German Institute
for Economic Research
(DIW Berlin)
Koenigin-Luise-Str. 5
14195 Berlin
customerservice@diw.de

DIW Berlin

Weekly Report

No. 3/2007

Volume 3/June 1st 2007

DIW Berlin electronic edition – available online only

Contents

ISSN 1860-3343
Price: Euro 10.–
www.diw.de/english/produkte/publikationen/weeklyreport

Comprehensive package of climate protection measures could substantially decrease cost of emission reductions in Germany

Claudia Kemfert, Thure Traber, and Truong P. Truong

Seeking to play a pioneering role in climate protection, the European Union has decided to pursue a reduction of at least 20% in greenhouse-gas emissions (on 1990 levels) by the year 2020. Moreover, Europe has declared its willingness to commit itself to emission reductions of 30% over the same period if other developed countries commit themselves to similar targets and if developing countries also make an appropriate contribution. A fair distribution of the burden of emission reductions in Europe and a comprehensive package of climate protection measures in Germany could substantially reduce the cost of emission reductions for the German economy. If Germany succeeds at European level in pushing through a fair burden-sharing mechanism that takes into account the emission reductions achieved to date in the different member states, and at the same time implements a comprehensive package of climate protection measures at home, then climate protection costs can be kept low. It would be very difficult for Germany to achieve its reduction target only by shutting down nuclear installations. What are also needed, in particular, are increased exploitation of energy efficiency potentials, the further development of renewable energy sources, the improvement of the system of emissions trading, and the promotion of innovative energy technologies. If European burden-sharing were fairly distributed and if Germany were to exploit all its energy efficiency potentials, then, in order to achieve a 20% reduction in current European emissions, Germany's climate protection costs would amount to total of around 1.9 billion euro per annum up to 2020. In this case, Germany would have reduced its emissions by 31% on 1990 levels. If it were not possible to negotiate a fair distribution of the burden, and if Germany were unable to exploit the necessary energy efficiency potentials, then the reduction costs would increase to around 5.7 billion euro per annum.

JEL Classification: Q54, Q5, Q42
Keywords: Climate protection, Germany, costs of climate policy

Box

Evaluation of climate protection costs: Methodology

Climate protection costs were evaluated using an economic general equilibrium model which was extended so as to incorporate data about the costs of emission reductions specific to the different technologies used.1 The model is based on the assumption that a fully functional European emissions trading system will be in operation up until 2020. It takes all known reduction technologies and also cost-degression effects over time into account. The reported reduction costs are inclusive of the learning-curve effect for the individual technologies.

1 Truong, T.P., Kemfert, C., Burniaux, J.-M.: GTAP-E: An Energy-Environmental Version of the GTAP Model with Emission Trading. DIW Berlin Discussion Papers No. 668, 2007.

Table 1

Greenhouse-gas emissions in Europe

CO2 equivalents in million t

	1990	2004
Belgium	145.8	147.9
Denmark	69.0	68.1
Germany	1226.7	1015.7
Finland	71.2	81.5
France	570.8	565.2
Greece	108.8	137.6
Great Britain	764.5	659.4
Ireland	55.6	68.5
Italy	519.8	583.3
Luxembourg	12.7	13.7
Netherlands	213.0	217.8
Austria	79.0	91.3
Portugal	60.1	84.7
Sweden	72.5	70.0
Spain	287.2	427.9
Estonia	42.6	21.3
Latvia	25.9	10.8
Lithuania	50.9	20.3
Malta	2.2	3.2
Poland	459.8	386.4
Slovakia	73.4	51.1
Slovenia	18.4	20.1
Czech Republic	196.3	147.2
Hungary	103.4	83.1
Cyprus	6.0	8.9
EU-25	5235.6	4984.9

Sources: EEA; calculations by DIW Berlin.

