

Worldwide Climate Protection Policy – Still No Visible Success

International policy on climate protection is still far from reaching its targets for reducing greenhouse gas emissions. Although a number of measures have been taken, the divergence between the targets agreed in the Kyoto Protocol and what has been achieved so far is still all too evident, and in some cases it is blatant. In 2002 greenhouse gas emissions were still around 8% higher than in the base year 1990 in the OECD countries, which agreed in Kyoto at the end of 1997 to reduce their emissions by 2008/2012 (they are known as the Annex II countries).¹ Emissions of carbon dioxide (CO₂), which is by far the most important greenhouse gas, rose worldwide by nearly 4% in 2003, according to preliminary estimates. This made CO₂ emissions in 2003 greater by nearly one fifth than in 1990.

The European Union (EU) has underlined its determination to implement the Kyoto Protocol by introducing emissions trading. Most of the EU countries have now also presented a national allocation plan for 2005/2007. However, in view of the big gap that still exists in many EU member states between the present level of emissions and the agreed targets, and the generally very moderate emission figures laid down in the national allocation plans for 2005/2007, considerable doubts must be expressed about whether the targets can be achieved. Within the EU-15 only Great Britain, France and Sweden have now exceeded their reduction targets, according to current emission inventories, and Germany is very close to doing so. That must not be seen as a reason for relaxing efforts at climate protection, particularly as in the longer term even more stringent reduction targets are to be met.

In the Framework Convention on Climate Change agreed in Rio de Janeiro in 1992, which came into force in 1994, the Annex I countries, as they are called, agreed in principle to reduce their emissions of greenhouse gases to the 1990 level by the year 2000. The Kyoto Protocol, which was agreed in 1997, for the first time laid down binding quantitative reduction obligations for the industrial countries, but it has not been ratified widely enough and so it is still not binding in international law (cf. box 1).

¹ 1990 is generally the base year. Any deviations are explicitly identified.

However, independently of this the EU and its member states, which ratified the Protocol in 2002, have undertaken to reduce their emissions by altogether 8% from the 1990 level by the first obligatory period. The distribution within the EU-15 follows the agreements made as part of European burden sharing, which provide for differing levels of reduction for most member states, and for some actually limited increases in emission.

The development of greenhouse gas emissions worldwide

Only incomplete data is available on the current worldwide development of emissions of the six greenhouse gases laid down in the Kyoto Protocol. For countries with quantified obligations to limit or reduce their emissions (the Annex B countries) data is available, although it is not up to date in every case.² The data shows that total greenhouse gas emissions in this group were a good 6% lower in each of the last years reported than in the base year 1990 (cf. table 1). So the joint reduction target of 5.3% in total for the first obligatory period 2007/2012 is already practically exceeded.

However, the fall is almost entirely due to the economic collapse in the transition countries, where greenhouse gas emissions were most recently nearly 40% below the 1990 level. In the 'western' industrial countries listed in Annex B of the Kyoto Protocol (the Annex II countries), on the other hand, emissions rose in total by just under 8% from 1990 to 2002. The United States alone accounted for four fifths of this rise, which was 1 billion t in CO₂ equivalents. But even without the United States and Australia, greenhouse gas emissions in the group of Annex II countries rose by just under 2% from the base year 1990 to 2002. Within that group of coun-

² The chief data sources used in this report are: '2004 Annex I Parties GHG Inventory Submissions' to the UNFCCC Secretariat (www.unfccc.int/program/mis/ghg/submis2004.html), which is available for most Annex I countries and contains data for the years up to 2002; International Energy Agency (IEA) (ed.): 'CO₂ Emissions from Fuel Combustion', Paris 2002 and 2003; Energy Information Administration (ed.): 'World Energy Use and Carbon Dioxide Emissions 1980-2001', Washington D.C. 2004; Energy Information Administration (ed.): 'International Energy Annual 2002', Washington D.C. 2004 (www.eia.doe.gov/government/emen/iea/carbon.html); BP Statistical Review of World Energy, June 2004 (www.bp.com). The data on greenhouse gas or CO₂ emissions in the above sources is for the years up to 2002 for most of the Annex I countries. The most recent data for Poland and Lithuania is for 2001, for Russia 1996 and for Ukraine 1998. The CO₂ emissions up to and including 2003 given in this article were extrapolated on the basis of the energy consumption data published in the BP statistics and the changes they show. This goes up to 2003, and is shown by country and energy sources. The estimates of CO₂ emissions for Germany in 2003 were based on the preliminary data from the Arbeitsgemeinschaft Energiebilanzen on primary energy consumption in 2003.

The legal framework and country classifications

The Protocol agreed at the Third Conference of Contracting States in Kyoto in 1997 for the first time set specific limits or reductions in emissions for the countries listed in Annex B (known as the Annex B countries, see below), as the countries mainly responsible for the additional greenhouse effect. The obligations were binding in international law.

However, under Art. 25, Para. 1 the Protocol will only come into force if at least 55 contracting parties to the agreement, including the contracting parties listed in Annex I, which together accounted for at least 55% of the total carbon dioxide emissions by the contracting parties listed in Annex I in 1990, have deposited their ratification, acceptance, approval or accession documents.

In mid-September 2004 125 contracting parties had ratified the Protocol, but the second condition was not fulfilled, as they covered only 44.2% of the relevant emissions. Now that the United States has 'exited' and Australia also no longer feels bound by the Kyoto obligations, the 55% level can only be reached if more countries ratify. Most important is Russia,

which accounts for 17.4% of emissions. The Russian Cabinet has now agreed to ratify the Protocol, but until this is done the Kyoto Protocol is not binding in international law.

- Annex I countries: All the OECD countries and the transition countries except South Korea and Mexico. Accordingly, most of the non-Annex I countries are developing and newly developed countries.
- Annex II countries: All the OECD countries except South Korea, Mexico, Turkey, Poland, the Czech Republic, Hungary and the Republic of Slovakia.
- Annex B countries: All the OECD countries except Turkey, South Korea and Mexico; the transition countries except Belarus.
- Transition countries (EIT – Economies in Transition): Poland, the Czech Republic, Hungary and the Republic of Slovakia (also OECD members), the Russian Federation, Ukraine, Bulgaria, Estonia, Croatia, Latvia, Lithuania, Romania, Slovenia and Belarus.

tries the only reductions of any weight were in Germany and Great Britain.

Estimates of the changes in CO₂, by far the most important greenhouse gas, indicate that the development in emissions worldwide has rather moved even further from the desired objectives (cf. table 2, figure 1).³

According to the estimates, total world energy-induced CO₂ emissions were nearly 4% higher in 2003 than in the preceding year. The rise was only slightly less in the EU-15 at 2%. In the transition countries the increase in emissions lay around the world average in 2003, so that the upward trend that started in 2000 after a steady decline in the 1990s intensified. With the exception of the Non-Annex I countries the rise in CO₂ emissions has in some cases been much stronger in the last five years than in the preceding eight years.

CO₂ emissions in the developing and newly developed countries (the Non-Annex I countries) have continued to grow especially strongly, at slightly more than 6%.⁴ The substantial total increase in emissions in this

group of countries – around 58% from 1990 to 2003 – markedly increased their share in worldwide CO₂ emissions during that period: from around one third to about 45%. However, it must be remembered that per capita emissions in the industrial countries are a good 11 t per inhabitant, i.e. still around six times as high as in the developing countries.

The US Energy Information Administration (EIA) concludes in its estimate of May 2004 that under reference conditions worldwide CO₂ emissions will be around 55% higher in 2025 than in 2001; that would be a rise of nearly three quarters from 1990 (cf. figure 2).⁵ Emissions are also expected to rise in the OECD countries (by 50% by 2025). In future by far the greatest rise in emissions, according to this estimate, will be in the developing countries, which will be emitting nearly three times as much CO₂ in 2025 as in 1990. In the transition countries emissions will remain below the initial level (–12%), owing to the drastic fall in the 1990s, but a clear rise is expected again for the period 2001 to 2025 at +37%.

³ On the worldwide development in emissions see also Hans-Joachim Ziesing: 'Greenhouse Gases on the Increase Worldwide – No Turnaround in Sight', in: *DIW Economic Bulletin*, vol. 40, no. 10, October 2003.

