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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). The ACCF Center for Policy Research offers this report, based on a new study by DRI-WEFA, to help policymakers understand the potential economic consequences of near-term actions to reduce greenhouse gas emissions.

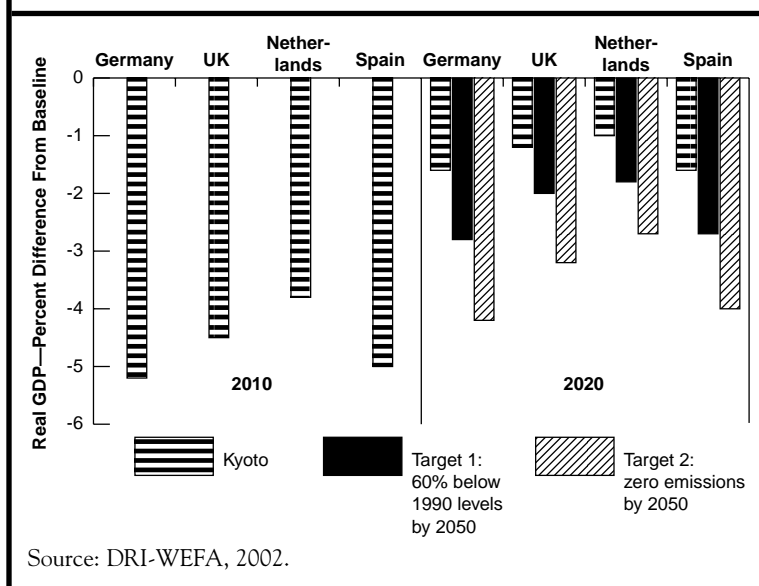
### BACKGROUND

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.

However, 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 United Kingdom (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 (see Appendix). Overall, carbon emissions are expected to increase in the range of 9 percent for EU countries between 1990 and 2010. As carbon emissions are capped or constrained, economic growth will slow due to lost output as new energy taxes are imposed and prices rise for carbon-intensive goods—

goods that must be produced using less carbon and/or more expensive processes. As a result, the economic impact of meeting the additional reduction required by the Kyoto Protocol will have a significant negative effect on GDP levels (see Figure 1 and Table 1) and employment (see Figure 2 and Table 1).

**Figure 1 Impact of Purchasing Carbon Emission Permits on GDP Levels Under the Kyoto Protocol and Under More Stringent Targets**



**Table 1 Impact of Kyoto Target on GDP and Employment Levels in 2010**  
Change from baseline forecast

	Real GDP levels (percent)	Employment
Germany	-5.2	-1,800,000
Spain	-5.0	-1,000,000
United Kingdom	-4.5	-1,000,000
Netherlands	-3.8	-240,000

Source: DRI-WEFA, 2002.

\*This report was prepared by the American Council for Capital Formation Center for Policy Research based on studies done for the Center 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, Executive Vice President and Director of Research, ACCF Center for Policy Research, 1750 K Street, N.W., Suite 400, Washington, D.C., telephone: 202.293.5811, email: mthorning@accf.org, Web site: www.accf.org.

Second, 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 3). (The Kyoto Protocol does not require developing countries to reduce their emissions.)

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 carbon dioxide emissions by 2050, achieved via a continuous annual reduction per year beyond the first Kyoto commitment period.

