INTERNATIONAL COUNCIL
FOR CAPITAL FORMATION

Kyoto Protocol and Beyond: The Economic Cost to Germany

2005

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FOREWORD

Scope

This study assesses the economic cost of reducing carbon dioxide emissions through the mechanisms of the current emissions trading system for the industrial sector as well as economy wide taxes or fees on energy use including the household and transportation sectors. While the Kyoto Protocol established limits for participating countries' emissions from six greenhouse gases, for this analysis it is assumed that the other gases meet the target reductions each year, but provide no offset to the reductions required from the energy sector. Additionally, the costs of reducing the other gases are not included here.

Sponsor

This study was prepared for the International Council for Capital Formation although the views expressed are strictly those of the authors.

Contributors

This study was prepared under the direction of Mary H. Novak, Managing Director, Energy Services of Global Insight. Junya Tanizaki, Senior Economist, and Raj Badiani, Senior Economist, were principal contributors.

TABLE OF CONTENTS

EXECUTIVE SUMMARY **1**

INTRODUCTION **4**

STUDY GOALS AND DESIGN 4

IMPLICATIONS OF THE PROPOSED LIMITS ON GERMANY'S GREENHOUSE GAS EMISSIONS **5**

STUDY RESULTS **9**

MECHANISMS FOR ACHIEVING THE REQUIRED CARBON EMISSION REDUCTIONS 9
THE ALLOWANCE PRICES THAT ACHIEVE THE REDUCTION 9
IMPACT ON DELIVERED PRICES TO HOUSEHOLDS AND INDUSTRY 12
IMPACT ON ENERGY CONSUMPTION 12
ECONOMIC IMPACTS 14

NUCLEAR RETIREMENT CASE **17**

APPENDIX A: SUMMARY OF THE KYOTO PROTOCOL **19**

APPENDIX B: GLOBAL INSIGHT'S OUTLOOK FOR GERMANY **21**

Executive Summary

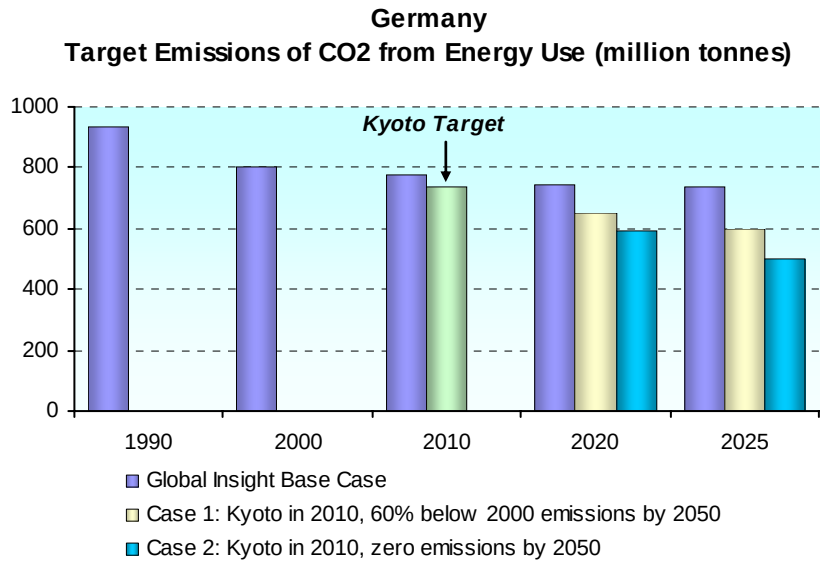
The Kyoto Protocol entered into force as an international treaty for those countries that had ratified it on February 16, 2005. Of the Annex B countries that ratified the Kyoto Protocol, only a few have begun implementing measures necessary to limit their greenhouse gas emissions to their Annex B obligations. As a result, most of the Annex B economies are experiencing rising greenhouse gas emissions. To the extent that initial measures and incentives have been implemented, they have been relatively ineffective and it is highly likely that in the absence of significantly more onerous measures the Annex B countries will exceed their emission targets.

While the prospects for meeting the emission limits established for the first budget period appear doubtful, discussion of tightened emission limits for subsequent periods has begun. Recent proposals under consideration and analyzed here are:

Case 1: Current commitment under the Kyoto Protocol through the first period (2008-2012) and a target level of 60% below year 2000 levels of CO_2 emissions by 2050, achieved via a continuous annual reduction per year beyond the first Kyoto commitment period. (For Germany, this results in a target emission rate of 65% of 1990 levels in 2025--or 35% below 1990 levels.)

Case 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. (For Germany, this results in a target emission rate of 53% of 1990 levels in 2025--or 47% below 1990 levels.)

Exhibit 1.



Implementing limits on carbon dioxide emissions would dramatically increase delivered prices of energy to consumers and businesses. In 2010, Germany is expected to achieve Kyoto Protocol commitment from domestic actions.

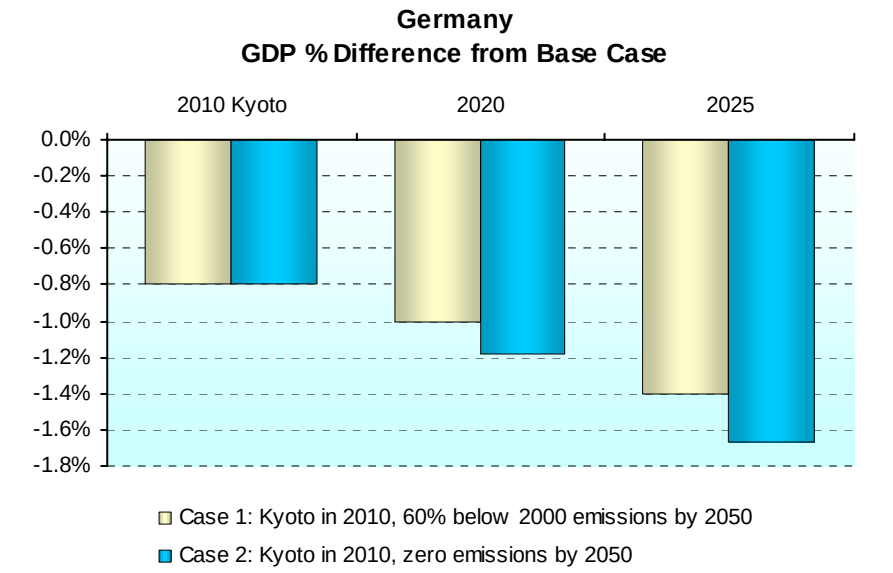
However, energy prices in Germany would be impacted by emissions trading under the EU-ETS and by additional energy taxes (or tradable permits) that would be imposed on all energy consumers throughout the economy:

- the price of home heating oil would rise by nearly 30%.
- gasoline and diesel prices would be 9% and 12% higher, respectively, than the baseline estimates.
- industry would pay 30% more for its natural gas and electricity above the baseline estimate.

