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DRAFT--May 12, 1997

Economic Effects of Global Climate Change Policies

Results of the Research Efforts of the Interagency Analytical Team

June 1997

Introduction

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

Since that June 1996 workshop, the IAT has reviewed its work, selected new modeling instruments and 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 the DOE and the Environmental Protection Agency 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 readily 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 of bringing a unique capability to the IAT's work. Used separately, but in concert with each other, they provide the broad analytical capability needed to examine the many complex economic effects of potential global climate change policies.

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

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

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

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

The Base Case

The domestic energy and emissions baseline forecasts were taken from the Energy Information Administration's 1997 Annual Energy Outlook (AEO97) while 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. Moderate price increases and the growth of more energy-intensive industries in the late 1980s lead to a slower decline of energy intensity--about 0.9 percent annually. 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 of 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 negotiating process as the level of carbon to stabilize at, carbon emissions were 1,340 million metric tons, 22 percent below EIA's projection for 2010 and 21 percent below DRI 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 include gasoline.

Table 2: IAT International Baseline

	Real Economic Growth (Annual)			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	1.7	1.2	0.7
Canada	2.6	2.5	1.2	1.7	1.0	0.4	2.2	1.5	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	1.6	1.1
Eastern Europe	-4.5	4.2	4.3	-3.0	1.3	1.2	-3.5	1.3	1.2
India	4.1	4.4	3.5	3.9	1.3	3.1	4.7	2.0	2.9
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 "Plain Vanilla" Scenario

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 "plain vanilla" scenario -- is aimed at reducing carbon and other greenhouse gas emissions by freezing them at 1990 levels. (Reductions in non-carbon emissions, such as methane, are solved for outside the model.) The "plain vanilla" scenario pursues those reductions by issuing tradable emission permits at the earliest point of energy production. The policy is announced in 2000 and its restrictions are phased-in over a ten year period, so that the policy would take effect in 2010. The permits are initially auctioned, in a way that is revenue neutral, i.e., all revenues generated through permits would be recycled back through the economy through deficit reduction. The "Plain vanilla" scenario assumes no international cooperation, although this option is discussed later in the paper along with other alternatives and sensitivities.

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 consequences of emissions reductions on industry. As the year goes on, the IAT hopes to provide further detail to the industrial analysis by examining jobs, international trade, industries comparisons between countries, and the possibility that domestic industries might relocate overseas due to increased costs.

The "plain vanilla" scenario incorporates a slight improvement in energy intensity (E/GDP) over the EIA/AEO baseline, which declines by 1.0 percent per year. This improvement comes about because of "announcement effects" -- that is, the actions that take place because the climate change policy undertaken produces anticipatable increases in the future price of energy. The "announcement effect," therefore, is what allows the model to distinguish between a change in future policy regarding carbon emissions and an exogenous shock, such as the two oil price increases in the 1970's. 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.)

Core Results

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

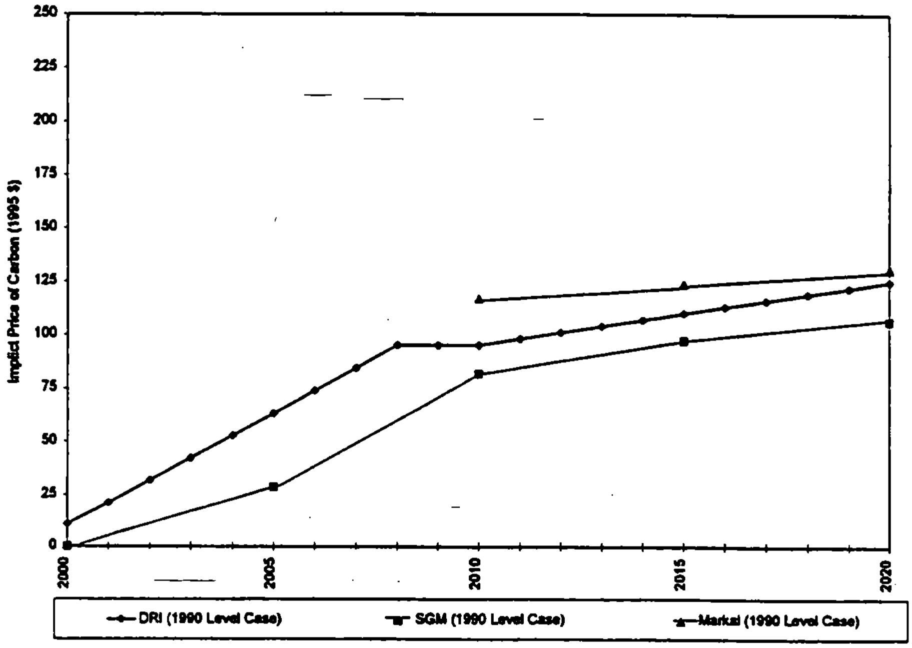
1990 Level Case

	2010	2020
DRI-DRI Energy	95	125
SGM	82	107
Markal-Macro	130	122

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

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

2010 to 2020



Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues recycled back into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP. SGM and Markal-Macro permit prices are calculated using the rate of change in C/GDP. SGM and Markal-Macro models use data and generates 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 $130 (1995$) while the SGM model predicted about $82 (1995$), in 2010. A carbon tax of $100 per ton is the equivalent of a price increase of 26 cents per gallon of refined petroleum product, of $1.49 per thousand cubic feet of natural gas, of $52.52 per ton of coal, and of 2 cents per kilowatt hour of electricity produced.

These models also agree that this implicit price of carbon grows somewhat over time. This reflects the fact that the 1990 emission ceiling becomes a progressively more binding constraint over time given projected growth in base case emissions. By the year 2020, the implicit price of carbon rises, in 1995 dollars, to $125, $107, and $131 per ton in the DRI, SGM, and Markal-Macro respectively.

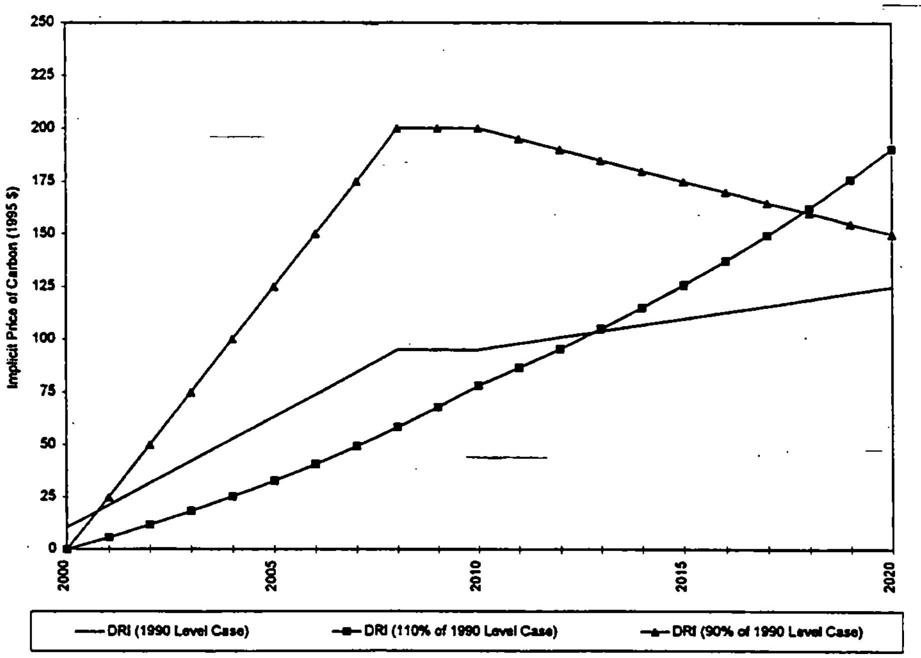
Sensitivity to the Emissions Target. The DRI model was used to analyze how changes in the level of emissions level allowed affect the implicit price of carbon. If the emission target for the year 2010 and beyond is raised (made less severe) to a level equal to 110 percent of the 1990 emissions level (that is, to a target of 1,472 million tons as opposed to 1,338 million tons), then permit prices drop almost by half -- to about $50 per ton of carbon. 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. Table 4 and Figure 2 describe the sensitivity of these results using DRI and SGM.

Table 4: Sensitivity of the Implicit Price of Carbon to the Stringency of the Emissions Target

	2010	2020
DRI-DRI Energy		
Carbon Emissions 90% of 1990 Level Case	200	150
Carbon Emissions 110% of 1990 Level Case	50	85
SGM		
Carbon Emissions 90% of 1990 Level Case	n/a	n/a
Carbon Emissions 110% of 1990 Level Case	n/a	n/a

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

Figure 2 : Sensitivity of the DRI Implicit Price of Carbon to the Stringency of the Emissions Target --2010 to 2020

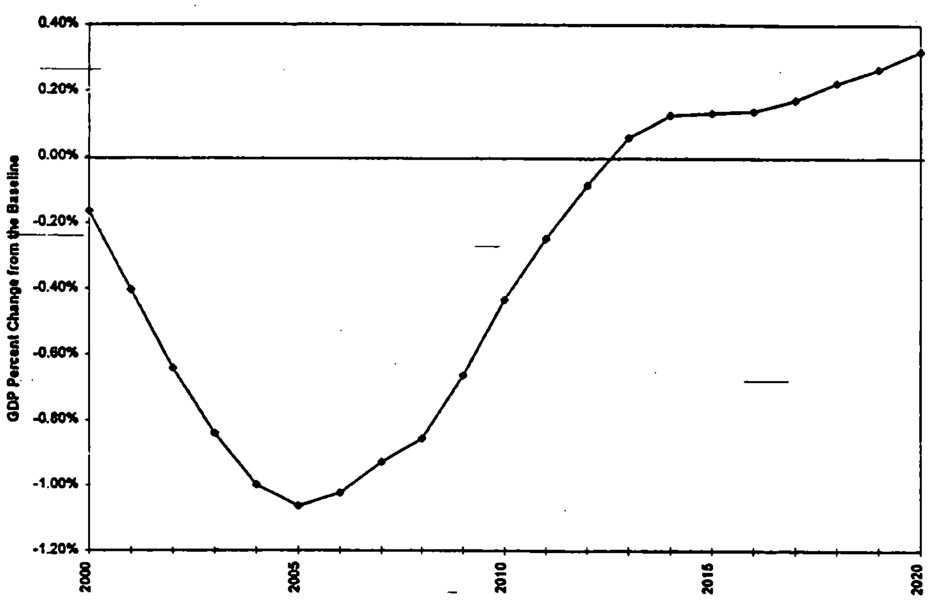


Note: 10 year phase-in with revenues recycled back into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

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 3. 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 1.0 percent of total economic output in the year 2005 -- that is, the economy's growth slows until the size of the economy is, at worst, 1.0 percent smaller in that year. 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 is actually slightly improved -- this differential reaches 0.3 percent by 2020, the last year of the model run.

Figure 3: DRI 1990 Level Case--Gross Domestic Product



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

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

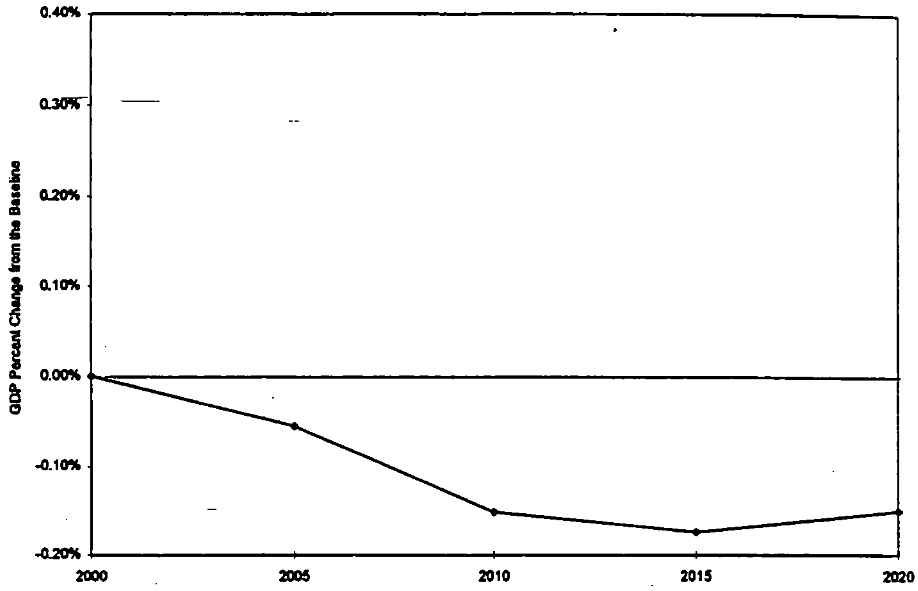
Figure 4 shows comparable results from the SGM model. Just as the DRI model focuses on short-term transition issues and may therefore tend to produce larger estimates of GDP losses, the SGM model moves quickly through these issues and focuses on longer-term prospects. The SGM model estimates peak losses for the economy of 0.17 percent in 2015, but the economy then stabilizes through 2020.

The two models offer a similar picture in some regards -- both show initial losses that are not very large (even the DRI peak loss is spread over five years). But they also differ in predictable ways, given their structure. Disequilibrium macro models, such as DRI, tend to identify deeper transitional losses and steeper transitional rebounds. Computable general equilibrium models, such as SGM, see more sanguine short-term effects and see the economy stabilizing after a more frictionless adjustment. A recent analysis by Dr. Robert Repetto and Dr. Dunkin Austin of the World Resources Institute examined about 162 analyses of climate change policy and found that this difference in structure can account for two-thirds of the difference in results, if environmental benefits are ignored.[1]

Which, then, is right? The likely answer is somewhere in between the two. DRI's transitional losses may be overstated, but so would be the rebound and the shift to a higher growth path it estimates for later years. SGM probably understates the transitional problem, but also avoids the later-year growth surge that DRI sees as driven by higher levels of investment. The two model 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.

[1] Repetto, Robert and Dunkan Austin. "The Cost of Controlling CO2 Emissions: A Guide for the Perplexed." *World Resources Institute*, June 1997 (Forthcoming).

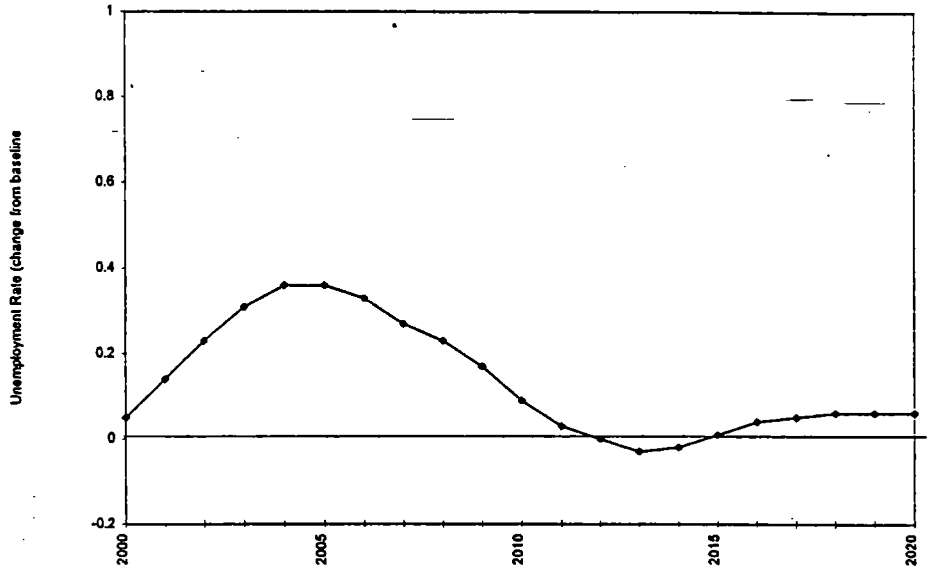
Figure 4: SGM 1990 Level Case--Gross Domestic Product



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

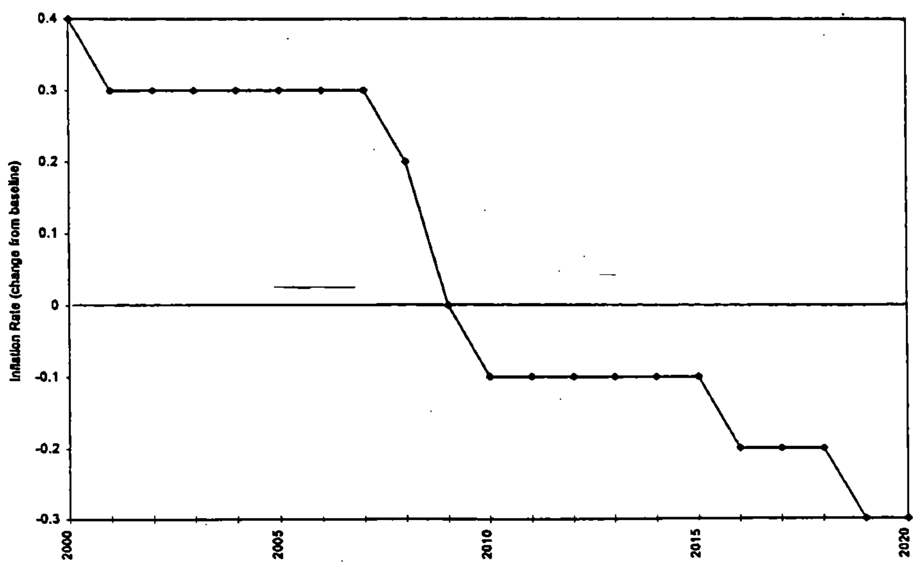
Unemployment and Inflation. The effect of the stabilization policy results in approximately a 0.2 percentage point increase in the unemployment rate from 2001 through 2011, as estimated using the DRI model. The unemployment rate first rises as GDP falls, but then returns to its pre-policy level by 2012, as shown in Figure 5. 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 reduces by about 0.1 to 0.2 percentage points per year through 2020, as shown in Figure 6.

Figure 5: DRI 1990 Level Case -- Unemployment Rate



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

Figure 6: DRI 1990 Level Case -- Inflation Rate

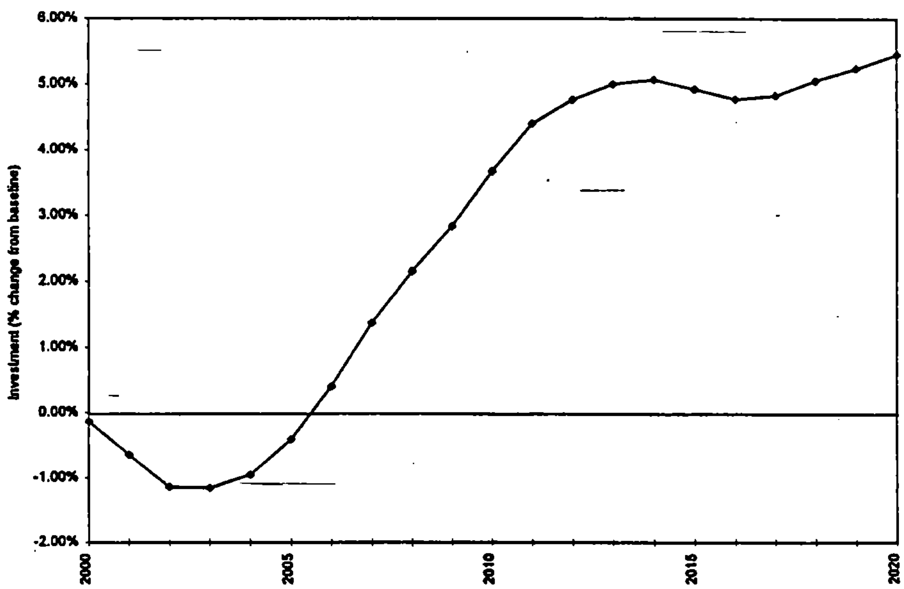


Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues recycled back into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

Investment policies are key to getting the economy back on track. In the baseline forecast, slow labor force growth of 0.8% per year yields 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-using 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 to have any chance of success. The policy must convert less efficient to more efficient energy-efficient capital. 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 7. 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 throughout the forecast period, so that PCE drops by about $80 billion in 2008, as seen in Figure 8. After the trough in 2008, PCE gradually moves toward baseline by 2020.