⁴ Within the group of the developing countries the People's Republic of China showed the biggest rise in absolute figures. According to data from the IEA emissions in China in 2001 were around 820 million t CO₂ or a good one third higher than in 1990. The powerful rise estimated for 2003 on the basis of the BP energy data may partly also be due to statistical problems (cf. box 2). That should be taken into account in interpreting the data in table 2.

The development in emissions in the EU

Greenhouse gas emissions

According to the latest national emissions inventories of EU member states, total greenhouse gas emissions in

⁵ Cf. Energy Information Administration (ed.): 'International Energy Outlook', Washington D.C. 2003.

Table 1

Greenhouse Gas Emissions in the Countries with Quantified Emission Limitation or Reduction Obligations under the Kyoto Protocol (Annex B Countries)¹

	Base year 1990 (1995) ²	1990	1995	2000	2001	2002	1990(1995) ² to 2002	Reduction targets by 2008/12 ³
	Greenhouse gas emissions in million t CO ₂ equivalents						Changes (%)	
EU-15	4 246.6	4 231.7	4 119.9	4 092.8	4 142.0	4 121.8	-2.9	-8.0
Australia ⁴	430.5	430.5	451.7	512.9	520.1	526.0	22.2	8.0
Iceland	2.8	2.8	2.7	2.9	2.7	2.7	-4.1	10.0
Japan	1 237.0	1 187.3	1 327.0	1 336.7	1 302.3	1 330.8	7.6	-6.0
Canada	608.7	608.7	675.1	725.0	716.2	731.2	20.1	-6.0
New Zealand	61.6	61.6	64.8	70.4	73.7	75.0	21.6	0.0
Norway	52.1	52.1	51.7	55.4	56.7	55.3	6.1	1.0
Switzerland	53.1	53.1	52.0	52.3	53.4	52.3	-1.7	-8.0
USA ⁴	6 129.1	6 129.1	6 484.7	7 038.3	6 883.9	6 934.6	13.1	-7.0
Total Annex II countries ⁵	12 821.7	12 757.0	13 229.6	13 886.9	13 751.0	13 829.7	7.9	-6.7
Annex II countries without USA and Australia	6 262.1	6 197.4	6 293.2	6 335.6	6 347.0	6 369.1	1.7	-7.3
Bulgaria	141.8	122.1	85.9	63.6	64.9	62.4	-56.0	-8.0
Estonia	43.5	43.5	22.3	19.7	19.4	19.5	-55.2	-8.0
Croatia	31.6	31.6	22.3	26.1	26.9	28.0	-11.5	-5.0
Latvia	28.9	28.9	14.0	10.2	10.9	10.8	-62.8	-8.0
Lithuania ⁶	50.1	50.1	32.3	19.7	18.8	18.3	-63.5	-8.0
Poland ⁶	564.4	458.9	417.4	386.2	382.8	376.4	-33.3	-6.0
Romania	262.8	231.5	175.1	127.4	131.4	136.6	-48.0	-8.0
Russia ⁶	3 030.7	3 030.7	2 060.5	1 894.4	1 906.0	1 927.1	-36.4	0.0
Slovakia	72.4	72.4	53.7	49.0	51.7	51.2	-29.3	-8.0
Slovenia	20.6	18.7	19.0	19.2	20.3	20.4	-1.1	-8.0
Czech Republic	192.2	192.0	153.4	147.7	148.1	142.9	-25.6	-8.0
Ukraine ⁶	919.2	919.2	538.8	432.2	440.1	431.3	-53.1	0.0
Hungary	113.1	95.8	77.9	78.0	79.3	78.0	-31.0	-6.0
Total transition countries ⁷	5 471.4	5 295.5	3 672.6	3 273.4	3 300.5	3 302.8	-39.6	-2.0
Total Annex B countries	18 293.2	18 052.6	16 902.2	17 160.3	17 051.5	17 132.5	-6.3	-5.3
Annex B countries without USA and Australia	11 733.5	11 492.9	9 965.8	9 609.0	9 647.5	9 671.9	-17.6	-4.8

1 Greenhouse gas emissions excluding CO₂ emissions/removals from land-use change and forestry. — 2 Base year for CO₂, CH₄, N₂O is 1990. For HFC, PFC and SF₆, 1995 can be chosen as the base year. Transition countries can also use earlier years (Bulgaria and Poland 1988; Hungary 1985 to 1987; Romania 1989). Where data is available on other base years than 1990 the corresponding figures are taken from the national inventories; otherwise on principle the 1990 figures are used. — 3 Reduction targets compared with the base year; in the EU member states following the European burden sharing; figures for totals are weighted for changes. — 4 The USA and Australia no longer feel bound by the obligations laid down in the Kyoto Protocol. — 5 Annex II countries without Turkey, which is not an Annex B country, either. — 6 Most recent figures for Poland and Lithuania are for 2001, for Russia 1995 and for Ukraine 1998. These have been extrapolated to 2002 in accordance with the rates of change in CO₂ emissions. — 7 Countries in transition to the market economy (transition countries) include the EU accession countries Poland, Estonia, Latvia, Lithuania, Slovakia, the Czech Republic, Hungary and Slovenia.

Sources: UNFCCC; IEA; EIA; DIW Berlin calculations.

the EU-25 fell slightly in 2002 from the 2001 level (-0.7%). However, in 12 countries they rose by between 0.3% (Greece) and 10.3% (Luxembourg), while they fell in the other 13 countries by between 0.1% (Italy) and 3.5% (Czech Republic). Altogether the fall from the base year 1990 was around 490 million t of CO₂ equivalents, or a good 9%. However, three quarters of this was in the accession countries alone, where the reductions in emissions were in some cases more than 60% (cf. table 5).⁶

Within the EU-15 the picture is highly differentiated. In the 1990s only the reductions in Germany (base year 1990 to 2002: 237 million t) and Great Britain (111 mil-

⁶ It should be remembered that Poland chose 1988 as the base year, and this alone results in a difference between the figures for this base year and those for 1990 of 105 million t CO₂ equivalents. Altogether the choice of a different base year causes a difference of 140 million t for the EU-25.

Table 2

Energy-induced CO₂ Emissions from 1990 to 2003 in Selected Countries and Regions¹

