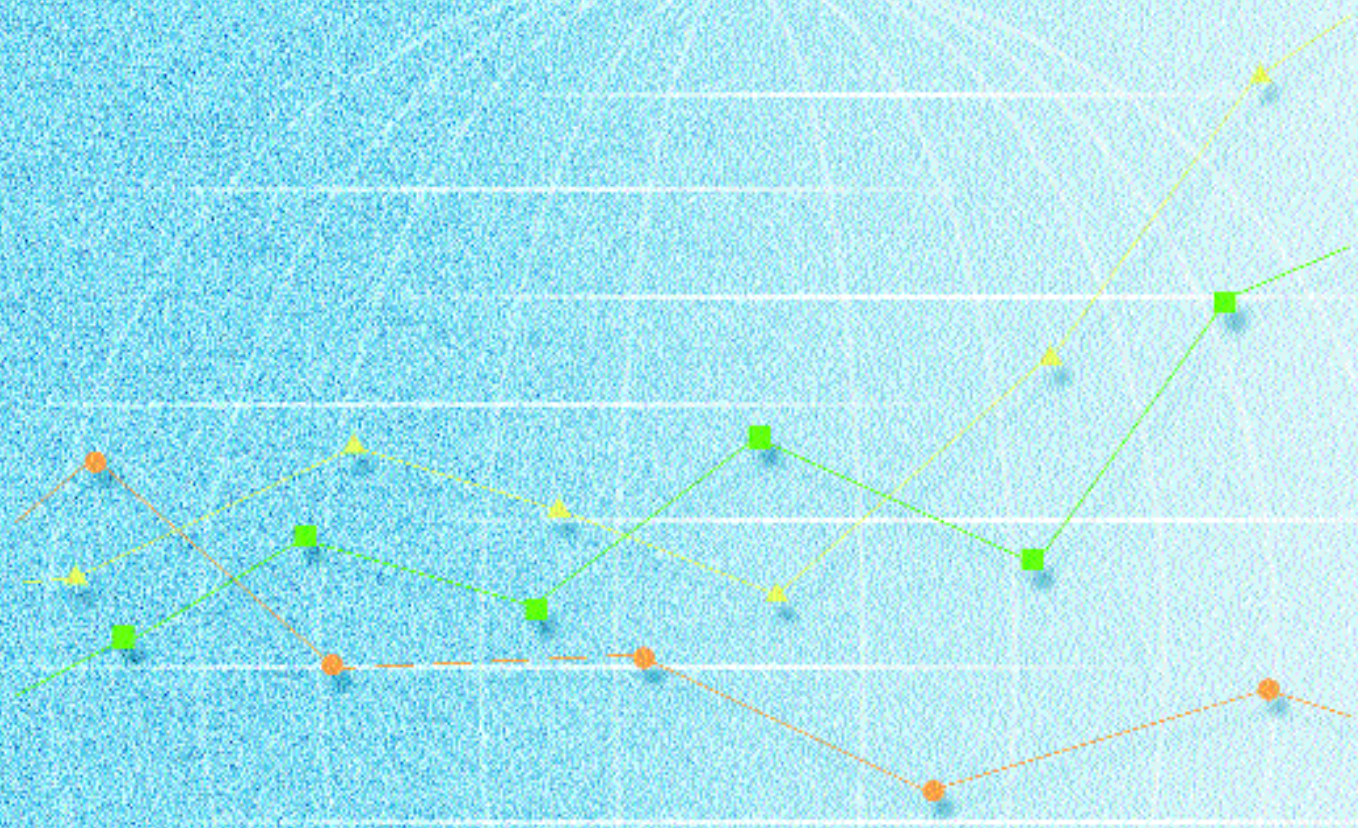
THE IMPACTS OF THE

KYOTO PROTOCOL



This report summarizes the major findings from four recent studies on the impact on the U.S. economy of meeting the greenhouse gas emissions limitations that would be mandated if the Kyoto Protocol became a legally binding international treaty.