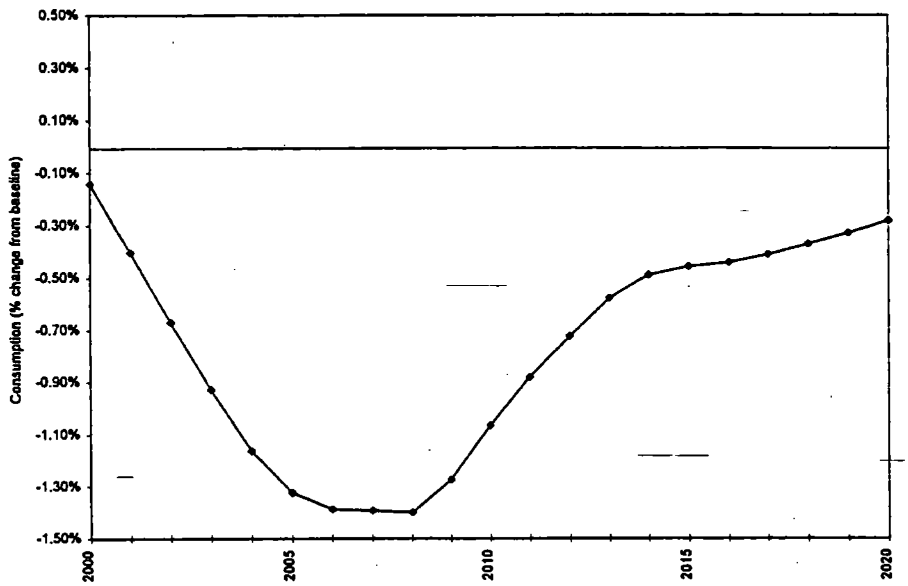
Figure 7: DRI 1990 Level Case--Investment



Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues recycled back into the economy through deficit reduction and assuming a 1.25 percent annual decrease in 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 8. 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 8: DRI 1990 Level Case--Consumption



Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Revenues recycled back into the economy through deficit reduction and assuming a 1.25 percent annual decrease in 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 Federal Reserve policy. These sensitivities are discussed in a later section.

Among fuels, demand for coal bears the brunt of greenhouse gas stabilization. Table 5 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 when compared to the base case for that year, from 109 quads to 87 quads. The table also shows comparable results using the Markal model, when the 1990-level emissions freeze produces a decline in projected energy consumption of 14 percent in 2010 and 20 percent in 2020.

Table 5: Effects of Carbon Stabilization on Energy Consumption and Fuel Mix (quadrillion Btus)

	2010		2020	
	Base case	1990 Level Case	Base case	1990 Level Case
DRI-DRI Energy				
Total US Energy Consumption	105.3	88.2	108.9	86.7
Natural Gas	25.1	22.9	26.7	24.9
Oil	40.4	35.6	43.3	37.4
Coal	22.7	17.2	23.7	15.2
Markal-Macro				
Total US Energy Consumption	107.8	97.1	115.6	100.9
Natural Gas	29.0	22.8	35.1	25.8
Oil	43.4	36.2	45.0	35.8
Coal	22.5	16.0	24.6	11.1

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

Both DRI and Markal demonstrate that dampened energy consumption and reduced carbon emissions are concentrated in coal use. As seen in Table 6, 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 produces somewhat different results; it shows that about 42 percent of total emissions reductions in 2020 occur due to reduced coal use and 29 percent due to reduced oil use, and 29 percent due to reduced natural gas consumption. By 2020, coal begins to grow in importance.

The different spread of percent of total emissions reductions by fuel occurs because renewable energy sources play a more important role in the Markal model. 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 6: 1990 Level Case -- Percent of Total Emissions Reduction by Fuel

	2010	2020
DRI-DRI Energy		
Natural Gas	13	8
Oil	30	28
Coal	57	65
Markal-Macro		
Natural Gas	31	29
Oil	36	29
Coal	33	42

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

On the demand side, according to DRI, about 46 percent of total emission reductions in 2010 result from reduced demand for electricity, 26 percent from reduced demand for transportation and 19 percent from reduced demand from the industrial sector, as shown in Table 7. The commercial and residential sectors contribute a combined 8 percent to the total of emissions reductions. The corresponding estimates obtained from the Markal model show that electricity uses account for [FORTHCOMING] percent of total reduction in emissions, and transportation, industrial, and residential and commercial uses for [FORTHCOMING] percent, [FORTHCOMING] percent, and [FORTHCOMING] ~~percent, respectively.~~

Table 7: 1990 Level Case -- 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
Markal-Macro		
Residential	n/a	n/a
Commercial	n/a	n/a
Industrial	n/a	n/a
Transportation	n/a	n/a
Electricity	n/a	n/a

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

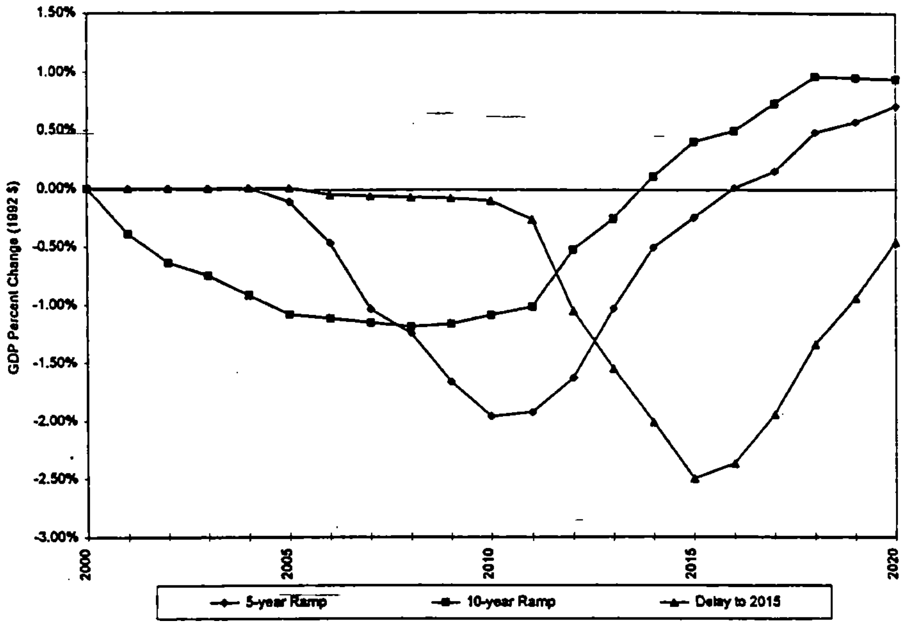
Thus, across models and when viewed from different perspectives, the center of the reductions in emissions obtained under the broadest strategies moves toward reducing utility consumption of coal. Reducing coal use under utility boilers is generally the largest, cheapest option to reduce carbon emissions in the economy. This is accomplished through better operating rates and through the substitution of gas-fired combined-cycle units for coal-fired units. The implicit price of carbon obtained in most model runs is usually the one that accomplishes this transition in electricity baseload. The range of carbon values -- generally about $100 per ton -- is as high as it is because most coal-fired units are fairly old and already fully amortized. Thus, their costs 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 than electricity generated by a new gas-fired plant that entails new capital costs.

Important Sensitivities

The following represents a number of variations from the "plain vanilla" scenario that the IAT analysts examined to address a number of factors that negotiators are likely to face in the global climate change policy process. These include the effects of: (1) timing, including different transition periods to full implementation and delaying implementation; (2) lower or higher emission level targets (the effects to permit prices were already discussed in a previous section); (3) revenue recycling options, including a comparing the deficit reduction case with revenues returned to consumers, returned to business, and a combination of returned to both consumers and investors; (4) the effects of the Federal Reserve Board reaction function on interest rates and the effect of the Price Expectation assumptions in the DRI model, (5) the effects of a policy announcement on technology innovation and diffusion as well as the steps needed to achieve a higher level of innovation and diffusion; (6) Annex I permit trading; (7) Joint Implementation with developing countries; (8) other collateral environmental benefits; and (9) effects on international trade.

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

Figure 9 : 1990 Level Case--Sensitivity to the Length of the Implementation Period and to Implementation Timing



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

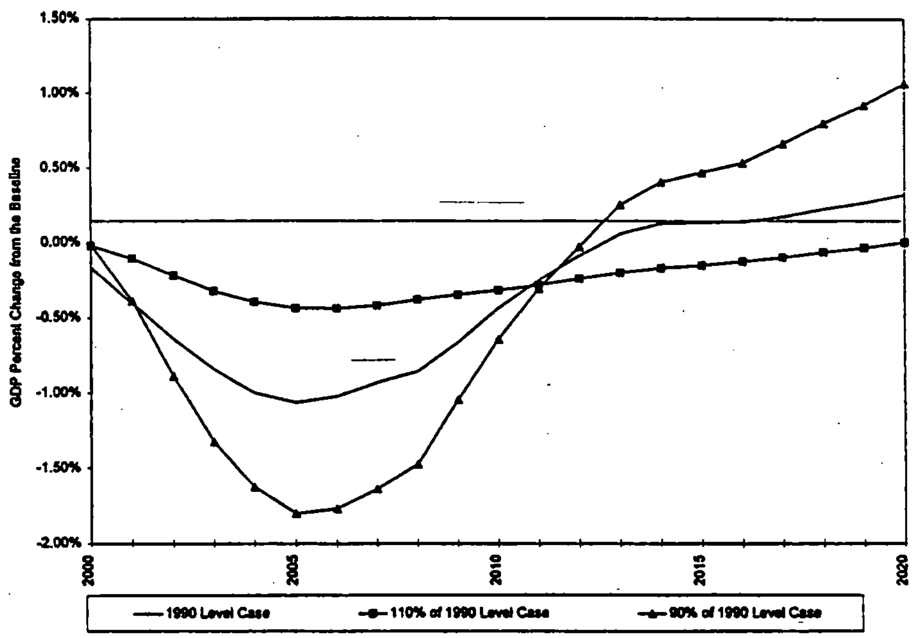
Figure 9 also shows the result of delaying the implementation by 5 years, to 2015 combines with the shorter 5-year ramp-up period. GDP effects for the delayed case are less severe in the initial period, but become greater than either the 5-year or 10-year ramp-up to stabilization in 2010 reaching a maximum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

Raising or lowering emission targets lead to obvious results --more stringent emission targets lead to greater economic losses while less stringent ones result in less severe impacts. As discussed briefly above, the IAT examined emissions targets that were both 10 percent above and 10 percent below the emissions levels of 1990. The implicit carbon prices in 2010 of the 110 percent of 1990 ~~level~~ case in 2010 are $50, or approximately half the "plain vanilla" stabilization permit price. In 2020, permit prices rise to about $85 compared with the $125 permit price under stabilization. Alternatively, an emissions target of 90 percent of 1990 level results in an implicit price of carbon of $200 per ton in 2010 and $150 in 2020. Unlike in the other cases, the implicit price of carbon falls after 2010. This is because the initial price increase is large enough to set in motion a series of capital stock improvements, particularly in utilities, that reduce the ongoing level of emissions by enough to allow the implicit price to fall. 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, if that this scenario also has a greater long-term potential for economic recovery. As shown in Figure 10, GDP declines to a peak loss of 1.9 percent below the base case in 2005. It recovers to the base case level in 2013 and increases to 1.0 percent above the base case in 2020. The long-term rebound effect results from a greater amount of revenue recycled to deficit reduction (or debt retirement), which pushes interest rates down substantially and drives up investment.

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

Figure 10: Sensitivity of GDP to the Stringency of the Emissions Target



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

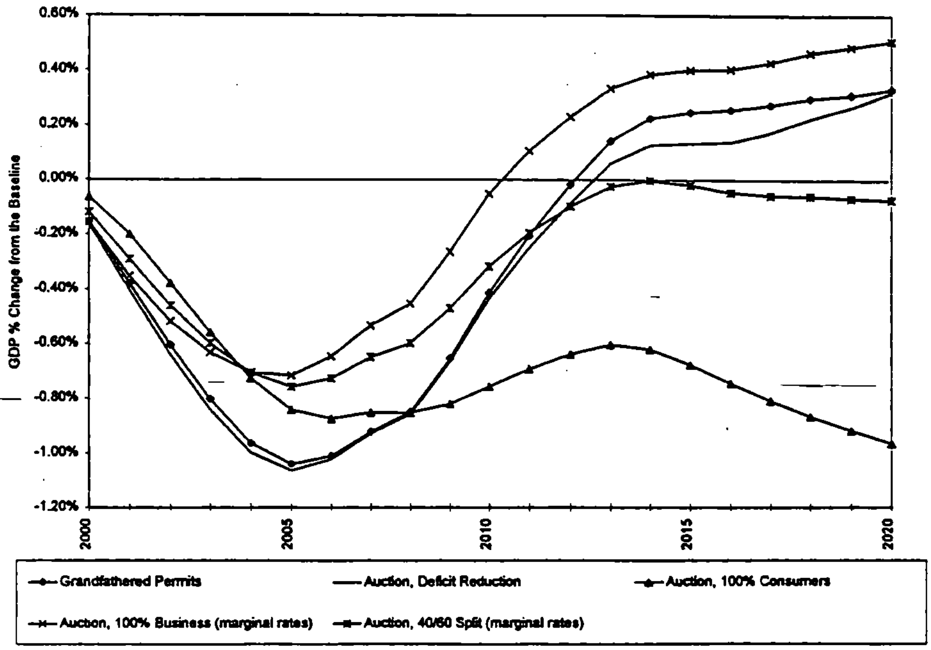
The portion of total emission reductions from coal and oil in both the 90 percent and 110 percent of 1990 Level Case, increases only slightly--about 5 percentage points--while total emission reductions from natural gas change significantly. In 2010, under stabilization, about 13 percent of total emission reductions are from natural gas. Under a 10 percent increase in the target (that is, a target of 90 percent of 1990 emissions), about 24 percent of total emission reductions are from natural gas. This occurs because the substitution of gas for coal in electric utilities is not enough to achieve the bulk of the 90 percent (more stringent) target. Additional emissions reductions must be found, which forces the burden to be spread more evenly among fuel types and sectors.

Adopting a revenue recycling option that leads to investment in energy efficient capital leads to less impact on the economy during the transition and greater returns to the economy in the long term. The IAT looked at a number of revenue recycling policies in addition to the deficit reduction case. These options are depicted in Figure 11. These include:

- "grandfathering" permits to producers, meaning that every carbon-emitter would be allowed to pollute at their 1990 level. The permits allowing them to do so would then be traded freely, allowing a least-cost response to the problem to emerge;
- a 100 percent recycling of any revenues from permit auctions to consumers through a reduction in the personal income tax;
- a 100 percent return to business through a reduction in the marginal rates of the corporate income tax or through lump-sum rebates; or
- a 40/60 split to consumers and businesses, in proportion to their shares of energy use, either through a tax rate reduction or a lump-sum return.

Figure 11: DRI 1990 Level Case --

GDP Sensitivity to Revenue Recycling Options



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

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

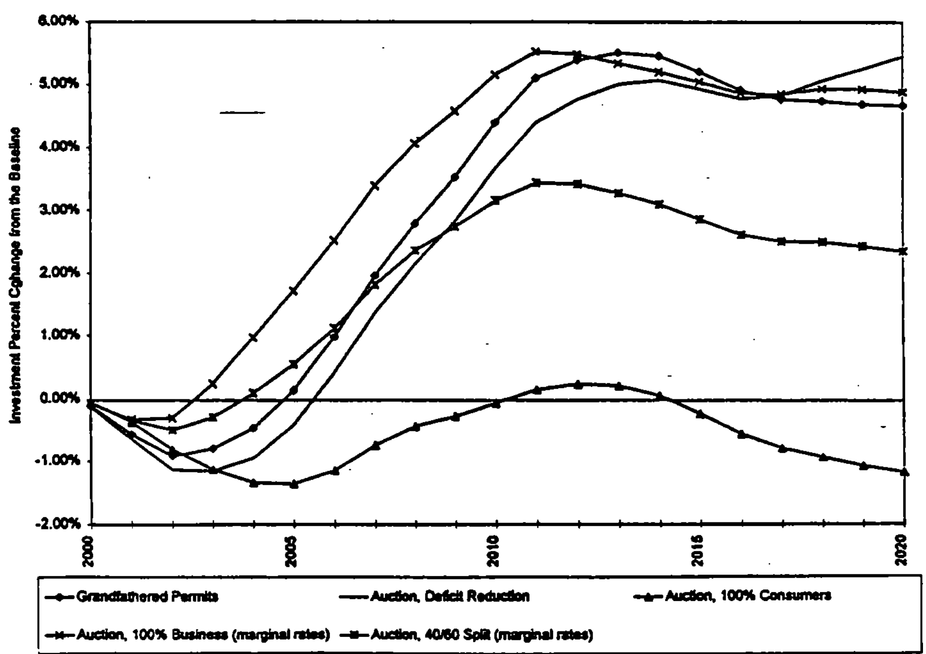
The revenue recycling options that lead to better economic outcomes are all those associated with greater investment and capital formation. Deficit reduction leads to lower interest rates, which lowers the cost of capital and facilitates investment. Recycling revenues to companies has the effect of increasing savings through apparent profits and provides the wherewithal for greater investment spending. Similarly, grandfathering permits to producers allows them to "assetize" their right to pollute. This allows firms to realize gains 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 12 and 13 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 12: DRI 1990 Level Case

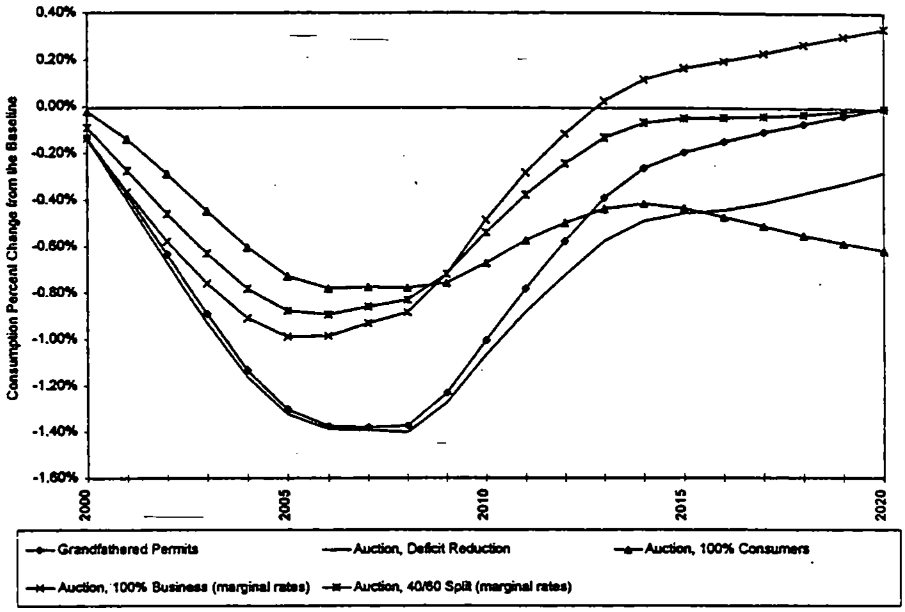
Investment Sensitivity to Revenue Recycling Options



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

Figure 13: DRI 1990 Level Case

Consumption Sensitivity to Revenue Recycling Options

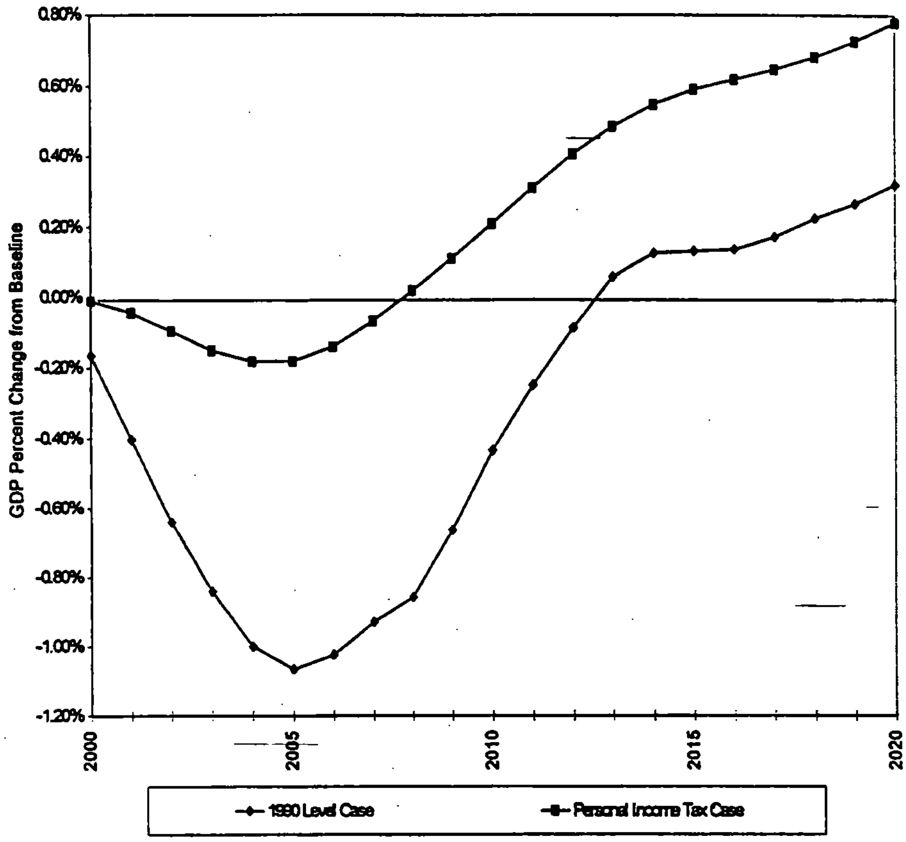


Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Assuming a 1.25 percent annual decrease in E/GDP.

