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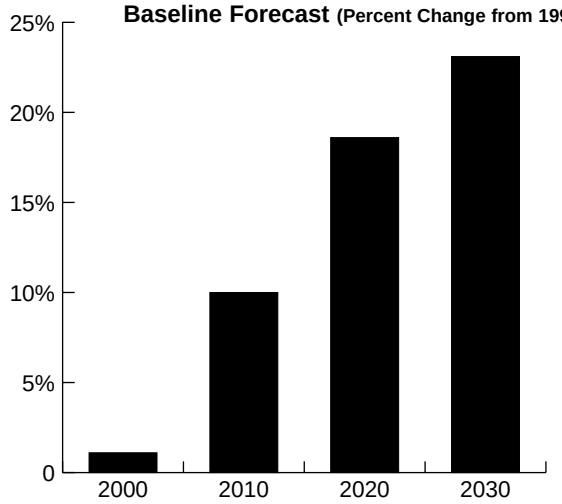
# Kyoto Protocol and Beyond: Economic Impacts on EU Countries*

*by Margo Thorning, Ph.D.*

*Notwithstanding the European Union's recent ratification of the Kyoto Protocol on climate change, the world's second largest economy faces major challenges in meeting not only the Kyoto greenhouse gas targets but also the more stringent emission reductions being debated for the post-Kyoto commitment period (after 2012). New data from the International Energy Agency (IEA) suggest that EU carbon emissions will continue to rise over the 2000-2030 period (see Figure 1). Even with strong policies to reduce emissions there is almost no change from 1999 emissions levels, according to the IEA report. The ICCF offers this report, based on a new study by DRI-WEFA (which includes all six greenhouse gases), to help policymakers understand the potential economic consequences of near-term actions to reduce greenhouse gas emissions.*

**Figure: 1** **Growth In Carbon Emissions in the European Union: 2000-2030 Under the Baseline Forecast** (Percent Change from 1999)




Source: International Energy Agency, *World Energy Outlook 2002*, p. 437

## BACKGROUND

In December 1997, the Kyoto Protocol was agreed to by the Conference of the Parties to the Framework Convention on Climate Change. Under this Protocol, the 38 Annex B (developed) countries agreed to reduce their greenhouse gas emissions in aggregate to about 5 percent below 1990 levels for the period 2008–2012. Specific targets were set for individual countries.

More stringent emissions reduction targets are now being considered. Germany is pushing for an agreement at the EU level to cut greenhouse gas emissions by 30% from 1990 levels by 2020. Germany is also pledging to cut its national emissions by 40% by 2002.[1] The UK government's report "Climate Change: The UK Programme" calls for reducing emissions by 95% in industrial nations (see Figure 2). [2]

## EU EMISSIONS: ALTERNATIVE PROJECTIONS

The outlook for EU greenhouse gas emissions and climate policy is complex. First, while the European Union as a group did meet its stated goal of keeping 2000 carbon emissions at 1990 levels, this was largely the result of one-time events in the UK (significant replacement of coal by natural gas in electric power generation) and Germany (shutting down inefficient industries following reunification). In contrast, carbon emissions in ten of the 15 EU countries actually increased between 1990 and 1999, according to International Energy Agency (IEA) data. Even more importantly, most major economic forecasting groups, including the IEA and U.S. Department of Energy's Energy Information Administration, project increases in carbon emissions in virtually all the EU countries between now, 2010, and 2020 unless significant new policies are implemented. Overall, carbon emissions are expected to increase in the range of 9 percent for EU countries between 1990 and 2010 (see Appendix A).

In addition, the International Energy Agency's new report, *World Energy Outlook 2002*, concludes that carbon emissions in the EU will rise more rapidly over the 2000-2030 period than in the past three decades. From

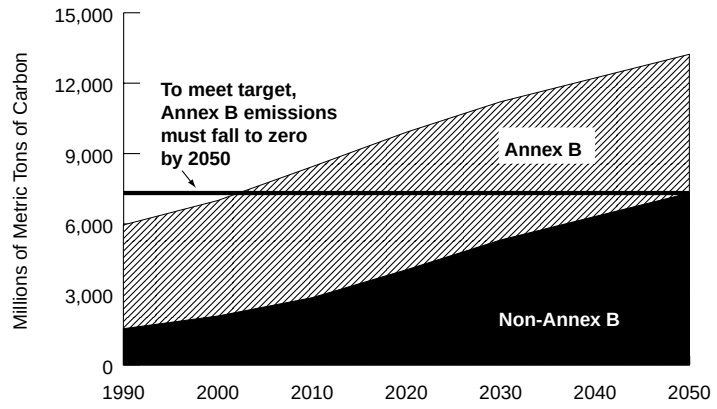
[1] *ENDS, Environment Daily 1306, 11/10/02*

[2] *"Climate Change: The UK Programme." London: Department of the Environment, Transport and the Regions, November 2000*

**This report was prepared by the International Council for Capital Formation based on studies done for the ICCF by DRI-WEFA under the direction of Mary H. Novak, Managing Director, Energy Consulting, DRI-WEFA. Junya Tanizaki, Margaret Rhodes, Lilly Teng, and David Goldsack performed the energy sector analysis. William Thomson and Joyce Brinner prepared the economic analysis. For more information, contact Dr. Margo Thorning, Managing Director, ICCF, 1750 K Street, N.W., Suite 400, Washington, D.C., telephone: 202.293.5811; email: mthorning@accf.org; Web site: www.iccfglobal.org.*

858 million metric tons (Mmt) in 2000, emissions rise to 933 Mmt in 2010 and 1,044 Mmt in 2030, an average annual increase of 0.7% (see Appendix B). Furthermore, even under alternate policy scenarios designed to curb emissions, according to the IEA carbon emissions in the EU grow by 0.3% per year from 2000 to 2010 compared to 0.8% in the reference (base case) scenario. In 2030, carbon emissions will be about 0.3% below 1990 levels (see Appendix B).

**Figure: 2 Carbon Emissions for Developed (Annex B) and Developing Countries: Business-as-Usual Case and Emissions Cuts Required to Meet Target of 550 PPM Using IPCC Data**




Source: See IPCC reports on page 8 of this report.

## POST-2012 EMISSIONS TARGETS

Despite the current lack of specificity regarding policies to prevent this projected growth in emissions between now and 2010, more stringent greenhouse gas emissions targets are being proposed for the years after the Kyoto Protocol's first compliance period (2008–2012).

For example, some EU officials are calling for a 60 percent reduction in carbon dioxide emissions by 2050. Others have suggested that we must stabilize carbon dioxide concentrations in the atmosphere at 550 ppm by 2100. Based on the 2001 Intergovernmental Panel on Climate Change data, in order to put the world on that trajectory developed country emissions must fall to zero by 2050 in order to allow developing countries to continue to grow (see Figure 2). (The Kyoto Protocol does not require developing countries to reduce their emissions.)