The studies are:

Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity, by the U.S. Energy Information Administration;

Global Warming: The High Cost of the Kyoto Protocol, National and State Impacts, by WEFA;

The Impact of Meeting the Kyoto Protocol on Energy Markets and the Economy, by Standard & Poor's DRI; and

The Post-Kyoto Climate – Impacts on the U.S. Economy, by Charles River Associates.

This report focuses on the impacts on:

- Economic Activity
- Employment
- Carbon Prices and Permit Trading
- Energy Prices
- Energy Demand
- Electricity Sector

Compiled by the Economics Committee
Global Climate Coalition
May 2000

IMPACTS ON ECONOMIC ACTIVITY

Administration proposals as well as assessments of the impact of meeting the Kyoto Protocol's greenhouse gas emission limits assume that a tradeable permit system would be used to limit emissions. Although there are different ways to implement permit systems, the common element is that fuels cannot be used without a permit equivalent to the carbon content of the fuel. Limiting the number of permits, and, through that, energy use, limits greenhouse gas emissions. This also means that permits are costly - so people not only have to pay for the energy they use, they also have to pay the cost of the permit as well. As a result, the price of energy purchased by homeowners and businesses would increase.

This increased energy cost has impacts throughout the entire economy. For businesses, production costs increase and the prices of products sold to consumers also increase. This is especially true for energy intensive industries such as steel, chemicals, paper, and glass. Higher production prices induce inflation and raise the likelihood of higher interest rates. Companies will also face increased competition from imports as energy costs in developing countries will not increase because they have no obligations to limit greenhouse gas emissions under the Kyoto Protocol. In fact, energy prices in developing countries may actually decrease because of lower demand for energy in developed countries subject to the Kyoto Protocol. For homeowners, the increased cost of energy reduces the amount of money left over for other purchases like food, clothing, housing and education - and they all cost more because of increased inflation. Impacts like this lead to a slowdown in the growth of personal income and in economic activity overall.

Gross domestic product (GDP) is the overall measure of economic activity in the economy and GDP is the most commonly used measure for comparing estimates of the Kyoto Protocol impacts across different models of the U.S. economy. Figures 1 and 2 summarize recent estimates of the economic impact of meeting the Kyoto emissions target from four different models and different assumptions as to what portion of the U.S. emission reduction target is achieved domestically (as opposed to using sinks or purchasing tradeable permits from other countries).[1] Figure 1 shows that in the most likely scenarios, lost GDP in 2010 alone could range from $225 billion to about $440 billion. With optimistic assumptions regarding so-called international flexibility mechanisms, optimistic because the rules for the mechanisms are yet to be written, lost U.S. GDP might be in the $120 billion to $210 billion range in 2010.

Figure 1

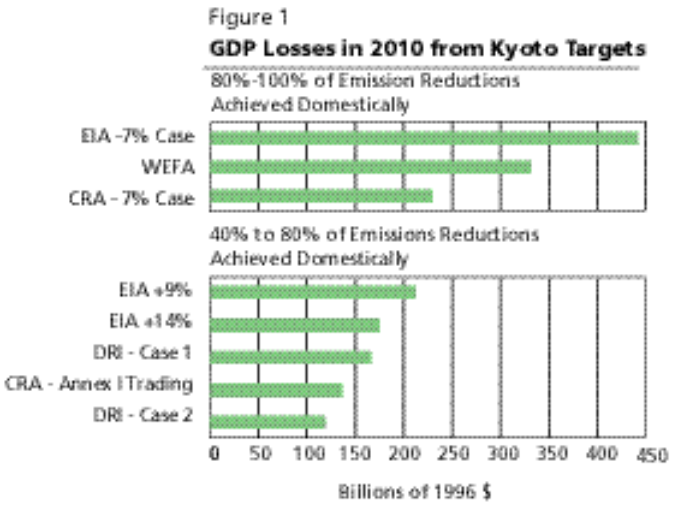
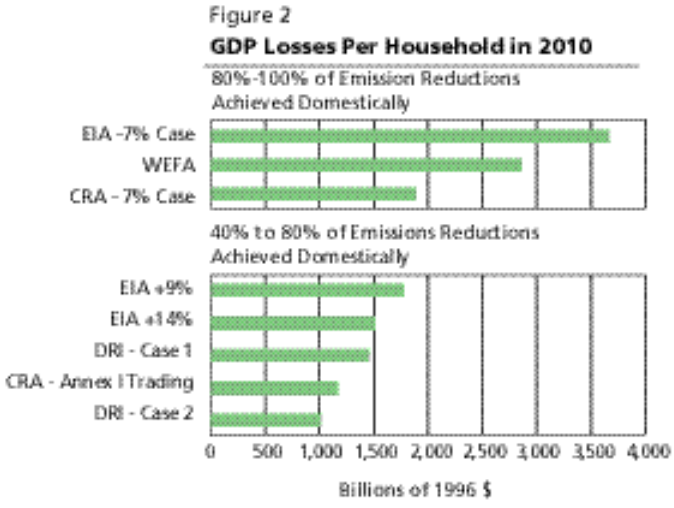


