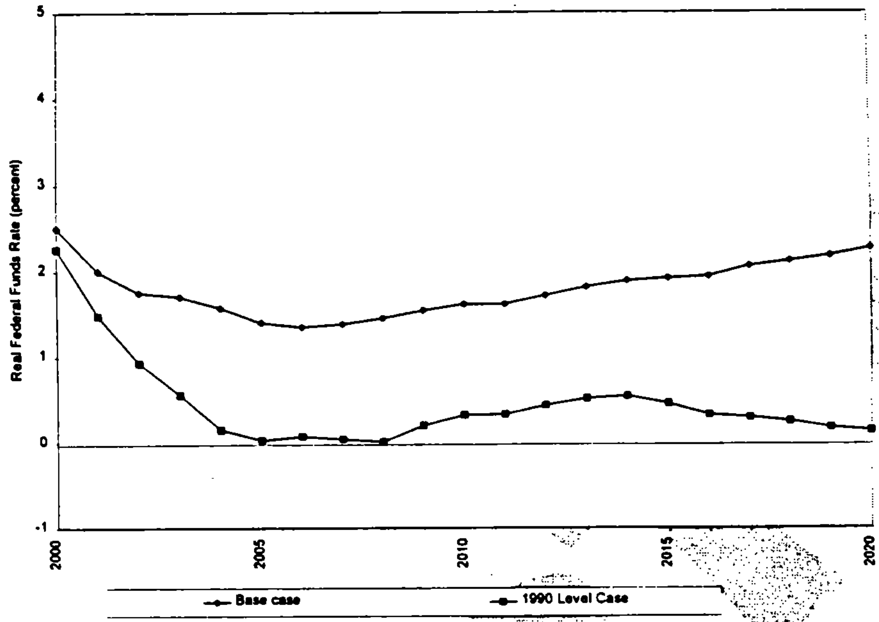
Figure 23: DRI-DRI Energy, No International Trading-- Sensitivity of GDP to Federal Reserve Policy Assumptions



Note: Emissions stabilized at 1990 levels in 2010. Revenues used for deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

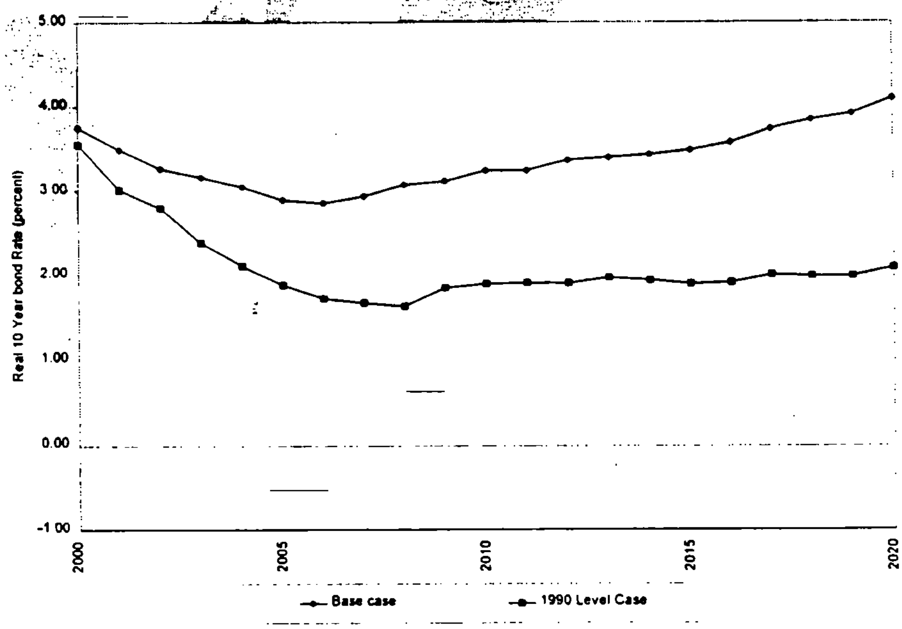
Figures 24, 25, and 26 show projections of the Federal Funds Rate, the 10-year Long Term Bond Rate, and the Federal Deficit/Surplus, respectively, from the DRI model with the Federal Reaction Function used in the analysis of the 1990 Level Case, No International Trading ("starting point"). These results show how important the treatment of revenue flows is in the DRI model. Substantial declines in the deficit (these runs were produced before the agreement to balance the budget in 2002 was achieved in May) allow interest rates to fall, which is the key to the economy's investment response.

Figure 24: DRI-DRI Energy 1990 Level Case, No International Trading-- Real Federal Funds Rate



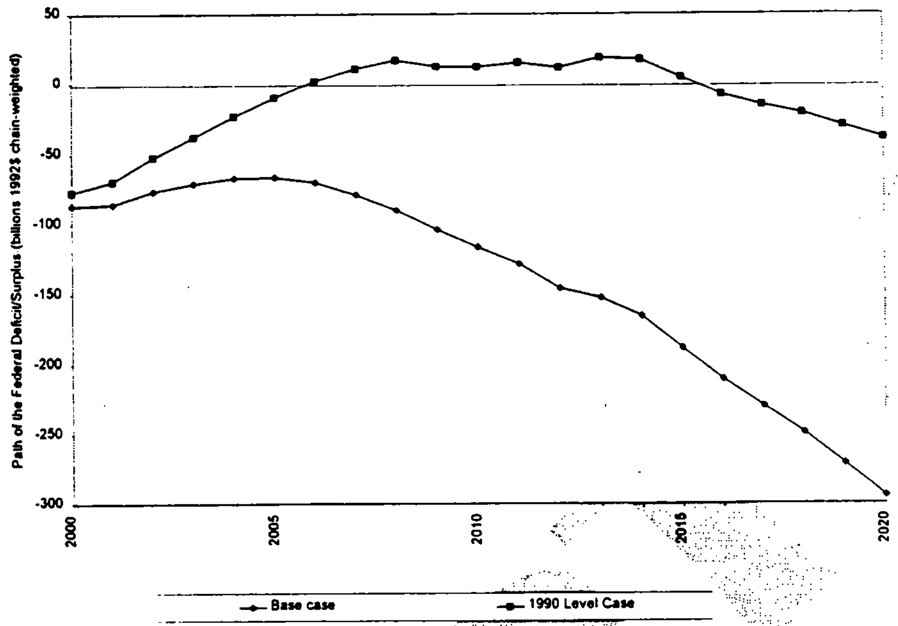
Note: Emissions stabilized at 1990 levels in 2010. Revenues used for deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

Figure 25: DRI-DRI Energy 1990 Level Case, No International Trading-- Real 10 Year Long-Term Bond Rate



Note: Emissions stabilized at 1990 levels in 2010. Revenues used for deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

Figure 26: DRI-DRI Energy 1990 Level Case, No International Trading--Path of the U.S. Federal Deficit/Surplus



Note: Emissions stabilized at 1990 levels in 2010. Revenues used for deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

> ***The results presented in the sections below on "Industry Results" and "Regional and Employment Effects" do not include cross-border emissions trading. The IAT is in the process of generating industry and regional results based on using implicit carbon prices from SGM Annex I trading results to simulate macro economic conditions for the DRI model, which will extend the final section of the core results to the industry and regional levels.***

Industry Results

Using the DRI model, the IAT examined both the industry impacts and the impacts to regional employment associated with carbon-limiting policies. Regional impacts are discussed in the next section of the report. Table 11 provides impacts to the energy producing industries and to industries that are considered to be energy intensive. Table 12 lists the industries with the greatest increase from base case output and the largest decline from base case output in 2010.