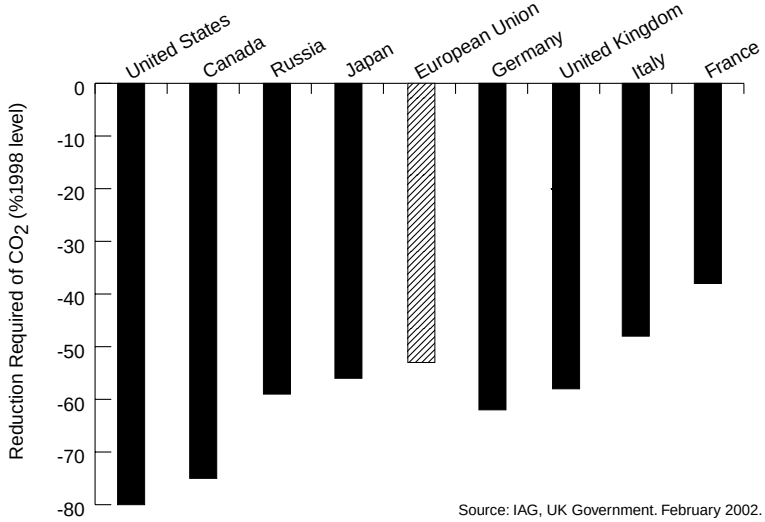
In another example, the UK government's February 2002 report by the Interdepartmental Analysts Group calls for a 60% reduction in $CO_2$ from 1998 levels by 2050 in the UK and even larger cuts by Russia, Germany, Canada, and the US (see Figure 3). The report notes that a countries' relative competitiveness can be affected by these large scale cuts.

Accordingly, the DRI-WEFA analysis assesses two additional targets besides the Kyoto Protocol:

**Target 1:** Current commitment under the Kyoto Protocol through the first period (2008–2012) and a target level of 60 percent below current (2000) levels of $CO_2$ emissions by 2050, achieved via a continuous annual reduction per year beyond the first Kyoto commitment period.

**Target 2:** Current commitment under the Kyoto Protocol through the first period (2008–2012) and a target level of zero $CO_2$ emissions by 2050 achieved via a continuous annual reduction beyond the first Kyoto commitment period.

**Figure: 3 $CO_2$ Reductions Required by 2050 Under 550ppm Scenario (1998 Base Year)**




Source: IAG, UK Government. February 2002.

Clearly, there is a clash between the projected growth in emissions and calls for even tighter emission targets beyond the initial Kyoto targets.

## STUDY ASSUMPTIONS

The DRI-WEFA report examines the economic impact of meeting the current policy and the two proposed

**Table: 1 Outlook for Germany: Baseline Forecast**

| | 1990 | 2000 | 2010 | 2020 |
|---|---|---|---|---|
| Population (million persons) | 79.5 | 82.2 | 81.8 | 79.9 |
| *% Change from 2000* | | | *-0.5* | *-2.8* |
| Real GDP (billions of 1997 US$) | 1550.7 | 1827.6 | 2270.9 | 2780.3 |
| *% Change from 2000* | | | *24.3* | *52.1* |
| Energy Consumption (million toe) | 361.1 | 338.7 | 369.6 | 393.8 |
| *% Change from 2000* | | | *9.1* | *16.3* |
| $CO_2$ Emissions (Mmt carbon) | 265 | 223 | 248 | 259 |
| *% Change from 2000* | | | *11.2* | *16* |
| $CO_2$/Energy Consumption | 0.73 | 0.65 | 0.67 | 0.66 |

Source: DRI-WEFA, 2002.

policies described above on four European countries: Germany, the Netherlands, the UK, and Spain.

The DRI-WEFA report's conclusion that without stringent new measures carbon emissions will continue to rise for the four countries is reflected in other reports as well.

The simulations for Germany, the Netherlands, the UK, and Spain assume that the United States does not participate in the Kyoto Protocol. The simulations do assume intra-country trading. The analysis assumes that emission permits would be auctioned to energy producers at the point of first sale.

This study assesses the marginal cost of $CO_2$ abatement accounting for projected changes in other greenhouse gases, and the resulting economic cost. While the Kyoto Protocol established limits for participating countries' emissions from six greenhouse gases, this analysis analyzes the cost of reducing $CO_2$ from energy use after taking into account reductions in the other greenhouse gases that were projected by reliable sources. There was no attempt to quantify the cost of these reductions in the analysis.

Further, the so-called Kyoto mechanisms such as Joint Implementation (within Annex B) or the Clean Development Mechanism (outside of Annex B) were not included in this analysis. These measures would allow countries to reduce carbon emissions in other countries through investments in capital or technology. However, the proposals currently under consideration by the EU Parliament have not clarified how these credits would be implemented. Neither do these proposals include credits from carbon sinks.

## SUMMARY OF RESULTS BY COUNTRY

### ■ Germany

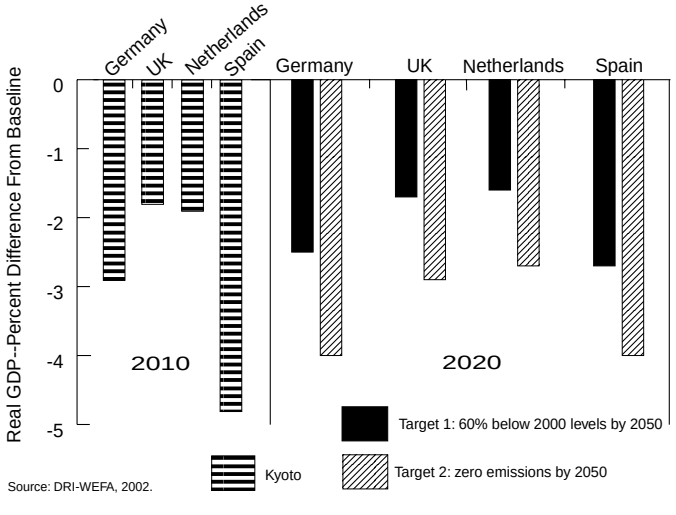
Given the projected increase in Germany's real gross domestic product and energy use over the 2000-2020 period (see Table 1), the Kyoto Protocol and the further reductions being considered by the German government will be very difficult and impose significant costs (see Figure 4). The DRI-WEFA baseline forecast already includes significant increases in energy efficiencies, which is indicated by the fact that over time less carbon is emitted for each dollar of GDP (see Appendix C: Figure 1).

Under the Kyoto Protocol, the marginal cost of carbon abatement would dramatically increase delivered prices of energy to consumers and businesses in 2010:

- The price of home heating oil would rise by more than 28 percent.
- Gasoline and diesel prices are expected to be 9 percent and 14 percent higher, respectively, than the baseline forecast.
- Industry would pay nearly 26 percent more for its natural gas and electricity prices would rise by more than 60 percent.

The economy would suffer from a loss of output as real GDP shrinks more than 2.9 percent below the baseline forecast and employment falls by 1.0 million jobs annually during the 2008–2012 budget period (see Figure 5).