By 2025, if one of the more stringent targets were implemented, consumers and businesses will be subjected to even higher energy prices even assuming continued operation of nuclear power plants.

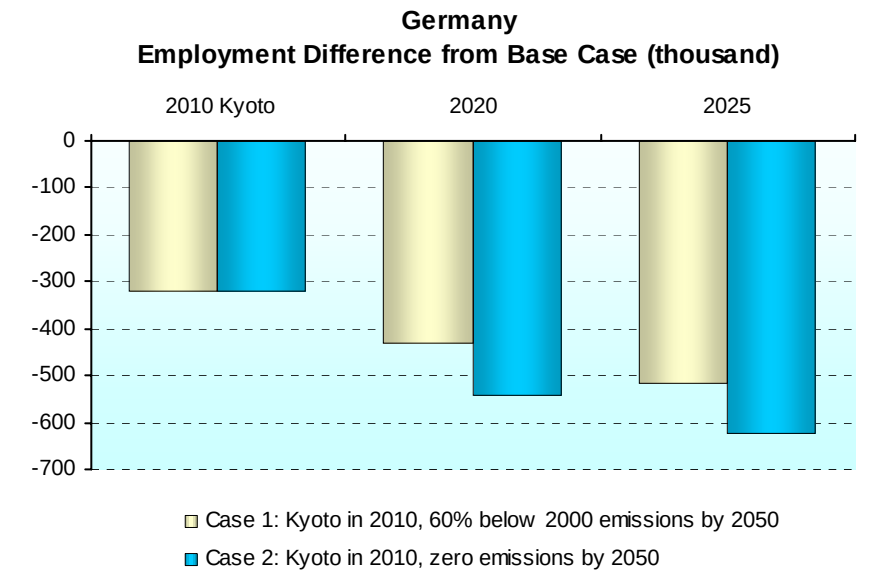
The economy will suffer from a loss of output as real GDP shrinks 0.8% (18.5 billion Euros) below base case levels during the 2008-12 budget period. In 2025, real GDP would be 1.4-1.7% (40 to 48 billion Euros) below the baseline level depending on whether Case 1 or Case 2 has to be achieved.

Exhibit 2.



Annual job losses are projected to be 318,000 in 2010. By 2025, job losses will be 519,000 under the proposal for Case 1 or 622,000 if the Case 2 proposal were implemented.

Exhibit 3.


Germany
Employment Difference from Base Case (thousand)
2010 Kyoto
2020
2025
0
-100
-200
-300
-400
-500
-600
-700
Case 1: Kyoto in 2010, 60% below 2000 emissions by 2050
Case 2: Kyoto in 2010, zero emissions by 2050

Introduction

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While the prospects for meeting the emission limits established for the first budget period appear doubtful, discussion of tightened emission limits for subsequent periods has begun. Recent proposals under consideration and analyzed here are:

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Case 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. (For Germany, this results in a target emission rate of 53% of 1990 levels in 2025--or 47% below 1990 levels.)

Study Goals and Design

Targets and Timetable: The goal of this study is to assess the economic cost of meeting carbon emissions limits established for Germany under the Kyoto Protocol and under two proposals for reducing carbon emissions after 2012. While the Kyoto Protocol established limits for participating countries' emissions from six greenhouse gases, for this analysis it is assumed that non-CO_2 emissions meet the target reductions each year, but provide no offset to the reductions required from the energy sector. The costs of meeting the non-CO_2 emission caps are not included in this analysis.

For this analysis, the US and Japan are assumed not to participate. Non-Annex B countries do not participate.

Participation: Only the Annex B countries that have announced their intention to meet the targets and timetables of the Kyoto Protocol are assumed to participate. The U.S. has announced that it would not participate, and Japan has announced its intention to rely on voluntary measures to meet its commitment.

International trading has been included in this analysis.

Implementation: For this study, Global Insight has assumed an international carbon dioxide trading mechanism is established. Such a system, which has not yet been developed, would be much broader and inclusive than the current emission trading system operating in the European Union. The study assumes that companies may purchase emission credits in the international market for the portion of carbon reduction not met through domestic actions. Credits from sinks, JI, or CDM are implicitly included, but not explicitly modeled, in this analysis which uses an international CO_2 permit price for EU countries consistent with that in the International Energy Outlook 2005 "Kyoto Case" analysis by the U.S. Energy Information Administration.

Implications of the Proposed Limits on Germany's Greenhouse Gas Emissions

The ratification and implementation of the Kyoto Protocol would have a significant impact on the economic performance of Germany. The carbon dioxide emission reductions for the first period (2008-2012) are significant, and the reductions required to meet either of the proposed emission caps for the second period (2013-2017) and beyond are daunting.

The targets established under the Kyoto Protocol as well as restrictions that are even more stringent would be difficult to achieve as economic output grows. Population growth through 2020 will also add to the difficulty of reducing emissions.