	1990	1995	2000	2001	2002	2003	1990 to 2003	2002 to 2003
	CO ₂ emissions in million t						Changes (%)	
EU-15	3 172.5	3 116.4	3 173.0	3 238.9	3 230.9	3 295.5	3.9	2.0
Australia	258.6	282.4	330.2	335.4	340.1	336.5	30.1	-1.1
Iceland	1.7	1.8	1.8	1.8	1.8	1.8	5.2	0.0
Japan	1 048.3	1 132.2	1 161.4	1 139.0	1 174.3	1 216.5	16.0	3.6
Canada	431.7	460.9	532.9	525.9	536.9	553.5	28.2	3.1
New Zealand	22.9	24.3	28.1	30.1	30.8	31.7	38.6	2.8
Norway	28.4	30.6	33.6	35.1	34.7	35.8	26.0	3.3
Switzerland	39.7	39.5	39.7	40.6	39.5	38.9	-1.9	-1.6
USA	4 831.4	5 144.9	5 697.3	5 583.0	5 635.1	5 672.4	17.4	0.7
Total Annex II countries ²	9 835.2	10 233.0	10 997.9	10 929.7	11 024.1	11 182.7	13.7	1.4
Korea	226.2	370.2	421.7	435.8	454.6	465.4	105.7	2.4
Mexico	292.0	312.6	362.0	359.0	359.0	368.7	26.3	2.7
Poland	371.5	338.0	302.5	307.3	308.0	322.5	-13.2	4.7
Slovakia	55.7	41.1	36.9	39.3	38.9	39.6	-28.9	1.9
Czech Republic	160.1	128.4	125.0	122.8	118.0	120.2	-24.9	1.9
Turkey	128.8	155.4	203.7	188.0	181.0	184.0	42.8	1.6
Hungary	67.5	57.6	56.1	56.1	54.6	57.0	-15.7	4.4
Total OECD	11 137.0	11 636.2	12 505.7	12 438.0	12 538.2	12 740.0	14.4	1.6
PR China ³	2 289.5	3 009.6	3 035.5	3 112.6	3 259.2	3 720.4	62.5	14.2
Russia	2 326.0	1 567.3	1 428.0	1 436.7	1 452.7	1 514.3	-34.9	4.2
Ukraine	672.1	365.4	283.6	288.8	283.0	282.6	-57.9	-0.1
India	591.4	787.9	997.9	1 013.5	1 062.3	1 087.2	83.8	2.3
Africa	540.7	596.8	688.5	720.2	737.4	771.3	42.6	4.6
Middle East	585.2	782.2	999.7	1 044.6	1 082.8	1 106.4	89.1	2.2
Latin America	599.0	711.2	847.6	841.8	831.6	840.6	40.3	1.1
Asia ⁴	662.7	893.9	1 118.5	1 165.7	1 221.0	1 266.5	91.1	3.7
Other countries	1 835.6	1 662.9	1 795.9	1 861.2	1 929.3	2 003.3	9.1	3.8
Bunker ⁵	650.4	701.4	798.7	780.8	780.8	780.8	20.0	0.0
World ⁶	21 889.6	22 714.9	24 499.7	24 704.0	25 178.2	26 113.5	19.3	3.7
World ⁶ without PR China	19 600.1	19 705.2	21 464.2	21 591.4	21 919.1	22 393.0	14.2	2.2
Annex I countries ⁷	14 068.0	13 197.9	13 676.6	13 620.2	13 715.8	13 971.2	-0.7	1.9
Non-Annex I countries ⁷	7 171.2	8 815.5	10 024.4	10 303.1	10 681.6	11 361.5	58.4	6.4
Annex I economies in transition (EIT) ⁷	4 104.0	2 809.6	2 475.0	2 502.4	2 510.7	2 604.6	-36.5	3.7
Annex B countries ^{7, 8}	8 748.6	7 554.6	7 394.6	7 463.0	7 509.3	7 724.1	-11.7	2.9
Annex II countries ^{7, 9}	4 745.2	4 805.6	4 970.4	5 011.4	5 048.9	5 173.7	9.0	2.5

1 Energy-induced emissions for countries with national emission inventories in accordance with UNFCCC (all OECD countries except Turkey, Mexico and South Korea, and including Estonia, Latvia, Lithuania, Slovenia, Belarus, Bulgaria, Romania), for all other countries CO₂ emissions from fuel combustion using the sectoral approach. Data from the national emissions inventories for the above countries from 1990 to 2002, for the other countries from 1990 to 2001, from the International Energy Agency (IEA 2003). Estimates for 2003 or 2002 and 2003 with changes in CO₂ emissions that can be calculated on the basis of the energy consumption data in the BP Statistical Review of World Energy (BP 2004) and for Germany using the preliminary energy consumption data from the AG energy balance sheets. Data for countries, regions and groups of countries without international marine and aviation bunkers. — 2 Annex II countries without Turkey; OECD countries without South Korea, Mexico, Poland, Czech Republic, Hungary and Slovakia. — 3 Including Hong Kong. — 4 Without PR China, Hong Kong, Japan, Korea and India. — 5 Data for 2002 and 2003 as 2001. — 6 Including international marine and aviation bunkers, and taking into account the data for countries for which national emissions inventories are available. — 7 Without international marine and aviation bunkers, and taking into account the data for countries for which national emissions inventories are available. — 8 Annex I countries except Turkey and Belarus, and Australia and the USA, which do not intend to ratify the Kyoto Protocol. — 9 Without Australia and the USA, which do not intend to ratify the Kyoto Protocol.

Sources: INFCCC (national emissions inventories); IEA; EIA; BP; AG Energiebilanzen; calculations by DIW Berlin.

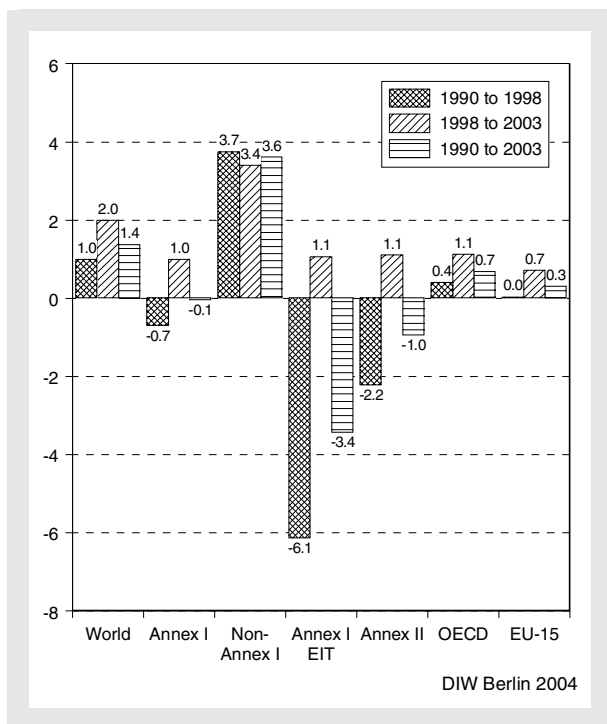
lion t) were of quantitative significance. Without these two countries greenhouse gas emissions in the EU-15 were one tenth higher in 2002 than in 1990. The southern European countries Spain, Italy, Greece and Portugal (a total of 208 million t) and Ireland (just under 16 million t) showed a particularly strong rise. Apart from Germany and Great Britain, emissions in 2002 were lower than in 1990 only in Luxembourg, Sweden and France and – slightly lower – in Denmark. Altogether, therefore there are considerable deviations between the reduction targets agreed and the level of emissions achieved to date (cf. figure 3).

Emissions of carbon dioxide (CO₂)

According to estimates by DIW Berlin emissions of CO₂ in the EU-25 were 2.2% higher in 2003 than a year before (cf. table 6). With the exception of Ireland they rose in every member state, with a particularly strong increase in Finland, Denmark and Austria; the rise in Germany was comparatively weak (+0.4%).

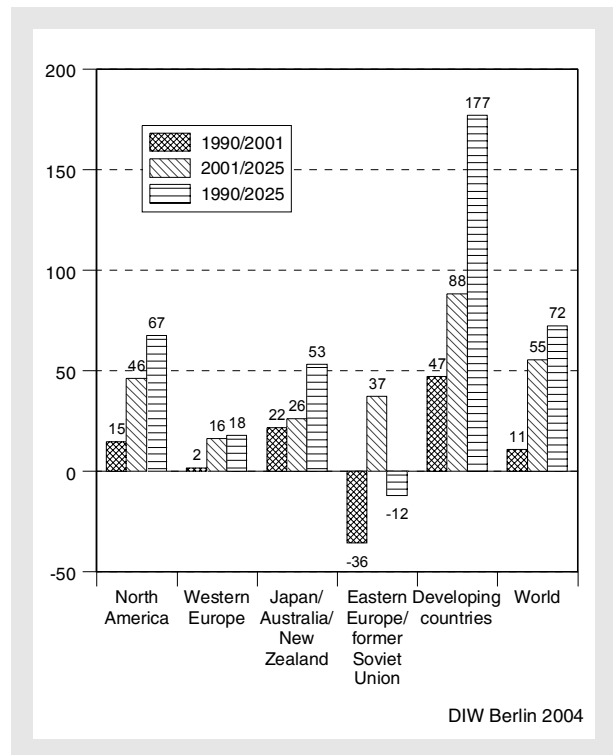
In the period 1990 to 2003 the rise throughout the EU was rather slight at 0.3%, but this was primarily due to

Figure 1
Energy-induced Worldwide CO₂ Emissions from 1990 to 2003 by Groups of Countries
Annual average changes (%)



Sources: UNFCCC; IEA; BP; DIW Berlin calculations.

Figure 2
Worldwide CO₂ Emissions According to the Reference Scenario of the Energy Information Administration
Changes (%)



Source: EIA 2004.

the development in the accession countries (a fall of about 17%) and the major reductions in Germany and Great Britain. In most of the EU-15 countries CO₂ emissions rose strongly, as in Portugal at around 56%, and Spain by nearly 50%. Without Germany and Great Britain emissions in the EU-15 were nearly one fifth higher in 2003 than in 1990.