**Figure: 4 Impact of Purchasing Carbon Emissions Permits on GDP Levels Under the Kyoto Protocol and Under More Stringent Targets**




Source: DRI-WEFA, 2002.

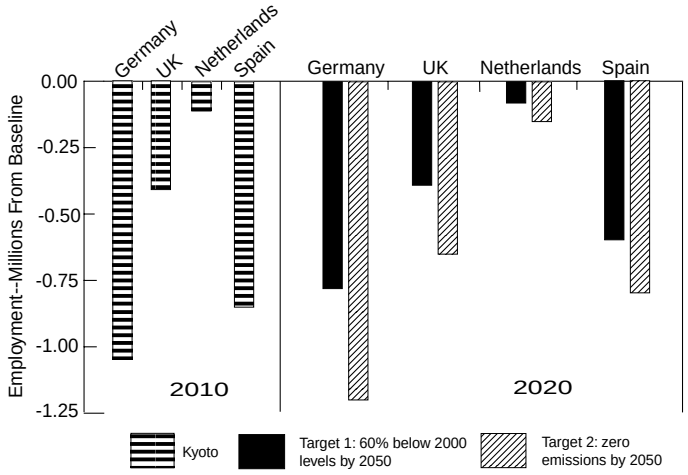
By 2020, if either of the more stringent targets were implemented, consumers and businesses would be subjected to higher energy prices than anticipated under the Kyoto Protocol. In 2020, real GDP could be 2.5 percent or 4.0 percent lower depending upon whether Target 1 or Target 2 had to be achieved (see Figure 4). Employment would fall by 780,000–1.2 million jobs annually depending upon the severity of the target (see Figure 5). The cost of carbon permits would range from €181–€248 ($190–$260) per metric ton (see Figure 6).

If the new government proposal of a 40% reduction by 2020 is implemented the impacts will be more severe than DRI-WEFA's Target 2 analysis.

If nuclear power is phased out by 2020 in Germany, the impacts of the various emission targets become more severe and GDP impacts harsher (see Figure 7).

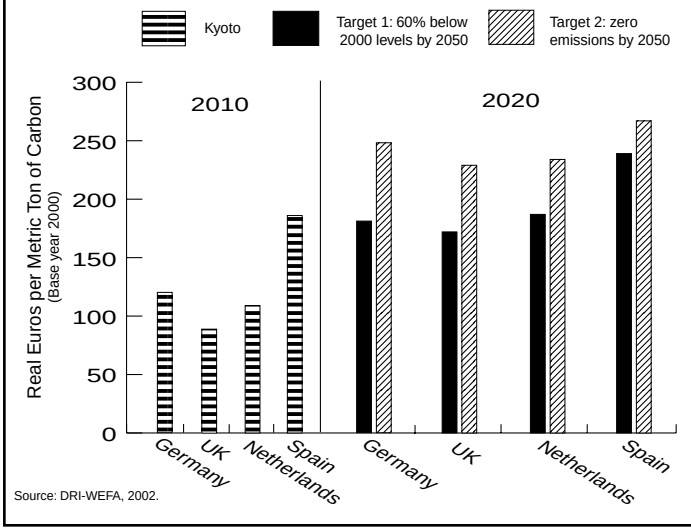
DRI-WEFA's business-as-usual forecasts (see Table 2), which show carbon emissions falling by 2010 by substantially less than the 21 percent required, are corroborated by the International Energy Agency and Energy Information Administration data which indicate rising emissions between 2000 and 2010 (see Appendix C: Figure 2).

**Figure: 5 Impact of Purchasing Carbon Emissions Permits on Jobs Under the Kyoto Protocol and Under More Stringent Targets**




Source: DRI-WEFA, 2002.

**Figure: 6 Cost of Carbon Permits Under the Kyoto Protocol and Under More Stringent Targets**




Source: DRI-WEFA, 2002.

## ■ Netherlands

Given the projected increase in the Netherlands' real gross domestic product, population and energy use over the 2000-2020 period, the Kyoto Protocol will impose significant costs (see Table 2). The DRI-WEFA baseline forecast already includes significant increases in energy efficiencies, which is indicated by the fact that over time less carbon is emitted for each dollar of GDP (see Appendix C: Figure 2).

Under the Kyoto Protocol, the marginal cost of carbon abatement would dramatically increase delivered prices of energy to consumers and businesses in 2010:

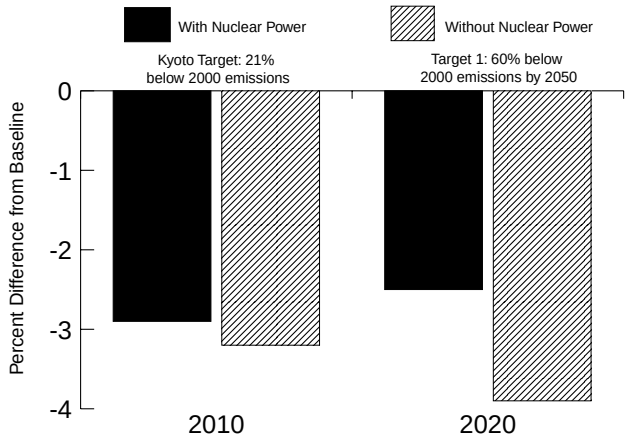
- The price of home heating oil would rise by nearly 30 percent.
- Gasoline and diesel prices would be 11 percent and 20 percent higher, respectively, than the baseline forecast.

**Table: 2 Outlook for the Netherlands: Baseline Forecast**

| | 1990 | 2000 | 2010 | 2020 |
|---|---|---|---|---|
| Population (million persons) | 15.0 | 15.9 | 16.7 | 17.1 |
| *% Change from 2000* | | | *5.0* | *7.5* |
| Real GDP (billions of 1997 US$) | 292.0 | 389.2 | 499.5 | 633.6 |
| *% Change from 2000* | | | *28.3* | *62.8* |
| Energy Consumption (million toe) | 78.1 | 87.6 | 95.5 | 102.8 |
| *% Change from 2000* | | | *9.0* | *17.4* |
| $CO_2$ Emissions (Mmt carbon) | 47.4 | 50.3 | 50.0 | 54.0 |
| *% Change from 2000* | | | *-0.6* | *7.4* |
| $CO_2$/Energy Consumption | 0.61 | 0.57 | 0.52 | 0.52 |

Source: DRI-WEFA, 2002.

**Figure: 7 Impact on German GDP of Reducing Emissions With and Without Nuclear Power**




Source: DRI-WEFA, 2002.

- Industry would pay nearly 71 percent more for its natural gas, and electricity prices would be nearly double the baseline estimate.

The economy would suffer from a loss of output as real GDP shrinks nearly 1.9 percent below the baseline forecast and employment falls by 111,000 jobs annually during the 2008–2012 budget period (see Figures 4 and 5).

By 2020, if either of the more stringent targets were implemented, consumers and businesses would be subjected to higher energy prices than anticipated under the Kyoto Protocol. In 2020, real GDP could be 1.6 percent or 2.7 percent lower depending upon whether Target 1 or Target 2 had to be achieved (see Figure 4). Employment would fall by 80,000–150,000 jobs annually depending upon the severity of the target (see Figure 5). The cost of carbon permits would range from €187–€234 ($196–$245) per metric ton (see Figure 6).

