



**UNITED
NATIONS**



**Framework Convention
on Climate Change**

Distr.
RESTRICTED

FCCC/IDR.2/DEU
24 August 1999

ENGLISH ONLY

GERMANY

Report on the in-depth review of the second national communication of Germany

Review team:

Carlos Lopez (Cuba)

Mykola Raptun (Ukraine)

Knut Alfsen (Norway)

Fiona Mullins (Organisation for Economic Co-operation and Development)

Vitaly Matsarski (UNFCCC secretariat, coordinator)

Also available on the World Wide Web (<http://www.unfccc.de>)

I. INTRODUCTION AND NATIONAL CIRCUMSTANCES

1. Germany ratified the United Nations Framework Convention on Climate Change (UNFCCC) on 9 December 1993. Its second national communication (NC2) was received by the secretariat on 16 April 1997. The in-depth review of this communication was carried out during the period from February to December 1998 and included a country visit by a review team from 16 to 20 February 1998. The review team consisted of Dr. Carlos Lopez (Cuba), Dr. Mykola Raptsun (Ukraine), Dr. Knut Alfsen (Norway), Ms. Fiona Mullins (Organisation for Economic Co-operation and Development, OECD), Mr. Vitaly Matsarski (UNFCCC secretariat, coordinator).

2. The Federal Ministry of the Environment, Nature Conservation and Nuclear Safety (BMU) took the lead in organizing the review visit and arranging for meetings with representatives of various ministries, agencies and non-governmental organizations. Additional supplementary information was provided during and after the visit on various aspects of climate related activities.

3. Germany is located in northern Europe and has a temperate climate. The average temperature is about 9° C annually and from 17° to 20° C in the hottest summer months, depending on region. The lowlands experience average temperatures around 0° C in the coldest winter month, whilst in the mountainous areas temperatures can be several degrees below freezing. Between 1990 and 1995, Germany's population grew by 2.4 million, largely as a result of immigration, to reach 81.8 million. In the west, in particular, the population density is high although there are some rural parts of Germany where this is not the case. Of Germany's 35,696 million hectares around 55 per cent was devoted to agriculture and 29 per cent to forest in 1993 when the last land survey was performed.

4. The Germany economy, during the 1990s, was predominantly based on manufacturing and services. Gross domestic product (GDP) showed an increasing trend between 1990 and 1995, rising from DM 2,787 billion to DM 3,023 billion. In the new Länder (as the territory of the former German Democratic Republic is now referred to) there has been a significant GDP increase, but energy related carbon dioxide (CO₂) emissions have decreased significantly since 1990. The review team was informed that emission reductions in the new Länder are not all "windfall" profits as the cost of unification (October 1990) has been enormous. Primary energy consumption fell from 14,795 petajoules (PJ) in 1990 to 14,150 PJ in 1992, mainly as a result of developments in the new Länder, and stabilized in the following three years. This is interpreted by officials as an illustration of the fact that the link between GDP growth and energy consumption and hence greenhouse gas (GHG) emissions has been broken in Germany. Furthermore, whilst for the OECD member countries as a whole, energy consumption per capita, on average, increased from the late 1980s to mid-1990s, this indicator for Germany had a downward trend; having been above the OECD average for at least two decades it fell below that level as of 1990. Per capita GHG emissions in Germany decreased between 1990 and 1995 by 16 per cent, whilst emissions per unit of GDP decreased by 19 per cent.

5. Germany's energy production is highly dependent on fossil fuels, although its own reserves are limited to coal and relatively small amounts of oil and gas. Domestically deep-mined coal has been expensive, compared to world prices, yet this source is being maintained for reasons of security of supply and domestic employment. Nevertheless, coal production was reduced by around 40 per cent between 1990 and 1995. In 1995, around 40 per cent of primary energy requirements were met by mineral oils, 20 per cent by natural gas and 15 per cent by hard coal, whilst lignite accounted for 12 per cent, nuclear power about 10 per cent and renewable sources the remaining 3 per cent. In the new Länder lignite had been the dominant fuel, accounting for about 70 per cent of primary energy requirements prior to unification, but the balance then shifted to mineral oil and natural gas so that the figure had fallen to 38 per cent by 1995. Nuclear power is produced exclusively in the old Länder¹ after the closure of the plant in the new Länder, following unification. Coal had a 55 per cent share of Germany's electricity generation in 1995, nuclear approximately 30 per cent, natural gas 7 per cent, renewables around 7 per cent and heating oil about 1 per cent.