The sectoral change in CO₂ emissions

The sectoral distribution of CO₂ emissions and their changes in the individual EU member states (cf. table 7) give an indication of which structural changes have most influenced the development in emissions in the EU-25 since 1990. The powerful rise in transport emissions is particularly striking. In Europe as a whole they were nearly one fifth higher in 2002 than in 1990 and now account for nearly one quarter of total CO₂ emissions. In some EU countries traffic and transport emissions now account for more than one third (Sweden, France and Latvia), while their increase was clearly below the EU average in Finland, Great Britain, Ger-

The People's Republic of China: Contradictory Data

The changes in world greenhouse gas emissions are influenced to a very considerable extent by the development in the People's Republic of China. However, the data on the energy consumption that causes the emissions is contradictory, especially the information on the production and consumption of coal, and here particularly for the years since 1995. According to the data published by BP primary energy consumption and

coal production in the People's Republic of China have leaped up dramatically. These figures show coal consumption falling by nearly 230 million toe, or one third, from 1997 to 2000 and then rising by nearly 350 million toe or around three quarters, between 2000 and 2003. The changes in coal production are similar (cf. table 3).

Table 3

Consumption and Production of Coal in the PR China¹ from 1995 to 2003

Sources	Unit	1995	1996	1997	1998	1999	2000	2001	2002	2003
Coal consumption (primary)										
BP ²	Million toe	677.5	685.8	685.2	612.7	496.2	458.7	522.6	699.6	806.3
IEA ³	Million toe	670.8	698.7	681.5	675.2	658.0	659.3	642.3	n.a.	n.a.
Coal production										
BP ²	Million toe	651	692	666	620	524	502	547	732	843
IEA ³	Million toe	691	718	714	694	670	678	699		
IEA ⁴	Mill. metr. t						1 231	1 268	1 326	1 562
Coal statistics ⁵	Mill. metr. t	1 291	1 393	1 352	1 236	1 045	1 005	940	1 045	1 350
Coal importers ⁶	Million t			1 330	1 218	1 023	950	956	1 393	1 736

n.a. = data not available. — 1 Incl. Hong Kong. — 2 BP Statistical Review of World Energy, June 2004. — 3 IEA: Energy Balances of Non-OECD Countries ... 2002 and 2003, Paris 2002 and 2004. — 4 Oil, Gas, Coal and Electricity Quarterly Statistics, first quarter 2004, vol. 2004, no. 3, IEA, Paris. In the first three quarters of 2003 coal production rose over the same periods of the previous year by 18.5%; the figure shown for the year 2003 results from growth in production in the fourth quarter of 2003 and a comparison of the third quarters. — 5 Statistik der Kohlenwirtschaft e.V. (www.kohlenstatistik.de). — 6 Verein der Kohlenimporteure, Annual Report for 2003. Source: BP Statistical Review of World Energy, June 2004.

However, the International Energy Agency (IEA) regards this development as unlikely. It comments:

'Since 1997, Chinese coal production has been declining for several reasons. Among these are: a switch to higher quality coal, implementation of environmental regulations, especially in urban areas, changes in economic structure,

new fuel mix policies in power generation, shutdown of thousands of small mines and the strict implementation of state-supported energy efficiency policies. However, analyses of original Chinese coal production and consumption data show that the drop in production is much more significant than the drop in consumption, which creates very big

many and Sweden. In the Baltic states they were still lower in 2001 than in 1990.

Emissions by industry and construction showed a very heterogeneous development. With an average fall of around 14% the range is from a drop of 80% in Lithuania (1990 to 2001) and about one third in Germany to a rise of two fifths in Spain. In nine of the 15 'old' EU countries industrial emissions were lower in 2002 than in 1990. The only slight rise in the EU-15 was in the energy industry (0.6%). The low increase was mainly due to the strong falls in Germany, Great Britain and France, while emissions in this sector rose in almost every other country. In the accession countries, on the other hand, emissions in the energy sector fell drasti-

cally, except in Slovenia, the Czech Republic and Hungary. But with an average share of nearly 37% the energy sector is still by far the biggest CO₂ emitter in the EU-25, followed by transport, the other sectors (i.e. private households, trade and commerce, and services) and industry and construction.

The emissions trading that will start in 2005 in the EU will initially be largely limited to the energy and industry sectors; but together these sectors (including process-induced industrial emissions) account for more than half of total CO₂ emissions in almost every EU country, with a range from one third in Luxembourg to around 87% in Estonia and Slovakia. On average for the EU-25 the share is just under 58%; it is nearly three

statistical differences after 1997. Based upon the assumptions that coal consumption statistics are more reliable than coal production statistics, that the production-consumption relationship should maintain a better balance over time, that changes in the number of miners working in the coal mines and coal productivity trends reflect higher production, the IEA has revised Chinese coal production statistics upward. It should be noted that these data are IEA estimates and in no case represent official data released by the Chinese government.¹

Paul Suding, head of the GTZ environmental programme in Beijing, also points out in a personal memorandum that the coal balance data from 1998 to 2001 does not reflect the real situation. After the Coal Ministry was dissolved in 1997 and the coal sector was changed to a 'kind of market economy' the references for statistical reporting were capped and the com-

¹ Cf. 'Energy Balances of Non-OECD Countries 1999-2000', Paris 2002, p. I.26.

petences changed. At the same time mine closures were ordered, and this resulted in considerable amounts of illegal mining. In addition, the use of high sulphur content coal was forbidden, but trade in this coal and its use in heating plants, in industry and in public power stations continued. The closure of old power stations with output below 30 MW was also ordered, but the order was not always obeyed. During these years a confused situation evolved, with illegal trade in coal flourishing and the compilation of statistics not functioning.

In view of this it is not surprising that the available data on CO₂ emissions in the People's Republic of China show considerable divergences in some cases. After weighing the different sources the data published by the International Energy Agency has been used here for the years 1990 to 2001; for the estimates of the current situation the changes from 2001 to 2002 given by the Energy Information Administration and the changes from 2002 to 2003 calculated from the BP energy data (cf. table 4) have been used as the basis for the data on China given here.

Table 4

Data on the Development in CO₂ Emissions in the PR China¹ from 1990 to 2003

In million tonnes

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003
EIA data ²	2 302	2 935	2 990	3 063	2 999	2 970	3 068	3 232	3 384	n.a.
IEA data ³	2 290	3 010	3 177	3 099	3 142	3 017	3 035	3 113	n.a.	n.a.
DIW estimate variant I ⁴	2 459	3 161	3 237	3 274	3 007	2 616	2 549	2 814	3 547	4 049
DIW estimate variant II ⁵	2 290	3 010	3 177	3 099	3 142	3 017	3 036	3 113	3 929	4 487
DIW estimate variant chosen ⁶	2 290	3 010	3 177	3 099	3 142	3 017	3 036	3 113	3 259	3 720

n.a. = data not available.

¹ Including Hong Kong. — ² EIA: World Carbon Dioxide Emissions from the Consumption and Flaring of Fossil Fuels 1980-2002, International Energy Annual 2002, Washington D.C., March to July 2004 (www.ela.doe.gov/emeu/international/enviro.html#intlCarbon). — ³ IEA: CO₂ Emissions from Fuel Combustion ... 2002 and 2003, Paris 2002 and 2003. — ⁴ Estimated on the basis of the development in energy source structured primary energy consumption according to data in the BP Statistical Review of World Energy, June 2004, and using specific CO₂ emission factors (coal: 3.85 t CO₂/toe; crude oil: 3.03 t CO₂/toe; natural gas: 2.275 t CO₂/toe. — ⁵ 1990 to 2001 as IEA 2002 and 2003, extrapolated using the emissions calculated on the basis of the BP Statistical Review. — ⁶ 1990 to 2001 as IEA 2002 extrapolated with the changes in emissions from the EIA and 2003 with the emissions calculated on the basis of the BP Statistical Review. Sources: BP; IEA; DIW Berlin calculations.

quarters in the accession countries and around 55% in the EU-15. Consequently, the sectors not participating in emissions trading account for 45% of all emissions in the EU-15.