Exhibit 4: Outlook for Germany

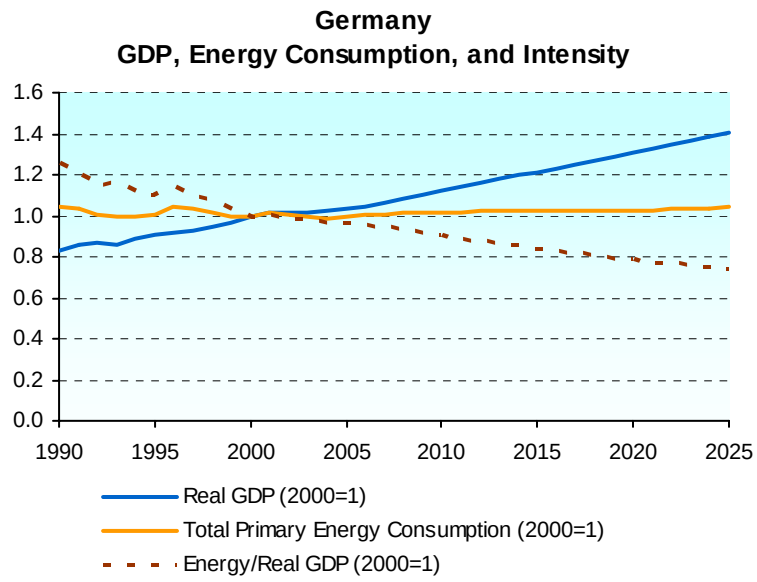
	1990	2000	2010	2020	2025
Population (million persons)	63.3	82.2	82.7	82.4	81.8
% change from 2000			*0.6%*	*0.3%*	*-0.5%*
Real GDP (billions of 2000 €)	1,717	2,065	2,318	2,702	2,898
% change from 2000			*12.2%*	*30.9%*	*40.3%*
Energy Consumption (million toe)	361.8	345.4	350.8	355.2	360.4
% change from 2000			*1.5%*	*2.8%*	*4.3%*
CO_2 Emissions * (million tonnes)	933	801	776	744	735
% change from 2000			*-3.1%*	*-7.0%*	*-8.2%*
CO_2/Energy (tonnes/toe)	2.58	2.32	2.21	2.10	2.04
% change from 2000			*-4.6%*	*-9.6%*	*-12.0%*
CO_2/Real GDP (tonnes/thousand €)	0.54	0.39	0.33	0.28	0.25
% change from 2000			*-13.7%*	*-28.9%*	*-34.6%*

** from energy use*

The outlook for German energy use and CO_2 emissions is driven by outlook for economic growth. Compared to 2000, real GDP in Germany is expected to increase 12% by 2010 and 40% by 2025 compared to 2000. The base case projection assumes continued energy efficiency efforts and structural change in the German economy, which leads to much smaller increases in energy consumption. However, energy use is still projected to increase 1.5% in 2010 and 4.3% in 2025 above 2000 levels in the baseline forecast. Due to continuing substitution away from coal and an increased reliance on renewable sources of energy, carbon dioxide emissions are projected to remain flat to declining over the period to 2025.

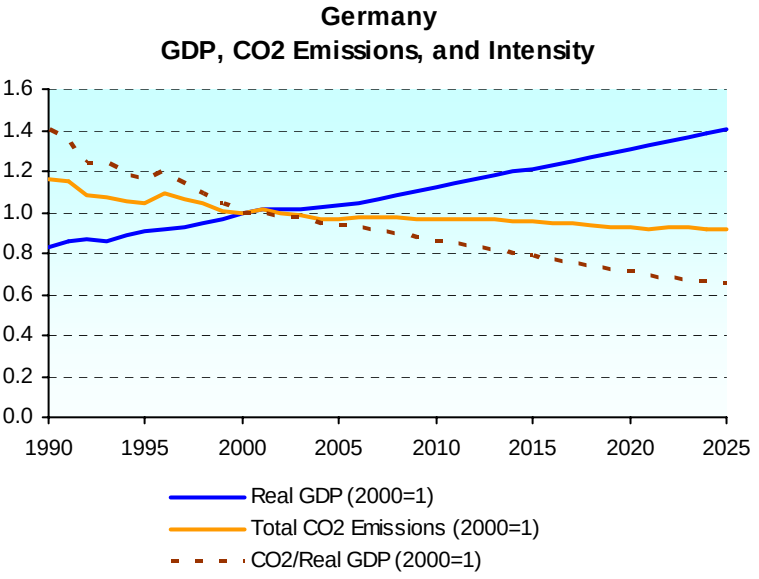
Rising population and economic performance will offset the improvement in energy consumption per real GDP – leading to more fossil fuel use.

Exhibit 5.



Falling CO_2 intensity (CO_2/Real GDP) outpaces rising population and economic growth – leading to slightly declining CO_2 emissions.

Exhibit 6.



In this study, we examined the economy-wide and energy sector impacts of the Kyoto Protocol target and two proposals for further reductions during the post-2012 period. The table below shows the target emission levels for carbon dioxide emissions from the energy sector relative to 1990 emissions.

Exhibit 7.
Target Emissions of Carbon Dioxide from the Energy Sector relative to 1990 emission levels

Germany	2010	2020	2025
Case 1: Kyoto Protocol plus achieve 60% below 2000 emissions in 2050	0.790 * 1990	0.701 * 1990	0.645 * 1990
Case 2: Kyoto Protocol plus achieve zero emissions in 2050	0.790 * 1990	0.632 * 1990	0.533 * 1990

Carbon dioxide emissions from the Germany's energy sector under the Kyoto Protocol commitment are required to be 5% below Global Insight's baseline assessment. If tighter emission levels were implemented after 2012, Germany's target carbon dioxide emissions would be 18%-32% lower than the baseline projection.

Exhibit 8.
CO_2 Emissions for Germany (million tonnes)

	1990	2000	2010	2020	2025
Baseline Emissions	933	801	776	744	735
Target Emissions					
Case 1: Kyoto + Post-2012 (60% below 2000 in 2050)			737	654	601
Case 2: Kyoto + Post-2012 (zero in 2050)			737	590	497
Difference from Baseline					
Case 1: Kyoto + Post-2012 (60% below 2000 in 2050)			-39	-91	-134
Case 2: Kyoto + Post-2012 (zero in 2050)			-39	-155	-238
Percent Difference from Baseline					
Case 1: Kyoto + Post-2012 (60% below 2000 in 2050)			-5%	-12%	-18%
Case 2: Kyoto + Post-2012 (zero in 2050)			-5%	-21%	-32%

Exhibit 9.