Different energy models place different emphasis on three strategies for coping with energy price increases, with corresponding differences in projected fossil fuel impacts. These strategies include increased end-use efficiency, reduced end-use activity, or fuel-switching towards an increased market share of low- and no- carbon fuels. Increased end-use efficiency or reduced end-use activity tends to lower overall fuel demand, while fuel-switching favors low- and no-carbon fuels, such as natural gas and renewable energy, relative to high carbon fuels such as coal.

The DRI energy model results (reported here) emphasize improved efficiency and reduced end-use activity. In this model, stabilization reduces the use of all fossil fuels (coal, oil, and natural gas) relative to baseline levels. In contrast, for example, the NEMS results rely more heavily on fuel switching opportunities in the utility and transportation sectors, as well as efficiency improvements in cars. The NEMS stabilization runs show greater reductions in coal use than the DRI runs, but natural gas use actually increases relative to baseline due to fuel switching and a higher level of end-use energy demand.

Table 11: DRI-DRI Energy 1990 Level Case, No International Trading Impact on the Output of Energy Producing Industries and Energy Intensive Industries (percent change from the base case)

	2010		2020	
	No trading	With International Trading	No trading	With International Trading
Energy Producers				
Electric Utilities	-11.6%	n/a	-17.7%	n/a
Petroleum Refining	-8.8%	n/a	-9.3%	n/a
Coal Mining	-25.9%	n/a	-39.3%	n/a
Natural Gas	-19.9%	n/a	-18.2%	n/a
Gas Utilities	-11.4%	n/a	-10.9%	n/a
Crude Petroleum	-11.8%	n/a	-12.4%	n/a
Fuel Oil	-13.6%	n/a	-16.7%	n/a
"Pipelines, ex. Natural Gas"	-7.8%	n/a	-8.0%	n/a
Energy Intensive Industries				
Food and Kindred Products	-0.9%	n/a	0.2%	n/a
Chemical and Allied Products	-1.9%	n/a	-1.6%	n/a
Petroleum and Coal Products	-9.2%	n/a	-10.0%	n/a
Stone, Glass, and Clay Products	0.8%	n/a	2.3%	n/a
Paper and Allied Products	-0.6%	n/a	0.4%	n/a
Primary Metals	-1.0%	n/a	-1.0%	n/a

Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues are used for Federal deficit reduction, assuming a 1.25 percent annual decrease in E/GDP. Estimates for the international trading scenario are forthcoming.

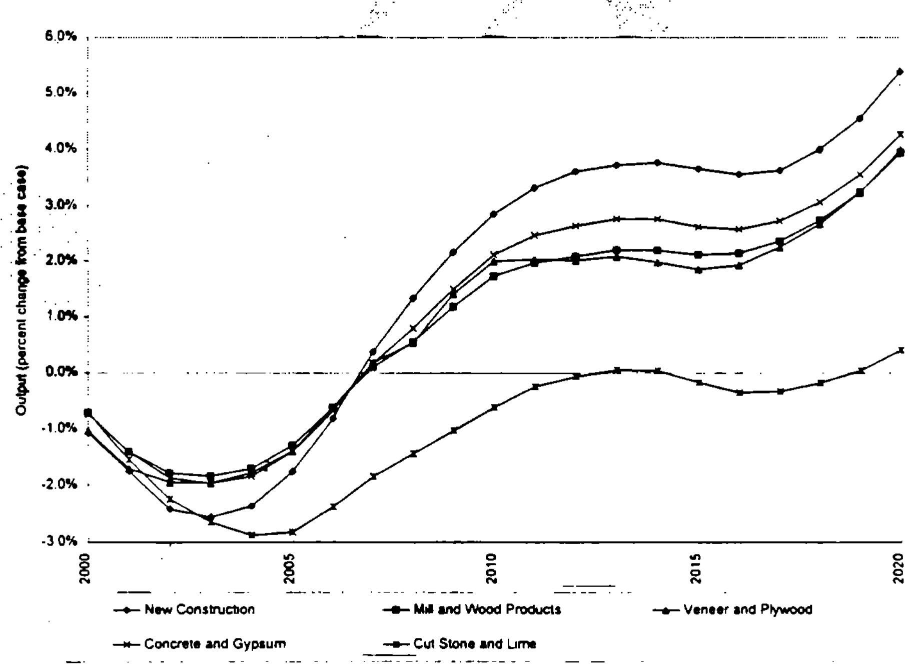
Energy intensive industries are put at a disadvantage by higher implicit prices for fossil fuels following the imposition of policy. This occurs because they are displaced through trade -- an effect that DRI depicts as relatively minor -- or because the composition of the economy's output changes in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

For example, a number of energy intensive manufacturing and construction sectors benefit in the long-term by the stimulus to investment created by the reduction of the deficit. Table 12 shows that 6 of the top 10 industries, in terms of output increasing above the base case, are directly or indirectly related to construction, which reflect the increase to the investment component of the economy. Figures 27 and 28 show the short-term output losses and the long-term output gains of a number of these industries.

On the other hand, industries whose production is used primarily for consumption, particularly energy products such as petroleum and coal, but also including paper, chemicals, and food and kindred products, continue to show losses in annual output. The energy producing industries show losses in output from between 8 percent for pipelines and 26 percent for coal mining. Consumer non-durable goods producing industries show losses of output that ranges from 1 percent for food processing to 10 percent for rubber and plastic footwear. In the longer-term, other than the energy producers, the consumption-oriented industries are expected to just about reach their output levels in the baseline.

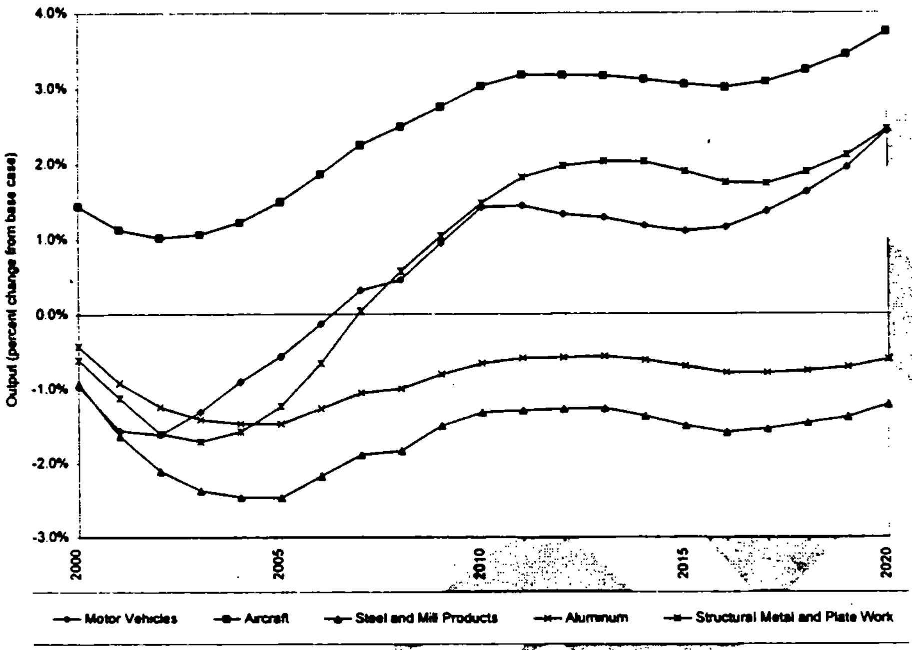
This mix effect is particularly and obviously important for energy producers. The DRI model suggests output of petroleum products will decline by 9 percent in 2010 and in 2020, when compared to the base case. As seen in Table 12, coal production in the United States will be 26 percent lower in 2010 and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