Factors influencing the development in carbon dioxide emissions

The changes in emissions of carbon dioxide can be traced to various factors. The most important are the developments in size of population (the demographic component), in per capita gross domestic product (the

income component), in energy intensity in the economy as a whole (the energy intensity component) and in the CO₂ content of the consumption of primary energy (the energy mix component).

The influence of these factors on the changes in CO₂ emissions in the period from the base year 1990 to 2002 has been estimated for the Annex II countries using 'component analysis' (cf. table 8 and figure 4).⁷ This

⁷ On the component analysis method used here see Jochen Diekmann, Wolfgang Eichhammer, Anja Neubart, Heilwig Rieke, Barbara Schlomann and Hans-Joachim Ziesing: 'Energie-Effizienzindikatoren: Statistische Grundlagen, theoretische Fundierung und Orientierungsbasis für die politische Praxis', Heidelberg 1999.

Table 5

Greenhouse Gas Emissions in the EU-25 from 1990 to 2002 and Targets for 2008/12

	Base year 1990 (1995) ¹	1990	1995	2000	2001	2002	Changes base year 1990(1995) ¹ to 2002		Emission target by 2008/2012		Reduction in emission needed by 2008/2012 from 2002	
	Million t CO ₂ equivalents						%		Million t CO ₂ equivalents		%	
Belgium	147.2	146.1	154.9	149.9	149.5	150.3	3.1	2.1	-7.5	136.2	-14.2	-9.4
Denmark	69.0	68.7	77.0	67.8	69.3	68.5	-0.5	-0.8	-21.0	54.5	-14.0	-20.4
Germany	1 251.7	1 246.8	1 099.1	1 014.1	1 025.6	1 014.6	-237.1	-18.9	-21.0	988.9	-25.8	-2.5
Finland	76.8	76.8	76.3	75.0	80.6	82.0	5.2	6.8	0.0	76.8	-5.2	-6.3
France	564.2	564.2	559.6	557.6	561.2	553.4	-10.8	-1.9	0.0	564.2	10.8	2.0
Greece	109.4	107.1	112.8	133.8	134.6	135.0	25.6	23.4	25.0	136.8	1.8	1.3
Great Britain	746.0	742.6	686.1	647.7	656.2	634.9	-111.2	-14.9	-12.5	652.8	17.9	2.8
Ireland	53.4	53.2	57.6	68.3	70.0	68.9	15.5	28.9	13.0	60.4	-8.5	-12.4
Italy	508.2	509.1	524.6	544.0	554.3	553.8	45.6	9.0	-6.5	475.2	-78.6	-14.2
Luxembourg	12.8	12.8	10.0	9.5	9.8	10.8	-1.9	-15.1	-28.0	9.2	-1.6	-15.2
Netherlands	212.5	211.4	224.5	213.4	216.1	213.8	1.3	0.6	-6.0	199.7	-14.0	-6.6
Austria	78.0	77.7	79.4	80.6	84.4	84.6	6.6	8.5	-13.0	67.9	-16.8	-19.8
Portugal	58.4	58.4	67.9	78.3	78.6	81.9	23.6	40.4	27.0	74.1	-7.8	-9.5
Sweden	72.3	72.1	73.8	67.5	68.3	69.6	-2.7	-3.7	4.0	75.1	5.5	8.0
Spain	286.8	284.6	316.5	385.2	383.5	399.7	112.9	39.4	15.0	329.8	-69.9	-17.5
EU-15	4 246.6	4 231.7	4 119.9	4 092.8	4 142.0	4 121.8	-124.9	-2.9	-8.0	3 901.5	-220.3	-5.3
EU-15 excl. Germany and Great Britain	2 248.9	2 242.2	2 334.7	2 431.0	2 460.2	2 472.3	223.4	9.9	0.5	2 259.8	-212.5	-8.6
Estonia	43.5	43.5	22.3	19.7	19.4	19.5	-24.0	-55.2	-8.0	40.0	20.5	105.2
Latvia	28.9	28.9	14.0	10.2	10.9	10.8	-18.2	-62.8	-8.0	26.6	15.9	147.4
Lithuania ²	50.1	50.1	32.3	19.7	18.8	18.3	-31.8	-63.5	-8.0	46.1	27.8	151.9
Malta ³	2.3	2.3	2.2	2.3	2.1	2.1	-0.2	-8.7	-8.0	2.1	0.0	0.8
Poland ²	564.4	458.9	417.4	386.2	382.8	376.4	-188.0	-33.3	-6.0	530.6	154.1	40.9
Slovakia	72.4	72.4	53.7	49.0	51.7	51.2	-21.2	-29.3	-8.0	66.6	15.5	30.2
Slovenia	20.6	18.7	19.0	19.2	20.3	20.4	-0.2	-1.1	-8.0	19.0	-1.4	-7.0
Czech Republic	192.2	192.0	153.4	147.7	148.1	142.9	-49.3	-25.6	-8.0	176.8	33.9	23.7
Hungary	113.1	95.8	77.9	78.0	79.3	78.0	-35.1	-31.0	-6.0	106.3	28.3	36.3
Cyprus	3.9	3.9	5.1	6.3	6.2	6.2	2.3	59.8	-8.0	3.6	-2.6	-42.4
Total accession countries	1 091.4	966.7	797.2	738.3	739.5	725.8	-365.7	-33.5	-6.8	1 017.7	291.9	40.2
Total EU-25	5 338.1	5 198.4	4 917.1	4 831.1	4 881.5	4 847.5	-490.6	-9.2	-7.8	4 919.1	71.6	1.5

1 Base year for CO₂, CH₄, N₂O is 1990, for HFC, PFC and SF 1995 can be chosen as the base year; transition countries can also use earlier years or periods (Poland 1988, Hungary 1985 to 1987). Where data on other base years than 1990 is available the corresponding figures from the national inventories are taken, otherwise on principle the figures for 1990 are used. — 2 Data for 2002 estimated. — 3 CO₂ emissions (some estimated), as no information on greenhouse gas emissions was available. Sources: National emission inventories of EU member states, 2004 edition; DIW Berlin calculations.

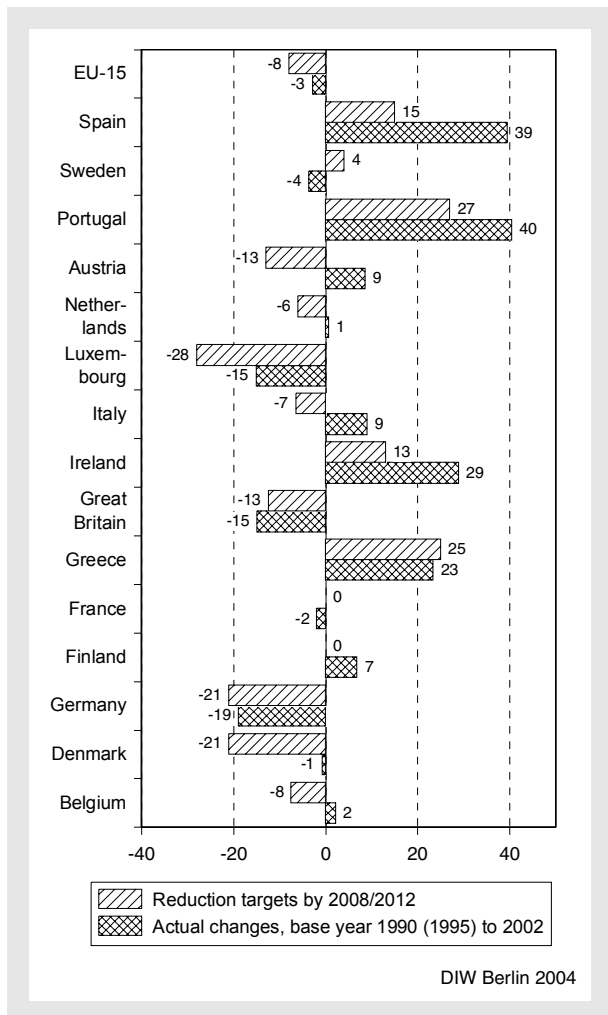
shows that the rise in emissions in this group of countries, in total almost 1.2 billion t CO₂, can be explained by the rises in per capita GDP (1862 million t) and in the number of inhabitants (824 million t). The effect of falling energy intensity (1083 million t) and the changes in the energy structure in favour of non-emitting or low-emitting energy sources (414 million t) was not nearly enough to compensate for the influence of these two factors.