DRI-WEFA's business-as-usual forecasts (see Appendix C: Table 2) which show carbon emissions rising over the 1990–2010 period are similar to the trend in the International Energy Agency and Energy Information Administration data (see Appendix C: Table 2).

## ■ United Kingdom

The outlook for UK energy use and $CO_2$ emissions is driven by the outlook for economic growth in the UK. Compared to 2000, real GDP in the UK is expected to increase 27.1% by 2010 and 57.1% by 2020 (see Table 3). The DRI/WEFA projection assumes continued energy efficiency efforts and structural change in the UK economy which leads to much smaller increases in energy consumption. The DRI-WEFA baseline forecast already includes significant increases in energy efficiencies, which is indicated by the fact that over time less carbon is emitted for each dollar of GDP (see Appendix C: Figure 3). However, energy use is still projected to increase 14% in 2010 and 21.9% in 2020 compared to 2000. Without a shift in fuel mix comparable to that between 1990 and 2000, when UK coal use fell dramatically with corresponding increases in natural gas, this will lead to roughly 14% and 19% increases in $CO_2$ emissions from energy by 2010 and 2020, respectively (see Table 3).

Under the Kyoto Protocol, the marginal cost of carbon abatement would dramatically increase delivered prices of energy to consumers and businesses in 2010. The DRI-WEFA results show:

- The price of home heating oil would rise by more than 23 percent.
- Gasoline and diesel prices would be 5 percent and 6 percent higher, respectively, than the baseline forecast.
- Industry would pay 57 percent more for its natural gas, and electricity prices would rise by about 59 percent.

The economy would suffer from a loss of output as real GDP shrinks 1.8 percent below the baseline forecast and employment falls by 410,000 jobs annually during the 2008–2012 budget period (see Figures 4 and 5).

By 2020, if either of the more stringent targets were implemented, consumers and businesses would be subjected to higher energy prices than anticipat-

**Table: 3 Outlook for the UK: Baseline Forecast**

| | 1990 | 2000 | 2010 | 2020 |
|---|---|---|---|---|
| Population (million persons) | 57.6 | 59.4 | 60.4 | 63.0 |
| *% Change from 2000* | | | *1.7* | *6.1* |
| Real GDP (billions of 1997 US$) | 1088.3 | 1353.5 | 1720.0 | 2126.5 |
| *% Change from 2000* | | | *27.1* | *57.1* |
| Energy Consumption (million toe) | 214.6 | 230.5 | 262.9 | 280.9 |
| *% Change from 2000* | | | *14.1* | *21.9* |
| $CO_2$ Emissions (Mmt carbon) | 157.5 | 147.5 | 167.7 | 175.3 |
| *% Change from 2000* | | | *13.7* | *18.8* |
| $CO_2$/Energy Consumption | 0.73 | 0.64 | 0.64 | 0.62 |

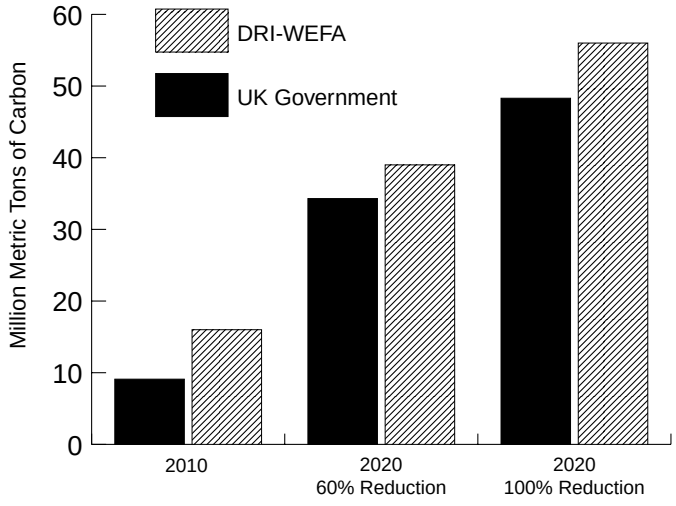
Source: DRI-WEFA, 2002.

ed under the Kyoto Protocol. In 2020, real GDP could be 1.7 percent or 2.9 percent lower depending upon whether Target 1 or Target 2 had to be achieved (see Figure 4). Employment would fall by 390,000–650,000 jobs annually depending upon the severity of the target (see Figure 5). The cost of carbon permits would range from €180–€240 ($240–$280) per metric ton (see Figure 6).

## Can the UK Meet Its Kyoto Target?

An emerging issue in the UK is whether the Kyoto target can actually be achieved in 2010 with relatively little economic pain when all six Kyoto gases are included. Cambridge Econometrics, a UK economic forecasting firm, suggests that when all gases are included, the 2010 target may be achievable. This results from two fortunate events which occurred in the 1990s: (1) a one-time decrease in nitrous oxide emissions at a plant operated by DuPont and (2) the "dash for gas" in which gas was substituted for coal in electricity production.[3] However, after 2010, and perhaps as early as 2013, meeting even the 12 percent Kyoto target will become costly for the UK. The reasons are, as the Cambridge Econometrics report notes, that coal burning for electricity is increasing and will continue to rise to offset the loss in nuclear power as plants are closed. Further compounding the problem is that carbon emissions from transport, households, and commerce will also increase after 2010. While the UK might achieve its targets in 2010 and enjoy a competitive advantage between now and then over countries such as Germany, which is expected to have more difficulty in reaching its Kyoto target, the advantage may decrease shortly after the first commitment period.

**Figure: 7** **Comparison of Gap Between Carbon Emissions Targets and Emissions Projections for the United Kingdom**




Sources: "Kyoto Protocol and Beyond: The High Economic Cost to the United Kingdom" (Lexington, Mass.: DRI-WEFA, October 2002). Carbon gap for the United Kingdom calculated using data from "Climate Change: The UK Programme" (London: Department of the Environment, Transport and the Regions, November 2000).

Summing up, when all greenhouse gases are included, the 2010 target might be achievable under the UK government projection and the negative impact on jobs and GDP growth less than predicted by DRI-WEFA. However, shortly after 2010, the negative impact on jobs and economic growth of policies to reduce carbon emissions will increase. DRI-WEFA's conclusion that meeting the target will require strong new measures is reflected in other independent forecasts of UK emissions. As shown in Appendix A, the International Energy Agency forecasts carbon emissions in 2010 at 159.5 Mmt, or 2.2 percent above 1990

**Table: 4** **UK Government Cost Estimate of a Permit to Emit Carbon Under Alternative Targets in 2050**
(Real euros per million metric tons)

| | Average Cost | Marginal Cost |
|---|---|---|
| 60% Reduction | €316 | |
| 70% Reduction | €427–569 | €696–1,739 |
| 95% Reduction | ? | ? |

Source: "Long-Term Reductions in Greenhouse Gas Emissions in the UK, Report of the Inter-departmental Analysts Group," February 2002, http://www.dti.gov.uk/energy/greenhousegas/, pp. 66–67.