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

An increase in the personal income tax results in smaller economic losses and a more prompt economic rebound than a "deficit-equivalent" carbon reduction policy, as shown in Figure 14. 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 14: Comparison of Deficit Reduction to Personal Tax Increase: Effects to GDP



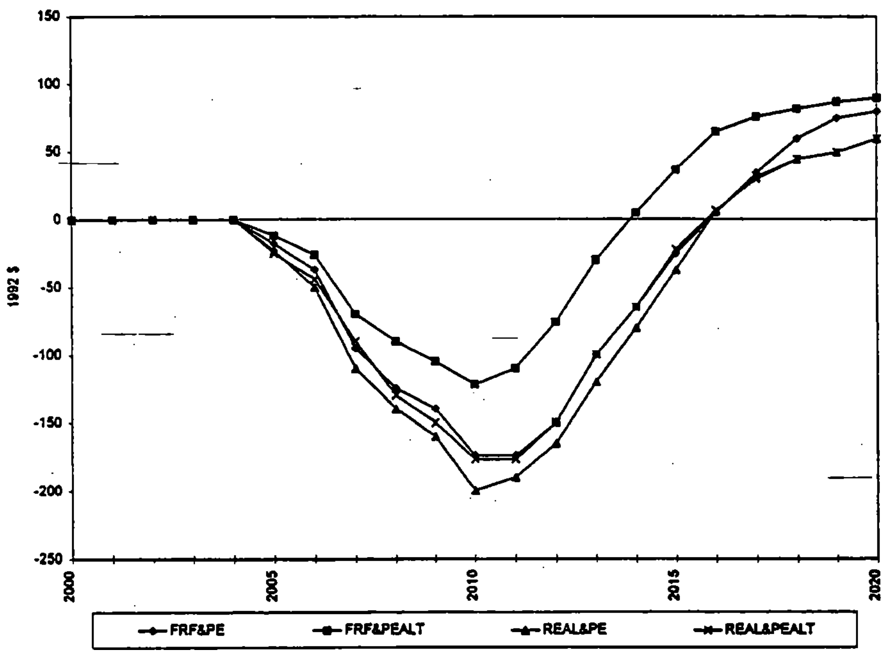
Note: Emissions stabilized at 1990 levels in 2010 with a 10 year phase-in. Assuming a 1.25 percent annual decrease in E/GDP.

The IAT decided to maintain the DRI assumptions about the reaction of the Federal Reserve Board (Fed) to price inflation, while excluding DRI's price expectation function for consumers, business and the Fed. 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. This reaction function was used in the analysis. The price expectation equation in the DRI model presumes that three agents in the economy--business, consumers and the Fed -- have adaptive expectations, that is, they believe that future levels of inflation can be guessed by extrapolating current levels of inflation. This price expectations equation was ***not*** used in the analysis, because it seemed a poor way to model a widely-known and anticipated one-time policy event that would affect prices as would, in some sense, a sales tax. Nonetheless, the IAT ran sensitivity analyses to discover what the differences in the economic effects there would be under a carbon policy scenario if these assumptions were altered.

As can be seen from Figure 15, the effects of the DRI reaction function are very similar to those obtained when the Fed's target is assumed to be constant real non-borrowed reserves, itself a fairly accommodating policy (depicted in Figure 15 as "REAL"). The alteration of price expectations is also important. When all three agents--business, consumers, and the Fed --view expected inflation as unchanged as a result of the imposition of a carbon permit policy, GDP losses are smaller (depicted in Figure 15 as "PEALT").

Thus, alternative views of price expectations appear to have as large an impact on the ultimate results as do alternative monetary policy reactions: when consumers, businesses, and the Fed all see a carbon-limiting policy as inseparable from an increase in underlying inflation fundamentals, and while their doing so would be myopic in the extreme, the economic results are worse. Moreover, should they do so, they force the Fed into an even more output-limiting policy posture and the combined results are far worse.

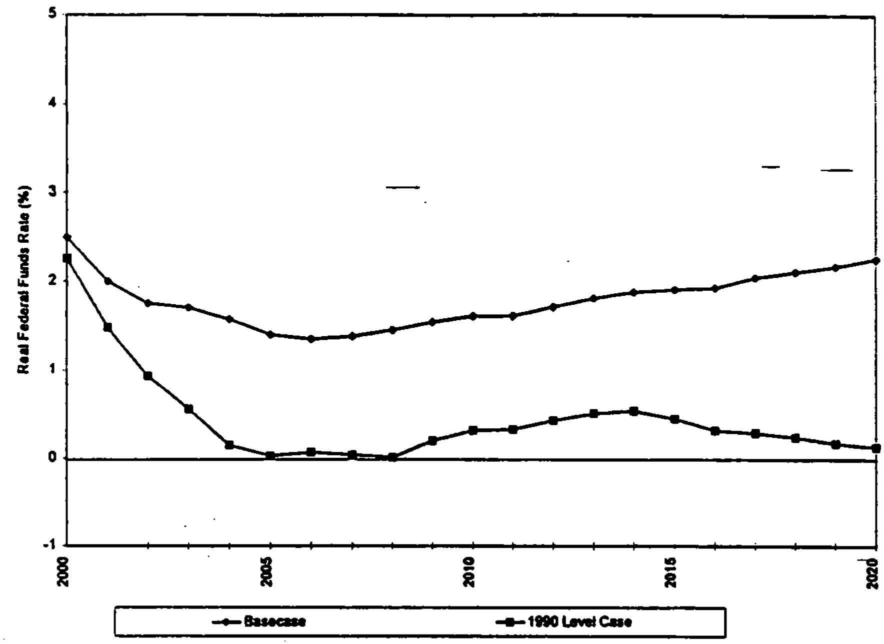
Figure 15: 1990 Level Case--Sensitivity of GDP to Assumptions about Federal Reserve Policy and Price Expectation



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. FRF&PE means DRI's Federal Reaction Function and Price Expectation equations are both left on. FRF&PEALT means DRI's Federal Reaction Function equation is left on while the price expectation equation is switched off. REAL&PE means that the Federal Reaction Function equation is switched off and constant real non-borrowed reserves are used instead and the Price Expectation equation is left off. REAL&PEALT means that the Federal Reaction Function and the Price Expectation are switched off.

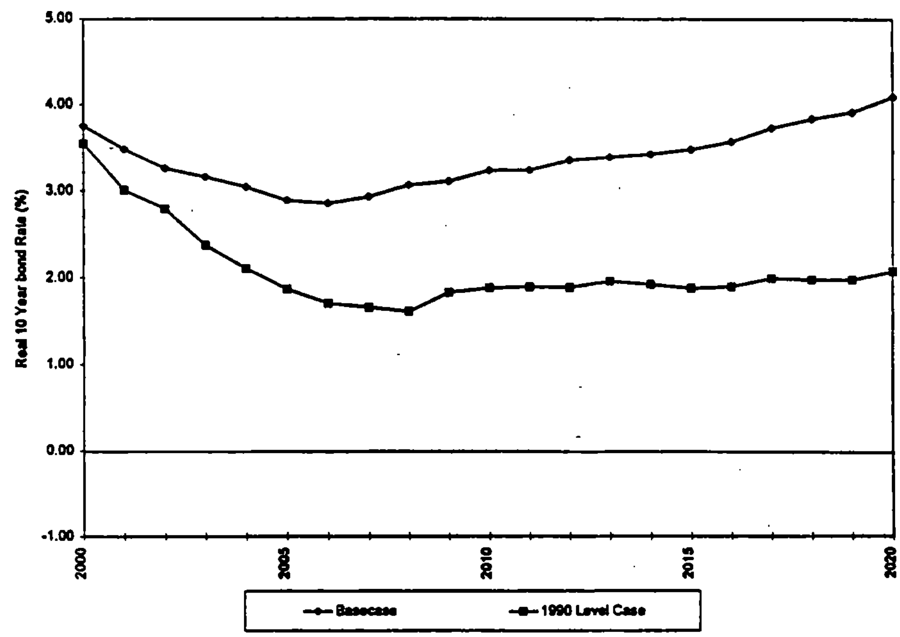
Figures 16, 17, and 18 show projections of the Federal Funds Rate, the 10-year Long Term Bond Rate, and the Federal Deficit/Surplus, respectively, from the DRI model while both the Federal Reaction Function and the Price Expectation equations are used in the analysis of the 1990 Level Case ("plain vanilla"). 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 16: DRI 1990 Level Case--Real Federal Funds Rate



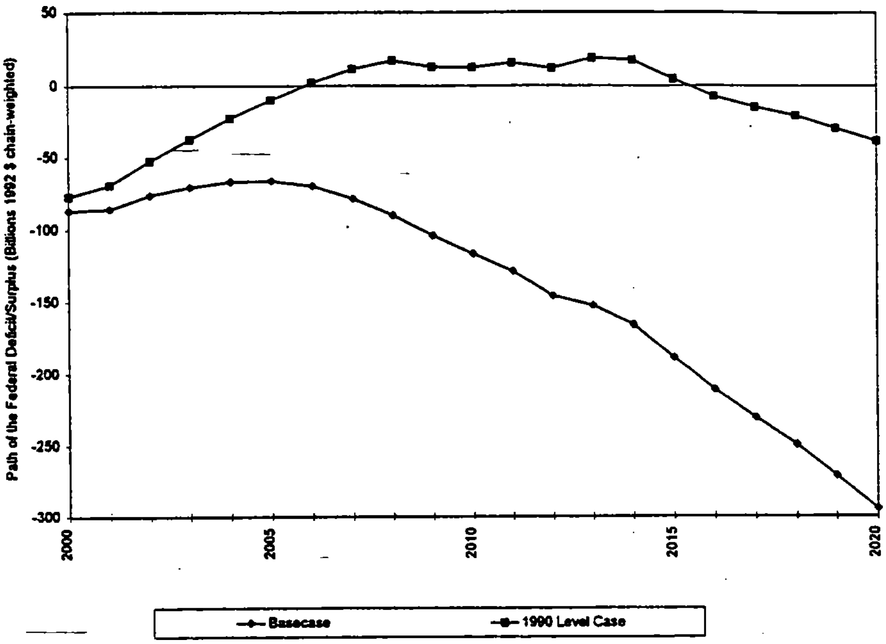
Note: Emissions stabilized at 1990 levels in 2010. Revenues recycled back into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

Figure 17: DRI 1990 Level Case--Real 10-Year Long-Term Bond Rate



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

Figure 18: DRI 1990 Level Case--Path of the Federal Deficit/Surplus



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

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

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

In fact, some analysts believe that the enactment of the Climate Change Action Plan gets us to the 1.25 annual reduction. DRI achieved a 1.25 percent annual rate of improvement in E/GDP using the latest estimates of energy savings from CCAP, as seen in Table 8. The model then takes these savings and computes carbon emission reductions based on the energy savings profile.

Table 8: CCAP Emission Reduction Estimates by Sector in DRI Energy Model (MMTC)

	2000	2010	2020
Residential	-1.5	-6.1	-9.9
Commercial	0	0	0
Industrial	-11.2	-19.8	-20.8
Transportation	-4.8	-8.3	-9.1
Electricity	-15.5	-53.2	-76.3
Total	**-33.0**	**-87.4**	**-116.1**

But 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 the 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. Many of these are aggressive in their scope: for example, the average fuel efficiency of the vehicle fleet in the year 2020 is 33 miles per gallon in the 1.25 case, but rises to 55 miles per gallon in the 1.75 case. 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 include a "first-cost bias" which weights up-from capital costs more heavily than future fuel costs: this is comparable to the higher discount rates used in Markal.

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

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

Table 9 summarizes the effects of higher technological progress (that is, the 1.75 annual rate versus the 1.25 annual rate) on the economic effects of carbon-limiting policies. As seen, higher rates of technological progress can cut dramatically the implicit price of carbon and the associated transitional GDP losses. For example, in the IAT "plain vanilla" case (assuming 1.25 percent annual efficiency improvements), the implicit price of carbon in the two models is $82 and $130 per ton in 2010 and $125 and $122 per ton in 2020, for DRI and Markal-Macro respectively. In the more advanced technology case, the implicit price of carbon is $88 per ton and $95 in 2010 and $30 and 48 per ton in 2020, for DRI and Markal-Macro respectively.

Table 9: Sensitivity of Implicit Price of Carbon (1995 $)

to Rate of Technological Change --1990 Level Case

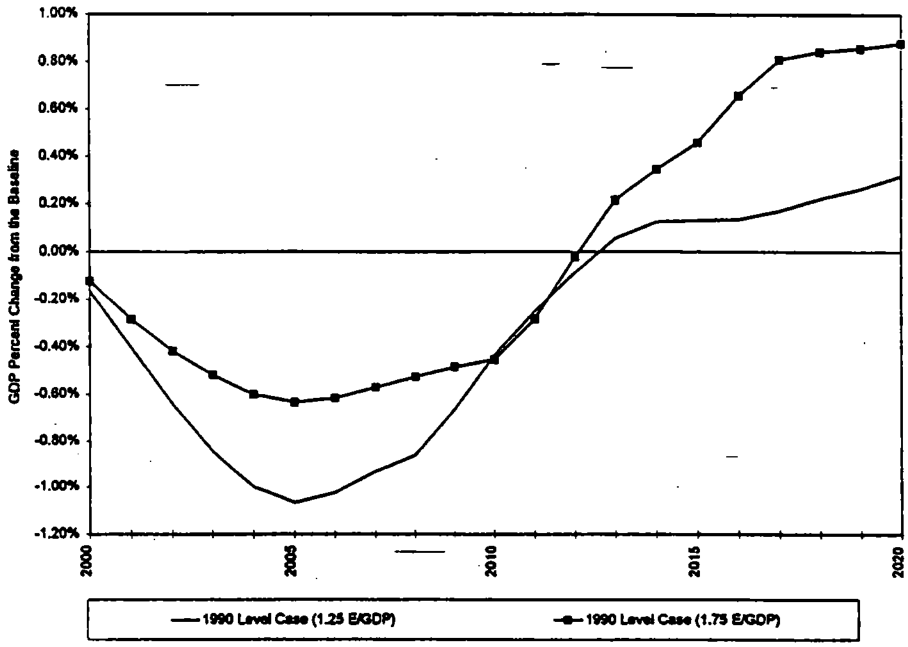
	2010		2020	
	1.25 Case	1.75 Case	1.25 Case	1.75 Case
DRI-DRI Energy	95	88	125	30
Markal-Macro	130	95	122	48

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

The peak GDP losses change accordingly, as shown in Figure 19. Using the DRI model, the peak output loss of -0.6 percent occurs in 2005, and the economy reaches its pre-policy growth path by 2012. The economy's shift to a higher growth path is also more pronounced, but here the result is more believable, because it is achieved through technological progress rather than revenue recycling that raises savings and fosters investment (in fact, the level of revenue recycling falls dramatically as does the implicit price of carbon). The risk, however, is that these output gains may be somewhat overstated, because they do not account for the cost of the investments needed to reach the higher rate of technological progress. For example, firms will have to perform R&D that might distract them from other R&D tasks. If other R&D in the economy fell as energy- and carbon-related R&D was performed, overall productivity could drop and offset the economy's potential elsewhere. Alternatively, they might increase their 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 19 : Sensitivity of GDP to the Rate of Technological Progress

DRI 1990 Level Case



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

These results indicate how important technological progress is in the long ~~term.~~ A substantially higher rate of technological progress does not affect short-term results in a striking fashion. But it is capable of moving the analysis significantly once its effects are allowed to accumulate.

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

In brief, under a system of tradable permits, a country could either reduce emissions or purchase additional emissions "rights" (i.e., permits) from other countries. Countries with opportunities to reduce emissions that cost less than the going permit price would have an incentive to reduce emissions and sell their "right to emit" for cash. Countries that had only high cost options to reduce emissions (that is, reduction options that cost more than the permit prices) could purchase emission permits. The forces of supply and demand would set the permit price and the market incentives would push the trading group, as a whole, to institute the least cost emissions reductions first. As a result, it costs less for the trading group, as a whole, to reach the target emissions levels, than it would for each country to unilaterally 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). In the second scenario, we 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 "plain vanilla" scenario for stabilizing carbon emissions ; that is, stabilizing CO2 emissions at 1990 levels in 2010 with a ten year phase in, where revenues are used to reduce the deficit, and under the assumption of moderate technological change (i.e., a .25 percent additional reduction over the baseline in the annual increase in energy or carbon efficiency).

The results obtained using the SGM model appear in Table 9. Under the "Annex I trading" scenario, the United States, Canada, Western Europe, Japan, and Australia each bear real costs for CO2 emissions reduction. The losses experienced by he different nations reflect the economic assumptions made for them (which are presented earlier in this report, in Table x) 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 and the implicit price of carbon in the presence of a 1990-level freeze is relatively low. Western Europe fares somewhat worse, since its economic growth is projected to be stronger, and its energy policies have been biased towards coal. Absent trading, the implicit price of carbon in the Annex I regions ranges from a low of $82 per ton to a high of $268 per ton in 2010.

Table 9: GDP Impacts to Annex I Countries, No Trading v. Annex I Trading

SGM 1990 Level Case

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

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

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

Table 10 shows the implicit price of carbon by country without trading, trading with Annex I countries, and with Joint implementation with the developing countries.

Table 10: 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
Australia	132	23	15	126	35	20
Canada	222	23	15	252	35	20
China	*	n/a	15	*	n/a	20
Former Soviet Union	0	23	15	0	35	20
Eastern Europe	0	23	15	0	35	20
India	*	n/a	15	*	n/a	20
Japan	268	23	15	257	35	20
Korea	*	n/a	15	*	n/a	20
Mexico	*	n/a	15	*	n/a	20
Western Europe	130	23	15	139	35	20
United States	82	23	15	107	35	20
Rest of World	*	n/a	15	*	n/a	20

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

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

Under Annex I trading, the implicit price of carbon falls dramatically -- permit prices start at $23 in 2010 and slowly climb to $35 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 former Soviet Union and the Eastern European nations. Carbon values fall 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.

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 $15 in 2010 and $20 in 2020. Under this broader market for tradeable emissions permits, however, the FSU and Eastern Europe lose their monopoly on permit sales. Specifically, Joint

Implementation encourages China and India to reduce their use of coal and enter the market as emissions permit sellers.