6. Climate change policies and implementation strategy in Germany are formulated under the auspices of the CO₂ reduction Inter-ministerial Working Group (IWG) established by a Federal Government resolution in June 1990. BMU chairs the IWG as a whole, whereas working parties on specific issues, such as energy supply, transport, buildings, new technologies and agriculture, are convened by the respective Federal ministries. IWG prepares reports which serve as a basis for decisions by the Federal Government related to the nation-wide climate change policies. German experts believe that this approach facilitates the implementation of coherent climate-related policies and measures in various branches of the national economy.

7. The national target, to reduce CO₂ emissions by 25 per cent in 2005 compared to 1990, did not change in the period between the publication of the NC1 and the NC2. There are no targets for other greenhouse gases, although objectives and corresponding measures listed in the fourth IWG report (1997), along with analysis of these measures, suggest that these emissions may also be reduced. Considering measures applied up to 1995, official studies found that the Government's goal was not achievable as CO₂ emissions could be in the range of 80,000 to 100,000 Gg higher than the target level. In November 1997, on the basis of the fourth IWG report, the Federal Government adopted a decision recommending additional measures which are aimed at meeting the national target.

8. There is a complex administrative and legislative structure in Germany. Legislative competence is distributed between the Federation (Bund) and the 16 Länder. The division of jurisdiction is such that the Bund is largely responsible for environmental legislation covering in particular waste management, air quality control, noise abatement, radiation protection, chemical safety and nuclear energy. In the fields of water resources as well as nature and landscape conservation the Bund has framework legislation competence only. In these areas it is the task of the Länder to adopt specific legal provisions. As a rule, Länder authorities are responsible for

¹ After the visit the team learnt that following general elections in October 1998, the Government has decided to phase out nuclear power altogether.

implementing federal laws. For example, Länder authorities grant licences for the construction and operation of industrial sites, power plants and waste treatment plants, for transportation of special waste and discharge of sewage. They also carry out monitoring and control activities and designate areas for natural and landscape reserves and water protection. Local (municipal) authorities in Länder are responsible, *inter alia*, for local land-use planning, water supply, waste water disposal, advice on environmental matters and local programmes in application of energy-saving and climate protection policies.

9. Germany sees itself as a major driving force in combating climate change, especially at the European Community (EC) level. Germany's climate change abatement strategy is set in the context of the EC commitment to stabilize CO₂ emissions at 1990 levels by the year 2000 for the EC as a whole. Apart from taking national measures, Germany actively seeks wider involvement of its EC partners, in particular in harmonization of economic policies and instruments relevant to climate change. In fact, a number of measures listed in the NC2 and discussed during the in-depth review, in the opinion of German officials, could be implemented only if similar measures are to be taken in the EC as a whole. According to a Federal Government decision of 6 November 1997, Germany still considered it necessary to introduce an at least EC-wide CO₂/energy tax, or another comparable tax instrument that is revenue neutral and does not affect competition. In the meantime, the new Government introduced the first stage of an ecological tax reform on 1 April 1999 providing fresh incentives for the rational use of energy. Yet, harmonization of energy taxes within the EC remains a high priority for the Federal Government.