Figure 27: DRI-DRI Energy 1990 Level Case, No International Trading--Output in Key Industries--New Construction, Mill and Wood Products, Veneer and Plywood, and Concrete and Gypsum



Note: Emissions stabilized at 1990 levels in 2010. Revenues used for Federal deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

Figure 28: DRI-DRI Energy 1990 Level Case, No International Trading--Output in Key Industries--Motor Vehicles, Steel and Mill Products, Structural Metal and Plate Work, Aircraft, Aluminum



Note: Emissions stabilized at 1990 levels in 2010. Revenues used for deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

Mining (including coal, oil, and natural gas extraction) employment would be 6 percent and 7 percent lower, respectively, in 2010 and 2020: these declines are lower than output losses because productivity in the industry is generally anticipated to improve and the nation's coal mix is projected to shift to more productive coal reserves. These employment losses are particularly severe in the east and west south central regions.

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

**Table 12: DRI-DRI Energy 1990 Level Case, No International Trading
Impacts on the Output of Selected Industries
(percent change from the base case)**

	2010	2020
Industries with the Largest Percent Increase in Output		
Aircraft	3.0	3.7
Truck Trailers	3.0	3.7
New Construction	2.8	5.4
Truck and Bus Bodies	2.7	3.5
Partitions and Fixtures	2.5	3.9
Lawn and Garden Equipment	2.3	3.3
Elevators and Materials Handling Equipment	2.3	2.8
Structural Metal Products	2.2	2.9
Concrete and Gypsum	2.1	4.3
Plumbing and Heating Equipment	2.1	4.0
Packaging Machinery	2.1	2.7
Industries with the Largest Percent Decline in Output*		
Rubber and Plastic Footwear	-10.3	-3.9
Nonferrous Metals	-3.2	-5.4
Household Audio and Video Equipment	-3.2	-6.1
Chemical and Fertilizer Mining	-3.1	-3.3
Watches and Clocks	-2.8	-4.9
Iron and Ferroalloy Ores	-2.6	-2.8
Other Leather Goods	-2.5	0.4
Nonferrous Wire and Cable	-2.5	-2.8
Misc. Nonferrous Ores	-2.3	-3.7
Industrial Organic and Inorg. Chemicals	-2.2	-2.1
Computers	-2.1	-6.1

Note: Emissions stabilized at 1990 levels in 2010. Revenues used for deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.
* Excluding energy producing sectors.

As discussed earlier, the DRI model found that the effect of a carbon-limiting policy on international trade is relatively small across all industries. However, as Table 13 shows, the trade impact on some specific industries are relatively large. For example, imports by the cement industry increase by 13 percent and exports are off by 3 percent, a net trade loss of 16 percent. Steel imports increase by almost 7 percent while its exports are cut by about 1 percent, a net trade loss of about 7 percent. On the other hand, fuel oil imports decline by about 39 percent, while exports increase by about 1 percent, a net trade gain of 40 percent. Imports for the industries listed in this table generally increase, while exports decline slightly.

Table 13: DRI-DRI Energy, 1990 Level Case, No International Trading Effects on Exports and Imports in 2010 (percent change from base case)

	Imports	Exports
Paper and Allied Products		
Pulp Mills	0.9%	0.1%
Paper and Paperboard Mills	2.3%	-0.5%
Paperboard Boxes and Containers	1.6%	-0.2%
Paper Coating and Laminating	1.2%	0.1%
Sanitary Paper Products	0.8%	0.3%
Chemical and Allied Products		
Industrial Inorg. and Organic Chemicals	3.6%	-1.0%
Fertilizers	5.3%	-2.0%
Pesticides and Agr. Chemicals	0.2%	0.4%
Petroleum and Coal Products		
Petroleum Refining	-7.7%	0.5%
Fuel Oil	-38.6%	0.6%
Stone, Glass, and Clay Products		
Cement	13.3%	-2.8%
Concrete and Gypsum	5.3%	-0.2%
Cut Stone and Lime	7.4%	-1.1%
Primary Metals		
Steel and Mill Products	6.6%	-1.4%
Iron and Steel Foundries	2.7%	0.0%
Iron and Steel Forgings	3.6%	-0.1%
Aluminum	3.8%	-0.5%
Transportation Equipment		
Truck and Bus Bodies	3.4%	0.1%
Truck Trailers	4.7%	0.0%
Motor Vehicles	3.1%	-0.1%
Motor Vehicle Parts and Accessories	1.4%	-0.1%
Aircraft	3.0%	3.7%
Aircraft and Missile Engines and Parts	1.5%	2.5%
Computer and Electronic Equipment		
Computers	2.7%	-0.8%
Computer Peripheral Equipment	2.3%	-0.2%
Semiconductors	0.3%	-0.6%

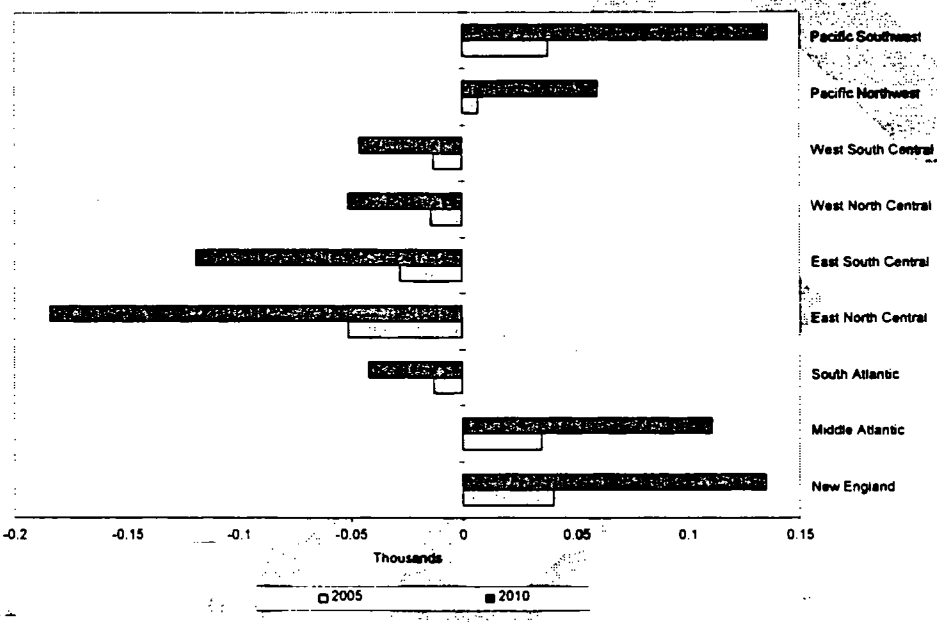
Note: Emissions stabilized at 1990 levels in 2010. Revenues used for Federal deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