In the EU-15 too, the increases due to the income and demographic components exceeded the effects of the energy mix and energy intensity components in reducing emissions; on balance the increase was around 58 million t CO₂. The picture is more differentiated for the individual Annex II countries:

In itself the *population factor* brought an increase in CO₂ emissions in every country. Measured by the relative contribution this is particularly marked in the big-

Figure 3
Changes in Greenhouse Gas Emissions in the EU-15: Development 1990 (1995) to 2002 and Reduction Targets by 2008/2012

Changes (%)



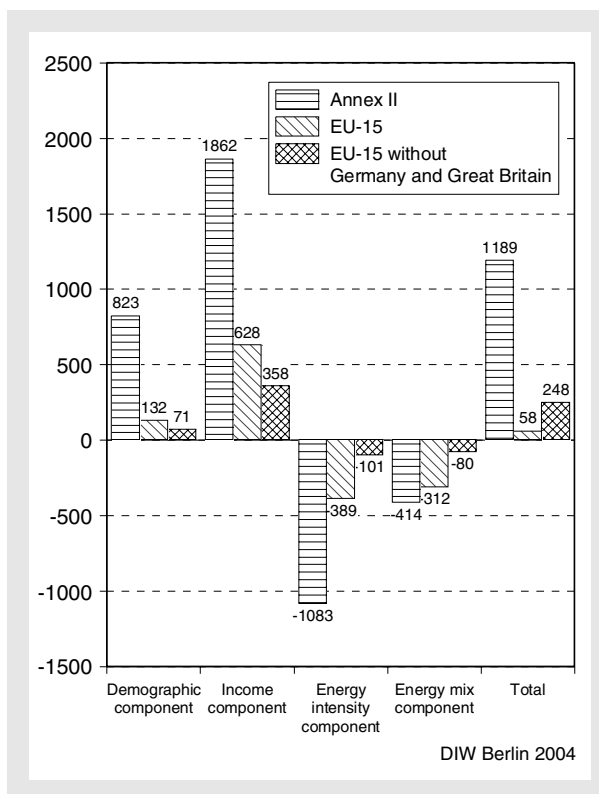
Sources: UNFCCC (national emission inventories); DIW Berlin calculations.

ger countries, especially Australia/New Zealand, the United States and Canada. Altogether, around 8.4% higher CO₂ emissions (4.1% in the EU-15) are due to the demographic development in the Annex II countries.

The *income effect*, that is the increase in real GDP per inhabitant, also contributed to the increase in emissions in every country, with the relative influence particularly marked in the small countries, such as Ireland and Luxembourg, and also very marked in Norway, Spain, Australia/New Zealand and Portugal. The income effect was weakest in Switzerland, Japan and Germany. In all the Annex II countries together the rise in per capita incomes alone led to 18.9% higher CO₂ emissions (EU-15 19.8%).

Figure 4
The Influence of Various Components on the Absolute Changes in Carbon Dioxide Emissions in the Annex II Countries in 2002 against 1990

Changes in million t CO₂



Sources: UNFCCC; IEA; Eurostat; World Bank; DIW Berlin calculations.

The *energy intensity effect* differs widely. It reduced emissions in every Annex II country except for Iceland, Portugal and Spain. The reduction was particularly marked in Ireland and Luxembourg, followed after a big gap by Germany, Norway, Great Britain and the United States. In Iceland, Portugal and Spain; on the other hand, energy productivity has deteriorated markedly. In Japan particularly, and also in Switzerland and Finland, there was hardly any progress in energy productivity. The energy intensity effect reduced CO₂ emissions for the Annex II countries as a whole by 11.0% (EU-15 12.3%).

There are serious differences between the individual countries in both development and level of energy productivity (cf. table 9).⁸ By far the lowest level of productivity (data for 2002) was in Iceland, Canada, the United States and Australia/New Zealand. Countries with the

⁸ Energy productivity is defined as the relation between real GDP and primary energy consumption in an economy.

Table 6

Energy-induced CO₂ Emissions from 1990 to 2003 in the EU-25¹

	1990	1995	2000	2001	2002	2003	1990 to 2003	2002 to 2003
	CO ₂ emissions in million t						Changes (%)	
Belgium	108.8	114.0	114.3	114.4	115.3	119.3	9.6	3.5
Denmark	51.5	59.6	51.2	52.8	52.5	57.2	11.2	9.1
Germany	988.9	876.1	835.0	850.6	841.4	844.5	-14.6	0.4
Finland	57.4	59.4	58.5	64.0	65.7	74.6	29.8	13.4
France	368.4	370.3	384.6	389.9	384.5	392.8	6.6	2.2
Greece	76.5	79.8	95.8	97.9	97.8	102.6	34.2	4.9
Great Britain	568.7	534.2	529.3	543.7	526.7	531.2	-6.6	0.9
Ireland	29.8	32.6	41.4	43.5	42.7	41.0	37.9	-3.8
Italy	402.7	420.3	436.2	443.2	443.0	456.5	13.4	3.0
Luxembourg	10.5	9.0	8.2	8.6	9.4	9.7	-7.5	3.5
Netherlands	158.1	170.9	169.5	175.7	174.7	175.7	11.1	0.6
Austria	53.2	55.0	57.3	61.2	62.0	67.1	26.1	8.3
Portugal	40.0	48.3	58.0	58.3	61.8	62.6	56.4	1.3
Sweden	51.5	53.1	48.2	48.9	50.5	52.2	1.3	3.2
Spain	206.4	233.7	285.5	286.4	302.9	308.4	49.4	1.8
EU-15	3 172.5	3 116.4	3 173.0	3 238.9	3 230.9	3 295.5	3.9	2.0
Estonia	37.5	19.1	16.5	16.7	17.0	17.0	-54.7	
Latvia	21.6	10.3	6.7	7.1	7.0	7.0	-67.5	
Lithuania	36.7	22.8	12.0	10.8	10.5	10.9	-70.4	3.3
Malta ²	2.3	2.2	2.3	2.1	2.1	2.1	-8.7	
Poland	371.5	338.0	302.5	307.3	308.0	322.5	-13.2	4.7
Slovakia	55.7	41.1	36.9	39.3	38.9	39.6	-28.9	1.9
Slovenia ²	13.5	14.0	14.4	15.4	15.5	15.5	14.2	
Czech Republic	160.1	128.4	125.0	122.8	118.0	120.2	-24.9	1.9
Hungary	67.5	57.6	56.1	56.1	54.6	57.0	-15.7	4.4
Cyprus ²	3.9	5.1	6.3	6.2	6.2	6.2	59.8	
EU accession countries	672.3	584.0	541.1	547.1	541.1	561.0	-16.6	3.7
EU-25	3 844.7	3 700.4	3 714.1	3 786.0	3 772.0	3 856.5	0.3	2.2

¹ Energy-induced emissions from data in the national emission inventories of all EU-25 countries except Malta and Cyprus for 1990 to 2002; for Malta and Cyprus IEA data on combustion-induced CO₂ emissions 1990 to 2001. Estimates for 2003, or 2002 and 2003, with the changes in CO₂ emissions calculated on the basis of the energy consumption data in the BP Statistical Review of World Energy (BP 2004) or for Germany using the preliminary energy consumption data in the AG Energiebilanzen. All data without international marine and aviation bunkers. — ² Data for 2002 and 2003 (Malta and Cyprus) as 2001, and 2003 as 2002 (Estonia, Latvia and Slovenia). Sources: UNFCCC (national emission inventories); IEA; BP; AG Energiebilanzen; DIW Berlin calculations.

highest productivity are Switzerland, Japan and Denmark; Germany is only slightly lower.⁹ Measured by the average annual improvements in energy productivity in the period 1990 to 2002, which accounted for 0.9% on average for the Annex II countries (EU-15 1.0%), Ireland and Luxembourg are far ahead, followed after a clear gap by Germany (1.9%), Great Britain (1.7%) and Norway (1.5%).