II. INVENTORIES OF ANTHROPOGENIC EMISSIONS AND REMOVALS

10. The reporting of GHG inventories in the NC2 improved compared to the NC1. Data were provided in the NC2 for emissions of the direct GHGs, including CO₂, methane (CH₄) and nitrous oxide (N₂O), perfluorinated hydrocarbons (PFCs), hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF₆), CO₂ removals, and emissions of the indirect GHGs, including nitrogen oxides (NO_x), carbon monoxide (CO) and non-methane volatile organic compounds (NMVOCs) for the period 1990-1994 inclusive. Data on emissions of CO₂ and the new gases were also provided for 1995. In addition, IPCC standard data tables covering activity data and emission factors were given for 1990-1994 to provide further information on how the estimates of the main GHGs were derived. There was no information in the NC2 about the uncertainty associated with the various GHG estimates and only limited additional information provided during the review. After the visit the German authorities submitted to the secretariat GHG inventory data for 1995 and 1996, which are included in the tables and graphs below for completeness.

11. The Federal Environmental Agency (a subordinate authority to the BMU) was responsible for the preparation of annual GHG inventories. Inventory information in the NC2 was reported according to the 1995 Guidelines for National Greenhouse Gas Inventories, of the Intergovernmental Panel on Climate Change (IPCC). Activity data were collected from various sources, including the Federal Statistical Agency and relevant ministries, such as energy, transport, economics and agriculture. The majority of emission factors used in estimating GHG

inventories were country specific, although in some cases the IPCC default factors were used (e.g. for N₂O emissions from soil, for which no national consensus could be reached). Country-specific emission factors were considered to be more accurate than the default IPCC values. Expert judgement was used where values for the old and new Länder differed. Emission factors were reviewed and adjusted annually on the basis of research conducted by the Federal Environmental Agency and a literature search. The team was informed that these annual adjustments usually did not affect the total estimates but were rather aimed at more precise allocation of emissions to different activity sectors. For this reason Germany was among the few Annex I countries that did not change their original estimates for the total emissions in the base year.

12. Inventory experts admitted that there were slight discrepancies between the activity data collected by the Federal Environmental Agency and the Federal Statistical Agency, yet there were no immediate plans to investigate the reasons for these discrepancies since they were not considered significant. There were also no plans to conduct national research on quantifying the uncertainty levels; it was felt that this work should be done by the IPCC. During the visit the team was informed that the uncertainty levels were about ± 3 per cent for CO₂, and about ± 13 to 15 per cent for CH₄ and N₂O. In general, German experts considered their national GHG inventory to be of high quality and believed that the existing procedures for collecting inventory data constituted a good basis on which a future national system, required by the Kyoto Protocol, could be built. The review team shared this opinion.

13. Following unification in 1990, the old and new Länder experienced different patterns of GHG emissions. CO₂ emissions in the old Länder grew by about 2 per cent between 1990 and 1995 as population grew and production increased, in order to supply additional goods and services to the new Länder. Over the same period, CO₂ emissions declined 44 per cent in the new Länder as the population fell and the economy was re-structured, involving a shift in some production to the West, improvements in energy efficiency and reduced use of lignite. In the old and new Länder, between 1990 and 1994, CH₄ emissions fell by 17 per cent and 7 per cent, respectively, whilst N₂O emissions grew 2 per cent in the old and fell 25 per cent in the new Länder.

14. The Federal Environmental Agency commissioned a study on the causes of the trends in CO₂ emissions in Germany between 1990 and 1995. The study, completed at the end of 1997, considered these trends on both the aggregate and sectoral levels. The main conclusions indicate that the reductions in CO₂ emissions achieved in that period were due exclusively to the new Länder. Yet they should not be attributed to the economic downturn only, since a number of measures aimed at improving energy efficiency had been implemented in eastern Germany, especially in the residential sector.