Regional and Employment Effects

The effects of climate change policy on the various regions of the country are shown in Table 14. In general, states in the East North Central, East South Central, and West North Central regions will have proportionally greater losses in population, 150-, 125-, and 75-thousand, respectively, and employment, 210-, 165-, and 125-thousand, respectively, than the other regions of the country. See Figures 29 and 30. Total non-farm employment loss due to the climate change policy is about 900 thousand in 2005 compared with the baseline total non-farm employment of

135.3 million in that year. In 2010, total non-farm employment loss due to the climate change policy is only 400 thousand, compared with the baseline total non-farm employment of 140.9 million, as the economy starts to recover. The New England, Middle Atlantic, and the Pacific Southwest are expected to show long-term gains in population of 125-, 110-, and 130 thousand, respectively, and in employment of 125-, 45-, and 65-thousand, respectively, because of climate change policy implementation.

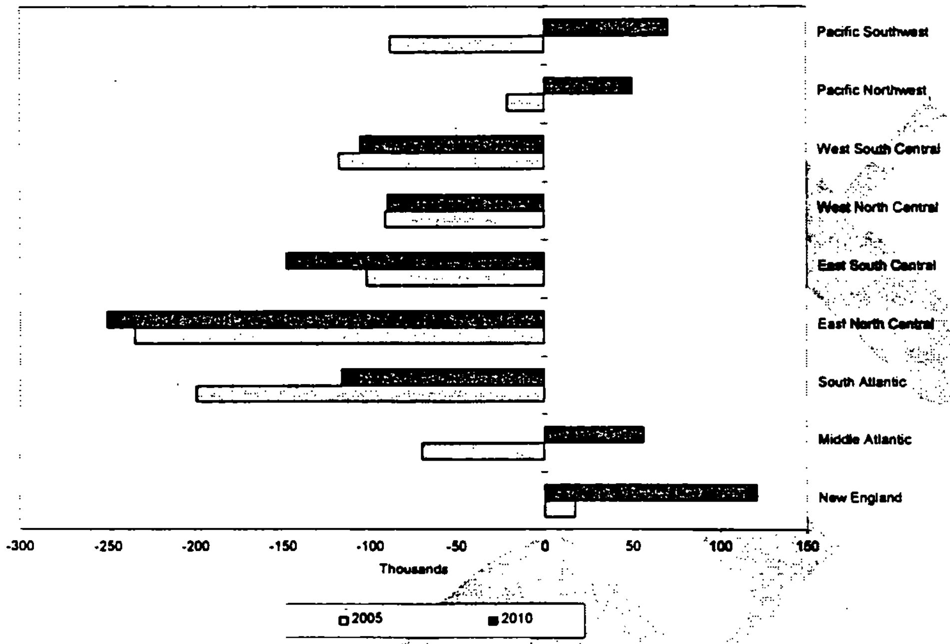
Figure 29: DRI-DRI Energy 1990 Level Case, No International Trading-- Population by Region (change from the base case)



Note: Emissions stabilized at 1990 levels in 2010. Revenues used for Federal deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

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

Figure 30: DRI-DRI Energy 1990 Level Case, No International Trading--Total Non-Farm Employment by Region (change from the base case)



Note: Emissions stabilized at 1990 levels in 2010. Revenues used for Federal deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

As shown in Table 14, although the West South Central region is expected to have the greatest losses in fossil fuel employment, about 15 thousand in 2010, this represents only about 6 percent of its total mining employment in that year. On the other hand, the East South Central Region is expected to lose about 8 thousand in 2010, but this represents about 22 percent of its total fossil fuel employment in the same year.

Table 14: DRI-DRI Energy 1990 Level Case, No International Trading Regional Impacts

Year	New England	Middle Atlantic	South Atlantic	East North Central	East South Central	West North Central	West South Central	Pacific North-west	Pacific Southwest
Disposable Income, % change from the base case									
2005	0.9	0.4	-0.1	-0.4	-0.5	-0.7	-0.2	0.3	0.3
2010	1.9	0.7	-0.1	-1.1	-1.3	-1.2	-0.4	1.1	0.6
2020	2.9	0.9	0.1	-1.4	-1.5	-1.9	-0.7	1.4	0.7
Total Non-farm employment, % change from the base case									
2005	0.3	-0.4	-0.8	-1.0	-1.3	-0.9	-0.8	-0.4	-0.4
2010	1.7	0.3	-0.4	-1.1	-1.8	-0.8	-0.7	0.8	0.3
2020	2.7	0.5	-0.2	-1.1	-1.7	-0.9	-0.8	1.1	0.5%
Mining, Oil, and Gas Employment, % change from the base case									
2005	0.4	-8.5	-8.3	-5.9	-10.9	-0.8	-1.4	-2.1	-0.9
2010	4.4	-10.9	-11.6	-7.8	-20.5	1.0	-6.4	-1.1	0.8
2020	9.0	-14.0	-15.6	-6.2	-27.8	4.3	-4.8	-8.3	0.6
Population, change from the base case (millions)									
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	0.1	0.1	0.0	-0.2	-0.1	-0.1	-0.1	0.1	0.1
2020	0.3	0.2	0.0	-0.3	-0.2	-0.1	-0.1	0.1	0.2
Manufacturing Employment, change from the base case (thousands)									
2005	9.6	1.7	-32.5	-77.1	-24.7	-19.5	-21.5	-1.0	-0.6
2010	26.5	21.7	-28.4	-116.1	-32.5	-28.3	-28.5	6.7	17.3
2020	36.9	13.9	-33.8	-142.5	-32.7	-35.3	-41.8	7.3	23.9
Transportation, Communication & Utilities, change from the base case (thousands)									
2005	1.7	-4.1	-12.1	-15.5	-4.9	-8.1	-8.7	-1.6	-6.5
2010	5.7	-2.9	-16.5	-25.9	-9.4	-13.5	-14.9	0.3	-5.5
2020	8.4	-4.8	-18.1	-31.8	-10.0	-16.1	-17.9	0.4	-5.4

Note: Emissions stabilized at 1990 levels in 2010. Revenues used for Federal deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

Appendix Table A: Assumptions Regarding Non-Carbon Greenhouse Gases (million metric tons of carbon equivalent)

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

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

7/15 Hearing before House Commerce

Wirth: "Evolution" - phase-in for developing countries
issue is not if, but when
threshold based on GDP/capita or emissions/capita
emissions budgets, full natl flexibility, intl trading, JI all
key parts of an intl accord