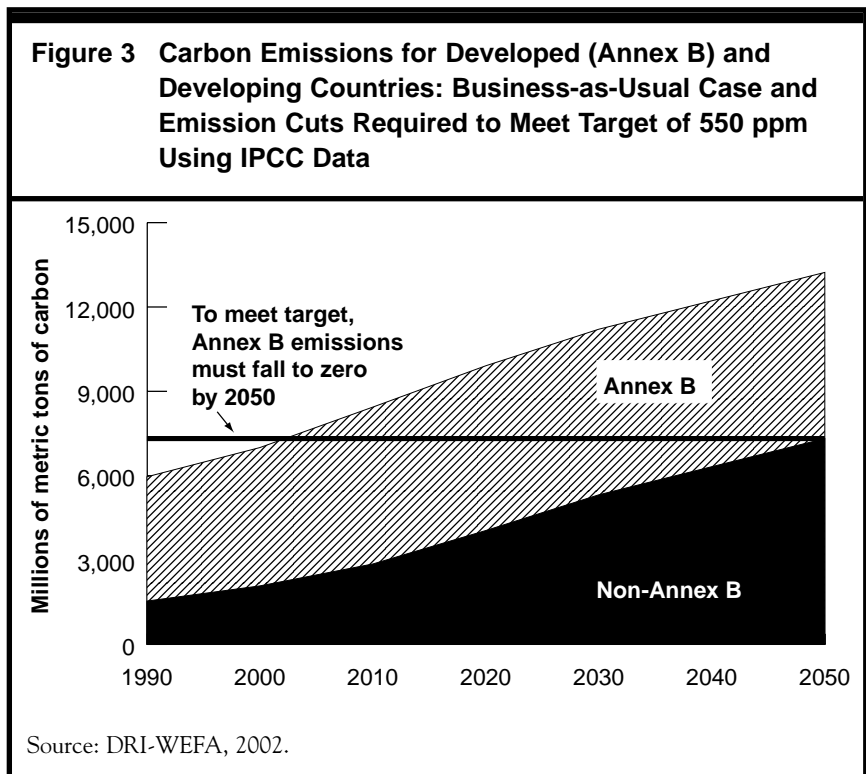
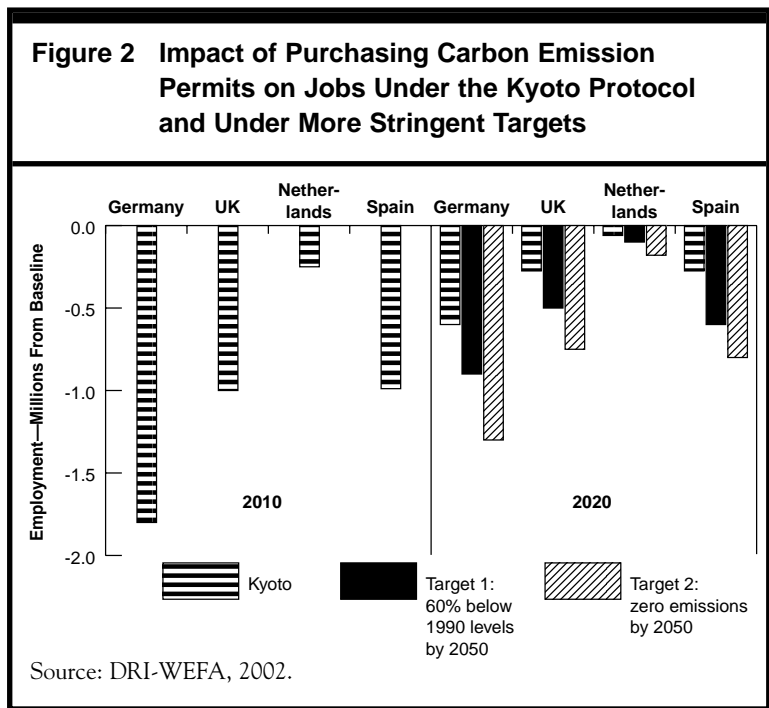
**Target 2:** Current commitment under the Kyoto Protocol through the first period (2008–2012) and a target level of zero carbon dioxide emissions by 2050 achieved via a continuous annual reduction beyond the first Kyoto commitment period.

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 policies described above on four European countries: the United Kingdom, Germany, the Netherlands, 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. In fact, a new



International Energy Agency report shows carbon emissions in the European Union rising from 855 Mmt in 1990 to 932 Mmt by 2010 (see Appendix).<sup>1</sup>

The simulations for Germany, the United Kingdom, Spain, and the Netherlands assume that the United States does not participate by reducing its Kyoto emissions as required by the Kyoto targets, but they do assume intra-country trading. The analysis assumes that emission permits would be auctioned to energy producers at the point of first sale. The cost of the permits to reach the Kyoto target ranges from €165–€184 (\$180–\$200) in 2010 and €175–€207 (\$190–\$225) in 2020 under the Kyoto Protocol (see Figure 4). The cost of permits under the more stringent Target 1 ranges from €207–€240 (\$225–\$260) in 2020. (The dollar cost exceeds the euro cost because the value of the euro is assumed to exceed the value of the dollar by 2010). Taxes on carbon are recycled to consumers through a combination of direct payments and government programs.

While the Kyoto Protocol established limits for participating countries' emissions from six greenhouse gases, this analysis focuses on carbon dioxide. Carbon dioxide generally accounts for 80 percent or more of overall greenhouse gas emissions of the six Kyoto gases for many developed countries, and almost all of this is carbon dioxide from energy use. It is assumed for this analysis that the established reductions would apply to each greenhouse gas. However, 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 do not allow credit for these mechanisms. Neither do these proposals include credits from carbon sinks.