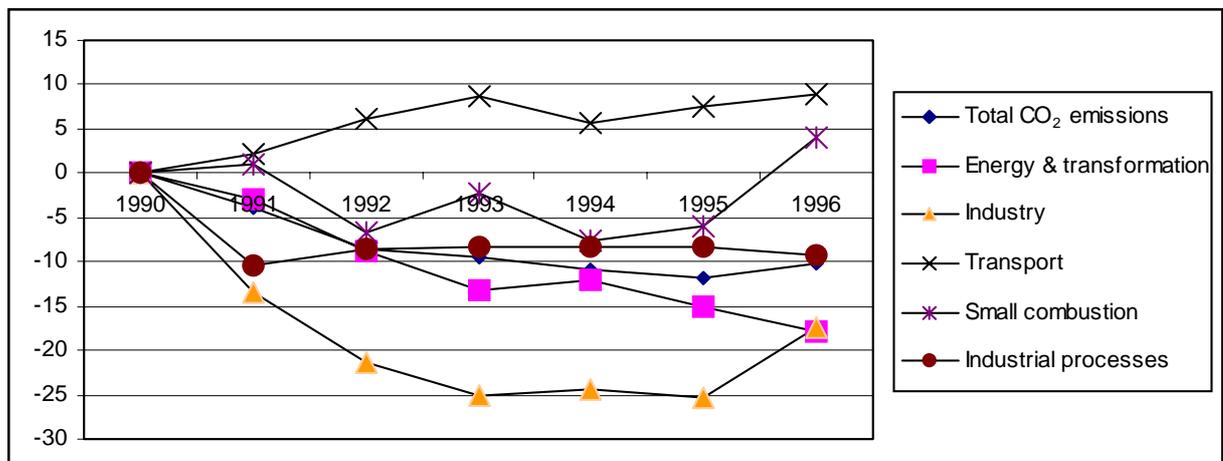
15. In 1996, total emissions in Germany were about 1,090,000 Gg in terms of CO₂ equivalent, of which CO₂ accounted for 910,000 Gg or 83.4 per cent. CH₄ accounted for 9.1 per cent of this total, N₂O for 6.4 per cent, and HFCs, PFCs, and SF₆ combined, for around 1 per cent. Over the period 1990-1996 the shares of the different gases in total emissions did not

alter significantly.

A. Carbon dioxide

16. Information on CO₂ emissions by sector is provided in table 1, and trends in CO₂ emissions for 1990-1996 are presented in figure 1. It can be observed that total CO₂ emissions fell to 894,500 Gg in 1995 (the lowest figure since 1990), and increased to 910,000 Gg in 1996, thus apparently reversing the previous downward trend. The increase in 1996 was mainly attributed to the severity of the winter resulting in higher heating requirements, although the emissions from transport and industry also increased in 1996 compared to 1995.

Figure 1. Carbon dioxide emissions by source, percentage change relative to 1990



17. Emissions from most sectors have been decreasing in recent years, but from residential and small-scale consumers they are increasing. For Germany as a whole, the shares of CO₂ emissions in 1996 and 1990 by sector were as follows, with numbers in parentheses referring to 1990: energy supply and transformation 39 per cent (43 per cent), transport 19 per cent (10 per cent), industry 15 per cent (17 per cent), small-scale combustion (including commercial, residential, institutional) 22 per cent (19 per cent), and other non-energy related sectors (such as industrial processes) the remaining 5 per cent (5 per cent).

Table 1. Carbon dioxide emissions by source, 1990-1996, Gg

	1990	1991	1992	1993	1994	1995	1996
Energy and transformation	439 427	426 597	400 775	381 700	387 000	373 200	361 000
Transport	158 647	162 107	168 297	172 500	167 600	170 700	173 000
Small combustion*	198 190	200 004	184 769	193 500	183 300	186 100	206 000
Industry	169 741	147 060	133 504	127 000	128 300	126 800	140 000
Other (incl. military)	20 635	14 875	12 038	12 500	13 100	12 500	5 000
Industrial processes	27 515	24 623	25 179	25 200	25 200	25 200	25 000
Total	1 014 155	975 248	926 562	918 300	904 500	894 500	910 000
International bunkers	19 569	18 099	17 818	20 100	20 100	20 100	19 874
Removals by sinks	- 30 000	- 30 000	- 30 000	- 30 000	- 30 000	- 30 000	-35 900

* Includes "commercial/residential/institutional" and "agriculture/forestry/fishery" sectors.