Schaefer: DOE Argonne study (6 industries) - what energy prices assumed
JY - prices from 96 analysis - similar to base case in IAT
assume no flexibility in implementation - would be
lower w/ flex
S - wants exact prices
JY - 2 scenarios: 1) ↑price in oil to $122 per metric ton in 2010
↑price in coal to $106 per metric ton
S - 10% below 90 levels => double cost (~$200/ton)
90 levels ($100/ton)
10% above ($50/ton)
has admin picked one for a policy, at what point will
industries move
JY - admin has no policy
IAT is draft staff analysis -> not a policy rec
not successful (based on reviewers' comments)
when evaluating policies in future, will need to draw
from larger pool of economics
S - when will admin have a policy
JY - we have begun dialogue w/ constituencies to
formulate a policy

S - running out of time - need a policy

Dingell - are you familiar w/ Geneva Declaration

- developed countries only quantified legally binding targets

JY - yes

D - are you familiar w/ A. Clawson statement c US support for this

W - I'm familiar

D - does admin still stand for these policies that focus only on developed countries

JY - admin values participation by developing

W - it depends on when

D - will US take a position that developing won't

W - ~~[illegible]~~ initially

D - why will we have WH conference to inform decision after picking decision/policy

JY - many details still to be worked out

D - Should I have you + W debate this out? I'm afraid this is too late

D - What kind of econ adv does non-participating country get over us

JY - depends on how agreement is implemented

D - there will be no requirements on developing countries

W - we are supporting no regrets measures for developing countries (eg remove subsidies)

D - China is not committed to take any actions

W - under US proposal, China will have to adopt no regrets

as a first step — China req'd in US proposal
D - if they don't do it, what are sanctions
W - no sanctions in framework, just very careful monitoring
no int'l police force to tell countries what to do
countries do what they say they're going to do
D - so China doesn't have to do anything but report
W - same for US

W - annex B - countries achieving OECD status
US proposal to bring in these countries

Whitfield
Wh - coal bears brunt of GHG stabilization
B admin going to anti-coal policy
Wirth - admin will have a strong climate + strong econ policy

McCarthy
M - 2300 economists statement
Y - there are real risks of CΔ
W - NRDC
Natl Labs in Los Alamos
WRI
SO_2 as an example
} studies → can get + GDP
Y - what did we learn from IAT, WRI
→ there are mkt-friendly ways of doing this at low cost

Shimkus

S - what do satellites measure of avg global temp.

W - what do you mean?

S - do we have true, verifiable science?

W - IPCC report

S - Where do we spend $ best - 0.01% for $1b in US or 10% for $1b in developing

Y - need flexibility to do it wherever it is least cost - this is the virtue of the mkt mechanism (trading, JI, flex)

S - reducing intl subsidies - will ↑ price ⇒ ↓ energy use - is this contrary to US power dereg which is supposed to ↓ prices

Y - when mkts work, prices ↓ + benefit consumers; US dereg is good in terms of lowering price, but price for fuels should reflect social costs

Markey

M - What are some of the bens of CΔ?

~~S~~Y - costs of inaction: delay in developing new tech - bc too expensive
an insurance policy

---

sector-specific

The IAT report does make these estimates - good thing he hasn't read it.

Nothing concentrates a man's attention like a hanging in a fortnight.

~~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

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.

Mr Trumka AFL-CIO

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.

Look into

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 it's 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, 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

're 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 Trumka

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 irly 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.

cts it would have on his membership, jobs, the ripple effect. I was talking h Senator Lugar this morning, who is a very distinguished member of this nel. 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

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.

Testimony of the Honorable John D. Dingell
Senate Foreign Relations Committee
Subcommittee on International Economic Policy, Export and Trade Promotion

June 19, 1997

Mr. Chairman, I appreciate your holding this hearing. I consider it a great honor to testify beside my good friend and highly respected colleague from West Virginia, Senator Byrd.

I do not appear before this Subcommittee as a critic of the idea that we are engaged in climate change negotiations and that we are moving forward. I'm critical of the idea that we are negotiating without the full and proper information that we need.

With respect to the climate change negotiations, I have several questions to which I have yet to receive satisfactory answers.

<u>One</u>: Have we overreached on the science?

The State Department has concluded that current science proves that global warming is "dangerous" and requires immediate emissions reductions. But the official U.N. scientific body has gone only so far as to identify a link between human activity and warming, but their own document on the science states, and I quote, "our ability to quantify the human influence on global climate is currently limited." In other words, we don't know with any degree of precision how big the problem is, we don't know how fast it's moving, or how it can be mitigated.

My friend and former colleague Tim Wirth, who will testify later this morning, agrees on this point. At a public forum this February he said there is "no doubt about the *theory*" of climate change and that "we don't know where, how much or how fast."

<u>Two</u>: Is what we're seeing here a classic example of mission creep?

We've seen a shift from voluntary to mandatory policies. Initially, the Administration's policy was based on voluntary agreements with industry and reliance on "joint implementation" of mutually beneficial partnerships between U.S. industry and developing countries. For instance, U.S. companies would get credit for helping developing countries build clean power plants. But sometime early in 1996, the tone changed. Mandatory emissions reduction became the goal.

Three: Who is representing America's interests? Are we setting ourselves up for an economic fiasco?

In a letter to me in 1995, President Clinton promised not to agree to anything which would adversely affect U.S. competitiveness. But the State Department has signed onto agreements that are procedurally and substantively disadvantageous. The outcome may be an agreement late in 1997 in Kyoto imposing mandatory emissions reductions on developed countries, and at best only voluntary steps for developing nations.

We've already committed ourselves to steps to control emissions and potentially harm our competitiveness. The developing countries are scot-free. We've gotten not a single, solid, binding commitment from them.

My friends in the Administration argue that they are being hard-nosed because they have rejected the more extreme proposals advanced by groups such as the Association of Small Island States, or AOSIS. But I find scant reason to congratulate our negotiators for refusing the chance to submit our unconditional surrender.

Four: Even if you agree that climate change is a problem, is the Administration really doing anything to protect the environment?

The theory of global warming holds that greenhouse gases have an effect no matter where in the world they are emitted. This is not like the debate over acid rain or ozone, where emissions from one part of the country were thought to cause problems in another, identifiable region. China will surpass us in terms of emissions early in the next century. If you accept the theory of global warming, those emissions will cause as much harm to the climate as emissions from the developed countries today.

Five: How is all this going to work?

I've yet to see a proposed negotiating text that includes specific dates and numbers. Those are important matters, but there are some other fundamental issues at hand: Who will have to do what? Who will enforce the agreement, and how timely would enforcement be? If we establish a trading system, is China or any other developing country going to be allowed to keep credits for themselves as a country? Or will companies be allowed to use them to offset operations elsewhere in the world? Does anyone seriously believe China, or any other country for that matter, will act on altruistic motives?

This leads me to my sixth and final question. Why are we doing this before we have the most basic information about how climate change policies will affect our economy? In short, has the Administration bothered to do its homework?