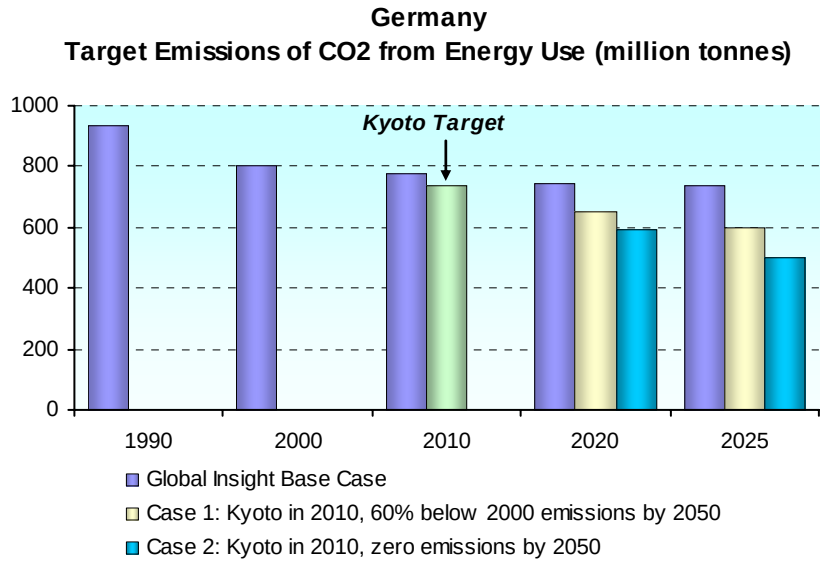
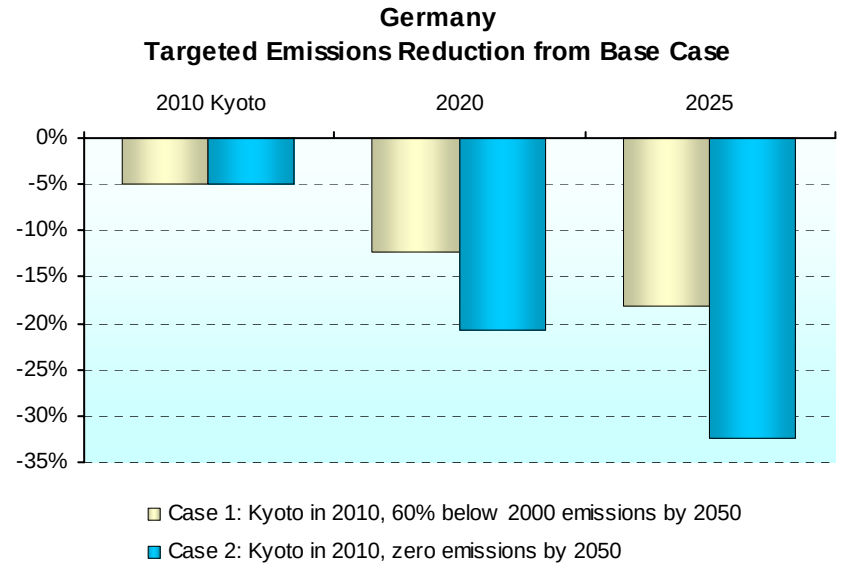


Exhibit 10.



Study Results

Mechanisms for Achieving the Required Carbon Emission Reductions

For Germany to achieve its targeted reductions in carbon emissions would require a dramatic reduction from currently projected levels of energy consumption. As there is no cost-effective technology currently available to capture CO_2 emissions, domestic actions to achieve a reduction in carbon emissions from the energy sector over the next few decades fall into three broad categories:

- **substituting non-carbon-emitting fuels for fossil fuel use:** Some emission reductions could be achieved through the increased use of nuclear or renewable energy in the generation of electricity. For this analysis, no changes were made to the nuclear assumptions included in the baseline analysis. Under a carbon emission limits policy, other renewable energy technologies would be steadily more economically attractive. However, significant investment in renewable is underway and incorporated in the Global Insight base case. The next trance of renewable would likely be developed after 2020.

- **substituting lower emitting fuels for higher emitting fuels:** Switching from fossil fuels with higher carbon emission rates (i.e., coal and petroleum) to those with lower emission rates (i.e., natural gas) can provide some of the reductions needed to reach a target. However, the potential is limited over the next ten to twenty years due to the increasing reliance on lower carbon fuels that is already included in the baseline analysis. Further, the prospect of steady reductions in carbon emissions assumed under for the post-2012 period reduces the incentive for large infrastructure developments needed to expand gas use dramatically.

- **using less energy:** Achieving a carbon emission target through reductions in energy use would require cutting energy use by nearly the same amount as the desired change in carbon emissions from the baseline. To the extent that some of the reductions would be obtained with the two previous options, the necessary reduction in energy use would be less. As these options are not expected to provide substantial relief from the target reductions under the Kyoto Protocol, to achieve this reduction, some form of intervention in the market (such as a fee or tradable permit) would be required. Once in place, energy use would be curtailed through four mechanisms:

    1. investment in energy efficient capital
    2. investment in process change
    3. reduction in purchases of energy and electricity by businesses and consumers
    4. leakage of industry to other countries.

The Allowance Prices that Achieve the Reduction

As the opportunity for meeting the Kyoto Protocol target emission reductions of CO_2 from energy use through substitution of non-carbon energy sources or low-carbon energy sources is limited, reducing energy consumption would require

large changes in energy prices and/or purchases of international credits. For this analysis, we have assumed that the price of international credits would, in 2010, start at $48 per metric ton of carbon dioxide (in 2004 dollars), and rise to $64 per metric ton (in 2004 dollars) by 2025. This assumption is based on the assessment of the international credit price under the Kyoto Protocol published in the International Energy Outlook 2005 "Kyoto Case" analysis by the U.S. Energy Information Administration.

Because of this assumption, participating companies would take actions to reduce emissions that are economic up to the price of the international credit price. If they required further allowances, they would purchase them in the international credit market. If they can reduce emissions for less than the price of international allowances, they can increase the emission reductions effort and sell allowances on the international market – up to the point where their emission reduction costs rise to the international market level.

Assuming continuing operation of nuclear power plants, Germany will be a seller of international credits during 2008-12 periods. However, in longer term the allowance price that would be necessary to fully meet stiffer targets would exceed the assumed price for international credits. Thus, under Case 1, domestic actions would meet only 95% of their target by 2025 and they would purchase international credits for the remaining 5%. Under the more stringent restrictions in Case 2, domestic actions would meet only 64% of the German target in 2020 and 53% in 2025.