[3]The fact that the United Kingdom cannot expect further reductions in non-carbon emissions post-2010 is corroborated in a UK government report, "Long-Term Reductions in Greenhouse Gas Emissions in the UK, Report of the Inter-departmental Analysts Group," February 2002, http://www.dti.gov.uk/energy/greenhousegas/, p. 3.

levels. The U.S. Department of Energy's Energy Information Administration shows emissions 7.3 percent above 1990 levels.

The Cambridge Econometrics study shows a 7.2 percent decrease in 2010 carbon emissions compared to 1990, corroborating the discussion above about the achievability of the 2010 targets. However, Cambridge Econometrics concludes that reaching the UK's voluntary goal of a 20 percent reduction in $CO_2$ emissions by 2010 is unlikely. The reasons are increased burning of coal for electricity to offset the loss in nuclear power as plants are closed, and higher emissions from transport, households, and commerce. Further emission reductions after the Kyoto commitment period is met will be difficult because $CO_2$ emissions will continue to rise after 2005 rather than fall as previously forecast. For example, Cambridge Econometrics forecasts that $CO_2$ emissions will increase from 147.7 Mmt in 2010 to 153.0 Mmt in 2015.

### UK Government Analyzes More Stringent Targets

Analysis conducted by the UK government ("Long-Term Reductions in Greenhouse Gas Emissions in the UK") in response to the call to investigate the cost of a 60 percent reduction by 2050 has also found high costs for more stringent targets in later years (see Table 4). For example, the average cost of a permit to emit carbon in 2050 ranges between €316 for a 60 percent reduction to €569 for a 70 percent reduction. The 95 percent reduction in carbon emissions called for in "Climate Change: The UK Programme" (DETR-November 2000) was not modeled. This is a serious oversight that needs to be rectified promptly.

As new, more stringent emission targets are imposed after the first commitment period, several studies corroborate the DRI-WEFA study estimates of increasing carbon emissions and suggest the UK will face hard choices regarding polices to curb emissions. The report "Climate Change: The UK Programme" calls for reducing emissions in industrial economies by 95 percent to accommodate developing country growth expectations. The UK government's own data show that it recognizes the challenge posed by tighter emission targets. In fact, a comparison of the gap between projected carbon emissions by the UK government and DRI-WEFA (Figure 7) shows that as the 2020 targets become more stringent, the differences between the two sets of estimates narrow. The reason for the large difference in 2010 is, as explained above, when all six Kyoto gases are included, the UK will be close to meeting its 12 percent reduction from 1990 levels. Energy from renewable sources may not play a large role in narrowing the carbon gap in the UK in the near term. For example, wind power, which has been singled out in a report by the UK government's Performance and Innovation Unit for major expansion, is not a very viable option. Wind power may not replace much conventional energy because, as the new Royal Academy of Engineering report, "An Engineering Appraisal of the Policy and Innovations Unit's Energy Review," notes, in the UK, there is a sizeable probability of no or very little wind blowing across the entire country (p. 27). Regarding biofuels, the report also notes, "It would require the whole of Kent to be covered with coppiced willow, for example, to replace the output of Dungeness B power station on the Kent coast" (p. 26).

## ■ Spain

Given the projected increase in Spain's real gross domestic and energy use over the 2000-2020 period, the Kyoto Protocol will impose significant costs (see Table 5 and Figure 4). The DRI-WEFA baseline forecast already includes significant increases in energy efficiencies, which is indicated by the fact that over time less carbon is emitted for each dollar of GDP (Appendix C: Figure 4).

Under the Kyoto Protocol, the marginal cost of carbon abatement would dramatically increase delivered prices of energy to consumers and businesses in 2010:

**Table: 5 Outlook for Spain: Basline Forecast**

| | 1990 | 2000 | 2010 | 2020 |
|---|---|---|---|---|
| Population (million persons) | 38.9 | 39.4 | 39.5 | 39.5 |
| *% Change from 2000* | | | *0.3* | *0.3* |
| Real GDP (billions of 1997 US$) | 539.4 | 692.4 | 910.3 | 1178.5 |
| *% Change from 2000* | | | *31.5* | *70.2* |
| Energy Consumption (million toe) | 93.9 | 128.0 | 144.0 | 150.8 |
| *% Change from 2000* | | | *12.5* | *17.8* |
| $CO_2$ Emissions (Mmt carbon) | 58.9 | 77.8 | 86.9 | 89.6 |
| *% Change from 2000* | | | *11.7* | *15.2* |
| $CO_2$/Energy Consumption | 0.62 | 0.60 | 0.60 | 0.59 |

Source: DRI-WEFA, 2002.

- The price of home heating oil would rise by 43 percent.
- Gasoline and diesel prices would be 18 percent and 26 percent higher, respectively, than the baseline forecast.
- Industry would pay more than 62 percent more for its natural gas, and electricity prices would be more than 70 percent above the baseline estimate.

The economy would suffer from a loss of output as real GDP shrinks by 4.8 percent below the baseline forecast and employment falls by 850,000 jobs annually during the 2008–2012 budget period (see Figures 4 and 5).

By 2020, if either of the more stringent targets were implemented, consumers and businesses would be subjected to higher energy prices than anticipated under the Kyoto Protocol. In 2020, real GDP could be 2.7 percent or 4.0 percent lower depending upon whether Target 1 or Target 2 had to be achieved (see Figure 4). Employment would fall by 600,000–800,000 jobs annually depending upon the severity of the target (see Figure 5). The cost of carbon permits would range from €239–€267 ($250–$280) per metric ton (see Figure 6).

The sharp upward trend in the DRI-WEFA business-as-usual forecasts is also reflected by the International Energy Agency data (see Appendix C: Table 4).

## ECONOMIC IMPACTS

Output and employment losses would be expected under the Kyoto Protocol because energy-using equipment and vehicles would be made prematurely obsolete and renewables can not fill the gap in the near term; consumers would be unsettled by rapid increases in living costs; and financial ministers would most likely need to target more slack in the economy to deflate non-energy prices and thus stabilize the overall price environment.

When the government auctions the tradable carbon permits to businesses, the cost of the permit would be passed along to consumers in the form of higher product prices. Consumers' purchasing power would be diminished by the higher cost of using energy, reducing real disposable income despite revenue recycling.

Consumption and residential fixed investment would be the hardest hit components of real GDP because of the direct loss in real disposable income. The short period to phase in the tradable permit prices (2005–2008) would lead to substantial declines in real consumption from baseline levels in the 2008–2012 period.

Imports would strengthen relative to baseline levels, spurred by the competitive price advantage of other non-participating Annex B countries and non-Annex B countries. Energy intensive industries such as automobile manufacturing, chemicals, steel, aluminum, etc., would tend to move to areas not required to meet mandatory emission targets.