## SUMMARY OF RESULTS BY COUNTRY

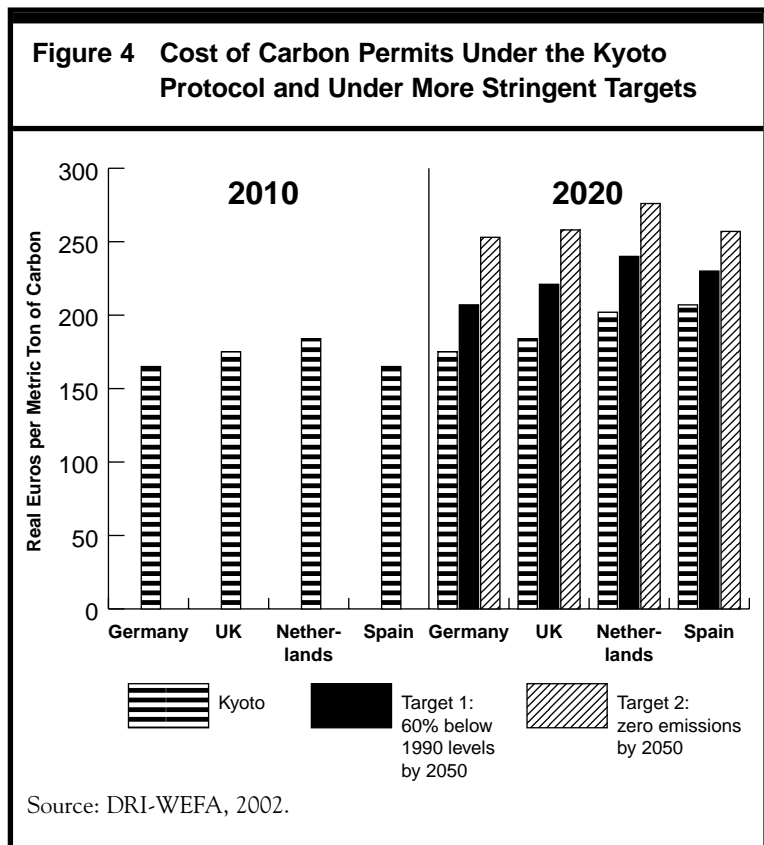
### ■ Germany

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 40 percent.
- Gasoline and diesel prices are expected to be 14 percent and 20 percent higher, respectively, than the baseline forecast.
- Industry would pay nearly 40 percent more for its natural gas and electricity prices would rise nearly twice that level.

The economy would suffer from a loss of output as real GDP shrinks more than 5 percent below the baseline forecast and employment falls by 1.8 million jobs annually during the 2008–2012 budget period (see Table 1).

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 2.8 per-



1. International Energy Agency, *Energy Policies of IEA Countries* (Paris, OECD/IEA, 2001), p. 41. Excludes international marine bunkers; data converted to metric tons of carbon.

cent or 4.2 percent lower depending upon whether Target 1 or Target 2 had to be achieved (see Figure 1). Employment would fall by 900,000–1.3 million jobs annually depending upon the severity of the target (see Figure 2). The cost of carbon permits would range from €207–€253 (\$225–\$275) per metric ton (see Figure 4).

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 5).

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 Table 3).

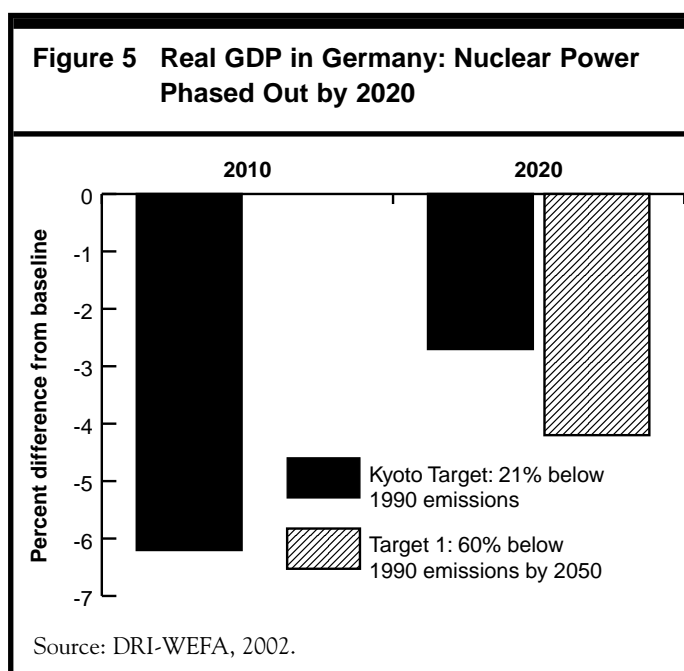
■ Netherlands

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.
- Industry would pay nearly 123 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 4 percent below the baseline forecast and employment falls by 240,000 jobs annually during the 2008–2012 budget period.