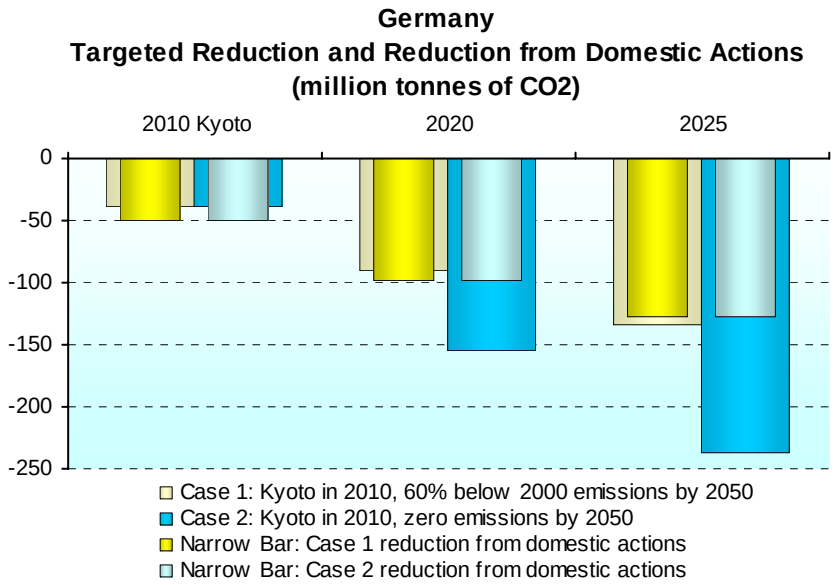
The total market value of CO_2 emission allowances in Germany would be 27.5 billion Euros (2004 €) in 2010, rising to 34.1 billion Euros in 2025 under Case 1 and 39.9 billion Euros under Case 2. The market value of CO_2 emission credits purchased on the international market would be 398 million Euros (2004 €) in 2025 under Case 1. Under Case 2, the value of purchased credits would be 2.8 billion Euros in 2020, rising to 6.2 billion Euros in 2025.

Exhibit 11:
Impact on Germany of Meeting the Kyoto Commitment in 2008-2012 and Meeting Alternative Targets for the post-2012 period

	2010	2020		2025	
	Kyoto: 21% below 1990 emissions	Case 1: 60% below 2000 emissions	Case 2: Zero emissions by 2050	Case 1: 60% below 2000 emissions	Case 2: Zero emissions by 2050
	.79 * 1990	**.70 * 1990**	**.63 * 1990**	**.64 * 1990**	**.53 * 1990**
Int'l Credits Price (2004 €/tone of CO_2)	€ 39	€ 50	€ 50	€ 55	€ 55
Int'l Credits Price (2004 US$/tone of CO_2)	$48	$59	$59	$64	$64
Target Reduction from Base Case (%)	5.0%	12.2%	20.8%	18.2%	32.4%
Target Reduction of Emissions *	38.8	90.9	154.9	133.8	237.9
Reduction from Domestic Actions *	50.7	99.1	99.1	126.6	126.6
Purchased International Credits *	-11.9	-8.2	55.9	7.2	111.3
% Reduction from Domestic Actions	100%	100%	64%	95%	53%
Value of Purchased Int'l Credits (million 2004 €)	0	0	2,768	398	6,166
Impact on Delivered Prices (% increase)					
Motor Gasoline, pump price	8.5%	11.5%	11.5%	13.2%	13.2%
Diesel, pump price	11.6%	15.6%	15.6%	17.8%	17.8%
Home Heating Oil	29.4%	38.3%	38.3%	42.4%	42.4%
Natural Gas, Industry Sector	30.3%	38.9%	38.9%	43.6%	43.6%
Electricity, Industry Sector	30.5%	31.6%	31.6%	31.5%	31.5%
Impact on Economic Performance					
Real GDP (% decline)	-0.8%	-1.0%	-1.2%	-1.4%	-1.7%
Real GDP (billions of real €)	-18.5	-29.7	-37.8	-40.6	-48.2
Employment (level decline, thousands)	-318	-433	-541	-519	-622

** unit: million tonnes of CO_2*

Exhibit 12.



Impact on Delivered Prices to Households and Industry

Meeting the Kyoto Protocol target in 2008-2012 through a combination of domestic actions plus purchases of international credits would increase the price of home heating oil by nearly 30%. Consumers would also pay more for gasoline and diesel.

If Germany meets the Kyoto Protocol's emission reduction target, prices for industry would also rise dramatically. Germany industries would pay more than 30% for natural gas and electricity than under the baseline projection.

Under the assumption that the Kyoto Protocol's emission targets are made even more stringent in the post-2012 period, the impact on household heating oil prices would rise to more than 40% above the baseline estimate by 2025. Gasoline and diesel prices would rise substantially, between 13-18% by 2025.

Impact on Energy Consumption

In general, the percentage reduction in energy demand would not need to be as large as the required percentage reduction in carbon emissions because not all Btus of energy have the same carbon content. Additionally, purchase of international CO_2 credits means that foreign CO_2 reductions lessen the need for domestic reductions, thereby avoiding some domestic reductions in energy used. However, use of international credits does have consequences, as companies pass the cost of the international credit onto final consumers of energy via higher prices. Implementation of a limit on carbon dioxide emissions via an international carbon dioxide allowance trading system would result in the following impacts.

Domestic Sector: The dramatically higher energy prices would force consumers to cut their consumption of energy. Since there is only limited opportunity to

substitute more energy efficient appliances and furnaces for the period 2008-2012, consumers would reduce their consumption of energy services. Longer term, consumers would attempt to replace some of these services by replacing their energy consuming equipment.

Industry Sector: Industry would respond to the dramatically higher prices through several mechanisms. First, industry would reduce energy consumption through process change. Second, industry would replace energy-consuming capital with more efficient capital (thus making a significant amount of the capital stock prematurely obsolete and "stranding" some investment. Third, to the extent possible, production of energy intensive goods would move to non-participating countries.