We were supposed to have the vaunted analysis and assessment of the impact of climate change policies on the U.S. economy by the end of last year. It has not been completed yet, despite repeated promises to Congress and industry that it would be available before important policy decisions are made. But the State Department formally proposed a cap-and-trade negotiating position in January. In short, the analysis is self-evidently too late to inform the process, and likely will be used to justify what the Administration has already decided to do. Just as clearly, public participation and comment on the analysis and assessment is irrelevant. And the Department of Commerce official in charge of the analysis and assessment has moved on to pursue other career opportunities.

I have asked the Administration whether, when they go to Kyoto next December, they will *refuse to* sign any agreement that binds the U.S. to new emissions obligations unless it holds our economic competitors in the developing world to equivalent obligations. I cannot in all truth say that I have received a reassuring answer.

My concerns very closely parallel those of American labor, and I am delighted that you will be hearing from Secretary-Treasurer Trumka of the AFL-CIO. I commend to you the resolution on climate change adopted by the AFL-CIO Executive Council, as well as the Senate resolution offered by Senator Byrd.

Let me close by noting again that I am not opposed to our being part of international negotiations on climate change. But I would approach those negotiations the way I would approach a high-stakes poker game: with an open mind, but not with a blank check.

New York Times, Wednesday, July 16, 1997

White House Begins Push for New Global Warming Pact

By JOHN H. CUSHMAN Jr.

WASHINGTON, July 15 — After tinkering with computer models for more than a year, the Clinton Administration predicted today that measures to combat the growth of global warming by limiting the emissions of carbon dioxide and other gases that trap heat from the sun would have a far less dramatic effect on the economy than had been projected by industries opposed to restraints on energy use.

The Administration's analysis opens what is expected to be a long campaign between now and the end of the year, when international negotiations are scheduled to conclude in Kyoto, Japan, to build support for a proposed binding treaty to limit the emissions of those kinds of gases.

Any measures to reverse the steady growth in such emissions, mostly given off by burning fossil fuels to operate cars and generate electricity and heat, would probably involve the biggest Federal intervention in energy markets since oil-exporting countries raised oil prices substantially in the 1970's.

But the Administration's computer models suggested that the economic side effects would be only half as severe as those projected in a recent study by economists at Charles River Associates for the American Petroleum Institute, a lobbying group for fuel producers.

Critics who say the Administration is moving too fast on global warming have warned that mines and factories would close, inflation would rise and productivity would fall. But another school of thought holds that energy conservation can pay for itself and that new technologies can be found, offering major economic gains, not to mention the benefits of limiting global warming and its potentially serious effects.

As the Administration tries to decide how fast and how far to cut those gas emissions, the question of the treaty's economic effect is being asked with increasing urgency in Congress, which has ultimate authority over the country's energy policy. In addition, any treaty would have to be submitted to the Senate for ratification.

In a staff paper released today, the White House said tough action on such gas emissions might, over the next few decades, shave a fraction of a percent from the nation's economic growth, followed by a recovery — or might, if implemented cleverly, have a barely discernible effect or even a net economic benefit.

"It just boils down to this," Janet Yellen, chairwoman of the Council of Economic Advisers, said at a hearing of the House Commerce committee. "If we do it dumb, it could cost a lot, but if we do it smart, it will cost much less, and indeed could produce net benefits in the long run."

Ms. Yellen's comments were met with skepticism from both the ranking Republican and Democrat on the committee, and by many junior members of the panel as well.

"Unfortunately, in the area of global climate change, the Administration has not yet presented a persuasive case," said Representative Thomas J. Bliley Jr., the Virginia Republican who heads the chairman.

Representative John D. Dingell, Democrat of Michigan, treated Ms. Yellen and Timothy Wirth, the Undersecretary of State for Global Affairs, to a sometimes blistering questioning.

Mr. Dingell, whose district is a prime manufacturer of automobiles, said the analysis suggested "huge economic constraints" on American businesses.

According to the Administration's projections, Mr. Dingell said, stabilizing emissions at their 1990 levels by 2010 would require steps equivalent to charging about $100 for every ton of carbon emitted when a fossil fuel is burned. That would be like raising the tax on gasoline of about 26 cents a gallon, a tax on electricity of 2 cents per kilowatt hour, a tax on coal of $52.52 per ton, and a tax on natural gas of $1.49 per thousand cubic feet.

But, Administration officials said, the projections are put in terms of taxes merely because that is the easiest way for economists to model things that are even more complex than the tax code.

Nobody seriously expects the White House to propose a big increase in the gasoline tax.

The White House supports a treaty that would bind the United States and other developed countries to significant reductions in emissions of carbon dioxide and other heat-trapping gases, leaving each country to decide how it wanted to do so.

Wall Street Journal, Wednesday, July 16, 1997

,ort to Curb Global Warming Is Tied 1'o Higher Energy Prices in Two Studies

By JOHN J. FIALKA

Staff Reporter of THE WALL STREET JOURNAL

WASHINGTON — Two new Clinton administration studies show that an international effort to curb global warming could result in a substantial increase in energy prices. But the administration played down the reports, saying they underestimated its "flexible" approach toward applying new controls.

Summing up the results of one interagency study led by the Commerce Department, Janet Yellen, head of the White House Council of Economic Advisers, said computer models of the economy can only provide a range of possible impacts, "not definitive answers."

The costs of reducing man-made "greenhouse gases," such as carbon dioxide, that are believed to be heating the atmosphere are "very difficult to predict with any certainty at all," she told members of a House Commerce subcommittee.

Ms. Yellen was asked about one mid-range estimate in the study, which predicted increases of 26 cents per gallon of gasoline, $1.49 per thousand cubic feet of natural gas, $52.52 per ton of coal and twocents per kilowatt hour of electricity by the year 2010. She noted that the study didn't take into consideration an international emissions-permit-trading plan being promoted by the Clinton administration that could, she said, "substantially" reduce the cost of pollution-control efforts.

The studies didn't account for the administration's emissions-permit-trading proposal because the computer models couldn't predict what trades would occur, administration officials said.

A second study, prepared by the Energy Department's Argonne National Laboratory, said energy-price increases would result in "significant reductions in output and employment" in six industries: chemicals, aluminum, steel, paper and pulp, petroleum refining and cement.

One of the worst-hit industries would be chemicals, the study said. It predicted that 20% to 30% of the nation's chemical-manufacturing capacity would move to developing nations that initially wouldn't be covered by a global-warming treaty. The move would mean U.S. job losses "as high as 200,000," the study said. The steel industry, it said, risked losing as many as 100,000 jobs.

In a statement accompanying the study, Marc W. Chupka, acting assistant energy secretary, said the report was based on "outdated" price-increase scenarios that would be "significantly lower" if the administration's international trading approach were taken into account. The plan has been used in the U.S. to cut the costs of complying with 1990 restrictions on sulfur dioxide, which causes acid rain.

As Washington roasted in a near-record heat wave, Ms. Yellen and Timothy E. Wirth, undersecretary of state for global affairs, told members of the House panel that the administration won't pick specific target levels for cuts in emissions until after a White House conference on global warming scheduled in October. The U.S. will then take its position to Kyoto, Japan, where final negotiations for a global-warming treaty will be held in December.

Q&A for Climate Change Hearings
7/14/97

IAT Questions:

Models:

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 on models that have a track record of being "very wrong"?