Figure 2



IMPACTS ON EMPLOYMENT

Figure 2 illustrates these costs on a per-household basis using EIA's estimate of 117 million households in 2010. Lost GDP per household in 2010 could range from about $1,940 to $3,740 if most of the required emission reductions have to be achieved domestically. If the so-called flexibility mechanisms are assumed to work perfectly, lost GDP might range from $1,000 and $1,770 per household.

The Kyoto Protocol flexibility mechanisms include international tradeable permits, joint implementation among the developed countries, and a so-called clean development mechanism that allows certain emission reduction projects in developing countries. The essence of all three mechanisms is that they would allow the U.S. to pay other countries to reduce their emissions instead of reducing U.S. emissions. The Kyoto Protocol also allows the use of "sinks" - such as planting new forests that would "sequester" carbon. However, the rules for sinks and the flexibility mechanisms are really just concepts at this point. However desirable in theory, there is substantial skepticism whether they can be made into successful tools for real international cooperation in limiting greenhouse gas emissions in a globally cost-effective manner.

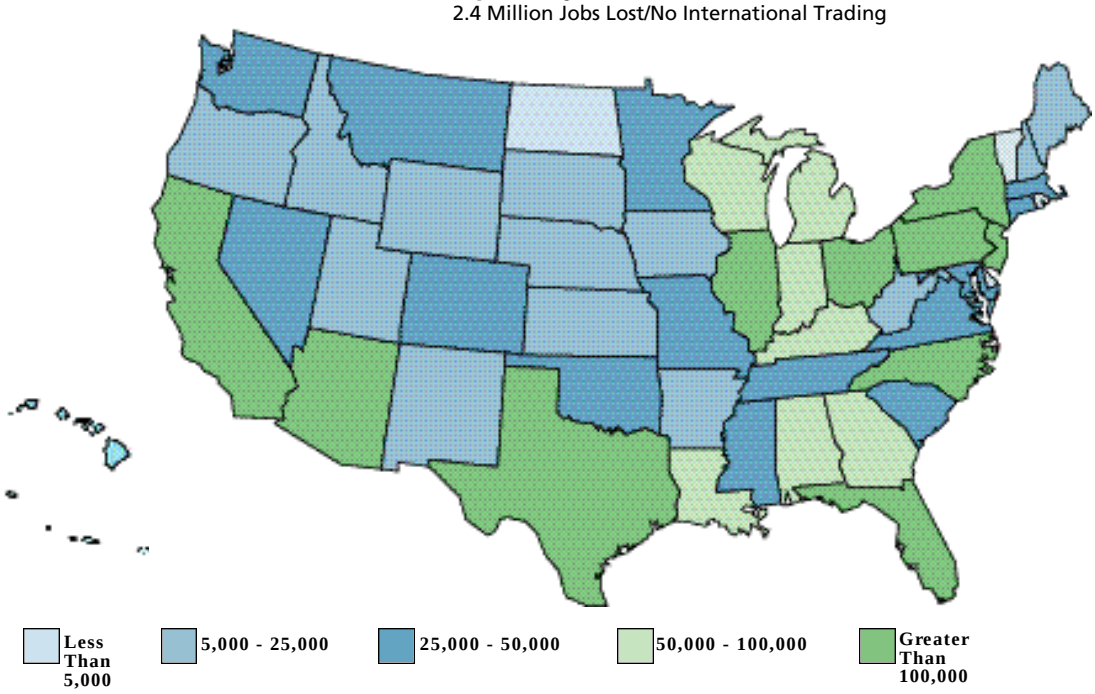
[1] GDP losses are from Tables 30 and 31 of *Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity*, U.S. Energy Information Administration, October 1998. They are converted to 1996 dollars using the GDP deflator.