18. The NC2 provides a comparison of fuel combustion related emissions calculated according to national methods and the IPCC reference approach for the years 1990-1993. The team noted that the discrepancy between the two approaches is small, being no more than 0.4 per cent on average, but increasing over time.

19. Germany's forest area is around 10.7 million hectares (ha) and the annual average timber growth is about 8 m³/ha with annual felling around 5 m³/ha. Activity data for this sector come from the Federal Forest Inventory for the old Länder and from the Forest Fund Database for the new Länder as well as from wood harvesting statistics. It was noted in the NC2 that the estimate for growth rates may be conservative. The figure for CO₂ removals from "changes in forests" is reported as a "rough estimate" in the NC2 and it was not clear to the team how the same figure was obtained for each year during the period 1990-1995. During the visit Government officials explained that significant storm damage in 1990 has led to problems with recording annual felling in the following years. Therefore, average forestry data for the period 1985 to 1989 were used for the reporting of felling estimates. Taking into consideration that annual growth rates are also just estimates, this approach was deemed the best available under the circumstances. In addition, officials presented preliminary data from annual wood harvesting statistics since 1990 and indicated that further refinements to the sink estimates for future GHG inventories were under consideration.

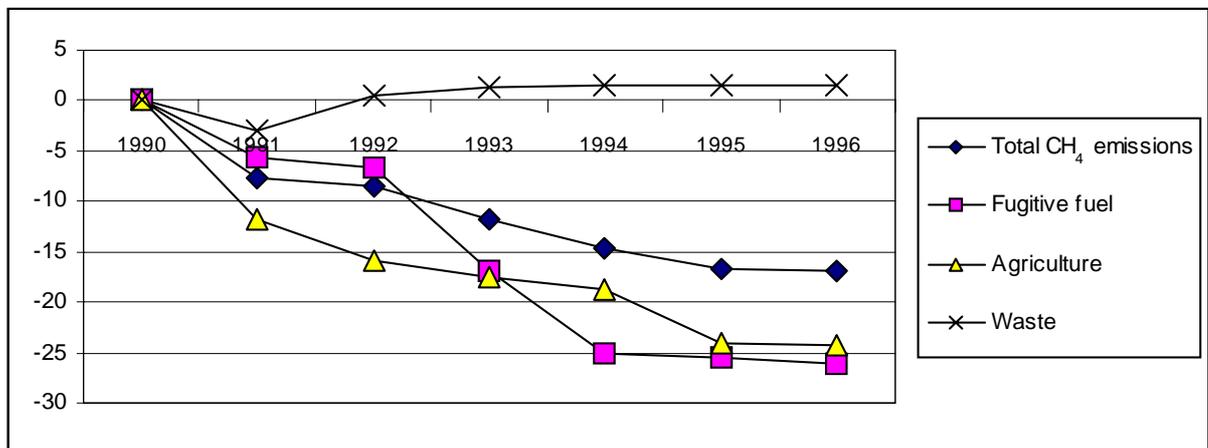
B. Methane

20. Emissions of CH₄, as observed in table 2 and figure 2, decreased by almost 17 per cent in the period 1990 to 1996. The main sources were waste, including landfills and wastewater treatment installations, livestock and fuel production and processing. The most significant reductions occurred due to reduced fugitive emissions and lower emissions from the agricultural sector, whereas emissions from waste rose slightly and then stabilized. The team was informed that this increase may be partly explained by better data obtained as a result of the inventory of waste sites which allowed the use of differentiated emission factors depending on the type of site.

Table 2. Methane emissions by source, 1990-1996, Gg

	1990	1991	1992	1993	1994	1995	1996
Energy and transformation	13	11	10	10	10	7	7
Industry	14	10	10	10	10	8	7
Transport	66	52	50	45	40	28	28
Small combustion	109	80	64	63	57	74	79
Fugitive fuel	1 563	1 474	1 458	1 300	1 170	1 163	1 155
Agriculture	2 044	1 805	1 718	1 688	1 660	1 553	1 547
Waste	1 870	1 814	1 881	1 895	1 900	1 900	1 900
Total	5 682	5 250	5 194	5 013	4 849	4 734	4 724

Figure 2. Methane emissions by source, percentage change relative to 1990



21. The inventory excludes emissions from waste-water treatment and also emissions in the new Länder related to the recycling of sewage sludge owing to problems with the quality of activity data.