> I would not characterize these models as being "very wrong". These models have provided and continue to provide useful information on how the economy operates, especially when government implements new policy. While the models may not pinpoint the exact state of the economy 15-25 years into the future, they do provide a reasonable range of the state of the economy. Further, they illustrate how different sectors and different energy inputs vary through time with policy implementation.

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)?

> The IAT selected the 3 models it did because the strengths of each one compensates for weaknesses in the others. The IAT process was designed to provide policy-makers with economic information on the effects of climate policy. The process did not necessitate an assessment with every available economic model in existence. The IAT process is another useful set of information that complements the existing economic literature on climate change.

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?

> Every model has a weakness, and in the case of the models used in the IAT process, none of them do a good job of describing the international trade implications of climate policy. Economists, both within the government and in the private sector, continue to conduct research on this issue. The key to minimizing negative impacts to U.S. competitiveness is ensuring that a climate change agreement requires non-annex I countries to participate in emissions reductions.

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)?

> Any forecasting exercise involves a large set of uncertainties, as I mentioned in my opening statement. Our efforts to assess the economic impacts can provide us with information on the range of costs, but cannot give a definitive answer. Drawing from the economic literature and further analyses on the sensitivity of these assumptions can assist in improving our confidence in the range of estimates we generate for policy-makers.

Benefits:

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?

> The benefits of climate policy have not been quantitatively assessed in this process, in large part because of the uncertainties in the biophysical and economic responses to climate change. However, the benefits from reducing the risk of climate change are significant enough to warrant the statement by 2000 economists in support of cost-effective climate policy.

GDP:

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?

> Some of these "win-win" technologies aren't fully adopted in part because of the bias in favor of low energy costs (for example, by subsidizing coal and hydro power and ignoring the environmental costs such as carbon dioxide emissions). The Climate Change Action Plan does attempt to encourage the adoption of these technologies, but low funding levels have prevented the program from being more successful.

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 report is correcting in using these point estimates simply as markers of a range of expected responses by the economy to climate policy. The more broad range in the Repetto and Duncan analysis represents greater variation in assumptions than the IAT analysis. Several of their low estimates of losses in GDP reflect assumptions not considered by the IAT (such as no low-cost substitute for fossil fuel energy, inefficient economic responses, and no joint implementation). Several of their high estimates of gains in GDP include other assumptions not considered by the IAT (such as averted air pollution damages and climate change damages). It should be noted then that the IAT range is fairly consistent with the Repetto and Duncan analysis.

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?

> IAT reports most modeling results in terms of GDP. This is consistent with most economic analysis on climate change where researchers have estimated the effects of emissions reductions on economic output. Further, providing only information on consumption misses the larger picture that includes potentially substantial increases in investment. To paint a fuller picture of the effects of climate change, however, both consumption and GDP results should be provided to inform policy-makers.

Revenue Recycling:

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?

> Many of the modeling efforts use economic instruments that increase federal revenues. Effectively targeting these revenues, towards deficit reduction or cuts in income or investment taxes, can help the economy grow. While this is not unique to climate change, it is important in considering the implementation of climate change policy.

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 economic literature indicates that revenue recycling that targets investments better stimulates economic growth than alternative recycling strategies. Therefore, revenue recycling through deficit reduction, which has the effect of reducing the real interest rate, or through tax cuts for investments are likely to generate more economic growth than other forms of recycling.

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?

> How far the real interest rate falls depends on how the Federal Reserve Board interprets the economic conditions after the implementation of climate policy. The decision about whether or not to employ revenue recycling and the method of recycling used are very important. Different revenue recycling approaches can affect the inflation rate and the unemployment rate differently, yielding different responses by the Federal Reserve. IAT analysis found that climate policy with recycling through deficit reduction resulted in almost a 2% fall in the real federal funds rate relative to the base case.

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?

> As you note, the reviewers questioned the likelihood that grandfathering could be that effective. On issues as important as permit allocation, we will do a careful and comprehensive assessment of the economics literature to ensure that any mechanism the administration supports can achieve our emissions goals cost-effectively.

Announcement Effect:

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.

> The announcement effect implies that announcing a policy to curb carbon dioxide emissions in the future will provide a stimulus for the private sector to invest in R&D and smoothen the transition to climate policy. The reviewers differed on what the appropriate rate of gains in energy efficiency should be resulting from this effect, and recommended that future analyses assess a range of values.

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?

> The IAT modelers could make this assumption for two reasons. First, the Climate Change Action Plan includes a set of voluntary actions for the private sector to take. Since these are voluntary, they may not generate the same kind of incentive as a mandatory cap-and-trade program. Second, the announcement effect is weakened for circumstances where the private sector discounts the likelihood of the policy actually being implemented. In this case, the low levels of funding for CCAP may make the private sector hesitant to invest in energy efficiency technologies.

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

> For climate policy, the costs of achieving emissions reductions are sensitive to the diffusion of energy efficiency technologies. The size of the announcement effect in the analysis affects the results generated by the models. The IAT tested two values for the announcement effect, and based on the recommendations by the peer reviewers, we will cast a wider net across the economic literature to identify the impacts of different announcement effects.

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

> Private firms undertake behavior to maximize their profits. Under the baseline scenario, firms are assumed to be producing at an optimal level. This question assumes then that under the announcement, but prior to policy implementation, firms would find it optimal to increase carbon emissions. Since the announcement generates expectations of higher prices in the future, firms are likely to invest in energy efficiency R&D. It is not likely that they would pump up emissions prior to policy implementation, unless the government implemented a grandfathering permit allocation scheme that rewarded that kind of behavior.

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.

> The reviewers made some valid comments on the capacity of these models to account for the opportunity costs of capital. The IAT process is simply another piece of knowledge on the economics of climate change. On issues such as this, we will incorporate some of the pool of knowledge to complement our understanding of the potential effects of climate 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?

> By instituting a climate policy, there will be a short period of time for the economy to make the transition to energy efficiency. Since there will be real costs, the economy will actually contract. During this period, investment falls below the expected baseline investment level. However, the surge in investment after this transition period brings the economy to well above the expected GDP under baseline in the later years.

Energy Prices:

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.

> These models vary in their results because they model how the economy works in different manners. By providing a set of estimates from several models that employ different assumption about the opportunities for substitutions, investments in energy efficiency, and the effects on business activity generates a reasonable range of information for policy-makers.

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?

> The exact value can vary based on the assumptions used. Other simulations by the IAT found that the price of carbon could be as low as $9 per ton with annex I country trading and joint implementation with non-annex I countries. How businesses and consumers are affected depends on the magnitude of the price increase. We do know that businesses and consumers will adapt to changes in the price, by investing in more energy efficient technology for example, thereby mitigating the effects of higher carbon prices.

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?

> This depends on the extent of higher prices. Research by several economists have found that the burden of higher energy prices does not fall disproportionately on lower income households. Adaptive behavior by industry, by making substitutions in their production of goods, and investing in energy efficiency, can minimize the costs of higher energy prices.

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%?

> This is a result of how different models model the nature of the economy. Some economic models assume that the prices for renewable energy sources will become competitive and utilities will substitute them for coal and natural gas. Other models do not assume that substitution can occur that quickly.