Power Sector: The power sector would be hard hit under these scenarios. The imposition of carbon permits would lead to extremely large increases in the delivered price of electricity, particularly to the industrial sector. Imposition of ever decreasing carbon permit levels would set in motion dramatic changes in this sector. Coal use would decline, slowly at first and then rapidly, as the price drove electricity prices up reducing demand and encouraging the substitution of natural gas or renewables. Investment in natural gas fired generating capacity would alleviate some of the pressure on electricity prices, but with the ever increasing stringency of the target, investment in end-use efficiency would need to be as great or greater than improvements in power supply efficiency. For this analysis, it was assumed that nuclear and hydroelectric energy would not change.

Transportation Sector: The impact on the transportation sector would be significant. However, due to the high taxes already in place on transportation fuels, the percentage change in price due to the addition of the carbon permit fees is less than the change in price in other sectors. Longer run, the permit price would have to be high enough to reduce energy use in this sector as the target tightens.

Even assuming an international carbon dioxide emission allowance trading scheme, meeting the Kyoto targets would result in the following:

- Coal, with the highest carbon content of the energy sources, would be the hardest hit.
- Petroleum would experience the smallest percentage decline of the fossil fuels because of strong demand and limited technology substitution options in the transportation sector over the forecast horizon.
- Natural gas demand would initially increase relative to the baseline as it is substituted for coal and petroleum but ultimately would need to decline as the cutbacks in demand required to meet ever tightening CO_2 limits outweigh this substitution effect.
- The demand for renewables would increase in all the cases.

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 concerned over possible inflation would most likely need to target more slack in the economy to deflate non-energy prices and thus stabilize the overall price environment.

The analysis assumes that the cost of emission allowances would be passed along to consumers in the form of higher energy prices and ultimately high prices for all goods and services. Consumers' purchasing power would be reduced by the higher cost of using energy, reducing real disposable income.

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 Base Case levels in the 2008-12 period. Imports would strengthen relative to Base Case levels, spurred by the competitive price advantage of non-participating Annex B countries, and non-Annex B countries.

Real GDP in Germany would decline 0.8% (18.5 billion Euros) during the 2008-12 budget period as the country would not be required to purchase any credits, although it would fall 1.4% (40.6 billion Euros) below Base Case levels by 2025 under Case 1 and 1.7% (48.2 billion Euros) below under Case 2.

The economy's potential to produce would fall below Base Case levels initially with the cut back in energy usage, since energy is a key factor of production. Stronger investment would be required over the longer-term to build capital as a substitute for this lost factor. The decline in consumption and residential fixed investment relative to Base Case levels, however, would have a depressing impact on business fixed investment in the near-term.

Annual employment losses in Germany are projected to be 519,000 jobs in 2025 under Case 1 and 622,000 jobs under Case 2. The percentage reduction in employment relative to Base Case levels would be less than the drop in output. This is due to an increase in the labor-to-output ratio (or a decline in labor productivity) attributed to the permit program. Labor productivity would decline because the other factors of production would be less efficient. Only as investment grows and the capital stock is expanded would productivity begin to improve.

Post 2012, if the target emission level under the Kyoto Protocol were maintained, the impact on economic performance would begin to lessen. The extreme change in the energy prices experienced during the years between 2008 and 2012 would not be repeated. While the percentage change in prices relative to the baseline would increase somewhat, the year-over-year change in prices would be reduced. However, achieving targets that are even more aggressive would take ever larger carbon fees, and would continue to take a significant toll on economic performance.

Exhibit 13.

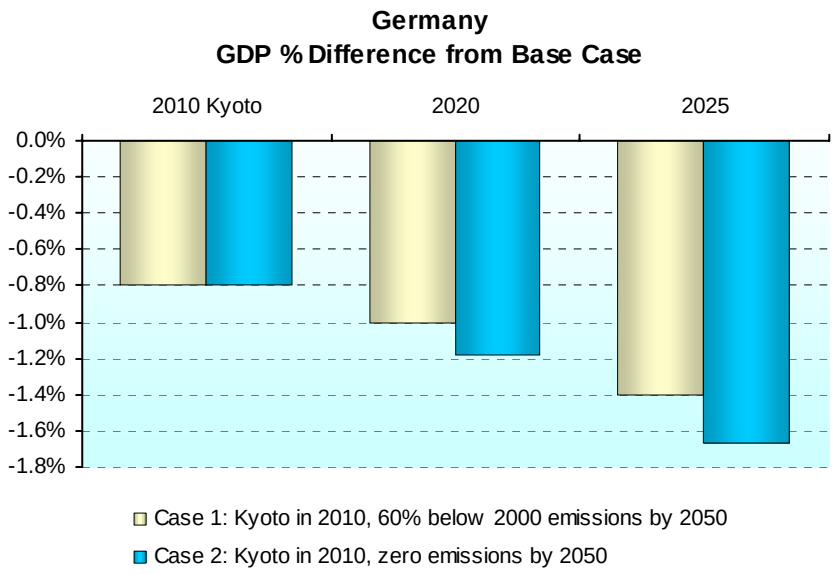


Exhibit 14.