Highly uneven distribution of reduction targets in Europe – fair burden-sharing recommended

The European Union plans to reduce its greenhouse-gas emissions in the order of at least 20% by 2020 on 1990 levels. If other developed countries, such as the USA, for example, were to commit themselves to a climate protection agreement specifying similar emission targets, and if developing countries were also to make an appropriate contribution, then Europe would be willing to reduce its emissions by 30% on 1990 levels over the same period.[1] In this case, Germany would also be willing to strive for larger-scale reductions.[2] Europe has committed itself under the Kyoto Protocol to reduce emissions of greenhouse gases by 8% from the base year (1990/1995) to the period between 2008-2012. Europe (EU-25)[3] has already made a very significant contribution to emission reductions and could meet or exceed this target by taking additional measures, the Kyoto mechanisms and credits for carbon sinks into consideration.[4] The contributions made to reducing emissions vary substantially across the individual member states of the EU, how-

1 Cf. Council of the European Union: EU objectives for the further development of the international climate regime beyond 2012 – Council conclusions. Brussels, 21 February 2007. 6621/07, ENV 114. The targets proposed here by the (Environment) Council were approved at the European Summit in March 2007. Cf. Council of the European Union: European Council (Brussels) 8-9 March 2007. Presidency Conclusions. Brussels, 9 March 2007. 7224/07, CONCL 1.

2 Cf. Coalition Agreement of 11 November 2005 between the CDU, CSU and SPD: "Working together for Germany – with courage and compassion".

3 The EU-25 includes all the countries of the European Union excluding Bulgaria and Romania.

4 Cf. Commission of the European Communities: Report from the Commission. Progress towards achieving the Kyoto objectives. Brussels 27.20.2006. COM (2006) 658 final.

Table 2

Greenhouse-gas emissions in Germany

CO2 equivalents in million t

	1990	2004
Private households	130	116
Transport	158	167
Crafts, trade, services	90	58
Manufacturing industry	216	162
Energy sector	436	383
Total CO2 emissions	1030	886
Non-CO2 emissions	196	130
Total	1227	1016

Source: BMU, February 2007.

ever. The sharp economic decline seen in eastern Europe over the last few years has led greenhouse-gas emissions to decrease rapidly in most of the new member states, while they have increased in most of the old EU members (EU-15) (Table 1).

Germany has substantially reduced its greenhouse-gas emissions since 1990 (Table 2). First and foremost, Germany was able to diminish emissions after 1990 by restructuring eastern Germany's power plant fleet, while other climate protection measures that have borne fruit were the increase in the use of renewable energy and of combined heat and power (CHP) plants, and the introduction of energy taxes. Moreover, energy consumption has declined as a result of high energy prices and this has also reduced emissions. However, recent developments show that emissions have been driven up again in Germany by the strong economic growth registered in 2006.[5] Other European countries, such as Spain, have failed to achieve significant emission reductions and are a far cry from meeting the emission targets laid down in the European burden-sharing agreement. Spain is likely to miss the target by 27.4%. Italy will only meet its target by taking additional measures, the Kyoto mechanisms and carbon sinks into account. Great Britain, by contrast, has already succeeded in significantly reducing its greenhouse-gas emissions and will probably exceed its target.[6]

The distribution of the burden of EU emission reductions of 20% by 2020 should take into account the reductions that have already been achieved in the individual countries and the reduction targets that have already been reached. A "fair" distribution of the remaining burden would take the emission reductions achieved to date into consideration and would distribute the reduction obligations across the different countries in accordance with a burden equalisation scheme.[7] If a fair distribution of the burden that takes past emission reductions into account is negotiated, then Germany would be required to achieve reductions of 175 million tonnes of CO_2 equivalents (as opposed to 203 million tonnes) or 17%; this would amount to total reductions of 31% on 1990 levels. Under the fair burden-sharing scheme, other European countries that have not yet contributed to reducing emissions would be obliged to make a much higher contribution based on the reductions they had achieved by 2004 (Table 3). In Spain, for example, emissions have risen substantially above the intended target, so that Spain's allocated contribution would be accordingly higher, while Great Britain's emissions today, by contrast, are already below the Kyoto target.