## POST-2010

Achieving even more aggressive targets in Annex B countries would take ever-larger carbon fees, and would continue to take a significant toll on EU economic performance. Under the Target 2 assumption—that the target emissions are on a trajectory to reach zero carbon emissions by 2050—real GDP would not recover relative to baseline levels by 2020. Meeting that commitment would result in real GDP levels from 2.7 percent to 4.2 percent below the baseline in 2020.

## SOURCES

Leggett, J., Pepper, W.J., and Swart, R.J.: 1992, 'Emission scenarios for the IPCC: an update', In (J.T. Houghton, B.A. Callender, and S.K. Varney eds.) *Climate Change 1992: The Supplementary Report to the IPCC Scientific Assessment*, Cambridge University Press, New York, 69-96

Schimel, D., Enting, I., Heimann, M., Wigley, T., Raynaud, D., Alves, D., and Siegenthaler, U.: 1995, '$CO_2$ and the carbon cycle', In (J.T. Houghton, et al. eds.) *Climate Change 1994: Radiative Forcing of Climate Change and an Evaluation of the IPCC IS92 Emission Scenarios*, Cambridge University Press, New York, 35-71.

Cambridge Econometrics Limited. 2002 (22 July). UK Energy and the Environment. Cambridge, U.K.: Cambridge Econometrics Limited.

Department of the Environment, Transport and the Regions. 2000 (November). Climate Change: The UK Programme. London.

DRI-WEFA. 2002 (April). Kyoto Protocol and Beyond: The High Economic Cost to the United Kingdom. Lexington, Mass.: DRI-WEFA.

International Energy Agency. 2001. *Energy Policies of IEA Countries: 2001 Review.* Paris: International Energy Agency.

Novak, Mary H. 2002. Kyoto Protocol and Beyond: The High Economic Cost to the United Kingdom. Lexington, Mass.: DRI-WEFA.

Royal Academy of Engineering. 2002 (August). An Engineering Appraisal of the Policy and Innovation Unit's Energy Review. www.raeng.org.uk.

U.S. Department of Energy, Energy Information Administration, Office of Integrated Analysis and Forecasting. 2002 (March). *International Energy Outlook 2002.* Washington, D.C.: U.S. Department of Energy.

## BACKGROUND ON THE INTERNATIONAL COUNCIL FOR CAPITAL FORMATION

*The International Council for Capital Formation (ICCF) is a unique European think tank in its focus on public policies to promote saving and investment in the private sector. The ICCF's mission is to ensure public and private citizens throughout the world realize that reducing tax, regulatory, anti-trust, and trade barriers will promote business investment, job growth, and international competitiveness.*

*The ICCF brings the message to policymakers, the media, and the public that economic strength and stability depend upon well-thought-out economic and environmental policies to promote capital formation. Its mission includes strengthening ties between EU, US, and business leaders internationally.*

*The ICCF shares good practices around the world on creating opportunities for economic growth, job creation, retirement security, and enhanced environmental quality. In this way the ICCF acts as a catalyst for dynamic changes worldwide to improve business as well as living conditions in both developed and developing countries.*

### ICCF PRIORITES:

- *Improving global business conditions by promoting policies that encourage saving, investment and retirement security.*
- *Encouraging the development of cost-effective regulatory and environmental policies.*
- *Raising awareness with policymakers, the media, and the public of the importance of ensuring an atmosphere hospitable to the growth of all sectors of industry.*
- *Developing closer cooperation between the EU, US, and the international business community.*
- *Promoting tax policies that reduce the cost of capital for business investment.*
- *Enhancing retirement security by promoting pension policy reform and private saving.*

### IMPLEMENTING ICCF PRIORITES:

***Coalition Building:*** *The ICCF seeks to obtain broad support from various stakeholders around the world and in the European Union. The council consults with Members of the European Parliament, Member States' Officials and the European Commission as well as other relevant parties. By bringing together representatives from the public and private sectors for focused discussions on specific policy initiatives, the ICCF intends to support industrial competitiveness and economic prosperity.*

***Advocacy:*** *Officers and members of ICCF's Board of Advisors and Scholars participate in official hearings and consultation meetings as well as in informal dialogues with officials to comment on specific proposed legislation and policies. ICCF officers advise policymakers in the various EU institutions, as well as in the Member States. In this way, the ICCF contributes to policy and legislative processes at the EU and Member States' level.*

***Research:*** *ICCF policy research focuses on elements necessary for a dynamic, nurturing climate for business expansion, international competitiveness, and job growth.*

***Visibility:*** *Influencing public policy requires that ideas reach people in government, business, academia and the media. The ICCF circulates its publications, commentary, and ideas around the globe to reach public officials on both sides of the Atlantic as well as in the Pacific Rim.*

*The ICCF, incorporated in Belgium, is funded by voluntary contributions from corporations, associations, individuals, and foundations. Corporate contributions to the ICCF are tax deductible in most instances. The ICCF is an affiliate of the American Council for Capital (www.accf.org). Visit www.ICCFGlobal.com for copies of recent ICCF reports, a list of upcoming events, and other useful information and links. For questions or comments about the ICCF in general, or for more information about the subject of the current report, please contact:*

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**APPENDIX A: Energy-Related Carbon Emissions for EU Countries, Alternative Projections**
Million metric tons carbon

■ **International Energy Agency**

| | 1990 | 1999 | 2010 | Percent change 1990–2010 | Percent change 1999-2010 |
|---|---|---|---|---|---|
| Austria | 15.5 | 16.6 | 17.5 | 12.7% | 4.9% |
| Belgium | 28.9 | 32.5 | 31.4 | 8.1% | -3.4% |
| Denmark | 13.6 | 14.5 | 16.1 | 18.3% | 11.3% |
| Finland | 14.5 | 15.8 | 17.7 | 20.9% | 12.1% |
| France | 99.3 | 98.5 | 126.0 | 26.8% | 28.0% |
| Germany | 263.7 | 224.2 | 228.5 | -13.3% | 1.9% |
| Greece | 18.8 | 22.4 | 36.5 | 93.9% | 63.4% |
| Ireland | 8.7 | 10.9 | 12.8 | 47.5% | 17.5% |
| Italy | 108.3 | 114.8 | 123.0 | 13.8% | 7.1% |
| Luxembourg | 2.7 | 1.9 | 2.2 | -22.0% | 14.3% |
| Netherlands | 42.5 | 45.5 | 50.7 | 18.7% | 11.4% |
| Portugal | 10.9 | 16.6 | 16.6 | 53.9% | 0.0% |
| Spain | 57.8 | 74.2 | 78.8 | 36.8% | 6.3% |
| Sweden | 13.4 | 13.1 | 14.5 | 9.1% | 10.4% |
| United Kingdom | 156.0 | 145.9 | 159.5 | 2.2% | 9.3% |
| **EU Total** | **854.7** | **847.4** | **931.9** | **9.0%** | **10.0%** |

***Notes:*** Excludes international marine bunkers. Data converted from carbon dioxide to metric tons carbon for comparison purposes. Percent change for 1990–2010 for individual countries taken from IEA data; percent change from 1999–2010 and EU total percent change for 1990–2010 calculated by ACCF Center for Policy Research.
***Source:*** Carbon emissions from fuel combustion, International Energy Agency, *Energy Policies of IEA Countries* (Paris, OECD/IEA, 2001), p. 41.