Studies show that the employment losses in transitioning to a lower-carbon economy as dictated by the Kyoto Protocol are substantial. These result from fuel price increases that generally raise the cost of producing goods and services throughout the economy. As prices rise, consumers reduce their purchases, which, in turn, reduces the nation's income and employment. In the absence of international trade in emission permits, employment losses in the year 2010 range from between 1.1 million and 4.9 million jobs as projected by Standard and Poor's DRI case 2, WEFA and the U.S. Energy Information Administration (EIA) 1990 -7% case.

WEFA's analysis, which addresses the case in which all mandated carbon emissions targets are achieved domestically, shows job losses in every state. Figure 3 shows how the Protocol impacts each state's employment in the year 2010. Ten states experience job losses, which exceed 100,000. The largest losses occur in California (279,000), Illinois (190,000), Florida (142,000), New York (140,000), and Texas, (124,000).

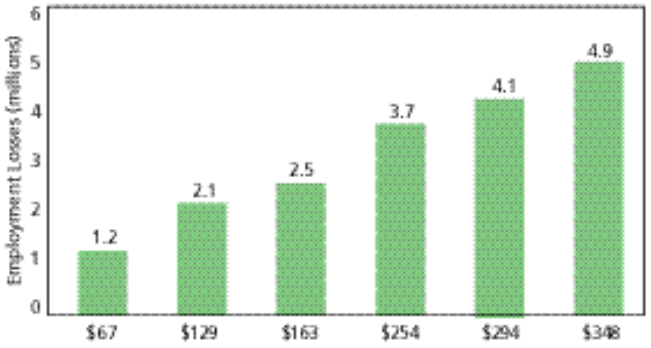
Low-cost emission permits from international markets theoretically could dampen some of the adverse employment effects. If low-cost foreign sources of emissions permits were available, the U.S. could purchase credits more cheaply than the cost that would be incurred in making the reductions domestically. DRI assessed several scenarios where the Kyoto Protocol is imple-

Figure 3
Impact of Kyoto on Jobs in 2010- WEF A
2.4 Million Jobs Lost/No International Trading



CARBON PRICES AND PERMIT TRADING

Figure 4
Employment Losses Increase with the Emissions Permit Fee
Year 2010



Source: *Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity*. U.S. Energy Information Administration, October 1998.

mented with varying degrees of trading. In its Case 2, 58% of the mandated U.S. reductions results from changes or reductions in domestic energy use. About 30% of the reductions comes from purchases abroad and 12% results from sinks and offsets from other gases. Despite the availability of permits from other countries, DRI's Case 2 still results in an estimated permit fee of $110 per ton that leads to job losses of 1.1 million in 2010.