Climate protection measures must be broad in scope

Different instruments have been used for climate protection in Germany to date. In addition to promoting renewable energy and CHPs, European emissions trading, an ecological tax reform and various other measures in the areas of manufacturing industry, transport and the energy sector have been introduced (Table 4). If Germany shuts down its nuclear installations and if one of the means chosen to replace nuclear power is an increase in lignite-fired power stations, then additional annual reductions of up to 130 million tonnes of emissions will be required up until 2020.

In order to achieve high cost-efficiency in the reduction of emissions, German climate policy must be based on a priority plan that encompasses both short-term and long-term climate protection measures. Increased R&D spending on innovative energy

5 Federal Environmental Agency (Umweltbundesamt): Kohlendioxidausstoß im Jahre 2006 leicht gestiegen. Press release 016/2007. Dessau, 30.3.2007.

6 Cf. Commission of the European Communities, loc. cit.

7 The calculation of a "fair" distribution of the burden credits the emission reductions achieved in the period 1990-2005 proportionately against the reduction targets such that countries with high achieved reductions are allocated a much smaller share to contribute, while countries with low achieved reductions or even increases are allocated a significantly higher due contribution.

Table 3

Burden-sharing in Europe

Emission reductions by 2020

	20 % fair	20 %	20 % fair		20 %	
	As of 2004		As of 2004	As of 1990	As of 2004	As of 1990
	CO2 equivalents in million t		in %			
Belgium	–32	–30	–22	–19	–20	–18
Denmark	–13	–13	–20	–26	–20	–26
Germany	–175	–203	–17	–31	–20	–34
Finland	–15	–14	–21	–22	–20	–22
France	–118	–113	–21	–22	–20	–21
Greece	–34	–27	–25	–6	–20	0
Great Britain	–119	–132	–18	–30	–20	–31
Ireland	–18	–14	–25	–6	–20	1
Italy	–136	–117	–23	–14	–20	–10
Luxembourg	–3	–3	–23	–14	–20	–11
Netherlands	–48	–44	–22	–19	–20	–17
Austria	–23	–19	–24	–10	–20	–5
Portugal	–22	–17	–27	3	–20	12
Sweden	–14	–14	–20	–24	–20	–24
Spain	–123	–88	–28	11	–20	23
Estonia	–1	–4	–2	–51	–20	–60
Latvia	1	–2	5	–56	–20	–67
Lithuania	1	–4	6	–57	–20	–67
Malta	–1	–1	–27	5	–20	16
Poland	–61	–77	–16	–29	–20	–33
Slovakia	–7	–11	–14	–38	–20	–43
Slovenia	–4	–4	–21	–14	–20	–13
Czech Republic	–22	–30	–15	–36	–20	–40
Hungary	–11	–17	–13	–29	–20	–34
Cyprus	–3	–2	–27	8	–20	19
EU-25	–998	–998	–20	–19	–20	–19

Sources: EEA; calculations by DIW Berlin.

technologies will only culminate in significant cost-efficiency potentials after such methods have been successful tested and launched on the market. Promotion of renewable energies and CHP will also only become cost-efficient climate-protection measures in the medium to long term when their costs fall substantially (learning-curve effect). In addition, the organisation of emissions trading must be significantly improved by auctioning off emissions credits and allocating them sparingly to all European countries.[8] Only high prices for emissions credits (at least 15 euro per tonne of CO_2 equivalents) will send out the kind of market signals that will promote increased climate protection.

The most cost-efficient climate protection measure available is the exploitation of energy efficiency potentials. Better insulation of buildings, reduced waste of standby power in household appliances and improved fuel efficiency can significantly lower the cost of emission reductions (Figure).[9] In addition, measures to reduce emissions of non-CO_2 gases such

8 Kemfert, C., Diekmann, J.: Europäischer Emissionshandel – Auf dem Weg zu einem effizienten Klimaschutzinstrument. Wochenbericht des DIW Berlin, No. 46, 2006.