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

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

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

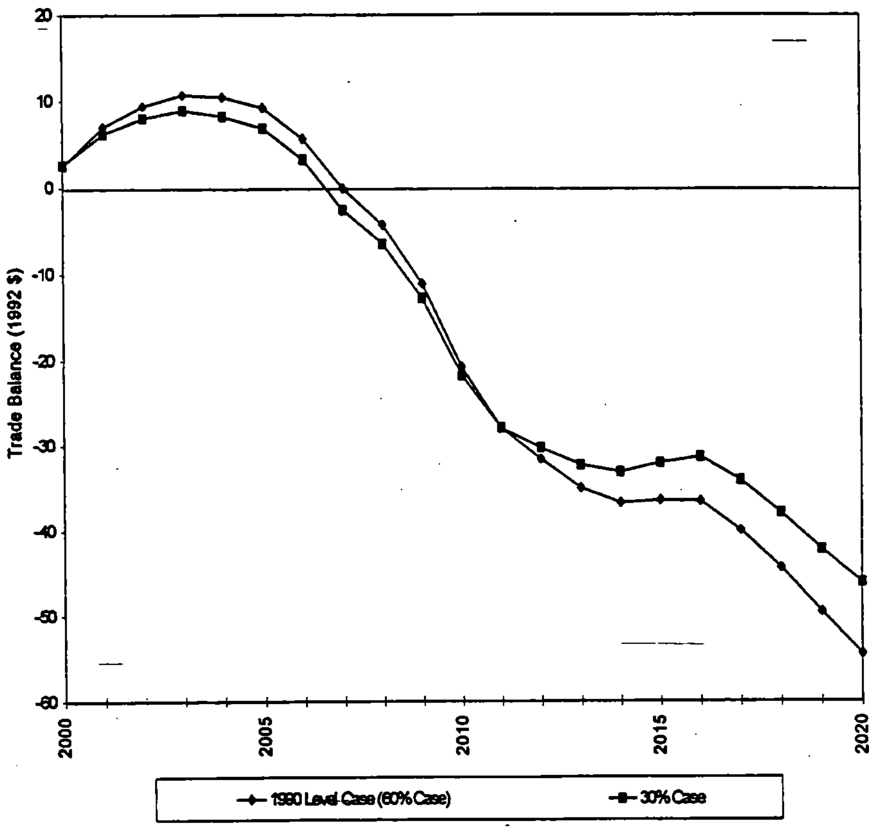
The losses experienced to the U.S. by handicapping energy-intensive industries in international trade need not be large. There ~~is~~ widespread and legitimate concern that forcing an implicit energy price increase on U.S. producers will disadvantage them substantially through trade, particularly with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

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

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

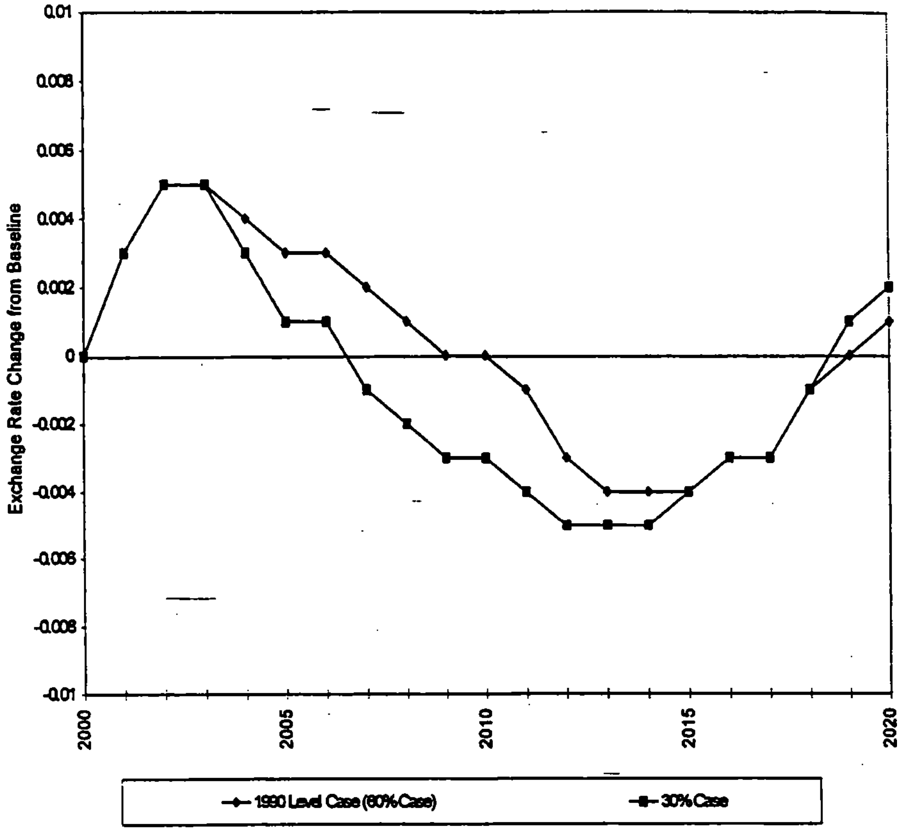
Figure 20 presents the results under these two cases. The effect of the carbon-limiting policy on trade is depicted in these runs as surprisingly small. Some of the change in trade flows is reconciled in the DRI model by allowing the exchange rate to move, but as seen in Figure 21, the anticipated changes in the exchange rate themselves are not large and do not vary between the two assumptions. The small differences are not necessarily counterintuitive. There are already substantial energy price differences and differing environmental restrictions among trading nations that are larger than the price increase that results from the policies considered here.

Figure 20: Sensitivity of the Trade Balance to International Price Ratio Assumptions



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

Figure 21:Sensitivity of the Exchange Rate to International Price Ratio Assumptions



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

Regional and Sectoral Detail

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

Table 11: DRI 1990 Level Case–Industry Impacts

Output (Percent Change from Base case)

	2010	2020
Energy Producers		
Electric Utilities	-11.6%	-17.7%
Petroleum Refining	-8.8%	-9.3%
Coal Mining	-25.9%	-39.3%
Natural Gas	-19.9%	-18.2%
Gas Utilities	-11.4%	-10.9%
Crude Petroleum	-11.8%	-12.4%
Fuel Oil	-13.6%	-16.7%
"Pipelines, ex. Natural Gas"	-7.8%	-8.0%
Energy Intensive Industries		
Food and Kindred Products	-1.0%	-0.6%
Chemical and Allied Products	-0.8%	-0.3%
Petroleum and Coal Products	-9.2%	-10.0%
Stone Glass Clay Products	1.5%	2.9%
Paper and Allied Products	-0.4%	3.0%
Primary Metals	0.8%	1.5%

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

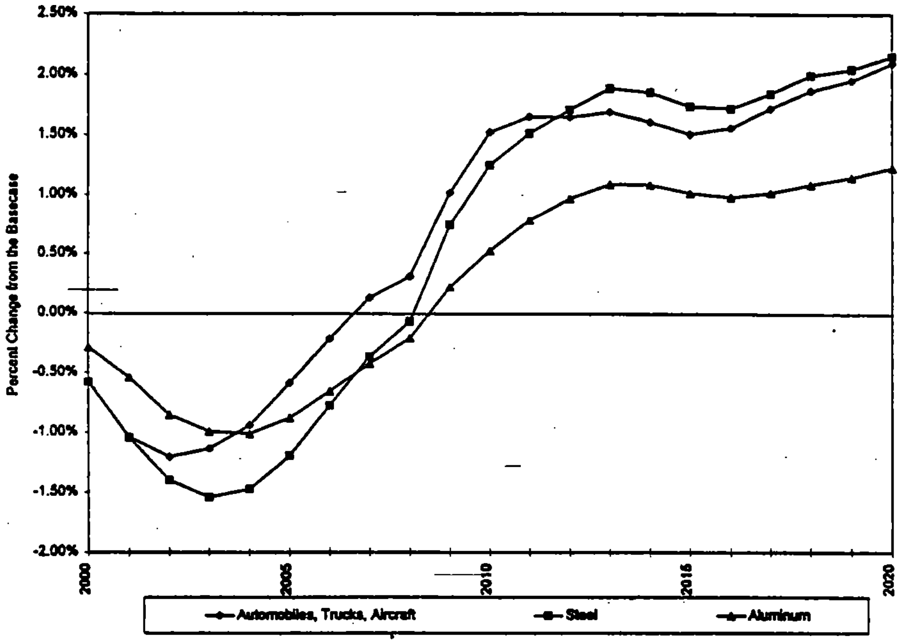
Energy-intensive industries are put at a disadvantage by higher implicit prices for carbon following the imposition of policy. This occurs because they are displaced through trade -- an effect that DRI depicts as relatively minor -- or because the composition of the economy's output changes in favor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

For example, a number of energy intensive manufacturing and construction sectors benefit in the long-term by the stimulus to investment created by the reduction of the deficit. For example, output of the construction, steel, aluminum, lumber and wood products, and motor vehicles are 1.0 to 4.0 percent above the baseline in 2010. Figures 22 and 23 show the transitional output losses and the long-tern output gains of a number of basic energy intensive industries that produce final or intermediate products for investment.

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

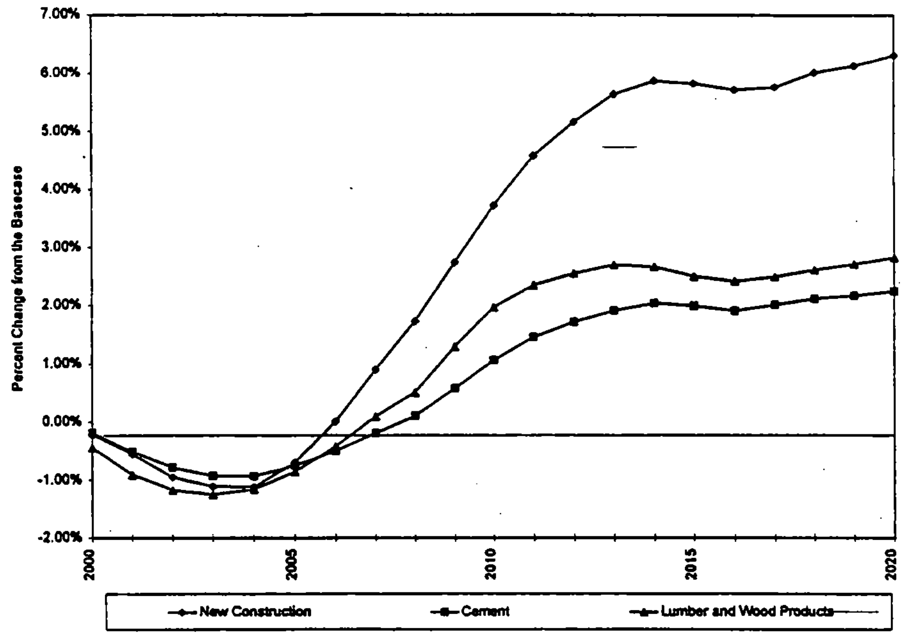
This mix effect is particularly and obviously important for energy producers. The DRI model suggests output of petroleum products will decline by 8 percent in 2010 and by 9 percent in 2020, when compared to the base case. As seen in Table 11, coal production in the U.S. will be 26 percent lower in 2010 and 39 percent lower in 2020 when compared to its projected levels in the base case.

Figure 22: DRI 1990 Level Case--Output in Key Industries--New Construction, Cement, and Lumber and Wood Products



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

**Figure 23: DRI 1990 Level Case--Output in Key Industries--
Automobiles, Trucks and Aircraft, Steel, and Aluminum**



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

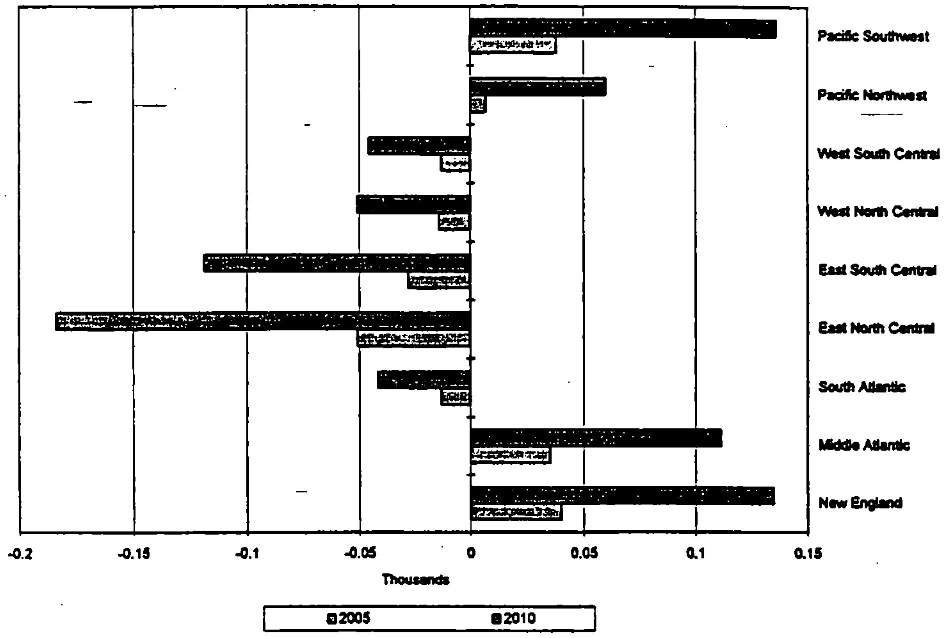
Coal employment would be [FORTHCOMING] percent and [FORTHCOMING] percent lower, respectively, in those years: these declines are lower than output losses because productivity in the industry is generally anticipated to improve and the nation's coal mix is projected to shift to more productive coal reserves. These employment losses are particularly severe in the east and west south central regions. Total coal employment in the U.S. would be [FORTHCOMING] lower by 2020.

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.

Regional Effects The effects of climate change policy on the various regions of the country are shown in Table 12. In general, states in the East North, East South, 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 24 and 25. 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 24 : DRI 1990 Level Case--Population

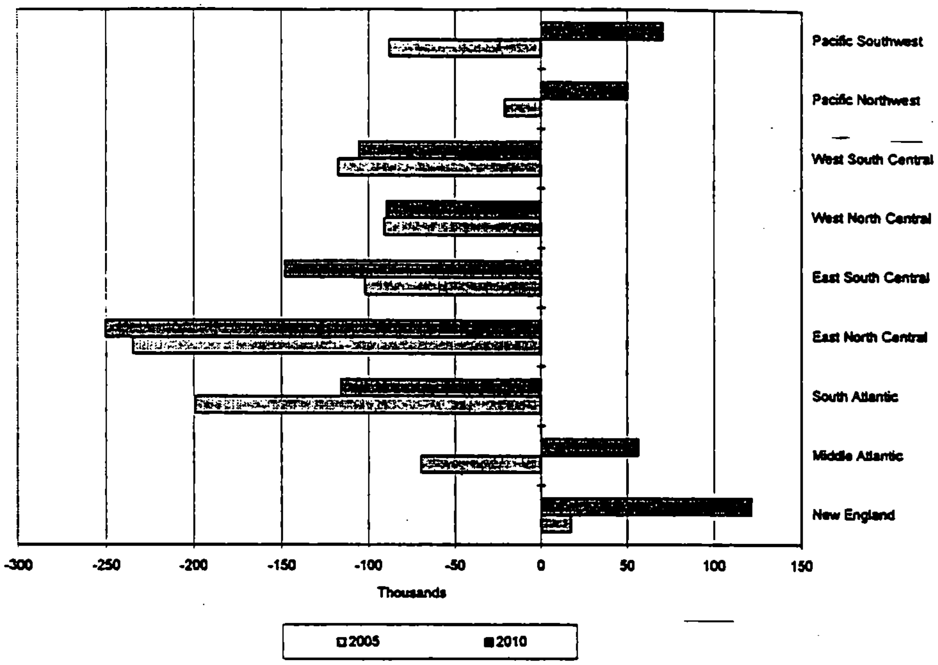
(change from the base case)



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

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

Figure 25: DRI 1990 Level Case--Total Non-Farm Employment change from the base case



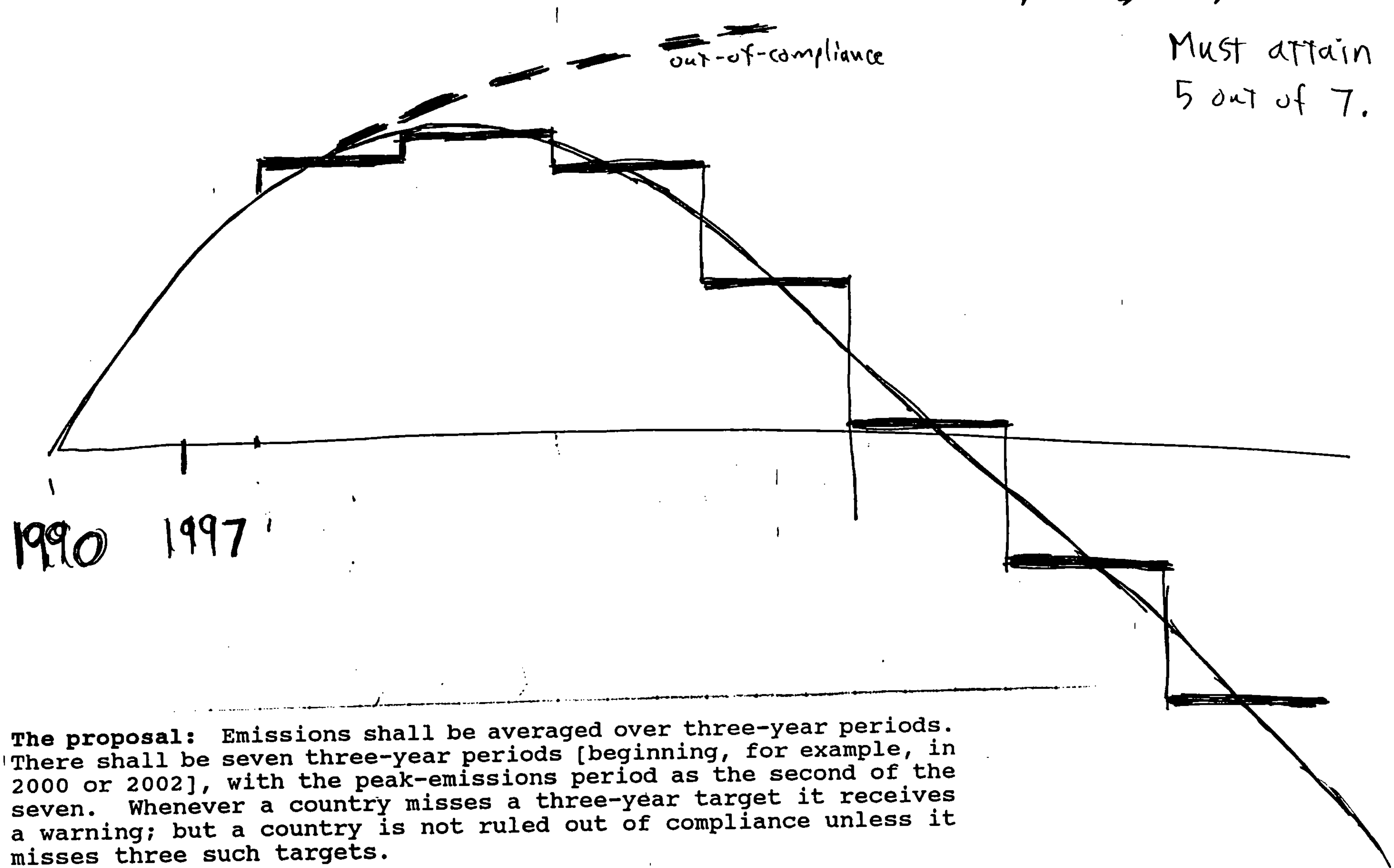
Note: Emissions stabilized at 1990 levels in 2010. Revenues recycled back into the economy through deficit reduction and assuming a 1.25 percent annual decrease in E/GDP.

As shown in Table 12, although the West South Central region is expected to have the greatest losses in mining employment, about 15 thousand in 2010, this represents only about 6 percent of its total mining employment in that year. On the other hand, the East South Central Region is expected to lose about 8 thousand in 2010, but this represents about 22 percent of its total mining employment in the same year.

Table 12: DRI 1990 Level Case
Regional Impacts

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

Frankel proposal: 7 × 3-yr.

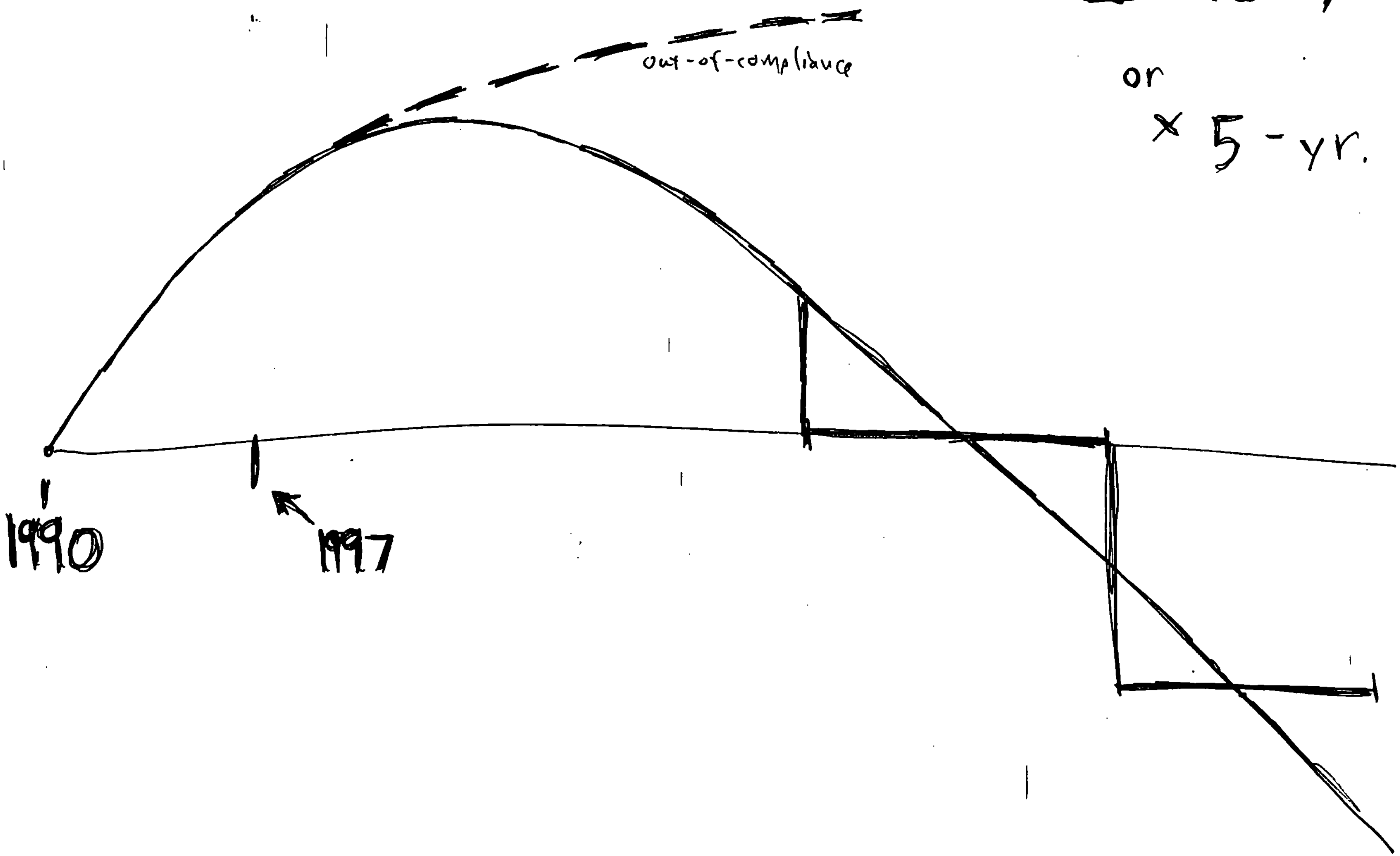


The proposal: Emissions shall be averaged over three-year periods. There shall be seven three-year periods [beginning, for example, in 2000 or 2002], with the peak-emissions period as the second of the seven. Whenever a country misses a three-year target it receives a warning; but a country is not ruled out of compliance unless it misses three such targets.