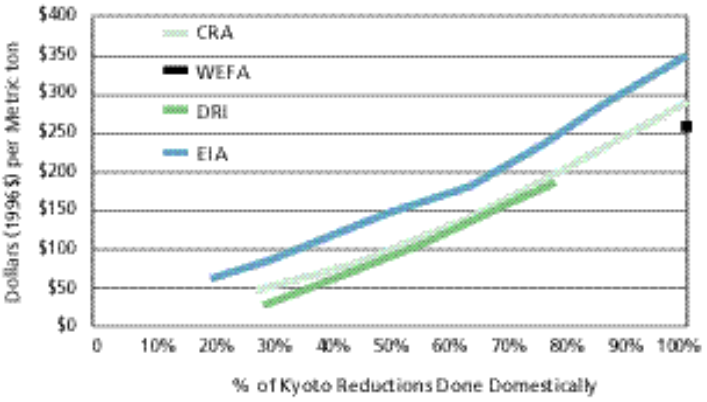
The EIA examined several scenarios with each assuming the Kyoto Protocol is implemented at a different degree of trading flexibility. It found that employment losses vary depending on the price and availability of emission credits in international markets (see Figure 4). In the case where there is no international trading, the emission permit fee rises to nearly $350 per metric ton of carbon (EIA 1990 - 7% case). Employment losses mount to 4.9 million as this carbon fee transfers through the American economy. In the lowest employment loss case, nearly 75 percent of the mandated U.S. carbon reductions are purchased from low-cost foreign sources (EIA 1990 +24% case). Employment losses remain significant, however, at 1.2 million jobs. The results suggest that larger supplies of international permits, if available for purchase, are associated with lower permit prices, which, in turn, somewhat mitigates the consumer price, income, and employment effects of transitioning to a lower-carbon economy.

The costs of implementing the Kyoto Protocol range widely depending on different assumptions concerning emissions trading as well as other factors such as macroeconomic conditions. Carbon prices provide a good measure for comparing studies and the results of different assumptions regarding flexibility mechanisms, such as emissions trading.

Simply put, with tradeable emissions permits, the price of emitting one ton of carbon will equal the marginal cost of preventing that ton of carbon from being emitted into the atmosphere. The cost of not emitting a ton of carbon can be looked at as a combination of all the steps taken to avoid that ton of emissions. This might include installing expensive first-generation technology for power generation, investment in sequestration and scrubber technologies, switching to more expensive, less carbon-intensive energy sources, or price incentives for consumers to demand less energy in the form of electricity and gasoline.

The graph below clearly illustrates the simple fact that with less flexibility and more required reductions domestically,

2010 Carbon Permit Prices To Reach Kyoto Target



the price of a carbon permit increases dramatically, as do the subsequent impacts on the U.S. economy. Even with some trading, carbon prices well in excess of $250 per metric ton of carbon are projected. However, even under favorable trading scenarios, the cost of complying with the Kyoto Protocol remains very high and has lasting effects. Imposing a cap on the amount of carbon reductions a country can achieve through flexibility mechanisms, as proposed by the European Union, clearly increases the cost of the Kyoto Protocol in the United States.

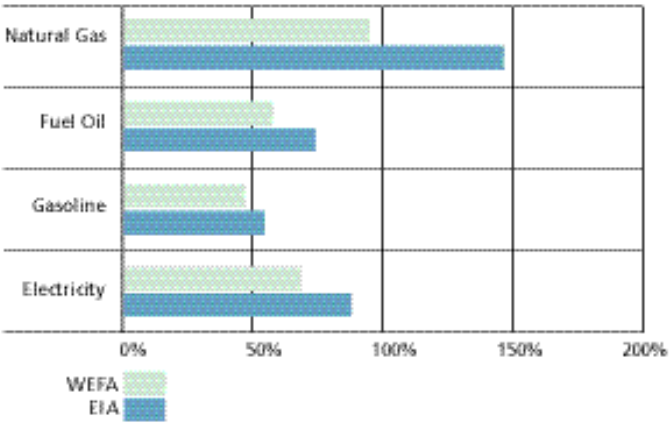
IMPACTS ON ENERGY PRICES

As the price of using fossil fuels increases in response to compliance with the Kyoto Protocol, so will energy prices faced by consumers and businesses. The range of energy price increases resulting from analysis of the Kyoto Protocol indicates a range of views on the costs of Protocol compliance. However, the recently concluded Energy Information Administration (EIA) study, when compared to the most recent industry-sponsored analysis prepared by WEFA, points out some surprising similarities. For the year 2010, these studies indicate close agreement on the implications for energy prices (in 1996 dollars) when the Kyoto targets for emissions are reached through domestic action. The table below outlines the similarities:

Product Prices	EIA 1990–7% CASE	WEFA
Electricity – per kWh	$0.11 or + 86%	$0.098 or + 67%
Gasoline – per gallon	$1.91 or + 53%	$1.83 or + 48%
Fuel Oil – per gallon	$1.90 or + 76%	$1.89 or + 56%
Natural Gas – per mcf	$9.57 or + 147%	$7.61 or + 95%

The similarities are even more striking when depicted graphically as shown below.

Increase in Prices



An effective international system for tradeable emissions permits would allow the U.S. to purchase low-cost permits from abroad and reduce the amount that emissions would need to be controlled in the U.S. Although that lower level of effort would reduce the cost of emissions permits in this country and would reduce the amount by which energy prices would rise, the resulting energy price increases would still be substantial. The table below compares EIA's base case or "reference" case with a middle-trading case and the case above in which the required emission reductions are achieved entirely domestically. Even with the assumption of a substantial amount of international trading, the increases in energy prices are substantial.

Energy Prices in 2010 From the EIA Analysis

Product	Reference Case	EIA 9% Above Case	EIA 7% Below Case
Residential:			
Distillate Fuel	$1.08 per gal	$1.45 per gal	$1.92 per gal
Commercial:			
Distillate Fuel	$0.77 per gal	$1.14 per gal	$1.61 per gal
Industrial:			
Residual Fuel	$0.44 per gal	$0.89 per gal	$1.44 per gal
Transportation:			
Motor Gasoline	$1.25 per gal	$1.56 per gal	$1.91 per gal

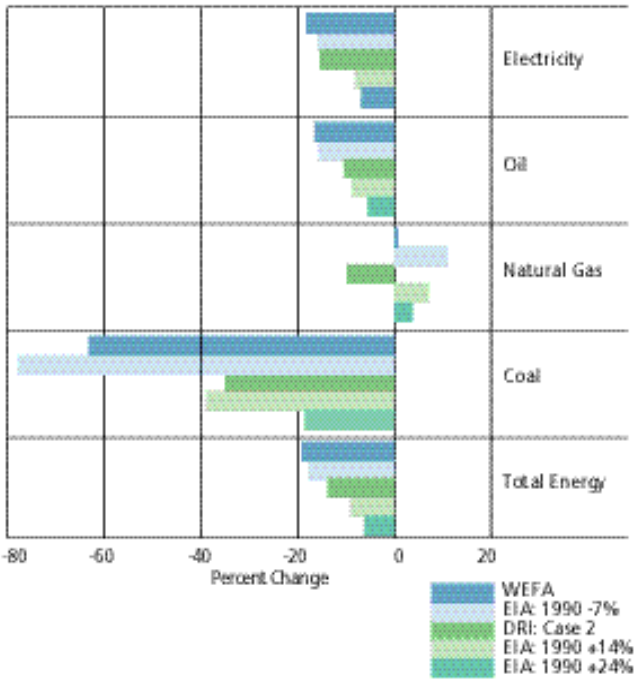
IMPACTS ON ENERGY DEMAND

Energy price increases that would occur with the implementation of the Kyoto Protocol would decrease energy consumption. Differences across cases in the projected reductions in energy use are largely driven by the assumptions regarding the ability of the U.S. to make reductions of greenhouse gases outside of the energy sector as well as to take advantage of the flexibility mechanisms under the Protocol. These flexibility mechanisms include emissions trading, joint implementation, the Clean Development Mechanism and sinks or sequestration.