9 Enkvist, P.-A., Naucler, T., Rosander, J.: A Cost Curve for Greenhouse Gas Reduction. In: The McKinsey Quarterly No. 1, 2007.

Table 4

Emission reduction potentials

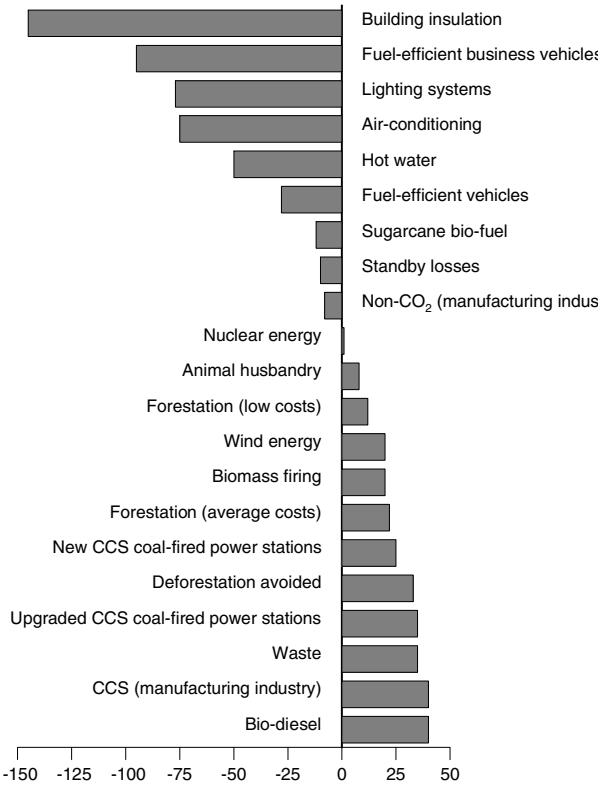
Energy sector	Manufacturing industry	Transport
Improved energy efficiency	Increased energy efficiency	Ecological tax reform
Promotion of Renewable Energies Act	Energy Conservation Ordinance	Promotion of sulphur-free fuel
Promotion of CHP	Ecological tax reform	Promotion of cycling
Extensions to gas and steam power stations	Promotion of CHP	Climate protection in the transport sector
Increased use of colliery gas	Self-commitment	HGV toll
Carbon capture and storage	Other measures	Motor vehicle tax
Emissions trading / Clean Development Mechanism / Joint Implementation	Emissions trading / Clean Development Mechanism / Joint Implementation	Self-commitment
Energy tax		CO_2 labelling requirement
		Promotion of renewable energies
		Emissions-related landing fees / Emissions trading
		"New Driving" campaign

Source: Compiled by DIW Berlin.

Figure

Global climate protection costs, 2030

Euro per tonne of CO_2 equivalents



Source: McKinsey Quarterly.

as methane and laughing gas should also be implemented. Other necessary climate protection measures are forestation programmes, ecological farming and increased use of bio-gas.[10] In the transport sector, further emissions can be avoided through the introduction of a CO_2-emissions-related motor vehicle tax,[11] for example, and the road toll on heavy goods vehicles.

Two scenarios will be examined in the following with a view to evaluating the costs of climate protection in Germany. We differentiate between a fair and a proportional distribution of the burden of emission reductions in the EU countries proceeding on the basis of current emissions. In the fair burden-sharing scenario, the changes in emission levels since 1990 are considered (20% fair). Two variants examining the consequences of exploitation or not of energy efficiency potentials in private households, the energy sector and manufacturing industry are also included. There is huge potential for emission reductions in the energy sector,[12] followed by manufacturing industry, transport and private households.

The inclusion of non-CO_2 greenhouse gases in the model can significantly increase the potential for emission reductions. World wide, greenhouse-gas emissions can be reduced substantially by means of reforestation programmes, avoidance of land clearance, reduction of cattle breeding and diminished cultivation of rice in wet fields.[13]

10 Cf. IPCC: Climate Change 2007. Cambridge.

11 Hartmut Kuhfeld, Uwe Kunert: Reform der PKW-Besteuerung überfällig: die Initiative der EU-Kommission zeigt den richtigen Weg. In: Wochenbericht des DIW Berlin, No. 49/2005.