The changes in the structure of energy sources led to a reduction in CO₂ emissions in every country except

⁹ This also reflects the 'reunification effect', which brought a rapid increase in energy productivity in the early 1990s; for the period 1993 to 2002 the average annual increase in productivity was 'only' 1.2%.

Portugal, Canada, Australia/New Zealand and Spain, so that in the other countries the energy mix shifted towards non-emittent or low-emittent energy sources, especially natural gas. Particularly in Iceland, Luxembourg, Great Britain, Germany, France, Sweden and Belgium this factor played a major part. Altogether emissions were reduced by 4.2% in this group of countries (EU-15 9.8%) by the changes in the energy mix.

With the exception of Germany, Luxembourg, Great Britain and Sweden the effects of the income and demographic components in increasing emissions were greater in all the Annex II countries than the effects of the energy mix and energy intensity components in reducing emissions. That applies most to Portugal,

Table 7

The Structure and Changes in CO₂ Emissions in the EU-25¹ from 1990 to 2002 by Sector

	Energy-induced emissions					Industrial processes	Other areas ³	Total CO ₂ emissions ⁴	Memo item: energy and industry ⁵
	Total	Of which:							
		Energy industry	Industry and construction	Transport	Other sectors ²				
Sectoral structure in 2002 (%)									
Belgium	91.1	20.9	26.8	19.7	23.6	7.8	1.1	100.0	55.6
Denmark	96.8	49.0	10.3	22.7	14.9	2.9	0.2	100.0	62.2
Germany	97.4	41.3	15.3	20.4	20.4	2.6	0.0	100.0	59.2
Finland	94.6	41.6	19.0	18.4	15.5	1.4	4.0	100.0	62.1
France	94.7	14.6	20.0	35.0	25.1	4.5	0.8	100.0	39.2
Greece	92.7	52.2	9.6	19.2	11.6	7.1	0.1	100.0	69.0
Great Britain	98.0	36.1	15.6	22.9	23.4	1.9	0.1	100.0	53.7
Ireland	93.2	35.4	10.7	24.5	22.6	6.6	0.2	100.0	52.6
Italy	94.5	32.7	18.1	26.6	17.1	5.2	0.3	100.0	56.0
Luxembourg	92.2	2.6	22.9	53.1	13.6	7.7	0.1	100.0	33.2
Netherlands	98.9	36.1	20.3	20.5	22.0	1.1	0.0	100.0	57.5
Austria	89.0	21.5	17.9	29.6	19.9	10.7	0.3	100.0	50.2
Portugal	91.6	36.7	14.8	29.4	10.7	7.4	1.0	100.0	58.9
Sweden	92.3	22.5	19.0	36.6	14.3	7.4	0.3	100.0	48.8
Spain	93.1	34.8	19.0	28.1	11.2	6.5	0.5	100.0	60.2
EU-15	95.5	33.9	17.2	24.9	19.5	4.1	0.4	100.0	55.2
Estonia ⁶	97.9	81.5	3.4	11.2	1.8	2.1	0.0	100.0	87.0
Latvia ⁶	96.3	35.1	11.8	35.5	14.0	2.3	1.4	100.0	49.1
Lithuania ⁶	91.7	45.3	8.8	28.6	8.9	8.3	0.0	100.0	62.5
Poland ⁶	96.7	56.0	14.8	9.5	16.4	3.3	0.0	100.0	74.1
Slovakia	91.5	78.3	0.0	13.2	0.0	8.2	0.3	100.0	86.5
Slovenia ⁶	94.6	38.3	14.5	23.2	18.6	5.2	0.2	100.0	57.9
Czech Republic ⁶	95.9	46.5	27.2	9.4	12.8	3.5	0.5	100.0	77.3
Hungary	100.0	36.1	18.6	17.0	28.4	0.0	0.0	100.0	54.6
Total accession countries ¹	96.3	53.5	16.3	11.5	15.0	3.5	0.2	100.0	73.3
EU-25 ¹	95.6	36.8	17.1	22.9	18.9	4.0	0.3	100.0	57.9
Changes from 1990 to 2002 (%)									
Belgium	6.0	-6.0	2.4	25.3	8.7	14.8	53.3	7.0	0.5
Denmark	1.9	1.4	3.2	18.1	-15.3	51.7	-9.6	2.9	3.3
Germany	-14.9	-13.8	-32.7	8.6	-18.5	-15.0	0.0	-14.9	-19.7
Finland	14.4	56.3	-7.9	2.5	-10.8	-15.8	-27.9	11.3	26.8
France	4.4	-12.2	-1.8	19.2	3.1	-21.7	-24.6	2.5	-8.6
Greece	27.9	27.3	3.6	32.2	52.9	22.0	-8.9	27.4	22.8
Great Britain	-7.4	-14.9	-10.7	5.3	-3.3	-27.8	-57.0	-8.0	-14.2
Ireland	43.4	46.5	27.6	123.7	5.0	56.1	19.2	44.1	43.3
Italy	10.0	15.3	-3.3	22.7	-0.3	-6.7	-33.3	8.8	6.4
Luxembourg	-10.6	-79.2	-55.5	99.0	8.8	-45.1	-69.7	-14.9	-57.4
Netherlands	10.5	24.3	-15.2	23.3	10.3	25.9	0.0	10.0	6.8
Austria	16.5	11.4	-4.1	61.5	-0.7	1.5	-32.5	14.4	3.3
Portugal	54.5	53.1	8.9	89.6	71.6	27.9	198.1	52.9	35.9
Sweden	-1.9	20.7	-2.8	9.4	-36.7	0.5	-42.0	-2.0	7.4
Spain	46.8	46.3	41.2	59.0	31.6	27.1	-18.1	44.8	42.4
EU-15	1.8	0.6	-10.6	20.7	-3.5	-4.7	-24.7	1.4	-3.6
Estonia ⁶	-55.3	-53.2	-77.8	-28.7	-87.2	-42.1	0.0	-55.1	-55.0
Latvia ⁶	-66.9	-74.5	-47.6	-42.2	0.0	-66.4	-0.3	-66.6	-70.5
Lithuania ⁶	-70.6	-67.3	-80.6	-41.7	-88.6	-55.5	0.0	-69.7	-69.2
Poland ⁶	-17.3	-24.8	-5.6	3.5	0.0	14.1	0.0	-16.5	-20.4
Slovakia	-30.3	-34.3	0.0	10.2	0.0	-10.9	0.0	-28.7	-32.6
Slovenia ⁶	13.7	-0.1	-22.1	42.3	86.9	-16.9	-2.8	11.6	-8.2
Czech Republic ⁶	-23.3	0.6	-41.3	65.8	-52.2	33.8	27.1	-21.9	-18.9
Hungary	-19.2	-2.2	-41.3	16.1	0.0	-100.0	-100.0	-24.0	-28.2
Total accession countries ¹	-24.9	-25.8	-30.4	5.6	-31.5	-16.4	16.0	-24.6	-26.5
EU-25 ¹	-3.4	-6.6	-14.1	19.4	-8.0	-6.4	-22.7	-3.6	-8.9

1 Without Malta and Cyprus. — 2 Including fugitive emissions from fuels. — 3 Solvent and other product use, agriculture, waste, other; without land-use change and forestry (LUCF). — 4 Without land-use change and forestry (LUCF). — 5 Including industrial processes. — 6 Data for 2001; changes in 2001 from 1990.

Sources: National emission inventories of EU member states; DIW Berlin calculations.