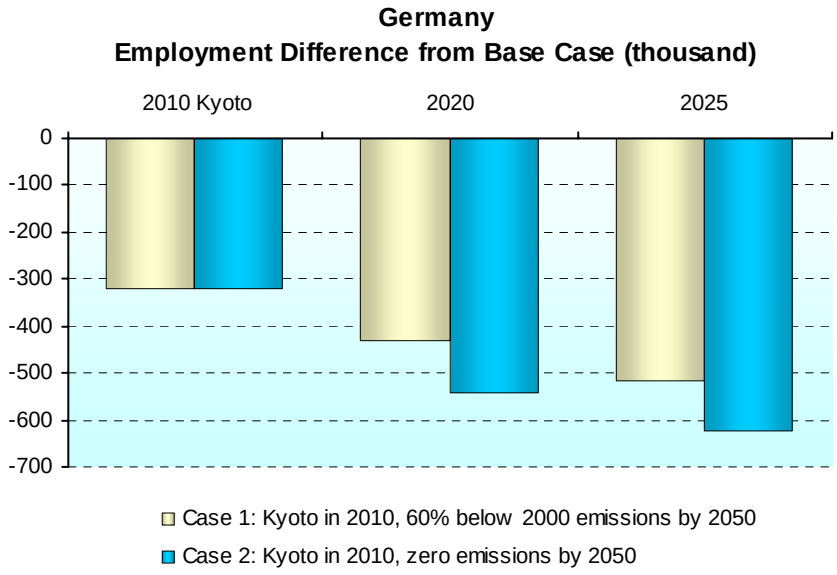
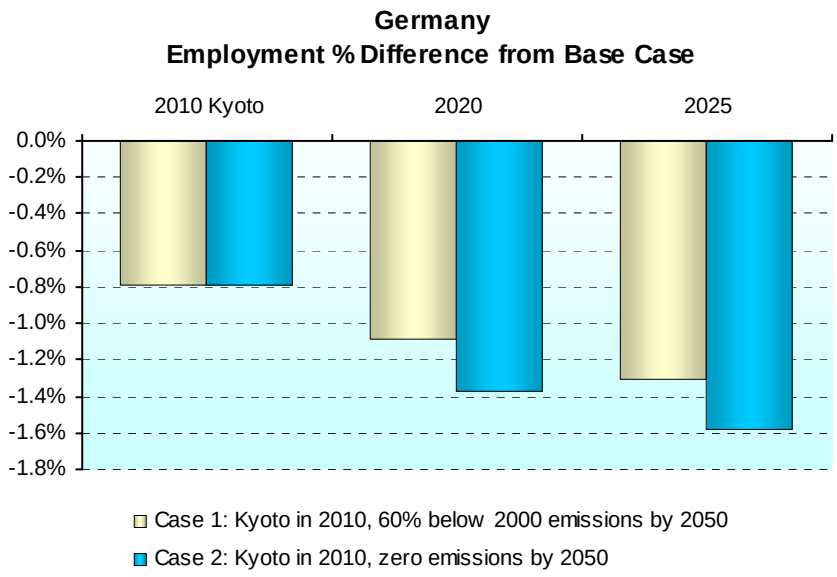


Exhibit 15.


Germany
Employment % Difference from Base Case
2010 Kyoto
2020
2025
0.0%
-0.2%
-0.4%
-0.6%
-0.8%
-1.0%
-1.2%
-1.4%
-1.6%
-1.8%
Case 1: Kyoto in 2010, 60% below 2000 emissions by 2050
Case 2: Kyoto in 2010, zero emissions by 2050

Nuclear Retirement Case

The ratification and implementation of the Kyoto Protocol has been shown to have an impact on the Germany's energy sector. Germany made a commitment to phase out its nuclear generating capacity by 2020. Under the assumption that Germany does retire its nuclear capacity as proposed, the economic implications of the proposed policies to limit CO_2 emissions would be even more severe.

As shown below, the reduction in emissions from domestic actions would not be sufficient to meet their commitment during 2008-2012 period, and the shares of reduction from domestic actions against their targets in longer term would become significantly smaller than those with continuing nuclear operations.

Germany would need to purchase credits on the international market and economic performance would deteriorate significantly. In 2010, the impact on real GDP would be 0.9% with 342,000 jobs lost. If Case 1 has to be achieved, GDP would fall 1.6% below the base case and there would be 627,000 fewer jobs in 2025. Under Case 2, GDP would fall 1.9% below the base case and there would be 744,000 fewer jobs in 2025.

Exhibit 16:
Impact on Germany of Meeting the Kyoto Commitment in 2008-2012 and Meeting Alternative Targets for the post-2012 period – Nuclear Retirement Case

	2010	2020		2025	
	Kyoto: 21% below 1990 emissions	Case 1: 60% below 2000 emissions	Case 2: Zero emissions by 2050	Case 1: 60% below 2000 emissions	Case 2: Zero emissions by 2050
	.79 * 1990	**.70 * 1990**	**.63 * 1990**	**.64 * 1990**	**.53 * 1990**
Int'l Credits Price (2004 €/tonne of CO_2)	€ 39	€ 50	€ 50	€ 55	€ 55
Int'l Credits Price (2004 US$/tonne of CO_2)	$48	$59	$59	$64	$64
Target Reduction from Base Case (%)	7.3%	20.8%	28.6%	26.1%	38.9%
Target Reduction of Emissions *	57.9	171.9	235.9	212.1	316.2
Reduction from Domestic Actions *	48.8	91.3	91.3	118.8	118.8
Purchased International Credits *	9.1	80.6	144.6	93.3	197.3
% Reduction from Domestic Actions	84%	53%	39%	56%	38%
Value of Purchased Int'l Credits (million 2004 €)	351	3,992	7,165	5,168	10,936
Impact on Delivered Prices (% increase)					
Motor Gasoline, pump price	8.5%	11.5%	11.5%	13.2%	13.2%
Diesel, pump price	11.6%	15.6%	15.6%	17.8%	17.8%
Home Heating Oil	29.4%	38.3%	38.3%	42.4%	42.4%
Natural Gas, Industry Sector	30.3%	38.9%	38.9%	43.6%	43.6%
Electricity, Industry Sector	30.5%	31.6%	31.6%	31.5%	31.5%
Impact on Economic Performance					
Real GDP (% decline)	-0.9%	-1.4%	-1.7%	-1.6%	-1.9%
Real GDP (billions of real €)	-19.9	-37.8	-45.9	-46.4	-55.1
Employment (level decline, thousands)	-342	-551	-670	-627	-744

** unit: million tonnes of CO_2*

Appendix A: Summary of the Kyoto Protocol

Countries. The Protocol would bind the Annex B countries to quantified emission limits. The Annex B countries, defined in the Protocol, are: US, Canada, Japan, Australia, New Zealand, European Community countries, the countries of Eastern Europe, Russia and the Ukraine. With the exclusion of Turkey and Belarus and the addition of a few smaller European countries, this is the same group of countries referred to as Annex I of the UN Framework on Climate Change (UN/FCCC).

Greenhouse Gases Emissions and Sinks (Carbon Sequestration). The Kyoto Protocol set quantified emission limits on the "aggregate anthropogenic carbon dioxide equivalent emissions" of six greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). To establish the emission target for each country, the first three gases use a 1990 base year and the last three gases may use a 1990 or 1995 base year for the commitment period 2008-2012. The Kyoto Protocol also requires that changes in emissions, relative to 1990 levels, from direct human-induced land use changes and forestry activities which impact this sequestration is counted. These activities have been restricted to afforestation, reforestation, or deforestation. Later, other agricultural soil, land use or forest related sinks might be added.