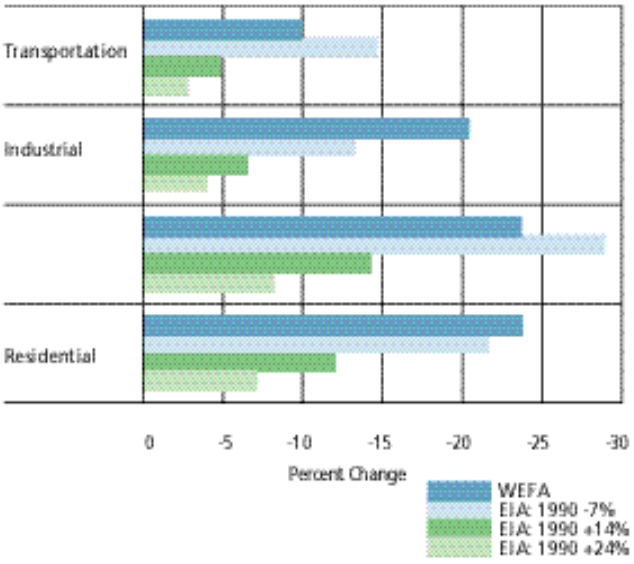
The first graph shows the changes in energy demand by type of energy for five cases: (1) EIA's 1990 + 24% case; (2) EIA's 1990 + 14% case; (3) DRI's Case 2, which is comparable to the EIA 1990 + 14%; (4) EIA's 1990 - 7% case; and, (5) WEFA's 1998 analysis, which is comparable to the EIA 1990 - 7% case. Results are generally consistent across the five cases. Specifically, reductions in total energy range from 4% to almost 20%, with the greatest reductions in energy use occurring in the two cases where greatest overall reductions in emissions are obtained from the domestic energy sector and the smallest reductions in energy use occurring where such emissions reductions are the smallest. Reductions in the use of electricity and oil track overall reductions in percentage terms. Use of coal shows dramatic reductions across the board (18% to 78%), while use of natural gas decreases 8% in DRI Case 2 and increases somewhat in the others (1% to 11%).

While there are strong similarities, differences occur also. For example, for the WEFA analysis and the EIA 1990 - 7% case, the WEFA study shows smaller reductions in coal use (63% vs. 78% for the EIA case) as well as smaller increases in natural gas use (1% vs. 11% for EIA). And when the DRI Case 2 analysis and the EIA 1990 - 14% case are compared, the DRI study shows somewhat smaller decreases in coal (33% vs. 38% for the EIA case) and a decrease in natural gas (8%) versus a 6% increase for the EIA case. These variations reflect different views of the extent to which coal will be replaced by natural gas in the production of electricity, and increases in gas use for electricity generation are offset by decreases in other sectors.

Changes in Energy Demand



Changes in Energy Demand by Sector 2010



ELECTRICITY SECTOR IMPACTS

The second graph shows changes in energy demand by sector for four of the five cases described above. (The DRI report does not identify energy use sector.) As expected, reductions are largest in the two cases where greater overall reductions occur in the domestic energy sector, while they are smallest when such emissions reductions are the least. Percentage reductions are slightly larger in the residential sector (7% to 24%) and commercial sector (7% to 29%) than in the industrial (4% to 21%) and transportation (2% to 15%) sectors. The sectoral results for the WEFA and EIA 1990 - 7% cases are generally consistent, although the WEFA analysis shows noticeably greater reductions in the industrial sector than does the EIA case (21% vs. 13%).

The reductions in energy use that would be caused by implementation of the Kyoto Protocol represent a decrease in the U.S. household's standard of living. Less energy is used but it is more expensive, and a smaller portion of overall income is available for consumption of other goods and services. In business, this reduction is driven by two elements. First, higher energy prices mean higher costs and, in turn, higher prices for products (to the extent that the market will allow). Second, consumers are buying less, as a result of both higher prices for the goods and the reduction in the portion of their income that is now available for non-energy products.