In other words, the binding requirement is to hit at least 5 of the 7 targets. Thus a country receives a clear warning at a stage when it is still feasible to get back into the system.

Existing plan: 2 × 10-yr.

or × 5-yr.



cc: JS

White House Climate Change Task Force

734 Jackson Place, N.W. • Washington, DC 20503

April 9, 1997

Per Alicia & Jeff, Mark will also represent CEA. called in Mark's name via Mary Washington.
af

MEETING NOTICE

To:	**Distribution**
From:	**Dirk Forrister** 343-1060
Re:	**First Monthly Task Force Meeting**

As you know, Katie McGinty (Council on Environmental Quality) and Dan Tarullo (National Economic Council) established the White House Climate Change Task Force to coordinate communications efforts across agencies in order to support the international negotiations leading up to the Kyoto Summit in December. I appreciate the many words of encouragement and support as we have been getting organized.

I would like to invite you to serve on the Task Force itself, which will meet on a monthly basis to coordinate communications efforts across agencies. If you are not the appropriate representative for your agency, please give me a call to discuss who would be more appropriate. The Task Force will help guide the work of three staff-level working groups: (1.) public communications and education; (2.) congressional affairs; and (3.) media response. Given the importance of this effort, there will be no substitutions for Principals at the Task Force meetings.

The Task Force staff has been working hard to audit our current communications situation and to begin to plan and work with your agencies to implement improved communications about the Administration's policy priorities. In order to develop and finalize our work plan, we need an intensive "kick off" session of the Task Force. After consulting with several of you, I plan to schedule a 3 hour off-site meeting. If you are willing to devote this time and we use it wisely, it should save us many hours of meetings later. The Task Force staff will provide agenda and background papers prior to the meeting to expedite our work.

Given scheduling difficulties, I thought it best to poll Task Force Members on your availability so that we can ensure maximum attendance. Please fill out the attached form with your preferences on meeting times and return it by fax to Mary Washington at the Task Force (fax: 343-1162) by noon Thursday, April 10. Your prompt response will enable us to select a final time and place so that you can plan your schedule accordingly.

I appreciate your interest in this effort. If you have questions, please feel free to give me a call.

RESPONSE FORM FOR TASK FORCE OFF-SITE PLANNING SESSION

Please respond with your preferences by noon Thursday, April 10

Name: ______________________

Agency: ______________________

I can be available the following days and times:

___ **Thursday, April 17, 3:00 to 6:00 pm**

___ **Friday, April 18, 9:00 am to Noon**

___ **Friday, April 18, 2:00 pm to 5:00 pm**

___ **Friday, April 18, ______ to ______**

Distribution:

David Sandalow, CEQ/NSC
Mark Mazur, CEA/NEC
Shelly Fidler, CEQ
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Josh Gottbaum, Treasury
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Bill Samuels, Labor
Frank Kruesi, Transportation
Charlie Rawls, Agriculture
Brooks Yeager, Interior
Terry Garcia, NOAA

cc: Bm
JAF
mm
JS

THE WHITE HOUSE
WASHINGTON

May 7, 1997

MEMORANDUM FOR DISTRIBUTION

FROM: MARK MAZUR
DAVID SANDALOW

SUBJECT: Climate Change

There will be a meeting Thursday, May 8 from 4:00-6:00 in OEOB Rm. 476. We will discuss:

1. June public meeting

2. Deputies decision memo (copy attached).

Attendance is invitees only. Everyone on the attached list has been cleared into the building. For questions concerning clearance, please call James Uwins (456-6540).

Please note that Eileen Claussen is holding a climate change meeting Friday, May 9 from 2:00-4:00 in State Department Rm. 3524. The agenda for that meeting was distributed yesterday by the State Department.

DISTRIBUTION:

Organization	Name	Fax
State	Eileen Claussen	647-0217
	Rafe Pomerance	
Commerce	Everett Erhlich	482-0432
	Jeffrey Hunker	482-4636
OSTP	Rosina Bierbaum	456-6025
CEA	Alicia Munnell	395-6958
NEC	Jeff Frankel	
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Treasury	Joshua Gotbaum	622-2633
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Interior	Brooks Yeager	208-4561
NOAA	Terry Garcia	482-6318
OMB	T.J. Glauthier	395-4639
USTR	Jennifer Haverkamp	395-4579
Agric	Charlie Rawls	720-5437
DOE	Mark Chupka	586-0861
	Joe Romm	586-9260
EPA	Mary Nichols	260-5155
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	David Gardiner	260-0275
DOT	Frank Kruesi	366-7127
OVP	Pete Jordan	456-9500
CEQ	Steve Seidel	456-6546
PCSD	Marty Spitzer	408-6839
TaskForce	Dirk Forrister	343-1162
USAID	David Hales	703-875-4639
DOL	Ed Montogmery	219-4902

PREDECISIONAL DRAFT 5/6
DO NOT QUOTE OR CITE

MEMORANDUM FOR THE DEPUTIES

FROM:

SUBJECT: Climate Change

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

ISSUES FOR DECISION

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

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

NEED FOR DECISION

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

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

PREDECISIONAL DRAFT 5/6
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I. BACKGROUND

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

A. Basis for Concern

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

Potential impacts from climate change include sea level rise, the spread of infectious disease, more extreme weather events (such as droughts and floods), loss of forest cover and shifts in agriculturally-productive regions. During the next century, for example, the ideal range of forests is expected to move several hundred miles north, exceeding the ability of many forests to migrate. The international scientific assessment concluded that "climate change is likely to have wide-ranging and mostly adverse impacts on human health, with significant loss of life."

Nevertheless, significant uncertainties remain concerning the magnitude, timing and regional distribution of impacts. Currently, there is currently almost no ability to predict changes in weather patterns in particular regions.

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

B. Human Sources of Greenhouse Gases

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

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

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

None of the actions contemplated during this round of negotiations will, by themselves, reverse the build-up of greenhouse gases in the atmosphere or even slow it significantly. That will require both technological change and additional negotiations during the next century.

C. International Negotiating Context

There is international agreement that the climate change problem is significant and requires action. There is also consensus that the existing UN Framework Convention on Climate Change, signed in Rio in 1992, is inadequate. Under the Convention, developed countries set a goal of reducing greenhouse gas emissions to 1990 levels by the year 2000, but few have done so. The Convention does not address steps beyond the year 2000.

In April 1995, in Berlin, the Parties to the Convention agreed to negotiate next steps for the post-2000 period. Under the terms of the "Berlin Mandate, " developed nations would agree to quantified emissions limits in the medium term (defined to include 2005, 2010 and 2020) by no later than 1997. Developing nations (who typically have less stringent obligations than developed nations in environmental treaties) agreed to "advance implementation of" their existing commitments under the Convention in this round of negotiations.

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

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

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

D. Constituency Views.

At present, public attention to climate change is low. Although polling data indicates that the public believes climate change is a serious problem (___ % in a 1996 poll), few rank it high on a list of concerns. Public and media attention to the issue will likely grow as the Kyoto Conference approaches.

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

Business is composed of several camps. The largest -- made up of coal companies, coal-dependent utilities, fuel producers, heavy industry and transporters -- is strongly opposed to any action at Kyoto. This group is well-funded and poised for a significant public relations campaign. A second group -- made up of chemical companies, natural gas interests, some appliance manufacturers and others -- is cautiously supportive of action at Kyoto. A third -- composed of renewable energy and energy efficiency companies -- strongly supports aggressive climate change policies. Many businesses point to international competitiveness as a primary concern.

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

Labor is increasingly opposed to action on climate change, largely in deference to the concerns of the United Mine Workers. An AFL-CIO resolution in [March], 1997 urged ______. Some unions -- including the UAW, the Steelworkers, the AFT and the NEA -- have taken considerably more moderate views in the past.

Finally, the religious community is increasingly engaged on this issue. ______ have collected more than 100,000 signatures in the past few months on a petition urging action on this issue.

E. Congressional Considerations

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

"Advice and consent" of the Senate will be required for any agreement reached in Kyoto. Implementing legislation will likely be needed as well. Favorable votes in the 105th Congress, or even the 106th, would be an enormous challenge.

II. ISSUES FOR DECISION

This memorandum poses two broad issues for decision:

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

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

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

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

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

1. Background

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

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

A threshold question is whether the United States should find a way to avoid an agreement on an emissions budget in Kyoto. That question is not addressed in detail in this memorandum. Although no agency has voiced support for avoiding an agreement, some agencies believe this question should be identified to principals in light of the large potential costs of even the least stringent emissions control options. The advantage of avoiding an agreement would presumably include avoiding such costs; disadvantages would include a lack of progress in addressing the climate change problem and criticism from those who would charge the administration with backtracking on this issue.

2. Options

This memorandum considers three options for emissions budgets:

OPTION 1 - 90% by 2010 and reduce thereafter: Reduce greenhouse gas emissions to 90% of 1990 levels by a multi-year period around 2010 and to lower levels thereafter. (This is similar to the EU proposal).

OPTION 2 - Stabilize by 2010 and reduce thereafter: Reduce greenhouse gas emissions to 1990 levels by a multi-year period around 2010 and to lower levels thereafter.

OPTION 3 - 110% by 2010 and stabilize by 2020: Reduce greenhouse gas emissions to 110% of 1990 levels by a multi-year period around 2010 and to 1990 levels by a multi-year period around 2020.

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

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

Tactical issues concerning the public formulation of the US position are not addressed in this memorandum.

3. Analysis of different options

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

a. Environmental impacts.

In terms of additional loadings of greenhouse gases into the atmosphere, the difference between the first three options in the short-term is small. Under Option 1 (the most stringent), greenhouse gas concentrations in the atmosphere would likely be ____ ppm by 2015; under Option 3 (the least stringent), concentrations would likely be _____ ppm. This alone does not equate to significant environmental impacts.

However, the options may produce different environmental impacts when considered as part of a longer, multi-decade path of reduced greenhouse gas emissions. For the world realistically to avoid a doubling of pre-industrial greenhouse gas concentrations (to 550 ppm) in the next century, global emissions must deflect from a "business-as-usual" path by about 2010. For the world realistically to avoid a near-tripling of greenhouse gas concentrations (750 ppm) (a level higher than any seen on this planet for 50 million years), global emissions must deflect from this "business-as-usual" path by 2020. Even assuming steep reductions in greenhouse gas emissions in distant decades (which our children and grandchildren may or may not be able to achieve), reductions must begin soon to avoid serious environmental damage.

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

Any of these options could have considerable environmental benefits unrelated to climate change. Strategies for reducing greenhouse gas emissions may also reduce emissions of NOX, SOX, carbon monoxide, PM 2.5 and other air pollutants. These benefits would likely be greatest with Option 1 and smallest with Option 3.

b. Economic impacts

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

Economic models are by nature imprecise. Their limitations are exacerbated by the complex and far-reaching effects of any policy aimed at reducing greenhouse gas emissions. Some agencies believe it is important to stress that similar modeling in the past with respect to

SO2 controls under the Clean Air Act dramatically overstated costs, due to unforeseen factors. Nevertheless, models can provide insight into the economic costs and benefits of various policy alternatives.

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

- Policy options are implemented by 2010, with a ten-year phase-in period.
- Domestic emissions reductions are achieved by a "cap and trade" system, where a limited number of greenhouse gas emissions permits are sold at auction and anyone who emits greenhouse gases must have a permit.
- All revenues raised through the auction process go to reduce the Federal budget deficit.
- There are no transaction costs nor compliance problems with the domestic emissions trading system.
- The Federal Reserve undertakes relatively favorable monetary policy to offset the effects of reduced economic activity through lower interest rates.
- The path of technological progress over the forecast period has energy use per unit of GDP decreasing more rapidly than observed in most historical periods, consistent with increased emphasis on greenhouse gas emissions and energy efficiency.
- Countries implement their policies in isolation, without an international trading regime that could permit countries with high-costs of emissions reduction to purchase emissions allowances from countries with lower abatement costs.
- The rest of the economy remains unchanged, which will not occur over the long forecast period used. Unexpected shocks to the economy are likely to have very large effects on the estimates presented.

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

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

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

The losses in aggregate economic activity are significant, but largely transitory. Table 1 shows GDP loss *in the absence of international trading* peaking around 1 percent in 20xx. After this initial loss, the economy begins to rebound as the proceeds from permit auctions reduce the Federal budget deficit and lower interest rates. Businesses respond by making capital investments to offset higher energy costs. After a while, the economy catches up to its original growth path and may even obtain real gains, indicating that the emissions reduction program modeled is implicitly pro-investment.

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

As noted above, the United States has strongly supported international trading of greenhouse gases. With trading, countries with high abatement costs (e.g., the United States and Western Europe) could purchase emissions reductions in countries with lower abatement costs (e.g., in the former Soviet Union). Adding a well-functioning international market to the base case model reduces the estimated energy price increases by as much as tt percent, with parallel economic savings. With international emissions trading, the United States is estimated to pay $XX billion per year to other developed countries (primarily the FSU) to purchase permits.

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

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

c. Domestic political implications

None of the options above are stringent enough for most environmental groups. All are too stringent for some in the business and labor communities. Opposition to any agreement from coal interests will be intense.

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

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

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

d. International negotiating implications

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

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

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

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

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

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

Discussion is divided into three parts:

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

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

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

With respect to the first and third questions, participants in the "Assistant Secretaries group" provide a consensus recommendation. With respect to the second question, several options are identified.

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

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

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

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

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

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

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

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

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

Option 1: Accept the recommendation.

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

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

A. Background. Over the long-term, the solution to the climate change problem depends on technological change. If technological change can be accelerated, the costs of addressing climate change can be reduced significantly.

A range of government programs might help accelerate technological change. Investments in basic research, support for commercialization, information dissemination programs and government procurement can all play role. However, government support for basic and applied research in energy technologies has been declining sharply since the early 1980's, and is now less than half of levels from the late 1970's (in constant dollars). FY98 proposed funding for related programs include: Climate Change Action Plan (DOE, EPA and USDA) -- $277 million; Partnership for New Generation of Vehicles (DOE,DOC, NSF, EPA, and DOT) -- $281 million; DOE's energy efficiency and renewables programs -- $1.08 billion; and DoE's other energy efficiency and renewable energy technology investments -- $670 million.

Some agencies believe we should commit ourselves to an "Apollo mission" in this area -- an intensive program to develop the alternative energy technologies needed for the next century. Possibilities include fuel cells, advanced industrial turbines, advanced diesel engines and transportation biofuels. Such a program could pay dividends not only in terms of our climate change objectives, but also by helping U.S. exports and reducing U.S. dependence on foreign oil.

Federal budget constraints with respect to technology programs are significant. [OMB, DoE to expand]. However, there may be ways to increase support for such programs in the years ahead.

Some agencies believe it is important to emphasize that, although the benefits of government technology programs may be greater than their costs, such programs are unlikely to provide significant greenhouse gas emissions reductions in the short- or medium-term unless accompanied by market-based measures like an emissions trading program.

B. Options

OPTION 1: Increase support for technology programs.

Possible policies under this option include:

-veto threat on appropriations bills that do not provide President's FY98 request for renewable energy and energy efficiency ($1.08 billion, a 21% increase over FY97 enacted levels),

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

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

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

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

A. Background. [text to follow].

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

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

Option 1: Accept the recommendation.

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

Table 1

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

[other tables follow]

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OSTP	Rosina Bierbaum	456-6202	FAX: 456-6025
CEA	Alicia Munnell	395-5036	FAX: 395-6958
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CEQ	David Sandalow	456-6543	FAX:456-2710
CEQ	Steve Seidel	395-3706	FAX:456-6546
AID	David Hales	875-4205	FAX:(703)875-4639

Climate Change – International Context

Background

There is international agreement that the climate change problem is significant and warrants additional near-term action. Further, there is a global recognition that the existing U.N. Framework Convention on Climate Change, signed in 1992, is inadequate to address this near term need. Current negotiations to develop next steps under the Convention began in April 1995 at the first meeting of the Parties to the Convention. At that session, the Parties agreed to begin negotiations toward a new legal instrument (a protocol or an amendment to the Convention) that would deal with next steps – in particular, how to address climate change in the post-2000 period. They agreed to conclude this effort by their third meeting, now set for Kyoto in December 1997.

In July 1996 at the second meeting of the Parties the United States called for an approach which would include three key elements: a legally binding target (instead of the voluntary aims of the existing Convention), flexibility in implementation (e.g., emissions trading and joint implementation), and the participation of developing countries. The U.S. call galvanized the negotiations, with ministers endorsing the objective of a legally binding instrument in the Geneva Declaration adopted by a large majority at the meeting.

U.S. Protocol Proposal

In January 1997, the United States tabled a framework protocol proposal that amplified the positions set forth in Geneva:

- developed countries would adopt binding emissions budgets covering specific periods, although no budget levels or timeframes were specified; provisions would be developed for detailed monitoring, review and compliance;

- countries with budgets would be able to trade emissions between themselves, and jointly implement projects with countries that do not have budgets, so that the most cost-effective reductions can be taken;

- developing countries would be required to take measures that reduce emissions, measure the effects of these measures, and report on the actions taken;

- advanced developing/newly developed countries (e.g., Korea and Mexico) would agree, on a voluntary basis, to adopt binding emissions budgets that might differ from those for industrialized countries; and

- all Parties would agree to adopt binding GHG emissions budgets in a future, post-Kyoto negotiation, with provisions for automatic "graduation" from one category to another based on agreed indicators.

Views Abroad

The U.S. proposal has received mixed reactions abroad. Some view it as the most comprehensive and forward looking of any proposal yet tabled. Others criticize it for focusing on design features without providing any indication of the level of emissions reduction to which we are prepared to commit. Countries (and positions) fall within several different groups:

European Union: Strong domestic green politics drive many key players in the EU (Germany, Netherlands, Denmark), although differences with the southern tier (Italy, Spain, Portugal) as well as France split the EU on some issues. They have set a target of 15 percent reduction below 1990 levels by 2010 for all developed countries (with the EU to meet the target jointly rather than as individual countries). While all analyses suggest that this is an unrealistic goal, it provides the EU with the moral high ground. Nominally supporting flexibility, the EU largely limits this to members states. They also reject a strong call for developing country actions.

Non-EU Developed Countries (Japan, Canada and Australia, Eastern Europeans, NIS/FSU): Japan, as host (and chair) of the Kyoto meeting is anxious for its success, but has reached no internal agreement on a desired outcome. Both Japan and Australia have supported allowing each industrialized country to have a different reduction target based on national circumstances (an idea considered almost impossible to negotiate by Kyoto). Canada and Australia have supported including flexibility provisions and developing country obligations in next steps, while Japan is weak on both. Many Eastern European countries await their turn to join the EU and have been reluctant to challenge EU positions. Further, most have seen dramatic declines in their own emissions due to economic decline – and few anticipate even returning to 1990 levels until 2005 or 2010. Russia (the world's third largest emitter) is the most vocal in the NIS/FSU group and takes a line independent of the EU. Russia has supported flexibility provisions and developing country participation – largely the result of a successful Gore-Chernomyrdin process.