Quantified Emissions Limits. Germany has committed to reduce greenhouse gas emissions to 79% of 1990 levels on average over the period 2008-2012. Other industrialized nations have also committed to cap greenhouse gas emissions at various multiples of 1990 emissions for this period. Tightened emission limits for subsequent periods have not yet been specified, but are under discussion.

Emission Banking. As a concept, banking emission credits is allowed from the date that the Protocol becomes effective.

Emission Trading. Emission trading between Annex B countries is allowed, at least conceptually. However, the details, such as the principles, modalities, rules, guidelines, verification, reporting and accountability are still under discussion.

Bubbles. Groups of countries are allowed to treat their aggregate quantified emission limits as a single party (acting under a "bubble"). For example, this provision allows the EU countries to operate under the long-declared EU "bubble" -- individual country emissions can be above or below the 92% of 1990 level target as long as the EU aggregate achieves the targeted level.

Joint Implementation (JI). Joint Implementation (JI) among participating Annex B countries is allowed. These are project-specific emission-reduction efforts undertaken by one Party in another Annex B country. JI projects must be approved by the parties, and generally entail a transfer of a stream of emission credits over time from one Annex B Party to another.

Clean Development Mechanism (CDM). The CDM would allow project-specific reduction efforts in non-Annex B countries. The resulting emission "credits" could then be used by Annex B countries. Certified emissions reductions achieved starting in the year 2000 in developing countries can count toward compliance in the first budget period. A new UN/FCCC body that will certify all CDM and JI projects has been proposed. A share of the proceeds from the CDM projects is to be collected by this body to cover administrative costs and to help developing countries with the costs of adaptation to climate change.

Compliance. Remains under discussion.

Quantified Emission Limits Established in the Kyoto Protocol
Percentage of 1990 (or Base Year) GHG Emissions Allowed during the Budget Years 2008-2012

OECD Non-European		Transitional Economies		Europe, Western	
OECD North America		Former Soviet Bloc		European Union**	92%
US	93%	Russian Federation	100%	Austria	(87%)
Canada	94%	Ukraine	100%	Belgium	(92.5%)
				Denmark	(79%)
OECD Pacific		Eastern Europe*	107%	Finland	(100%)
Japan	94%	Bulgaria	92%	France	(100%)
Australia	108%	Croatia	95%	Germany	(79%)
New Zealand	100%	Czech Republic	92%	Greece	(125%)
		Estonia	92%	Ireland	(113%)
		Hungary	92%	Italy	(93.5%)
		Latvia	92%	Luxembourg	(72%)
		Lithuania	92%	Netherlands	(94%)
		Poland	94%	Portugal	(127%)
		Romania	92%	Spain	(115%)
		Slovakia	92%	Sweden	(104%)
		Slovenia	92%	UK	(87.5%)
				Other European Countries	
				Iceland	100%
				Monaco	92%
				Liechtenstein	92%
				Norway	101%
				Switzerland	92%

Notes:
Several countries have joined the OECD since 1992.
Not As Annex B Countries: Mexico (1994), South Korea (1996)
As Annex B Countries: Poland (1996), Hungary (1996), Czech Republic (1996)
Several countries were designated Annex 1 (of the 1992 FCCC) countries, but are not Annex B (of the 1997 Kyoto Protocol) countries: Belarus and Turkey.

* The Kyoto target for Eastern Europe was recalculated to reflect Article 3.5 of the Protocol, which allows four countries to use base years other than 1990 -- Bulgaria (1989), Romania (1989), Poland (1988), Hungary (average 1985-1987). The result is to allow them a combined multiple of 107% when applied to the 1990 emission level. The country numbers shown are their official multiple of their base year.
[Source: US Department of Energy, Energy Information Administration, *International Energy Outlook 1999.]*

** Agreed European Union internal burden sharing arrangement shown in "( )".

Appendix B: Global Insight's Outlook for Germany

Energy Outlook

	1990	2000	2010	2015	2020	2025
Real Delivered Prices (2003 €/toe)						
Motor Gasoline, pump price	1,059	1,326	1,329	1,326	1,352	1,374
Diesel, pump price	--	953	978	974	1,000	1,020
Home Heating Oil	--	490	385	381	407	427
Natural Gas, Industry Sector	--	235	277	285	298	308
Electricity, Industry Sector (cents/kWh)	10.05	4.57	5.47	5.66	5.90	6.20
Energy Consumption (million toe)						
Primary Energy	361.8	345.4	350.8	353.6	355.2	360.4
Petroleum (1)	129.8	134.7	130.6	132.2	132.2	135.2
Natural Gas	53.6	69.0	83.3	89.9	93.5	99.1
Solid Fuels (2)	132.2	86.6	76.0	69.0	62.1	54.9
Nuclear, Hydro, Renewables (3)	41.4	47.4	49.8	51.0	53.3	52.8
Solid Waste & Biomass	4.8	7.8	11.1	11.7	14.1	18.5
Electricity Sales (million toe)	39.2	42.2	46.4	48.4	50.4	51.7
CO_2 Emissions (million tonnes)	933	801	776	765	744	735

(1) Oil consumption includes international marine bunkers.

(2) Solid fuel consumption and imports include net imports of coke.

(3) Hydro includes geothermal. Renewables include solar, wind and tide, wave and ocean energy.

Economic Outlook

	1990	2000	2010	2015	2020	2025
Real GDP (billions of 2000 €)	1,717	2,065	2,318	2,507	2,702	2,898
Population (million persons)	63.3	82.2	82.7	82.7	82.4	81.8
Employment (million persons)	30.3	39.1	39.8	39.6	39.4	39.2
Consumer Spending (billions of 2000 €)	--	1,213	1,342	1,447	1,556	1,668
Employee Compensation (billions of 2000 €)	933	1,099	1,135	1,205	1,280	1,351
Consumer Price Index (2000=100)	80.4	100.0	117.4	126.7	136.7	147.9
Industrial Production Index (2000=100)	90.1	100.0	112.9	122.9	133.7	144.8