12 Kemfert, C.: The European Electricity and Climate Policy – Complement or Substitute? In: Environment and Planning/C, 25, 1, 2007, 115-130.

13 Cf. IPCC, loc. cit.

Table 5

Energy efficiency and high costs variants

Reduction costs in millions of euro per annum

	20 % fair	20 %
Private households	–75	–80
Transport	93	143
Crafts, trade, services	50	50
Manufacturing industry	165	126
Energy industry	1 784	2 070
Total CO2 emissions	2 016	2 308
Non-CO2 emissions	–150	–125
Energy efficiency variant with shutdown of nuclear power	1 866	2 183
Energy efficiency variant without shutdown of nuclear power	1 693	2 069
Private households	150	160
Transport	93	143
Crafts, trade, services	75	75
Manufacturing industry	797	847
Energy industry	3 784	4 070
Total CO2 emissions	4 898	5 294
Non-CO2 emissions	225	375
High costs variant with shutdown of nuclear power	5 123	5 669
High costs variant without shutdown of nuclear power	3 350	3 955

Source: Calculations by DIW Berlin.

Substantial reduction in emission control costs through use of energy efficiency measures

All in all, the cost of emission reductions is substantially diminished when energy efficiency potentials are taken into consideration (Table 5). The scenarios show an emissions trading price of 15 euro per tonne of CO_2 equivalents, and it is assumed that an ecological tax of 18 euro per tonne of CO_2 equivalents will be in place until 2020. It is assumed that technologies that have relatively high costs will also be used – carbon capture and storage (CCS) coal-fired power stations, for example. The use of wind energy reduces control costs by 25 euro per tonne of CO_2 equivalents.

Under a fair burden-sharing scheme, Germany would have to spend around 1.9 billion euro per annum in order to fulfil its contribution to a 20% reduction in European emissions. To achieve this figure, it would be necessary to fully exploit all available energy efficiency potentials. If the potentials are not sufficiently exploited, then the costs would increase to 5.1 billion euro per annum. And if it does not prove possible to negotiate a fair burden-sharing arrangement, then the cost of reductions would increase to 2.2 billion euro (efficiency variant) or to 5.7 billion euro (high costs variant). Extending the lifetime of all the nuclear power stations currently operating would result in a cost reduction of around 170 million euro in this scenario (efficiency variant, 20% fair), or of 1.7 billion euro in the variant without efficiency measures.

Conclusion

If a reduction in current European greenhouse-gas emissions of 20% by 2020 is to be achieved, then a comprehensive catalogue of climate protection measures must be drawn up and implemented. Alongside the "low hanging fruits" of climate protection measures at low cost or cost saving, the costs of emission control will also be reduced by increased use of renewable energy sources and CHP and by the expansion of emissions trading. This is why it is essential that a fair distribution of the burden with respect to allocated emission targets is negotiated, while at the same time the existing energy efficiency potentials are fully exploited. If Germany were to succeed in obtaining a fair distribution of the burden, then a reduction of emissions by 17% on 2004 or 31% on 1990 would require implementation of a panoply of emission reduction measures. In addition to market-economy instruments such as emissions trading and energy taxes, innovative CO_2-free energy technologies must be researched and introduced to the market. Renewable energy sources and CHP must be further promoted and existing energy efficiency potentials must be exploited. In addition, the reduction of non-CO_2 emissions must also continue. If all these measures are implemented, then Germany can achieve its reduction targets at low cost, while also shutting down nuclear power. Costs can be kept low in particular via improved efficiency. If, by contrast, it proves impossible to negotiate a fair distribution of the burden and Germany also fails to exploit its efficiency potentials, then the costs of meeting the target would increase to around 5.7 billion euro per annum.