Developing Countries: Big countries (principally China, India and Brazil) drive the international developing country position; they argue that the developed world is responsible for global warming and should pay to redress the problem. Despite the public rhetoric, some (including China and Brazil) have been willing to engage constructively on a bilateral basis, and have significant domestic programs. OPEC, led by Saudi Arabia and Nigeria, fears that action to combat global warming will diminish oil revenues. They have called for developing countries to be "compensated" if their economies are affected, and have blocked adopting rules of procedure under the Convention. Small Island States, with an alliance 37 members strong, fears that sea level rise will inundate them. They have pushed for aggressive next steps (i.e., a 20 percent reduction in OECD emissions below 1990 levels by the year 2005).

The Kyoto Agreement: Key Elements

For us to reach an agreement that is in line with the framework we have proposed, and with a chance of Senate ratification, there are five elements that will be required:

1) **Intensive Diplomatic Efforts**: These are now underway at all levels and in various fora. Ultimately, they may require the personal involvement of the President and Vice-President. Opportunities such as the G-7, UNGASS, and APEC must be used to stress the importance we attach to reaching an agreement, to promote understanding of our position and to highlight what will be needed for the United States to sign on.

2) **Agreement on Emissions:** We cannot hope to convince others of the desirability of flexibility (the EU) or the need for greater commitment (developing countries) unless we have a serious emissions reduction target to put on the table. The bottom line number need not be announced until late in the negotiations – but a signal of the direction in which we intend to move must be given as soon as possible. For example, were we to indicate at UNGASS that we believe a reduction target in Kyoto must take us below 1990 levels, we may be able to prevent other countries from taking key elements of our position off the table.

3) **Negotiating Flexibility:** We will need to decide how much we can achieve in the Kyoto agreement itself and how much we could defer to subsequent discussions. For example, to win on some of our flexibility proposals, we may need to be willing to delay their implementation beyond Kyoto (e.g., subject to further agreement on guidelines). This could also be true with respect to emissions trading. In each case, we will need to consider precisely how much we must have in the agreement itself, recognizing that the commitments will not be implemented until well after the year 2000.

4) **Closer Partnership with Developing Countries:** For us to be successful, we must forge a closer partnership with developing countries. Already U.S. bona fides have been questioned (by developing countries and by other donors) because Congress has not appropriated the amounts requested by the Administration for the Global Environment Facility (GEF), the principal vehicle for implementing our financial commitments under the Convention (we pledged $430 million in 1994, but have been able to contribute less than half this amount). If we cannot improve our record of meeting our commitments, we will not be able to persuade others to take on any serious obligation – particularly developing countries. We will also need to consider launching a new U.S. initiative to repackage and enhance existing U.S. bilateral efforts that support developing and transition countries in responding to the threat of climate change.

5) **A Comprehensive Domestic Strategy with Constituency Building:** An extensive effort will be required to develop support for Senate advice and consent to ratification, as well as for implementing legislation. Key members of Congress, as well as business, environmental, and state and local government representatives, must be found and cultivated to help carry the agreement forward. It will be critical that vocal support be

obtained well prior to Kyoto, or the Administration will be accused (inaccurately) of negotiating the treaty without adequate consultation. Key to this will be the release of information on the international process, and on the methods used to generate the agreement on an emission target. We must also develop a process to educate the public.

United States Department of State

Bureau of Oceans and International Environmental and Scientific Affairs

Washington, D.C. 20520

DATE: 4-24-97

NUMBER OF PAGES TO FOLLOW: 5

FAX TO: See Distribution

TELEPHONE: FAX:

OFFICE:

****

FAX FROM: Eileen Claussen

TELEPHONE: 647-1554 FAX: 647-0217

OFFICE:

****

MESSAGE:

04/30/97 WED 19:36 FAX 202 6222633 Thurs 5/1/97 11 Am 001

Office of Economic Policy Department of the Treasury • Washington, D. C. 20220

FAX

Date: April 30, 1997
Number of pages including cover sheet: 8

	Name	FAX Number	Phone Number
To:	Lisa	395-6958	
From:	Rosemary Flanagan	202-622-2633	

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

Background for tomorrow's meeting with Mr. Summers. Please distribute to Alicia Munnell & Jeff Frankel. Thanks.

Get rid of ~~[illegible]~~ in developing world -

World Bank could be a major player

11:00 am - CC: - David ~~Rid~~ 12:15 - Clay Lowery

REDEFINING PROGRESS
One Kearny Street • 4th Floor • San Francisco • California 94108
Telephone 415 781.1191 • Facsimile 415 781.1198

April 30, 1997

Mr. Lawrence H. Summers
Deputy Secretary,
U.S. Department of Treasury
Room 3326
Washington, D.C.

ATTN: Beth

Dear Mr. Summers:

We are looking forward to our meeting tomorrow to discuss the "Economists' Statement on Climate Change," and to learn more about the Treasury Department and the Administration's work on this topic. Attached is background material on the statement.

Along with Professors Arrow and Jorgenson, Stephen DeCanio and I will also be participating in the meeting. Stephen DeCanio is a professor at the University of California, Santa Barbara, and served as a Senior Economist at the Council of Economic Advisors during the Reagan Administration. I formerly worked as a legislative assistant for Congressman Bill Frenzel (R-MN) and as the director of taxation at the National Association of Manufacturers.

Please call if you have any questions regarding the meeting. Otherwise, we will see you tomorrow.

Sincerely,

Peggy Duxbury

Peggy Duxbury

January 3rd, 1997

Dear Colleague,

As you may know, representatives of the world's nations will convene in Kyoto in December, 1997 to negotiate an international agreement addressing the threat of global climate change due to greenhouse gas emissions. This presents a significant opportunity for the United States to exercise a leadership role in ensuring our long-term well-being. Conversely, a failure on the part of the U.S. government to put forward a well-reasoned position would be a major environmental, economic, and diplomatic setback.

As the climate debate unfolds, it is imperative that public policy be guided by sound economics rather than misleading claims put forward by special interest groups. For this reason, we invite you to join us in endorsing the attached non-partisan consensus statement on the economics of climate change.

Once this statement has been signed by a large number of economists, it will be widely disseminated to leaders in the public and private sectors, and to the general media. This effort is being coordinated by Redefining Progress, a non-partisan, non-profit public policy organization.

Attached please find an endorsement form for your consideration. This letter and endorsement form are being sent to the membership of the American Economic Association. Please feel free to circulate it to your colleagues in case they are not on the AEA mailing list.

We thank you for your prompt attention to this critical issue.

Sincerely,

Kenneth J. Arrow

Dale W. Jorgenson

Paul R. Krugman

William D. Nordhaus

Robert M. Solow

ECONOMISTS' STATEMENT ON CLIMATE CHANGE

Endorsed by Over 2500 Economists including eight Nobel Laureates

I. The review conducted by a distinguished international panel of scientists under the auspices of the Intergovernmental Panel on Climate Change has determined that "the balance of evidence suggests a discernible human influence on global climate." As economists, we believe that global climate change carries with it significant environmental, economic, social, and geopolitical risks, and that preventive steps are justified.

II. Economic studies have found that there are many potential policies to reduce greenhouse-gas emissions for which the total benefits outweigh the total costs. For the United States in particular, sound economic analysis shows that there are policy options that would slow climate change without harming American living standards, and these measures may in fact improve U.S. productivity in the longer run.

III. The most efficient approach to slowing climate change is through market-based policies. In order for the world to achieve its climatic objectives at minimum cost, a cooperative approach among nations is required—such as an international emissions trading agreement. The United States and other nations can most efficiently implement their climate policies through market mechanisms, such as carbon taxes or the auction of emissions permits. The revenues generated from such policies can effectively be used to reduce the deficit or to lower existing taxes.

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One Kearny Street • 4th Floor
San Francisco, CA 94108
Phone: (415) 781-1191
Fax: (415) 781-1198
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[illegible] • San Francisco • [illegible] 94108
Telephone 415.781.[illegible] • Facsimile 415.781.[illegible]

PRESS AND OTHER COVERAGE OF THE ECONOMISTS' STATEMENT ON CLIMATE CHANGE

"[T]he nation's movers and shakers would do well to pay attention to a statement on global warming by some 2,000 mostly academic economists."
-Peter Passell, *New York Times*, Feb. 13, 1997

"Market-based approaches to coping with climate change generate as much consensus among economists as free trade."
-Paul Krugman, Peter Passell
column in *New York Times*, Feb. 13, 1997

"[T]he overwhelming consensus among economists is a blow for energy companies and other lobby groups which have managed to derail previous attempts to introduce such a carbon tax on the grounds that it would be prohibitively expensive."
-*Financial Times*, Feb. 14, 1997

"Some groups have asserted that we cannot address the global climate change problem without incurring serious economic harm. These 2,000 economists have said essentially the opposite -- that the greatest risks lie with inaction."
-Stephen DeCanio in *Financial Times*, Feb. 14, 1997

"The broad array of economists...said that measures to reduce greenhouse-gas emissions need not harm the economy...because there are many innovative and energy-efficient technologies just awaiting the right financial market."
-*The Washington Post*, editorial Feb. 16, 1997

"A near-term date would send the signal industry needs to begin seriously investing in more efficient technologies, and the commercialization of such technologies would offer an alternative path for development to giants like China and India."
-*The Washington Post*, editorial, Feb. 16, 1997

"Since reliable economic analysis shows that dealing with climate change need not harm -- and might strengthen -- the economy, we need to make sure that policy-makers use the best, most inclusive and longest-range models available."

-Dale Jorgenson, op-ed in *The Journal of Commerce*, Feb. 24, 1997

"No serious economist has come to the conclusion that one should do nothing...The idea of waiting around until everything is resolved in this particular case means doing something that's much more costly."

-William Nordhaus in *The Wall Street Journal*, March 10, 1997

"[M]ore than 2,000 economists signed a statement last month calling for carbon taxes as part of a system of tradable permits for greenhouse emissions...Surely a President who cannot run again -- and a Vice President who believes global warming to be a serious threat -- could support such progressive goals."

-Gregg Easterbrook, op-ed *The New York Times*, March 12, 1997

"The price system is very efficient and important where it works, but it doesn't work in certain areas, including environmental issues such as global warming...and we need to pay attention to these issues."

-Kenneth Arrow, *San Jose Mercury News*, March 23, 1997

"[G]lobal warming should be dealt with as efficiently as possible with as much use of market-based policies as possible."

- Kenneth Arrow in interview with Bob Frost, *San Jose Mercury News*, March 23, 1997

"Because economic growth and energy consumption have historically marched in lockstep, there is great concern that policy measures aimed at reducing fossil fuel use could constrain future prosperity. Fortunately, the world need not choose between catastrophic climate change and economic growth...When businesses improve their manufacturing processes to use energy and raw materials more efficiently, carbon dioxide emissions and environmental compliance costs fall while profitability, productivity, and competitiveness improve, creating jobs.

But don't just take my word for it. Last month, more than 2,500 economists, including eight Nobel Laureates, endorsed a consensus statement on the economics of climate change...Never before have so many economists joined to issue a policy declaration."

-Senator John H. Chafee, Chair of Senate Committee on the Environment and Public Works, Speech to California and the World Ocean '97, March 27, 1997

"More than 2,500 American economists, including eight Nobel Prize winners, recently endorsed...this idea called 'tax shifting'...As economist [Paul] Krugman points out... 'A market-based incentive such as a carbon tax would put individual initiative to work on finding thousands of ways to reduce carbon dioxide emissions -- purely as a matter of self interest'...Few policymakers in Washington are talking much about the costs and benefits of such an approach. That's too bad. The 'tax shifting' idea is too good to die without a hearing."

-Editorial, *Minneapolis Star and Tribune,* April 10, 1997

"Isn't this amazing? Not only do thousands of economists agree on something, but what they agree on is the warm and cuddly idea that we should do more to protect the environment. Can 2,500 economists be wrong? Well, yes -- but this time they aren't. The Great Green Tax Shift -- a shift away from taxes on employment and income toward taxes on pollution and other negative externalities -- has everything going for it. It is supported by good science and good economics, as well as by good intentions."

-Paul Krugman, *Slate - Dismal Scientist,* April 17, 1997

San Jose Mercury News

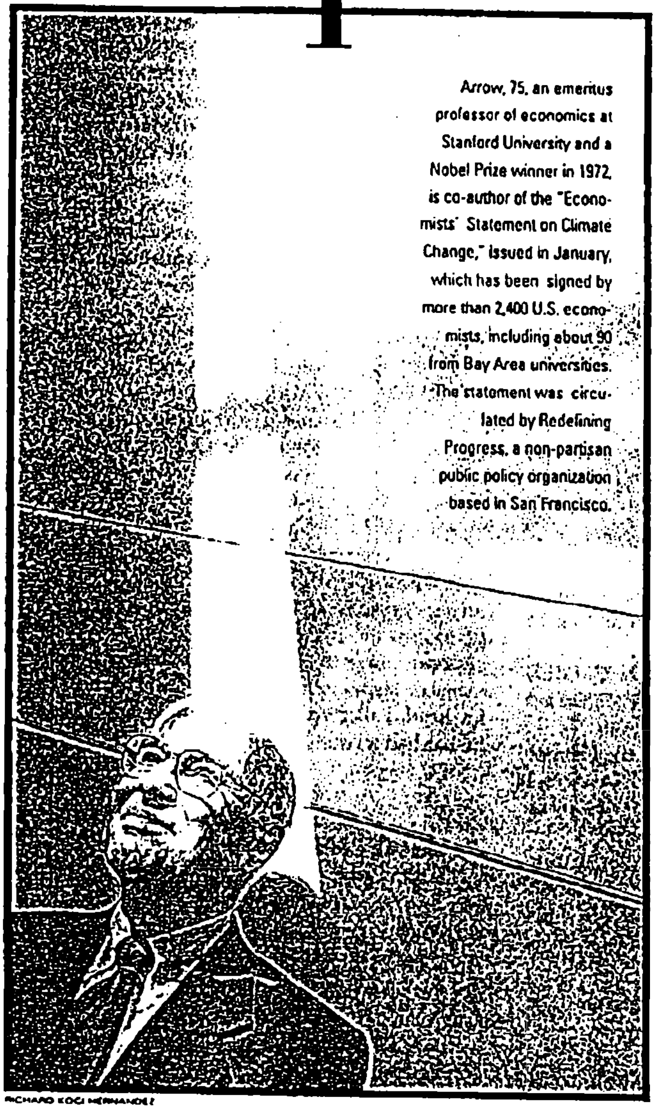
Leading question
KENNETH J. ARROW

Your statement is the first declaration by a large group of economists about climate change. What does it say?

A: It notes that the balance of evidence suggests a human influence on global climate. It states that global climate change—global warming—poses economic and social risks of considerable magnitude; that greenhouse-gas emissions resulting in global warming can be reduced without harming U.S. living standards; and that global warming should be dealt with as efficiently as possible with as much use of market-based policies as possible.

One market-based policy you endorse is an international emissions trading agreement.

Yes. Such an agreement would involve arriving at a global total for allowable greenhouse gas emissions. It would then permit economies to buy and sell the right to emit such gases. So, places with a deep need to emit carbon dioxide—high-combustion countries—could buy the right to do so from countries who need to emit less. This has various advantages. Everyone engaged in production, for example, will find here an incentive to minimize the amount of combustion involved. And, less developed countries will now have a monetary incentive to encourage energy conservation.



Arrow, 75, an emeritus professor of economics at Stanford University and a Nobel Prize winner in 1972, is co-author of the "Economists' Statement on Climate Change," issued in January, which has been signed by more than 2,400 U.S. economists, including about 90 from Bay Area universities. The statement was circulated by Redefining Progress, a non-partisan public policy organization based in San Francisco.

RICHARD KOCI HERNANDEZ

How difficult was it to get more than 2,000 economists from across the political spectrum to agree to sign your document—more economists than have ever agreed on a statement on any subject?

It was extremely easy, which quite surprised me, and which tells me that a lot of these people had already come around to these views and were waiting for a chance to express themselves. We made no attempts at persuasion, we just circulated the statement, and within a month or so had more than 2,000 signatures.

How did you get interested in the issue of global warming?

I spent several years, during World War II, as an Army meteorologist. The first lecture we had was on what determines the temperature of the Earth; the instructor said that it could be expected that industrialization would raise the world's temperature. So this theory has long been in the mainstream; it's not a view held just by a few nuts. When the debate about global warming started in earnest some years later, I was very inclined to follow it carefully. In addition, one of my primary interests in economics is in "externalities"—that is, the fact that the price system doesn't cover everything. The price system is very efficient and important where it works, but it doesn't work in certain areas, including environmental issues such as global warming. And we need to pay attention to these issues.

BOB FROST

1.

2. Equal marginal cost of abating

3. bring in developing countries

4. take emissions 1/5 the way

AHM, JAF

Total Pages: ___

LRM ID: EHF120

MJ
JS
MM

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
Washington, D.C. 20503-0001

Monday, May 5, 1997

LEGISLATIVE REFERRAL MEMORANDUM

TO: Legislative Liaison Officer - See Distribution below

FROM: Ronald K. Peterson (for) Assistant Director for Legislative Reference
OMB CONTACT: Robert J. Tuccillo
PHONE: (202)395-5609 FAX: (202)395-5836

SUBJECT: AGRICULTURE Report on Climate Change in response to incoming letter from Senator Lugar

DEADLINE: 5:00 PM Wednesday, May 7, 1997

In accordance with OMB Circular A-19, OMB requests the views of your agency on the above subject before advising on its relationship to the program of the President. Please advise us if this item will affect direct spending or receipts for purposes of the "Pay-As-You-Go" provisions of Title XIII of the Omnibus Budget Reconciliation Act of 1990.

COMMENTS: Attached is a list of individuals who should receive copies of this document for review.

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WHCCTF - Dirk Forrister

EOP:
Kathleen A. McGinty
MUNNELL_A
FRANKEL_J
David B Sandalow
MAZUR_M

Please provide a copy of this document to the following people:

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Commerce -- Everet Ehrlich, Jeffrey Hunker
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Treasury -- Josh Gotbaum
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WHCCTF -- Dirk Forrister
OSTP -- Rosina Bierbaum

LRM ID: EHF120 SUBJECT: AGRICULTURE Report on Climate Change in response to incoming letter from Senator Lugar

RESPONSE TO
LEGISLATIVE REFERRAL
MEMORANDUM

If your response to this request for views is short (e.g., concur/no comment), we prefer that you respond by e-mail or by faxing us this response sheet. If the response is short and you prefer to call, please call the branch-wide line shown below (NOT the analyst's line) to leave a message with a legislative assistant.

You may also respond by:
(1) calling the analyst/attorney's direct line (you will be connected to voice mail if the analyst does not answer); or
(2) sending us a memo or letter
Please include the LRM number shown above, and the subject shown below.

TO: Robert J. Tuccillo Phone: 395-5609 Fax: 395-5836
Office of Management and Budget
Branch-Wide Line (to reach legislative assistant): 395-4586

FROM: ______________________ (Date)
______________________ (Name)
______________________ (Agency)
______________________ (Telephone)

The following is the reponse of our agency to your request for views on the above-captioned subject:

_____ Concur

_____ No Objection

_____ No Comment

_____ See proposed edits on pages _______

_____ Other: __________ __________

_____ FAX RETURN of _____ pages, attached to this reponse sheet

Draft

May 2, 1997

The Honorable Richard G. Lugar
Chairman
Committee on Agriculture
United States Senate
Washington, D.C. 20510-6000

Dear Mr. Chairman:

Thank you for your letter from you and the other members of the Senate Committee on Agriculture, Nutrition and Forestry regarding the climate change negotiations and the potential impacts of climate change on U.S. agricultural production and competitiveness.

The issue of global climate change is an important one for agriculture. Over the next 50 years, U.S. food and fiber producers face major challenges in keeping pace with the ever increasing demands of a growing world population. Climate changes, environmental degradation, and increasing competition for land and freshwater supplies will make these challenges even greater. Based on current trends, the Intergovernmental Panel on Climate Changes project significant impacts to ecological systems and the economy, including food security, water resources, coastal zones, and human health.

With these consequences in mind, this Administration has called on developed countries to agree to realistic and achievable legally binding targets for greenhouse gas emissions in the current climate negotiations. We believe that each nation needs the flexibility to determine its own most cost effective means of reducing emissions. And finally, everyone -- all nations and all economic sectors -- must contribute to the solution because climate change is a global problem. We must begin now to lead the way to a sustainable future.