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 1.8 percent or 2.7 percent lower depending upon whether



**Table 2 DRI-WEFA: Carbon Emission Reduction Targets for Germany**  
Million metric tons carbon

	2010		2020			
	1990	2000	Target: Kyoto (21% below 1990 emissions)	Target: Kyoto (21% below 1990 emissions)	Target 1 (60% below 2000 emissions by 2050)	Target 2 (Zero emissions by 2050)
Target Emissions			219	219	192	173
% Targeted Reduction			14%	18%	28%	35%
	1990	2000	2010	2020		
Business-as-Usual Emissions	271	231	256	266	266	266

Source: DRI-WEFA, 2002.

**Table 3 Alternative Forecasts of Business-as-Usual Carbon Emissions for Germany**

	Million Metric Tons Carbon			
	1990	2000 <sup>a</sup>	2010	2020
DRI-WEFA 2002	271.0	231.0	255.8	266.0
IEA 2001 Review <sup>b</sup>	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	-14.8%	10.4%	-5.9%	-1.8%
IEA 2001 Review <sup>b</sup>	-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.

Target 1 or Target 2 had to be achieved (see Figure 1). Employment would fall by 100,000–180,000 jobs annually depending upon the severity of the target (see Figure 2). The cost of carbon permits would range from €240–€276 (\$260–\$300) per metric ton (see Figure 4).

DRI-WEFA's business-as-usual forecasts (see Table 4) 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 Table 5).

### ■ United Kingdom

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 46 percent.
- Gasoline and diesel prices would be 10 percent and 13 percent higher, respectively, than the baseline forecast.
- Industry would pay 117 percent more for its natural gas, and electricity prices would more than double the baseline estimate.

**Table 4 DRI-WEFA: Carbon Emission Reduction Targets for Netherlands**  
 Million metric tons carbon

	1990	2000	2010	2020		
			Target: Kyoto (6% below 1990 emissions)	Target: Kyoto (6% below 1990 emissions)	Target 1 (60% below 2000 emissions by 2050)	Target 2 (Zero emissions by 2050)
Target Emissions			52	52	46	41
% Targeted Reduction			23%	28%	36%	43%

	1990	2000	2010	2020	
Business-as-Usual Emissions	58	64	67	72	72

Source: DRI-WEFA, 2002.

**Table 5 Alternative Forecasts of Business-as-Usual Carbon Emissions for the Netherlands**

	Million Metric Tons Carbon			
	1990	2000 <sup>a</sup>	2010	2020
DRI-WEFA 2002	58.0	64.0	67.0	72.0
IEA 2001 Review <sup>b</sup>	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	10.3%	4.7%	15.5%	24.1%
IEA 2001 Review <sup>b</sup>	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.

The economy would suffer from a loss of output as real GDP shrinks 4.5 percent below the baseline forecast and employment falls by 1 million jobs annually during the 2008–2012 budget period (see Table 1).

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 2.0 percent or 3.2 percent lower depending upon whether Target 1 or Target 2 had to be achieved (see Figure 1). Employment would fall by 500,000–750,000 jobs annually depending upon the severity of the target (see Figure 2). The cost of carbon permits would range from €221–€258 (\$240–\$280) per metric ton (see Figure 4).

An emerging issue in the United Kingdom is whether the Kyoto target of a 12 percent reduction can be achieved with little economic "pain." Table 6 shows DRI-WEFA's business-as-usual emissions forecasts. Some proponents of the Kyoto Protocol

**Table 6 DRI-WEFA: Carbon Emission Reduction Targets for the United Kingdom**  
Million metric tons carbon

	1990	2000	2010	2020		
			Target: Kyoto (12% below 1990 emissions)	Target: Kyoto (12% below 1990 emissions)	Target 1 (60% below 2000 emissions by 2050)	Target 2 (Zero emissions by 2050)
Target Emissions			143	143	126	113
% Targeted Reduction			19%	22%	32%	39%

	1990	2000	2010	2020		
Business-as-Usual Emissions	164	151	176	184	184	184

Source: DRI-WEFA, 2002.

conclude that the United Kingdom will have little difficulty in meeting its target. However, 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 Table 7, the International Energy Agency forecasts carbon emissions in 2010 at 159.6 Mmt, or 2.2 percent above 1990 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 emissions compared to 1990, and suggests that when other gases are included, the United Kingdom may well meet its 12 percent reduction mandated by the Protocol. However, Cambridge Econometrics concludes that reaching the United Kingdom's voluntary goal of a 20 percent reduction in carbon dioxide 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 carbon dioxide emissions will continue to rise after 2005 rather than fall as previously forecast. For example, Cambridge Econometrics forecasts that carbon dioxide emissions will increase from 147.7 Mmt in 2010 to 153.0 Mmt in 2015.