Table 8

The Influence of Various Components on the Absolute and Relative Changes in Carbon Dioxide Emissions in the Annex II Countries in 2002 from 1990

	Demographic component		Income component		Energy intensity component		Energy mix component		Total carbon dioxide emissions	
	Changes in CO ₂ emissions									
	Absolute ¹	Relative ²	Absolute ¹	Relative ²	Absolute ¹	Relative ²	Absolute ¹	Relative ²	Absolute ¹	Relative ²
Belgium	3.4	3.1	22.3	20.5	-8.2	-7.5	-11.0	-10.1	6.5	6.0
Denmark	2.3	4.5	11.6	22.4	-7.8	-15.1	-5.1	-9.9	1.0	1.9
Germany	35.3	3.6	147.3	14.9	-207.5	-21.0	-122.5	-12.4	-147.4	-14.9
Finland	2.6	4.5	11.2	19.5	-1.5	-2.6	-4.0	-7.0	8.3	14.4
France	18.0	4.9	64.2	17.4	-23.0	-6.2	-43.2	-11.7	16.1	4.4
Greece	4.8	6.2	22.1	28.9	-3.5	-4.6	-2.0	-2.6	21.3	27.9
Great Britain	25.2	4.4	123.4	21.7	-112.2	-19.7	-78.5	-13.8	-42.1	-7.4
Ireland	4.0	13.6	26.5	88.9	-17.2	-57.9	-0.4	-1.2	12.9	43.4
Italy	5.5	1.4	71.1	17.7	-24.0	-6.0	-12.2	-3.0	40.3	10.0
Luxembourg	1.5	14.3	4.4	41.4	-4.6	-43.2	-2.4	-23.1	-1.1	-10.6
Netherlands	12.5	7.9	38.0	24.1	-24.1	-15.2	-9.9	-6.3	16.5	10.5
Austria	3.1	5.8	11.6	21.8	-3.9	-7.4	-2.0	-3.7	8.8	16.5
Portugal	2.5	6.2	12.4	30.9	5.0	12.5	1.9	4.8	21.8	54.5
Sweden	2.1	4.2	9.3	18.1	-6.9	-13.3	-5.6	-10.8	-1.0	-1.9
Spain	10.8	5.2	66.9	32.4	14.4	7.0	4.4	2.1	96.6	46.8
EU-15	131.6	4.1	628.2	19.8	-389.2	-12.3	-312.1	-9.8	58.4	1.8
EU-15 excl. Germany and Great Britain	70.7	4.4	357.8	22.2	-100.7	-6.2	-79.9	-5.0	247.9	15.4
Australia/New Zealand	45.8	16.3	86.6	30.8	-50.2	-17.8	7.4	2.6	89.5	31.8
Iceland	0.2	11.3	0.3	18.3	0.3	17.3	-0.7	-41.8	0.1	5.2
Japan	32.0	3.1	135.3	12.9	-3.2	-0.3	-38.1	-3.6	126.0	12.0
Canada	58.6	13.6	99.5	23.1	-72.0	-16.7	19.0	4.4	105.1	24.3
Norway	2.1	7.5	10.3	36.4	-5.9	-20.6	-0.4	-1.3	6.2	22.0
Switzerland	3.3	8.3	0.5	1.3	-0.7	-1.8	-3.2	-8.1	-0.1	-0.3
USA	761.7	15.8	1 043.7	21.6	-904.1	-18.7	-97.7	-2.0	803.7	16.6
Total Annex II countries	823.5	8.4	1 861.7	18.9	-1 082.5	-11.0	-413.8	-4.2	1 188.9	12.1

¹ Changes in million t CO₂. — ² Relative changes from 1990 (%).

Sources: European Commission; UNFCCC (national emission inventories); IEA; DIW Berlin calculations.

Spain, Ireland and Australia/New Zealand. Altogether CO₂ emissions in this group of countries were around 12% higher in 2002 than in 1990.

Conclusion: further than ever from the reduction targets

The development in world emissions of greenhouse gases and CO₂ gives no reason to assume that the targets agreed by the international community in Kyoto in

1997 are being reached. Moreover, the United States and Australia no longer feel bound by the agreements made then. On the contrary, it is evident that as a whole the Annex II countries have done anything but embark on a path to reduce emissions. Instead of the reduction originally agreed they registered a clear increase between 1990 and 2002, and the rise in CO₂ emissions in 2003 indicates that this trend is continuing. The situation is hardly better in the EU-15, where most member states are still far from fulfilling the reduction obligations which they undertook as part of European burden sharing.¹⁰

Table 9

The Development in Energy Productivity in the Annex II Countries from 1990 to 2002

	1990	1995	2000	2001	2002	1990/2002
	In 1000 US \$ (at 1995 prices) per t oil units					Change (%) per year
Iceland	3.09	2.93	2.69	2.67	2.62	-1.4
Canada	2.56	2.51	2.82	2.89	2.96	1.2
USA	3.38	3.51	3.89	3.98	4.02	1.4
Australia/New Zealand	3.65	3.93	4.07	4.27	4.25	1.3
Finland	4.60	4.38	4.97	4.88	4.71	0.2
Portugal	5.55	5.18	5.13	5.19	5.03	-0.8
Greece	4.98	5.01	5.00	5.05	5.19	0.3
Spain	5.94	5.66	5.66	5.66	5.61	-0.5
Belgium	5.25	5.26	5.34	5.41	5.65	0.6
Sweden	5.15	4.97	6.14	5.76	5.89	1.1
Great Britain	4.90	5.09	5.66	5.70	6.01	1.7
Netherlands	5.61	5.75	6.59	6.52	6.48	1.2
Luxembourg	4.17	5.35	6.96	6.77	6.49	3.7
Norway	5.70	6.20	6.85	6.81	6.85	1.5
France	6.48	6.45	6.88	6.79	6.89	0.5
Italy	6.75	6.82	7.03	7.12	7.15	0.5
Germany	6.24	7.18	7.82	7.65	7.82	1.9
Ireland	5.00	5.85	7.40	7.40	7.83	3.8
Austria	8.41	8.66	9.34	8.79	9.00	0.6
Denmark	9.30	8.99	10.61	10.44	10.79	1.2
Japan	11.04	10.61	10.90	11.04	11.08	0.0
Switzerland	12.28	12.16	12.69	12.10	12.50	0.1
EU-15	6.00	6.24	6.72	6.65	6.77	1.0
Total Annex II countries	5.11	5.21	5.55	5.62	5.67	0.9

Sources: World Bank; IEA; UNFCCC; DIW Berlin calculations.

Germany has undertaken to reduce its greenhouse gas emissions by 21% by 2008/2012, which is around three quarters of the total reduction undertaken by the EU. A reduction of 19% had already been achieved by 2002 so that Germany has already fulfilled 90% of its absolute obligation. Germany has a share of just under

12% in the reduction in emissions from the 2002 level to be achieved by the EU-15 altogether by 2008/2012. As Great Britain, Sweden and France have already fulfilled more than half their reduction obligations the main burden of adjustment will in future be on the other eleven EU member states. That will certainly require a drastic change in the trend in most of these countries.

The implementation of emissions trading could be an important step here. However, the trade in emissions certificates will initially be limited to CO₂ and it will not include every sector. In the sectors not included – particularly transport, which is expanding in most countries, and private households – effective measures to achieve permanent reductions in emissions are still needed in most cases. All in all doubts remain whether the overall

¹⁰ The European Environment Agency says that so far only four countries have fulfilled their obligation towards reaching the individual national targets, France, Germany, Sweden and the United Kingdom. On the same basis the other 11 countries are likely to miss their reduction targets – in some cases by a wide margin. That applies particularly to Spain, Portugal, Ireland, Austria, Italy, Denmark and Greece. European Environment Agency: Greenhouse Gas Emissions in the EU-15 fall after a two-year rise, Press Release of 15 July 2004 (org.eea.eu.int/documents/newsreleases/tec2-2004-de).

target for the EU-15 really has any prospect of being achieved.

Unlike the EU-15 as a whole Germany has come very close to its target, although here it must also be said that the reduction in emissions slowed down considerably during the 1990s, while emissions were actually higher again in 2003 than in 1999.¹¹ In view of this there is no reason to relax efforts in climate protection policy here either.

Hans-Joachim Ziesing

¹¹ On the current development in CO₂ emissions in Germany see also Hans-Joachim Ziesing: 'CO₂-Emissionen im Jahre 2003: Witterungsbedingt leichte Steigerung', in: *Wochenbericht des DIW Berlin*, no. 10/2004.