Further commitments under the United Nations Framework Convention on Climate Change must ensure that the U.S. economy remains strong and internationally competitive. To help find the best solution, the Administration is engaged in an assessment of the economic impacts of various emission targets coordinated by Dr. Everett Ehrlich, Under Secretary of Commerce. This assessment includes a variety of aggregate national economic impacts, as well as sectoral and international economic impacts. The White House Climate Change Task Force is in the process of confirming the logistics for release of these results through a draft report and public meeting, pending completion of peer review and a brief Administration review. Peer review is expected to last through the month of May. Once completed, the Administration will release a draft report for public comment at a public meeting, followed by Senate and House staff briefings, and opportunities for additional briefings as needed.

As part of this assessment, the Department of Agriculture will analyze the impact of any new agreement on America's food sector and our farmers, ranchers, and consumers. Evaluation of agricultural sector impacts of emissions reductions scenarios is contingent in some cases in national macroeconomic results . As a result, a full agricultural sector analysis will follow Dr. Ehrlich's modeling results by a few weeks.

Information on the potential impacts of climate change on agriculture and net greenhouse gas emissions from agriculture and forestry activities is currently available. My staff can provide a briefing on this at your earliest convenience. The Department will inform you of the results of the economic analysis when it becomes available.

I appreciate your concerns and look forward to working with you on this important environmental issue.

Sincerely,

Al Gore
or
Kathleen A. McGinty
or
Dan Glickman

OMB/RDI ID:202-395-5691 MAY 05'97 16:05 No.017 P.06

MAR 14 1997

United States Senate

COMMITTEE ON
AGRICULTURE, NUTRITION, AND FORESTRY
WASHINGTON, DC 20510-6000
202-224-2035

March 14, 1997

The Honorable Al Gore
Vice President
The White House
Washington, D.C.

Dear Mr. Vice President:

Farm state members of Congress have become increasingly concerned with the lack of adequate attention given to agricultural concerns as the Administration works on the United Nations Framework Convention on Climate Change (UNFCC). As you know, this treaty, if ratified, could affect U.S. agricultural production and competitiveness.

American agricultural interests must be adequately represented during the upcoming negotiations. This representation will ensure the continued success of farmers and ranchers and allow them to maintain their productivity, which ultimately benefits consumers. We believe we can address the global greenhouse gas issue and protect the environment while carefully considering the interests of America's farmers, ranchers and consumers. However, before the United States is committed to a final international agreement to limit greenhouse gases, it is essential that we know more about the treaty's impact on our nation's largest employer and the world's most efficient producers of food and fiber.

We will be closely monitoring the negotiations as work continues on the final agreement before its submission to the Senate for ratification. We request an analysis and briefing by the Administration on the following issues as soon as possible:

1) The potential effects of climate change on U.S. agriculture and livestock production.

2) The estimated greenhouse gas emissions resulting from the production of crops and livestock in the U.S.

3) The net contribution of U.S. forests and crops in the sequestration of greenhouse gases.

4) Actions or controls necessary to reduce agricultural greenhouse gas emissions to comply with obligations that may arise under the treaty and an economic analysis of their impact on U.S. farmers and ranchers.

5) Whether and to what extent greenhouse gas emission controls would disadvantage agricultural producers in this country compared to producers in other countries with less stringent emission controls or no controls at all.

We understand that serious discussions in preparation for the Kyoto meeting may commence during July and August of this year. We firmly believe this information, as well as the Administration's formal economic analysis, should be submitted to Congress well before then so that the various options for U.S. policy may be understood and their impact on American agriculture and the American economy may be carefully assessed.

We look forward to working with you on this important issue.

Sincerely,

Dick Lugar Tom Harkin
Thad Cochran Tom Daschle
Rick Santorum Jesse Helms
Max Baucus Tim Johnson
Kent Conrad Pat Roberts
Larry E. Craig Chuck Grassley
Mitch McConnell Bob Kerrey

cc: The Honorable Madeleine Albright
The Honorable Dan Glickman

FACSIMILE

To: Alicia Munnell, Jeff Frankel, Mark Mazur, Council of Economic Advisors

Fax #: 395-6958

Re: Climate Change Sectoral Paper

Date: April 30, 1997

Pages: 30, including this cover sheet.

Attached please find the Climate Change Sectoral Paper per the memorandum you should have received dated April 28 from Jeffrey Hunker and Judy Greenwald.

Please call 482-4127 to confirm receipt.

Thank you.

From the desk of...

Sandra L. Hawkins

U.S. Department of Commerce
14th & Constitution Avenue, NW, Rm 5835
Washington, DC 20230

(202) 482-6055
Fax: (202) 482-4636

Outline: Sectors Paper

	Needs:
1. Sources and Trends of US Emissions	breakout by key industries
2. Transportation	better discussion of Car Talk recommendations and impacts Technology (PNGV) and other regulatory impacts Other transportation sectors (eg: aircraft/air engine)
3. Electricity	Impact of deregulation/restructuring?
4. Industry Sectors That Will Benefit	? -- Needs analysis/
5. Energy Intensive Industry Sectors	All: tie analysis to the modeling results All: final review by agency analysts
a. Aluminum	
b. Petroleum refining	
c. Steel	
d. Cement	
e. Pulp and paper	Needs to be prepared
f. Chemicals	Needs to be prepared
g. Others?	Identified?
6. Buildings/residential stock	?

draft as of 4/14/97

SECTOR EMISSIONS AND MITIGATION OPTIONS

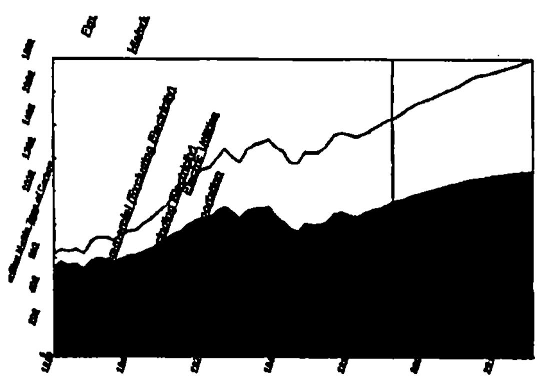
SOURCES AND TRENDS OF U.S. EMISSIONS

Total U.S. greenhouse gas emissions in 1995 were 1,557 MMTCe (million metric tons of carbon equivalent), with gross emissions of 1,674 MMTCe offset by 117 MMTC of carbon sequestered by the nation's forests. Emissions have increased by about 7% since 1990. Of the total, methane accounts for 11% (mainly from landfills and agricultural activities), nitrous oxides about 3%, and the various halocarbons 2%. While currently small in aggregate, these gases can play an important role in future warming because of the magnitude of their heat-trapping potential and their atmospheric lifetimes. The remaining 85% of U.S. emissions are carbon emissions from fossil fuel combustion and other industrial activities.

Annual U.S. fossil-related carbon emissions have grown by about 1.2% per year since 1950 and are projected to rise at almost the same rate over the next twenty years. There are three ways of viewing these emissions:

Primary fuel use: Coal's share of the total has fallen from 50% in 1950 to 35% in 1996; while oil's share has risen from 36% to 42% and natural gas' share has risen from 14% to 23%. However, these shares are now expected to remain fairly steady over the next quarter century.

First-tier energy users: The influence of the electric utility sector on total emissions has grown over time as the American economy has steadily increased its use of electricity. It now accounts for about 35% of total emissions – with over 85% of its total due to the combustion of coal.



Similarly, the transportation sector's share of fossil-related carbon emissions has grown from 28% in 1950 to 33% in 1996, with oil accounting for practically all of the fuel used in this sector. *Thus, the transportation and utility sectors together currently account for 68% of U.S. fossil-related carbon emissions.*

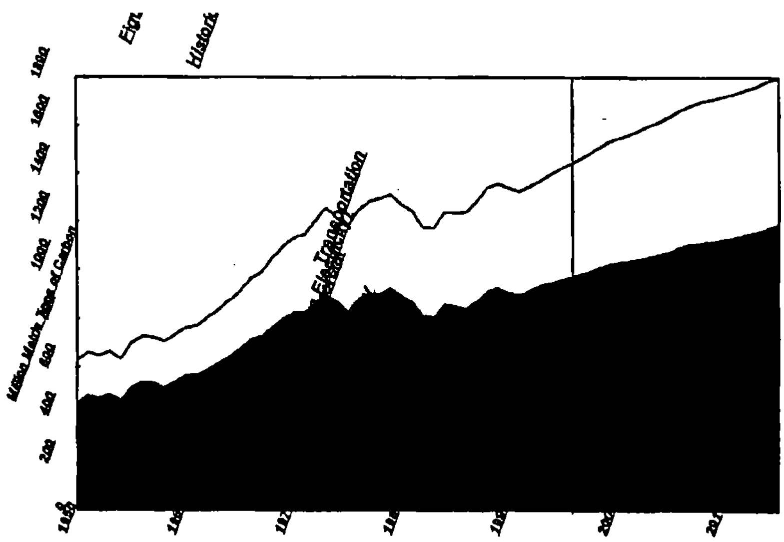
End-use sectors: It is also useful to attribute electricity-related carbon

draft as of 4/14/97

emissions to the sectors that consume the electricity rather than to the utility sector which produces it. Thus, viewed from the perspective of final energy demand, the importance of the residential and commercial sectors has increased since 1950, while industry's share of total emissions has fallen. This reflects the changing importance of the manufacturing and services sectors of the economy.

Emissions are now roughly equally distributed among households and commercial businesses (35%), transportation (33%), and industry (32%). These shares are projected to remain fairly constant over the next twenty to twenty-five years.

(NOTE: NEED TABLE SHOWING HISTORICAL AND PROJECTED ENERGY USE AND GREENHOUSE GAS EMISSIONS BY END - USE SECTOR -- HOUSEHOLDS, TRANSPORTATION, INDUSTRY, WITH SECOND TABLE BREAKING OUT INDUSTRY BY THE ENERGY INTENSIVE SECTORS AND ALL OTHERS -- CHEM, STEEL, ALUMINUM, GLASS, PAPER, ETC).



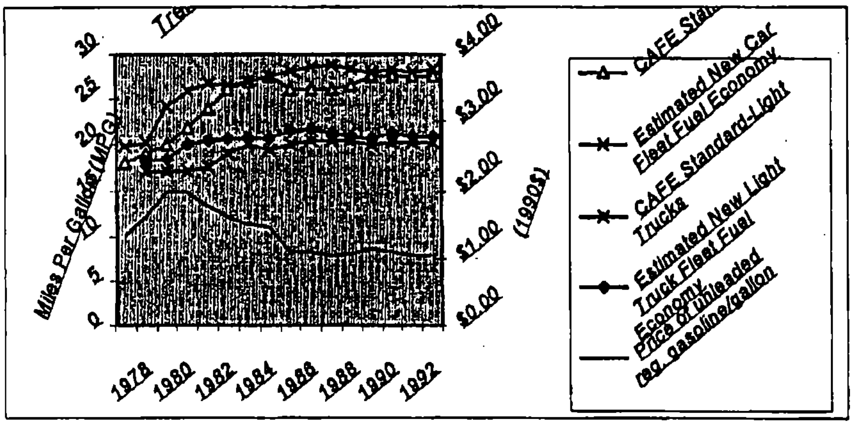
draft as of 4/14/97

TRANSPORTATION

Contribution to greenhouse gas emissions

Passenger cars and light duty trucks (light vehicles) contribute the majority of transportation emissions. Emissions from light vehicles alone accounted for 20% of total U.S. greenhouse gas emissions in 1990, and in the absence of new policy measures are expected to rise from about 250 million metric tons of carbon equivalent (MMTCe) in 1990 to 350-400 MMTCe in 2010.

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



Background on the automobile industry

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

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

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

Possible Climate Change Policies

(NEED A BETTER MORE DETAILED BUT PUNCHY DESCRIPTION OF THE POLICY RECOMMENDATIONS AND DISAGREEMENTS FROM CAR TALK -- PLUS THEIR ESTIMATED EMISSIONS IMPACTS)

- REGULATORY
- TECHNOLOGY

In 1994, President Clinton convened a Federal Advisory Committee Policy Dialogue to assist in the development of measures to significantly reduce greenhouse gas emissions from personal motor vehicles ("CarTalk"). Although CarTalk ended without consensus among all members of the Committee, the process did result in a number of analyses and proposed policy options. The analyses concluded that there are essentially three ways to reduce carbon emissions from light vehicles: improve fuel economy; use fuels with lower life-cycle carbon emissions (such as alcohol fuels from certain biomass processes); or reduce miles driven. Historically, most government regulatory efforts have been directed at improving fuel economy although, as stated earlier, such efforts are proving less effective.

PNGV?

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

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- Congestion Mitigation and Air Quality Improvement Program: Additional funds could be targeted to transportation projects that reduce air emissions and energy consumption on a long-term sustainable basis.
- Brownfields Restoration: Successful redevelopment of brownfields can help revive inner city areas and reduce sprawl, thereby reducing vehicle miles traveled. More funds could be made available for these projects.
- Incentive Funds: A new $500 million Fuel Efficiency Incentive Fund could be established to reward the ten states that are able to reduce fuel consumption, on a per capita basis, by the greatest amount over the next five years.

Factors Shaping Industry Response

(To come -- need to discuss strategic risk of CAFE, vehicle standards versus market demand; shifting market demand? Foreign manufacturer responsies or technologies?)

OTHER TRANSPORTATION SECTORS

(AIRLINES, RAIL, TRUCK -- HOW RELEVANT, ANY POLICES OR IMPACT?)

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ELECTRICITY

Contribution to greenhouse gas emissions

Electric generators are responsible for about 35% of national emissions of carbon dioxide, with over 85% of electricity-related emissions coming from coal combustion.

Background on Electric Generation

Fossil fuel power plants generated over 80% of U.S. electricity in 1970, but that share has fallen to about two-thirds as nuclear power's share has risen from virtually nil to about 22%; and it is expected to rise back to about 80% over the next twenty years as the existing stock of nuclear plants are phased out.

Although the overall efficiency of fossil generation – the rate at which fossil energy is converted to electricity – has barely changed in the past 35 years, modest improvements are expected over the next twenty years as natural gas-fired generation doubles its share of total generation from about 15% today to over 30%. New natural gas-fired "combined cycle" power plants – basically jet engines bolted to the floor – yield very high conversion efficiencies because they turn turbines both directly and indirectly using their waste heat.

Renewables are forecast to have high growth but remain a small part of the base. Excluding hydroelectric power, whose expansion possibilities are very constrained, renewable electricity generation is expected to double over the next twenty years but will still account for less than 2% of total electricity generation.

STRUCTURE OF INDUSTRY/
ROLE OF COGEN/ SMALL PROVIDERS
FEDERAL/STATE POLICY

FACTORS SHAPING INDUSTRY RESPONSE

Emissions can be reduced either by making generation and distribution less carbon intensive or by reducing the amount of electricity demanded. Efforts at the latter generally focus on making the electric system and electric customers more energy efficient.

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DEREGULATION

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

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

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

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

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

TECHNOLOGY OPTIONS

Technological options for reducing the emissions from electric generation include the following:

- Substitution of lower carbon emitting fuels such as renewable energy or natural gas for coal

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- Greater use of existing sources of nuclear generation by improving their reliability
- Use of more energy efficient generation equipment for fossil fuels, such as combined cycle gasification systems or fluidized bed technologies for coal, or high efficiency turbines for natural gas.

Many of these technologies are currently penetrating the market and their importance will grow in the future. The next generation of natural gas technologies (including gas turbines and fuel cells), for example, could achieve energy conversion efficiencies of 70% or more by 2005.

- High efficiency coal-fueled power plants, such as integrated gasification combined cycle perhaps combined with a fuel cell, could achieve efficiency exceeding 55%, with half the CO2 emission of current plants.
- Renewable technologies—wind power, photovoltaics, biomass power, solar thermal, and geothermal—have seen sharp cost reductions in the past two decades, some by a factor of ten.

Further R&D, coupled with expanded deployment to achieve economies of scale and improvements in manufacturing, would likely make one of more these technologies competitive with fossil fuels in a large number of areas in the next two decades. (NEED MORE BACKUP ON THIS. WHAT WILL MAKE THIS HAPPEN?).

(WHAT DOES THIS MEAN?

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INDUSTRY

Overview

Industry analysis needs to focus both on

1) those sectors facing structural and transitional pressures because of climate change policies; and
2) sectors which will more directly benefit.

The seven most energy-intensive industries—steel, aluminum, petroleum refining, chemicals, pulp and paper products, glass, and metal casting—may face significant structural adjustment pressures, which public policy needs to take into account. These sectors account for about 80% of the energy consumed in U.S. manufacturing and more than 90% of the hazardous waste.

Overall, the industrial sector directly emitted approximately 300 million metric tons of carbon in 1994 from the combustion of fossil fuels and industrial processes. In addition, electricity consumption by this sector is indirectly responsible for an additional 120 million metric tons of emissions.

The major manufacturing sectors and their CO_2 emission estimates are summarized below.

Sector	Direct Carbon Emissions Million Metric Tons
Primary Metals Industry (SIC 33)	38.9[*]
Chemical and Allied Products (SIC 28)	48.8[*]
Paper and Allied Products (SIC 26)	53.5[*/**]
Petroleum Refining (SIC 2911)	13.0[']
Cement (including non-combustion CO_2 emissions)	15.0[']

*Estimates are from 1991 MECS and net of electricity.

**For paper mills, over 50% of energy input is from waste wood. The carbon estimate incorporates emissions from wood based fuels. Emissions would be considerably lower (19 MMTC) if the carbon emissions from wood (a renewable source of biomass) were assumed to be zero.

'Estimates are from *CO_2 Trading*

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Issues, Volume 1, Decision Focus Inc. (based on 1988 MECS).

Manufacturing industry as a whole experienced dramatic improvements in energy efficiency (i.e. increases in output per unit of energy input) during the energy crisis of the late 1970s and early 1980s, as industries reduced their energy use and energy-intensive industries' share of total manufacturing output decreased. The energy-intensive industries discussed above all experienced significant energy efficiency improvements, with improvements between 1977 and 1985 ranging from about 14% for the Paper and Allied Products industry to more than 40% for the Chemicals and Allied Products industry. However, many of these industries actually experienced decreases in their energy efficiency (i.e. increases in their energy intensity per unit of output) between 1985 and 1991 after energy prices fell.

No single industry sector dominates in generating CO_2 emissions. Paper and allied products is the largest sector (including direct emissions from by-products), followed by chemical and allied products, primary metals, and petroleum refining.

(NEED TABLE)

(NEED DISCUSSION OF WINNING SECTORS -- NO DISCUSSION IN THIS DRAFT OF THESE).

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ALUMINUM INDUSTRY

Contribution to Greenhouse Gas Emissions

- (to come)

Background on the aluminum industry

The industry has three major segments :

-- primary aluminum, produced by electrolytically reducing alumina into aluminum;

-- secondary aluminum from recycling aluminum, which is used mostly for castings for the auto industry; and

-- semifabricated products, where primary aluminum is then processed into sheet, plate, foil, extrusions, etc.

In general, primary aluminum supplies about 45 percent of domestic aluminum consumption, secondary aluminum about 30 percent, and imports the remaining 25.

Total U.S. primary aluminum capacity is about 4.2 million tons, and employs about 21,500 persons; secondary aluminum employees ( ), and semifabricated products employees 39000 (?). Value-added is about equal in primary and semifabricated products.

Overall, the United States is globally competitive all parts of the industry, and is a net exporter of semifabricated aluminum products. Domestic primary capacity has remained competitive because of continuous upgrades in existing plants, and that the capital stock is fully depreciated. No new domestic smelting capacity has been added since 1980 and domestic primary aluminum production is not sufficient to meet domestic demand. The United States is a net importer of primary aluminum.

The corporate players differ by segment. Primary and semifabricated product aluminum is dominated by the large vertically integrated producers such as Alcoa, Alcan, Alumax, Kaiser, and Reynolds. A large portion of the trade in both products -- especially with Canada, the largest trading partner -- is actually intercompany transfers between facilities.

Secondary aluminum is a more fragmented industry. The metal produced is used principally by the foundry industry, and approximately two-thirds of the secondary metal produced is consumed by the auto industry. The majority of

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these facilities are in Southern California, and the Midwest.

Factors Shaping Industry Response

Primary aluminum is highly dependent upon the cost of electricity -- approximately one-third the cost of producing primary aluminum is the cost of electricity.

Utility restructuring may have a significant impact on competitiveness: The primary aluminum industry in the US purchases electricity at approximately half the price of other industries, in part because of hydro power (Pacific Northwest) and in part because of long term negotiated rates. Any change in pricing due to restructuring would have major impacts. (NB -- IS THERE ANY ANALYSIS ON THIS? WILL RESTRUCTURING HAVE AS BIG/BIGGER AN IMPACT AS CC?)