Three of the studies reviewed (EIA, DRI, and WEFA) report some of the impacts on the electricity sector. Unfortunately, results are not reported in a consistent manner, so extensive comparison is difficult. Even so, it is still possible to draw some conclusions about these impacts. Implementation of the Kyoto Protocol would have major negative impacts on electricity generators and their customers. Generators' fuel costs increase dramatically, and there is a significant shift in the nation's generation mix from coal to natural gas. Because of these cost increases, customers would face large price increases, which cause them to significantly decrease their electricity use. Details of these impacts are provided below.

Electricity Prices. In all three studies, electricity prices increase, with the level of increase being greater as the need to make reductions domestically increases. In the EIA study in 2010, this increase ranges from 1.2¢ per kWh, or 20% over business-as-usual (BAU) levels in their least stringent 1990 + 24% case to as much as 5.1¢ per kWh, or about 86% over BAU electricity prices in the most stringent 1990 - 7% case. In 2020, the increase ranges from 1.7¢ per kWh, or 30% over BAU to 3.7¢, or 66% over BAU.

For 2010, results from the WEFA and DRI analyses are slightly lower than but still consistent with the EIA results. For 2020, there is some divergence. DRI results are consistent with the EIA data, however, WEFA reports price increases of 81%.[1]

Electricity Demand. As one would expect, electricity demand decreases in all three studies as price increases. In 2010, the decrease ranges from 4% below BAU in EIA's 1990 + 24% case to 17% for the 1990 - 7% case. In 2020, the decrease ranges from 6% to 14%.

Again, results from the WEFA and DRI analyses are slightly lower than but still consistent with the EIA results. As with prices, results for 2020 do diverge. WEFA shows electricity use as 23% below baseline levels, while DRI shows reductions ranging from 15% for its least stringent case to 30% for its most stringent case.

Fuel Prices. In all three studies, both natural gas and coal prices to electricity generators increase, with larger increases occurring as the tons reduced domestically increase. The EIA study shows substantial increases in the prices that electricity generators pay for fossil fuel. In 2010, natural gas prices to generators show increases over the BAU price of $2.88 per Mcf that range from 35% to 206%. In 2020, these price increases range from 55% to

164% over the BAU price of $3.28 per Mcf. And the increase in coal prices is even more dramatic. In 2010, coal prices for the various scenarios range from about 2.5 times to about 9 times BAU levels of $1.11 per MMBtu. In 2020, prices range from about 3.5 to almost 9 times BAU levels of $1.00 per MMBtu.

The increase in natural gas prices to electricity generators in the WEFA and DRI analyses are both consistent with the EIA results in 2010. In 2020, the DRI increases are consistent with the EIA values. However, the WEFA result diverges, with a 208% increase in natural gas prices. Comparison of the increase in coal prices shows a similar pattern. The increases in the WEFA and DRI analyses are consistent with EIA's 2010 results. DRI's increases in 2020 are also consistent with EIA's; however, WEFA's 2020 increase of 805% diverges from the EIA results.

Fuel Cost. Despite a 7% to 40% decrease in fossil generation in 2010, fossil fuel expenditures in the EIA analyses increase $36 billion to $106 billion, or 81% to 238%. In 2020, fossil generation decreases 13% to 62%, while related fuel expenditures increase $54 billion to $72 billion, or 99% to 133%.

The reports for the WEFA and DRI analyses do not provide the data needed to compare their fuel expenditure increases with the EIA results.

Generation Mix. The EIA study reports that, in 2010, 9% to 43% of total generation will shift away from coal, relative to BAU levels. Roughly half of this is replaced by natural gas generation, while most of the remainder is simply eliminated as a result of sales reductions under the policy. In 2020, 21% to 50% of total generation shifts away from coal, relative to BAU levels. Of this, 12% to 18% is replaced by natural gas, with 1% to 11% being replaced by renewable generation. Most of the remainder is eliminated as a result of reductions in electricity use.

The reports for the WEFA and DRI analyses do not provide the data needed to compare their shifts in generation mix with the EIA results.

[1] In this section, comparisons among cases across studies are made on the basis of "MMTC reduced domestically in the energy sector."

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