## ■ Spain

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 40 percent.
- Gasoline and diesel prices would be 18 percent and 26 percent higher, respectively, than the baseline forecast.
- Industry would pay nearly 65 percent more for its natural gas, and electricity prices would be more than 70 percent above the baseline estimate.

**Table 7 Alternative Forecasts of Business-as-Usual Carbon Emissions for the United Kingdom**

	Million Metric Tons Carbon			
	1990	2000 <sup>a</sup>	2010	2020
DRI-WEFA 2002	164.0	151.0	175.8	184.0
Cambridge Econometrics <sup>b</sup>	159.1	—	147.7	
IEA 2001 Review <sup>c</sup>	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	-7.9%	16.4%	7.2%	12.2%
Cambridge Econometrics	—	—	-7.2%	—
IEA 2001 Review <sup>c</sup>	-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 8 DRI-WEFA: Carbon Emission Reduction Targets for Spain**  
Million metric tons carbon

			2010	2020		
	1990	2000	Target: Kyoto (15% above 1990 emissions)	Target: Kyoto (15% above 1990 emissions)	Target 1 (60% below 2000 emissions by 2050)	Target 2 (Zero emissions by 2050)
Target Emissions			72	72	64	57
% Targeted Reduction			24%	26%	34%	41%
	1990	2000	2010	2020		
Business-as-Usual Emissions	63	85	95	97	97	97

Source: DRI-WEFA, 2002.

The economy would suffer from a loss of output as real GDP shrinks by 5 percent below the baseline forecast and employment falls by 1 million jobs annually during the 2008–2012 budget period (see Table 1).

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 1). Employment would fall by 600,000–800,000 jobs annually depending upon the severity of the target (see Figure 2). The cost of carbon permits would range from €230–€257 (\$250–\$280) per metric ton (see Figure 4).

The sharp upward trend in the DRI-WEFA business-as-usual forecasts (see Table 8) is also reflected by the International Energy Agency and Energy Information Administration data (see Table 9).

**Table 9 Alternative Forecasts of Business-as-Usual Carbon Emissions for Spain**

	Million Metric Tons Carbon			
	1990	2000 <sup>a</sup>	2010	2020
DRI-WEFA 2002	63.0	85.0	95.0	97.0
IEA 2001 Review <sup>b</sup>	57.7	74.2	78.9	—
	Percent Change			
	1990– 2000	2000– 2010	1990– 2010	1990– 2020
DRI-WEFA 2002	34.9%	11.8%	50.8%	54.0%
IEA 2001 Review <sup>b</sup>	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.

## ECONOMIC IMPACTS

Output and employment losses would be expected under the Kyoto Protocol because energy-using equipment and vehicles would be made prematurely obsolete; consumers would be rattled 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 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 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.

## POST-2010

Post-2010, the economic impact would begin to lessen. The extreme change in energy prices experienced during the years between 2005 and 2010 would not be repeated. While the percentage change in prices relative to the baseline would need to increase, the year-over-year change in prices would be reduced.

However, 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. ❖



## BACKGROUND ON AMERICAN COUNCIL FOR CAPITAL FORMATION

*The American Council for Capital Formation and its public policy affiliate, the ACCF Center for Policy Research, are unique in their focus on the role of public policies to promote the saving and investment essential to economic growth, job creation, and international competitiveness. For more than a quarter of a century, the ACCF and its research affiliate have brought the message to U.S. and international policymakers, the media, and the public that a nation's economic strength and stability depend upon well-thought-out economic and environmental policies to promote capital formation.*

*Over 200 corporations, trade associations, individuals, and foundations provided financial support for the ACCF and the ACCF Center for Policy Research in 2001. Corporate and trade association support comes from a broad range of industries, including the financial services, real estate, commercial, small business, and industrial and mining sectors. ACCF does not conduct any work for or on behalf of individual companies and its views are entirely independent of financial support.*

**APPENDIX 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%
<b>EU Total</b>	<b>854.7</b>	<b>847.4</b>	<b>931.9</b>	<b>9.0%</b>	<b>10.0%</b>

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%
<b>Western Europe Total</b>	<b>930</b>	<b>940</b>	<b>1,045</b>	<b>1,136</b>	<b>12.4%</b>	<b>11.2%</b>	<b>22.2%</b>

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.