■ **U.S. Department of Energy, Energy Information Administration**

| | 1990 | 1999 | 2010 | 2020 | Percent change 1990–2010 | Percent change 1999–2010 | Percent change 1990-2020 |
|---|---|---|---|---|---|---|---|
| France | 102 | 109 | 122 | 136 | 19.6% | 11.9% | 33.3% |
| Germany | 271 | 230 | 253 | 270 | -6.6% | 10.0% | -0.4% |
| Italy | 112 | 121 | 139 | 150 | 24.1% | 14.9% | 33.9% |
| Netherlands | 58 | 64 | 67 | 71 | 15.5% | 4.7% | 22.4% |
| United Kingdom | 164 | 151 | 176 | 191 | 7.3% | 16.6% | 16.5% |
| Other Western Europe | 223 | 264 | 288 | 318 | 29.1% | 9.1% | 42.6% |
| **Western Europe Total** | **930** | **940** | **1,045** | **1,136** | **12.4%** | **11.2%** | **22.2%** |

***Note:*** Percent change calculated by the ACCF Center for Policy Research.
***Source:*** U.S. Department of Energy, Energy Information Administration, Office of Integrated Analysis and Forecasting, *International Energy Outlook 2002* (Washington, D.C.: U.S. Department of Energy, March 2002), p. 189.

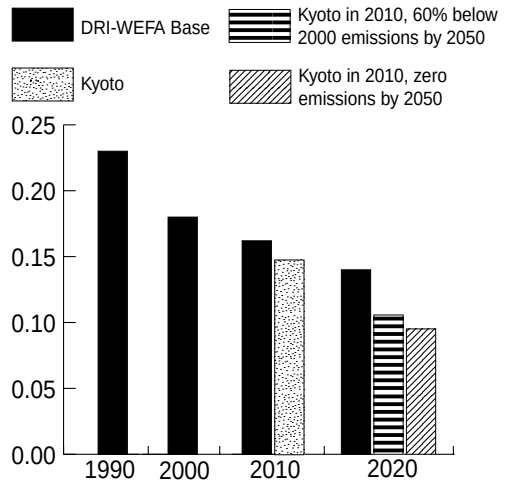
**APPENDIX B: Reference Scenario: European Union**

| | Carbon Emissions (Mt) | | | | | Growth Rates (% per annum) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1971 | 2000 | 2010 | 2020 | 2030 | 1971-2000 | 2000-2010 | 2000-2020 | 2000-2030 |
| Total $CO_2$ Emissions | 822.3 | 858.0 | 933.3 | 1006.1 | 1044.3 | 0.1 | 0.8 | 0.8 | 0.7 |
| *% change since 1990* | | *1.1* | *10.0* | *18.6* | *23.1* | | | | |
| Power Generation | 230.9 | 267.6 | 295.6 | 336.0 | 358.6 | 0.5 | 1.0 | 1.1 | 1.0 |
| Transformation, Own Use & Losses | 40.6 | 40.9 | 37.9 | 36.6 | 35.5 | 0.0 | -0.8 | -0.6 | -0.5 |
| Total Final Consumption | 551.9 | 549.3 | 599.5 | 633.6 | 651.0 | 0.0 | 0.9 | 0.7 | 0.6 |
| Industry | 228.0 | 147.6 | 149.2 | 150.8 | 150.8 | -1.5 | 0.1 | 0.1 | 0.1 |
| Transportation | 106.1 | 224.5 | 266.2 | 297.0 | 315.3 | 2.6 | 1.7 | 1.4 | 1.1 |
| Other Sectors | 207.3 | 169.1 | 175.4 | 175.9 | 174.0 | -0.7 | 0.4 | 0.2 | 0.1 |
| Non-Energy Use | 9.8 | 8.5 | 9.0 | 9.8 | 10.1 | -0.6 | 0.8 | 0.8 | 0.7 |

Source: International Energy Agency, *World Energy Outlook 2002*, p. 437

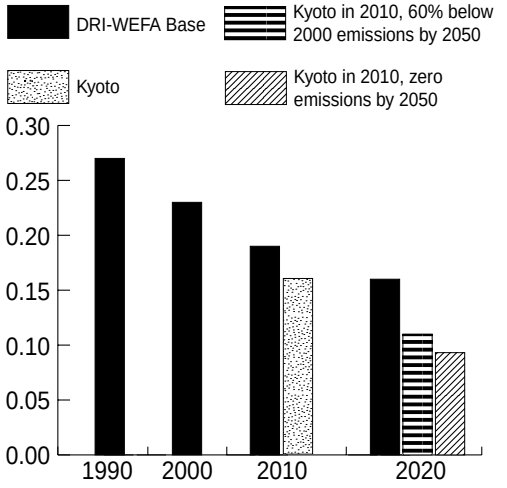
## APPENDIX C: Germany, the Netherlands, the United Kingdom, and Spain

**Figure: 1** **Germany - Energy Intensity**
**(Million tons of carbon emissions per 1997 US dollar of GDP)**




Source: DRI-WEFA, 2002.

**Figure: 2** **The Netherlands - Energy Intensity**
**(Million tons of carbon emissions per 1997 US dollar of GDP)**




Source: DRI-WEFA, 2002.

**Table: 1** **Alternative Forecasts of Business-as-Usual Carbon Emissions for Germany**

| | Million Metric Tons Carbon | | | |
|---|---|---|---|---|
| | **1990** | **2000[a]** | **2010** | **2020** |
| DRI-WEFA 2002[b] | 265.0 | 223.0 | 248.0 | 259.0 |
| IEA 2001 Review[b] | 263.6 | 224.1 | 228.6 | — |
| U.S. EIA 2002 | 271.0 | 230.0 | 253.0 | 270.0 |
| | **Percent Change** | | | |
| | **1990–2000** | **2000–2010** | **1990–2010** | **1990–2020** |
| DRI-WEFA 2002 | -15.8% | 11.2% | -6.4% | -2.3% |
| IEA 2001 Review[b] | -15.0% | 2.0% | -13.3% | — |
| U.S. EIA 2002 | -15.1% | 10.0% | -6.6% | -0.4% |

Notes:
a. 1999 for EIA and IEA.
b. Excludes international marine bunkers. Data converted from carbon dioxide to metric tons of carbon.

Sources:
Mary H. Novak, "Kyoto Protocol and Beyond: The High Economic Cost to Germany" (Lexington, Mass.: DRI-WEFA, 2002).
International Energy Agency, *Energy Policies of IEA Countries: 2001 Review* (Paris: International Energy Agency, 2001). See energy-related emissions, p. 217.
U.S. Department of Energy, Energy Information Administration, Office of Integrated Analysis and Forecasting, *International Energy Outlook 2002* (Washington, D.C.: U.S. Department of Energy, March 2002), p. 189.