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?

> Estimates on the reductions based on cutting coal emissions range between 50-80% of all carbon dioxide reductions. Again, this range is broad because of the uncertainties associated with how businesses and individuals adapt to a new set of economic incentives. Employment values in the IAT report assumed no international trading -- with trading, they would likely be lower. Mining employment in the west-south central region will decrease by about 15,000 in 2010, or 6% of its total mining employment. The east-south central region will lose about 8,000 mining jobs in 2010, or 22% of its total mining employment. It should be noted that regions that can support production in goods and services that take advantage of the need for improvements in energy efficiency could experience gains in employment.

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?

> It should be noted that two counteracting influences affect the impacts of climate policy on transportation. Higher energy prices can negatively impact transportation by increasing variable costs of transport, while lower interest rates can positively impact transportation by increasing capital investments. The IAT analysis indicates that these lower interest rates actually increase automobile production by 2.2% in 2010 over the baseline scenario. This illustrates again the importance of effective revenue recycling.

Employment:

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?

> Given the uncertainties in the modeling, it is more important to consider employment effects in terms of a range. DRI estimates in 2010 a drop in employment of 400,000, assuming no international trade. With international trade, the costs of implementing a climate policy drop significantly, and the effects on employment would be lessened.

International Cooperation/Non-Annex I

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?

> To achieve the goals of a global climate policy and to minimize the costs of such a policy, non-annex I countries must participate. As I noted before, "any comprehensive plan to deal with this global problem must include a mechanism to bring developing countries into the process."

Flexibility

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

> The IAT analysis did not focus on the effect of emissions budgets. We do know from other economic analyses that emissions budgets can increase the flexibility of climate policy and lower the costs to the economy.

Tuesday, July 15, 1997

Hearing 1:00 PM 2123 Rayburn House Office Building
Subcommittee on Energy and Power hearing on The Economic and Environmental Impact of the Proposed International Global Climate Change Agreement.

Questions

What will be the regional impact on jobs, production costs, industries, etc.?
- Michigan (automobiles)
- Kentucky (coal mining)
- Texas (oil)

What will be the national impact on jobs, production costs, industries, etc.?

What should the role of developing countries be?
- How will negotiations proceed if developing countries do not participate but we insist they do?

How will climate change policy affect the consumer?

What is the Administration position on climate change?

What policy tools does the Administration plan on using? What would be a cost-effective approach to lowering emissions in the US?

What benefits will the US see from a climate change treaty? The world?

IAT was working on determining the economic impacts of an Administration policy. What are these results?

Is global warming a problem?

Will any climate change treaty hurt the international competitiveness of US firms?

What role does CCAP play in achieving the needed emissions reductions?

Some might argue that R&D funds for the energy-producing industries should be cut to put us on the right path to cut emissions. What would be the impact on this down the road?

The Subcommittee on Energy & Power

(Ratio: 16-13)

Dan Schaefer, Colorado, *Chairman*

Michael D. Crapo, Idaho
Vice Chairman

Michael Bilirakis, Florida

J. Dennis Hastert, Illinois

Fred Upton, Michigan

Cliff Stearns, Florida

Bill Paxon, New York

Steve Largent, Oklahoma

Richard Burr, North Carolina

Ed Whitfield, Kentucky

Charlie Norwood, Georgia

Rick White, Washington

Tom Coburn, Oklahoma

James E. Rogan, California

John Shimkus, Illinois

Tom Bliley, Virginia
(Ex Officio)

Ralph M. Hall, Texas

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Karen McCarthy, Missouri

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Edward J. Markey, Massachusetts

Rick Boucher, Virginia

Edolphus Towns, New York

Frank Pallone, Jr., New Jersey

Sherrod Brown, Ohio

Bart Gordon, Tennessee

Peter Deutsch, Florida

John D. Dingell, Michigan
(Ex Officio)

Energy & Power Home	Members	Hearings & Markups	Jurisdiction

The Committee on Commerce
2125 Rayburn House Office Building
Washington, DC 20515
(202) 225-2927
Commerce@mail.house.gov

The economic and environmental impact of the proposed int. global CC agreement
Tuesday, 7/15, 1pm 2123 RHOB

Committee on Environment and Public Works

202-224-6176
410 Dirksen Senate Office Bldg.
Washington, DC 20510-6175

Committee on Environment and Public Works Home Page

Jurisdiction

Republicans

- John H. Chafee, Rhode Island, Chairman
- John W. Warner, Virginia
- Bob Smith, New Hampshire
- Dirk Kempthorne, Idaho
- James Inhofe, Oklahoma
- Craig Thomas, Wyoming
- Christopher S. Bond, Missouri
- Tim Hutchinson, Arkansas
- Wayne Allard, Colorado
- Jeff Sessions, Alabama

Democrats

- Max Baucus, Montana
- Daniel Patrick Moynihan, New York
- Frank R. Lautenberg, New Jersey
- Harry Reid, Nevada
- Bob Graham, Florida
- Joseph I. Lieberman, Connecticut
- Barbara Boxer, California
- Ron Wyden, Oregon

Subcommittees

- Clean Air, Wetlands, Private Property, and Nuclear Saftey
- Drinking Water, Fisheries, and Wildlife
- Superfund, Waste Control, and Risk Assessment
- Transportation and Infrastructure

Issues from past Senate Hearings:

Leakage/International Competitiveness
- Will current proposals hurt competitiveness of US firms?
- 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

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.

- 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_2 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_2 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_2 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_2 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_2 Allowance Trading program which has dramatically reduced the cost of the SO_2 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_2 emissions tradable permit system is in how to deal with non-point source polluters. Direct emitters of CO_2 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 emmissions 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?**

→ briefing book
- couple of pages on CCAP

issues:

Why is 1990 (or some percentage thereof) so important?

non-annex I countries - when do they participate
how do they participate

revenue recycling

CCAP

JI

US permit system } compliance/enforcement issues

US energy subsidies

R+D policy

in US, who wins, who loses

? IAT report

trade

Rodrigo Prudencio - Tim Wirth's special assistant
647-6240

H. or S. approp. report for State Dept

→ IAT econ analysis to support negotiations due in June

Fed news svc dated June 19

Who signed the letter re: non annex I countries?

2) Wind and solar power vary spatially: It would be interesting to know where wind power and solar power are most cost-effective. Some regions can definitely support one or the other better than other regions. However, is this an issue with deregulation of the utility industry? How could state rules on the use of renewable sources of energy by utilities affect allocation of wind- and solar-based electricity from regions with significant wind- and solar-generation to regions with less generation?

3) Factors that accelerate use of renewable energy: The author identifies four factors. Actually, the first two factors are the same: consumer choice and the opportunity to pay a price premium for "green" energy. The third factor is that states may require utilities to pass some renewable energy portfolio standards -- such standards eliminate the likelihood of a green energy premium, since consumers could not differentiate between utilities if they all provide green energy. The fourth factor is that lower renewable energy costs will spur more investments, especially relative to rising fossil fuel costs. Note that firms might invest in renewables even more under deregulation if the price premium effect becomes apparent.