The locus of primary aluminum production already is shifting gradually to low energy cost countries abroad. The last greenfield smelter in the US was built in 1980, and there are no plans to build further. While on average, the U.S. primary aluminum industry is around the median in terms of the costs of production internationally new primary aluminum capacity is being added in countries with cheap energy. Globally, new capacity is being constructed in countries with cheap sources of energy to produce electricity. These include the Middle East (natural gas), South Africa (coal), and Canada (hydro). Canada and South America are particularly well-positioned because they have almost 100 percent hydro based power.

Japan's strategy is noteworthy. With only one small aluminum plant domestically, Japan has historically undertaken joint ventures worldwide, i.e. Brazil, Australia and Indonesia, where energy prices and quantities have been guaranteed over a long term. (NEED MORE DETAILS --WHICH COMPANIES?).

The future of U.S. primary aluminum will depend on differences (if any) in the price and availability of hydro and coal generated electricity. These differences will have substantial regional impacts. Almost all the smelters in the eastern part of the U.S. rely upon coal based electricity whereas the smelters in the northwest use hydro based electricity. Should a policy be implemented based on carbon emissions, the eastern smelters in the U.S. could be impacted more than western smelters. The impact on the western smelters would depend on the cost increases to hydro based electricity.

The location of semifabricated production is linked to primary aluminum production:

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There is a close relationship, both physically and economically, between primary production facilities and semifabricating facilities. Semifabricating facilities, generally, are located near their source of primary aluminum in order to reduce costs.

Secondary aluminum is less sensitive to climate policies, but its potential is limited.

Secondary aluminum continues to increase in significance as a component of the overall supply of aluminum, it is restricted in its growth potential by the amount of primary metal consumed, and it is not substitutable for primary aluminum in all of its end-uses. The recycling industry uses only 10 percent of the energy required by primary producers and recycling typically uses natural gas. The effects of energy price adders on this industry depend critically on how policy actions affect natural gas prices relative to coal based and hydro based electricity prices.

Technological and Investment Options

Technological change is incremental: The Hall-Heroult electrolytic process for producing aluminum has remained relatively unchanged in the hundred years since it was developed. This process has experienced continuous and gradual improvements that have reduced energy consumption per metric ton by about 25 percent from 1960 to 1994. No new process for producing aluminum is expected, but DOE analysis pointed to "semirevolutionary and retrofit modifications" that could benefit existing capacity in the U.S. and in OECD Europe.

In order to reduce energy consumption, and, thus costs, the domestic industry, and in some cases in conjunction with the Government, is working on improving the current electrolytic technology. These improvements would decrease energy consumption, and hence greenhouse gas reductions.

Analytical Results of Sectoral Impacts

(NOTE: NEED IAT MODELING RESUTLS TO REPLACE DOE ANALYSIS)

In DOE's analytical base case of no new environmentally-driven constraints on aluminum production, practically all new alumina reduction plants will be built in developing countries, with the only exceptions being a few developed countries with access to low cost hydro power.

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The aluminum industry purchases electricity at approximately half the price of other industries, primarily because of its use of hydro power. The effects of the assumed fuel price adders on this industry depend on the future structure of the electricity market and the degree to which the assumed fuel price adders were applied.

- If the fuel price adders were only half as large for aluminum as for other industries, the least competitive plants in the U.S. and in Europe would close, which would reduce capacity in these regions by about 20 percent and 8 percent respectively.
- If the aluminum industry were subject to the same fuel price adders as the industry average, the domestic industry could not compete with developing countries that can produce aluminum in the $1,300 to $1,550 range.

> ... the revised economics would cause all of the US capacity to be noncompetitive by 2010 and virtually all of OECD-Europe except that in Canada, Iceland and Norway ... The loss of employment would be about 23,000 directly from the aluminum smelters.

In contrast to the primary aluminum producers, the aluminum recycling industry would be positively affected by the assumed fuel price effects. The significant increase in costs of producing primary aluminum would encourage a shift to recycled aluminum. However, the U.S. recycling market has a limited capacity to expand; about 70 percent of the aluminum cans in the U.S. is currently being recycled, and the predicted likely maximum is 80 percent.

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PETROLEUM REFINING SECTOR

Contribution to US greenhouse gas emissions

(To come)

Background on the Petroleum Refining Industry

Refinery products include refinery gases, distillate and heavy fuel oils, and transportation fuels including gasoline, jet fuels, diesel and bunker fuels. The US industry is particularly geared to the production of transportation fuels.

The petroleum refining industry is unique in being both the producer of fuels used as inputs downstream, and also a significant consumer of these products (8% of its output).

During the last 20 years, the U.S. refinery capacity has been approximately stable, but has declined somewhat since 1980. The refinery capacity in Western Europe has declined during the last 20 years. The OECD countries have accounted for a declining share of world capacity during the last two decades, because of both the declining capacity from within the OECD and the expansion in capacity in the developing countries.

The rate of return on refinery investments is currently 6 to 7 percent, which is just over one-half of the industry average.

Factors Shaping Industry Response

Charting the industry's evolution is complex, and industry impacts will be very sensitive to the precise form of the policies adopted. Key sensitivities include:

Whether policies affect only downstream demand of refinery products, or also increase costs of fuel used in refining. In petroleum refining, fuels are an input of the refinery process in addition to being an output. Relative international competitiveness of US refineries will be affected more by the extent to which prices of fuel used as an input are increased -- since these may change relative costs versus overseas competitors -- as opposed to policies that affect the overall demand for the refinery products produced.

Also, *policies to promote the use of non-petroleum fuels as substitutes* will clearly have an impact.

The extent to which marine transportation costs (the price of marine bunker fuel) are affected by climate policy: Transportation costs of crude oil and refined products are important in determining world trade flows and refinery location. Bunker fuel can account for 25 to 55 percent of transportation cost for a long haul voyage on a large crude oil carrier, and an increase in bunker fuel costs could affect -- and perhaps counter -- shifts in refining capacity offshore.

Other factors that will affect the response of the industry include:

-- *characteristics of individual refineries*: The refineries most vulnerable are located in highly competitive regions, they are typically old, and they produce a standardized product subject to a high degree of competition. Many of the old refineries are only marginally profitable under existing conditions. Less affected refineries will be those that have been renovated and modernized in the last five years, or produce specialized products.

The impact of increased fuel costs to refineries would also vary regionally. The large East Coast market is served by local refineries, by Gulf Coast refineries, and by foreign sources. The Gulf Coast refineries account for about 55 percent of U.S. capacity. DOE analysis highlighted differing views as to their vulnerability to cost increases that affected them but did not affect foreign suppliers. The Midwest and Rocky Mountain regions, which account for about 25 percent of U.S. capacity, are relatively geographically isolated and would be less impacted by energy price adders. The West Coast refineries are subject to stringent environmental controls and could also be undercut by lower import prices.

The conflict between refinery emissions and policies to produce environmentally enhanced fuels. Refinery emissions can be reduced by producing a larger share of lower grade heavier products, such as fuel oil. However, these products produce significant emissions when burned. Lighter, high grade products are environmentally cleaner when burned, but they result in more emissions in the refinery process.

Technology and Investment Options

The U.S. refinery sector relies significantly on natural gas in the refining process. In the short run, there is therefore little opportunity to improve emissions by switching to fuels with lower carbon emissions.

Longer term, radical breakthroughs in refinery technology are possible and would enable the refinery processes to operate at lower temperatures and atmospheric pressures. Such breakthroughs would be of major importance in reducing energy use in refinery operations. These advancements include improved catalyst technologies and biotechnology process.

Analytical Results of Sectoral Impacts

(NOTE: NEED IAT ANALYSIS TO REPLACE DOE ANALYSIS)

DOE examined the impact of exogenous increases in energy prices (fuel price adders) under two cases: included that the impact of the assumed fuel price adders on the global refinery industry would be "substantial, adverse, and complex with possibly unintended consequences." The impact of the assumed price effects depends on whether they apply only to refinery use of fuels or if they would also be applied to refinery products.

- If price increases (add factors) only applied to refinery products (ie -- the consumption of refined products), the demand for these products would decline substantially and so would refinery revenues and new investments.

  Refineries in non-affected countries would bear part of the cost to the extent that they sell products in participating countries.

- If the add factors were levied also applied against fuel used in the refining process in OECD countries, the result would be a significant increase in the operating costs of refineries, while competing refineries in non-affected countries would not be subject to these cost increases. In this case, most OECD refining would be shut down.

Some minor segments of U.S. and OECD refining may remain, e.g., those in highly interior regions with local crude supplies or, possibly, those refineries whose production was focused on high-value non-fuel products.

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STEEL INDUSTRY

Contribution to US greenhouse gas emissions

(to come)

Background on the Steel Industry

The U.S. market accounts for about one-fifth of steel demand worldwide.

There are three sectors in the U.S. steel industry:

- *Integrated producers* (58% of shipments) produce steel starting with iron ore and coal.

- *Minimills* (40% of shipments) melt ferrous scrap in an electric furnace to produce steel. This sector has grown rapidly in the last 25 years, largely at the expense of integrated mills, and will be bringing on line huge increases in flatrolling capacity through the rest of the 1990's.

- *Specialty steel producers* (2% of volume, 10% of value of shipments) melt scrap with alloying elements nickel and ferrochromium to produce stainless steel, electrical steel, and alloy tool steel products.

Growth varies by product. The demand for carbon steel has still not rebounded to levels achieved in the early 1970's, while specialty steel demand has increased an average of 4 percent over the last 30 years.

The United States is one of the few markets in the developed world where there is not significant overcapacity. In fact, domestic producers presently do not have the capability to supply their own market. Foreign producers supplied 21.2 percent of apparent domestic consumption in 1995. In the last several months, comparatively strong U.S. market and high prices encouraged a near record levels of imports.

(EMPLOYMENT?)

Factors Shaping Industry Response

A. Competitive and Structural Factors

Integrated producers -- while profitable and highly competitive -- remain financially weak:

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Beset by catastrophic losses and some bankruptcies in the 1980's, since 1981 integrated producers have sharply reduced their capacity and invested heavily in new technologies . They are now considered highly efficient; many mills are now recognized as world class and quality is on a par with that of Japan and Germany.

While the integrated mills are now profitable, they remain weak financially -- with a return on assets have been well below that of minimills and S&P 500 firms as a whole, and face difficulties raising capital. Furthermore, integrated mills will have to spend billions to conform to the 1990 amendments to the Clean Air Act, in large measure to reduce air toxics from coke ovens. Shutdowns are certain to occur.

Minimills and specialty producers are in much better shape -- being generally more profitable than integrated producers. Capital expenditures to construct a greenfield minimill are only a fraction of that for an integrated mill. Technologically innovations that boost productivity and reduce costs are coming along continually.

Minimills are very sensitive to the price of scrap: Melting ferrous scrap in an electric furnace to produce steel has generally been less costly than making steel from iron ore and other raw materials via the integrated route. However, the recent rise in the price of scrap has narrowed the minimills' edge.

The integrated and specialty producers already face substantial import competition. The US market has been particularly susceptible to imports. Foreign producers captured a large share of the increased consumption during the 1990's. Exports are not very important to the U.S. steel industry.

U.S. steelmakers have faced a near constant problem of global overcapacity in the steel industry. When markets are weak overseas, this has resulted in periodic surges in imports and consequent filings of unfair trade petitions, alleging dumping and massive government subsidies. In the last 15 years industry has won numerous cases.

Measures that increase coal prices will have a far more dramatic impact on integrated mills than on minimills, while all of the industry will be affected by electricity price increases: About 60 percent of the energy required to produce steel is derived from coal, and most of that is needed to produce coke. However, only integrated producers use coke. Steel companies from all sectors are very large users of electricity and consequently would all be adversely affected by higher electric rates.

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B. Technology Options

After a historical record of lagging technologically, the domestic steel industry has begun to exhibit a high rate of technological change, including:

-- *thin slab casting*, enabling minimills to produce flat rolled sheet at a minimill scale. Capital costs are low; productivity is high, and quality is improving. Since Nucor Corporation's initial mill was constructed in 1989, more than 7 million tons of (annual) flat rolled capacity have been built in the United States; 12 million tons more are expected to be added by 2000.

-- *new processes to extract iron from iron ore without using coke.* At least four facilities are now under construction in the United States to produce steel scrap substitutes. Typically they will use coal or natural gas as a reductant to produce iron. To replace antiquated (1940's era) coke ovens, Geneva Steel is expected to build a Corex direct reduction project in Utah. The facility, which will receive a $150 million grant from the Department of Energy's Clean Coal Technology Development Program, will include power and oxygen facilities.

Analytical Results of Sectoral Impacts

(NOTE: NEED IAT ANALYSIS TO REPLACE DOE ANALYSIS)

Based on the DOE roundtable, at present energy costs are about $54/ton for integrated producers (using the Basic Oxygen Furnace) and about $44/ton for minimills (using the electric arc furnace). Integrated mills rely primarily on coal for energy; minimills are primarily electricity users.

Without new polices, energy costs for producing steel are projected to decline over the next two decades; domestic shipments will increase and imports decline.

With the assumed increase in energy prices, shifts from US producers could be reduced by about 30% and employment reduced by about 65%.

- the major effect would be on integrated mills in the Pittsburgh-Chicago corridor;

- hot and cold rolled steel would be the most affected product category;

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- there would be a large increase in imports of steel slabs, while downstream processing could remain in the US.

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THE CEMENT INDUSTRY

Contribution to US greenhouse gas emissions

Cement manufacturers are the fourth largest source category among the manufacturing sector. In 1994, calcining cement manufacture (a non-combustion process by which limestone materials are converted to lime) accounted for 9.5 million metric tons of carbon emissions, while fuel combustion accounted for another 6 million MMTC.

Background on the Cement Industry

Over the last two decades, cement demand has grown less rapidly than GNP because construction growth has not kept pace with GNP growth and cement has grown at a slightly slower rate than overall construction.

The cement industry ships over $5 billion from 120 firms employing about 17000 workers. Domestic shipments and consumption of cement have remained at about the same level for the last two decades.

The manufacturing process of cement is standardized world wide in terms of both process and use of raw materials. The raw materials (chiefly limestone) are burned inside a cement kiln at a temperature of around 2700°F to produce a hard granular intermediate product termed "clinker". This product is then finely ground into cement.

The cement industry is energy intensive, with energy costs being about 30 percent to 40 percent of total manufacturing costs. The domestic industry switched to coal as the principal energy source during the 1970's.

Although overland transportation of cement limits production and use to within a few hundred miles, the fact that it can be transported by water world wide at low cost makes it a international industry.

US cement capacity peaked in the early 1980's, and has since declined. This has been accompanied by significant restructuring. Since 1975, 54 plants have been shut down and the industry has lost about half of its labor force. The number of cement kilns has similarly decreased by 50 percent. Most US plants are located in rural areas, and are oftentimes the major employer.

No new greenfield plants have been built in the US in 10 years.

Factors Shaping Industry Response

A. Competitive and Structural Factors

Domestic production is susceptible to increased import penetration: Almost all the large US markets are accessible by water, and hence to imports.

Furthermore, 65-70% of US cement capacity is foreign owned -- with three of the top five firms foreign. About 90% of cement imports are handled by domestic producers, who use imports to supplement domestic capacity. *Hence, corporate profitability is not necessarily linked to the health of the domestic industry.*

B. Technology and Investment Options

The manufacture of cement uses a process that is standard worldwide, with no apparent new manufacturing technologies which could dramatically increase energy efficiency.

Rather, opportunities are incremental:

Replacement of inefficient capacity: Scale economies, incremental improvements, and operating practice affect energy efficiency -- with US plants less efficient than others (see table). Japanese kilns, for example, are on average larger than the largest US kiln.

(Table -- US energy efficiency versus Japanese and European)

Incentives for this investment are unclear. The market is growing slowly; there is no need for additional capacity, and many investment decisions are made by non-US firms.

Potential for fuel switching: The extremely high burning temperatures permit the use of waste fuels such as sludge, old tires, and even some hazardous wastes. The cement industry is in the unique and enviable position of making an effective use of waste fuels. Almost anything that burns can be used to fuel a cement kiln, and typically without additional air quality problems. It is unclear as to the potential for significant expansion of low grade because: (1) permits are hard to obtain, (2) it is difficult to find waste that is suitable and accessible and (3) the industry is unwilling to burn municipal waste.

. Similarly, it would not be feasible to switch to natural gas. The industry switched to coal during the 1970s and is now better equipped to burn coal than gas. (NB -- WHY IS THIS? DOES IT MAKE SENSE?)

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Allow the use of blended cement. Cement blended with fly ash, blast furnace slag, or other pozzolans could reduce overall costs while not compromising quality. Existing building codes, state highway departments and other standards (STM standards) effectively preclude this cost saving measure.

Analytical Results of Sector Impacts

(NOTE: NEED IAT ANALYSIS TO REPLACE DOE ANALYSIS)

Based on the DOE roundtable analysis, the initial impact of higher energy prices would be to increase the price (NB -- OR COST?) of domestically produced cement by 13-20% by 2010, creating a large gap between the price of U.S. produced cement and cement produced by non-OECD countries whose energy prices are assumed to remain at baseline (no mitigation) levels.

- Cement imports would displace domestic production. Imports were estimated to increase from the 1994 level of 13.1 percent to capture 45.9% percent of the market in the year 2010 in one scenario case, compared to 19.8% in the base case.
- The result of lost market share would be the closure of domestic cement plants and foregone capital investments that would have been made to take advantage of growing demand.
- Approximately 26 million metric tons of clinker capacity would be shut down by 2010 in scenario 1 and 17 million metric tons in scenario 2. The plant closures would cause job losses: 5,800 and 3,700 in scenario 1 and 2 respectively by 2010. These losses are significant because cement plants are often located in small communities where the plant is one of the major employers.
- The most likely outcome of the assumed energy price increases in OECD countries would be the development of new cement production capacity in countries not subject to the price increases. The purpose of these plants would be to supply the U.S. market. These plants would use the same technology and emit the same amount of carbon dioxide as new capacity installed in the U.S.

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NEEDED:

DISCUSSIONS OF PAPER/ CHEMICAL/GLASS SECTORS

PLUS DISCUSSION OF 'WINNERS' SECTORS

RESIDENTIAL AND COMMERCIAL SECTORS

These sectors, sometimes called the "buildings" sector, account for 35% of final energy demand. The major components of energy use are the following:

End Use	Shares of Total
Space heating	26.8%
Air conditioning	9.8%
Water Heating	10.8%
Refrigeration	5.0%
Lighting	14.7%
Cooking	2.6%
Other Appliances/Uses	30.3%
Total	100%

Although the commercial sector's total energy use has risen over the past twenty years, the sector has experienced dramatic improvements in energy efficiency in terms of energy use per square foot of building space, on the order of 30% between 1979 and 1992. ~~Commercial~~ energy use per square foot is expected to decline modestly – by about 0.2% per year or 4% in total – over the next twenty years.

Residential energy use per household has declined by about 25% since 1978, while residential energy use per capita has declined by about 18%, despite an increase in the amount of residential space per person that must be heated, cooled, and lit. Residential energy use per square foot is expected to decline by about half a percent per year over the next twenty years.

Major technologies for improving end-use efficiency and/or reducing emissions:

- Better insulation of building shells, water heaters
- Better control systems for regulating the use of energy consuming equipment (time and temperature controls by zone, energy-use optimizers, energy management systems)
- High efficiency heat pumps
- Heat pump water heaters
- Decreased hot water requirements through low flow shower heads, better designed clothes washers and dishwashers
- Increased motor/compressor efficiencies for refrigerators
- High efficiency lighting – fluorescent fixtures, electronic ballasts, control systems
- Substitution of lower-carbon fuels (on a full fuel-cycle basis)

DOE operates a program of test procedures, energy conservation standards, and labeling for certain major energy using equipment in the residential and commercial sectors. These include refrigerators, freezers, air conditioners, water heaters, furnaces, dishwashers, clothes washers, clothes dryers and kitchen ranges, ovens, commercial heating and air-conditioning equipment, certain incandescent and fluorescent lamps, distribution transformers, and electric motors. The Energy Policy Act of 1992 (EPACT) also established maximum water flow-rate requirements for certain plumbing products and provided for voluntary testing and consumer information programs for office equipment, luminaires, and windows.

DOE estimates that the federal appliance standards implemented to date will reduce carbon emissions by 14 million tons in the year 2000. Further development of standards could result in additional reductions, although recent bipartisan attacks on implementing new standards under EPACT have stalled recent efforts to make progress in the appliance standards area.