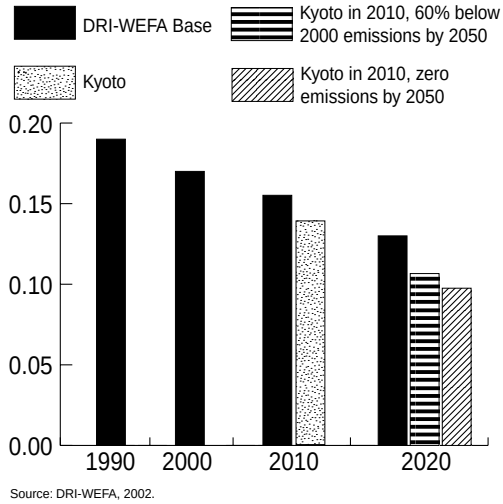
**Table: 2** **Alternative Forecasts of Business-as-Usual Carbon Emissions for the Netherlands**

| | Million Metric Tons Carbon | | | |
|---|---|---|---|---|
| | **1990** | **2000[a]** | **2010** | **2020** |
| DRI-WEFA 2002[b] | 47.4 | 50.3 | 50.0 | 54.0 |
| IEA 2001 Review[b] | 42.7 | 45.4 | 50.6 | 56.2 |
| U.S. EIA 2002 | 58.0 | 64.0 | 67.0 | 71.0 |
| | **Percent Change** | | | |
| | **1990–2000** | **2000–2010** | **1990–2010** | **1990–2020** |
| DRI-WEFA 2002 | 6.1% | -0.6% | 5.5% | 13.9% |
| IEA 2001 Review[b] | 6.5% | 11.5% | 18.7% | 31.8% |
| U.S. EIA 2002 | 10.3% | 4.7% | 15.5% | 22.4% |

Notes:
a. 1999 for EIA and IEA.
b. Excludes international marine bunkers. Data converted from carbon dioxide to metric tons of carbon.

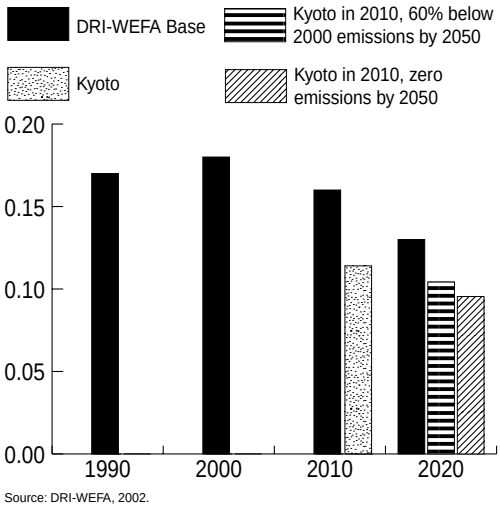
Sources:
Mary H. Novak, "Kyoto Protocol and Beyond: The High Economic Cost to the Netherlands" (Lexington, Mass.: DRI-WEFA, 2002).
International Energy Agency, *Energy Policies of IEA Countries: 2001 Review* (Paris: International Energy Agency, 2001). See energy-related emissions, p. 245.
U.S. Department of Energy, Energy Information Administration, Office of Integrated Analysis and Forecasting, *International Energy Outlook 2002* (Washington, D.C.: U.S. Department of Energy, March 2002), p. 189.

**Figure: 3** **United Kingdom - Energy Intensity (Million tons of carbon emissions per 1997 US dollar of GDP)**




Source: DRI-WEFA, 2002.

**Figure: 4** **Spain - Energy Intensity (Million tons of carbon emissions per 1997 US dollar of GDP)**




Source: DRI-WEFA, 2002.

**Table: 3** **Alternative Forecasts of Business-as-Usual Carbon Emissions for the United Kingdom**

| | Million Metric Tons Carbon | | | |
|---|---|---|---|---|
| | **1990** | **2000[a]** | **2010** | **2020** |
| DRI-WEFA 2002 | 157.5 | 147.5 | 167.7 | 175.3 |
| Cambridge Econometrics[b] | 159.1 | — | 147.7 | |
| IEA 2001 Review[c] | 156.1 | 146.0 | 159.6 | 170.1 |
| U.S. EIA 2002 | 164.0 | 151.0 | 176.0 | 191.0 |

| | Percent Change | | | |
|---|---|---|---|---|
| | **1990–2000** | **2000–2010** | **1990–2010** | **1990–2020** |
| DRI-WEFA 2002 | -6..3% | 13.7% | 6.5% | 11.3% |
| Cambridge Econometrics | — | — | -7.2% | — |
| IEA 2001 Review[c] | -6.5% | 9.3% | 2.2% | 9.0% |
| U.S. EIA 2002 | -7.9% | 16.6% | 7.3% | 16.5% |

Notes:
a. 1999 for EIA and IEA.
b. Excludes bunker and aviation fuel emissions. Cambridge Econometrics estimates 153 Mmt carbon emissions for 2015.
c. Excludes international marine bunkers. Data converted from carbon dioxide to metric tons of carbon.

Sources:
Mary H. Novak, "Kyoto Protocol and Beyond: The High Economic Cost to the United Kingdom" (Lexington, Mass.: DRI-WEFA, 2002).
Cambridge Econometrics Limited, "UK Energy and the Environment" (Cambridge, U.K.: Cambridge Econometrics Limited, 22 July 2002).
International Energy Agency, *Energy Policies of IEA Countries: 2001 Review* (Paris: International Energy Agency, 2001). See energy-related emissions, p. 277.
U.S. Department of Energy, Energy Information Administration, Office of Integrated Analysis and Forecasting, *International Energy Outlook 2002* (Washington, D.C.: U.S. Department of Energy, March 2002), p. 189.

**Table: 4** **Alternative Forecasts of Business-as-Usual Carbon Emissions for Spain**

| | Million Metric Tons Carbon | | | |
|---|---|---|---|---|
| | **1990** | **2000[a]** | **2010** | **2020** |
| DRI-WEFA 2002 | 58.9 | 77.8 | 86.9 | 89.6 |
| IEA 2001 Review[b] | 57.7 | 74.2 | 78.9 | |

| | Percent Change | | | |
|---|---|---|---|---|
| | **1990–2000** | **2000–2010** | **1990–2010** | **1990–2020** |
| DRI-WEFA 2002 | 32.1% | 11.7% | 45.1% | 52.1% |
| IEA 2001 Review[b] | 28.6% | 6.3% | 36.7% | |

Notes:
a. 1999 for IEA.
b. Excludes international marine bunkers. Data converted from carbon dioxide to metric tons of carbon.

Sources:
Mary H. Novak, "Kyoto Protocol and Beyond: The High Economic Cost to Spain" (Lexington, Mass.: DRI-WEFA, 2002).
International Energy Agency, *Energy Policies of IEA Countries: 2001 Review* (Paris: International Energy Agency, 2001). See energy-related emissions, p. 261.