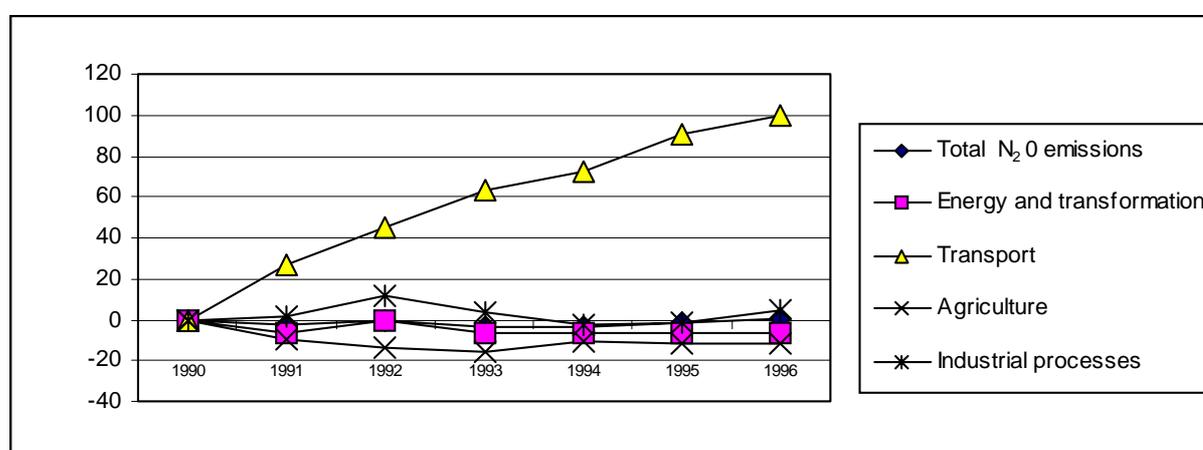
C. Nitrous oxide

22. Table 3 and figure 3 show that the total N₂O emissions fell by about 3 per cent in the period 1990 to 1994, mainly as a result of a sharp decrease in emissions from fertilizer use between 1990 and 1991. After 1994 the total N₂O emissions followed a slightly rising trend, which was mainly due to a growth in emissions from industrial processes and especially transport. The increased market penetration of cars with catalytic convertors caused a doubling of N₂O emissions from this source in 1996 compared to 1990. Since 1993, in spite of increased adipic acid production, one manufacturer has been able to change its production processes to reduce emissions and another is expected to do likewise.

Table 3. Nitrous oxide emissions by source, 1990-1996, Gg

	1990	1991	1992	1993	1994	1995	1996
Energy and transformation	15	14	15	14	14	14	14
Transport	11	14	16	18	19	21	22
Industrial processes	83	84	93	86	81	82	87
Agriculture	96	87	83	81	86	85	85
Waste management	4	4	4	4	4	4	4
Solvent & other product use	6	6	6	6	6	6	6
Other combustion-related	11	11	10	10	10	10	10
Total	226	220	226	218	219	222	228

Figure 3. Nitrous oxide emissions by source, percentage change relative to 1990



D. New gases

23. The NC2 presents actual emissions of the new gases. PFC emissions are primarily attributable to aluminium production and, to a lesser extent, to etching in the electronics industry. The dominant gas in this category is tetrafluoromethane (CF₄), emissions of which fell from 355 Mg in 1990 to 218 Mg in 1995, based on provisional data. Hexafluoroethane (C₂F₆) emissions fell from 42 Mg to around 27 Mg, with the reductions occurring in the aluminium industry in line with its voluntary agreement to limit emissions. The use of HFCs as a substitute for ozone-depleting substances in cooling equipment has increased during the 1990s resulting in an increase in emissions from 200 Mg to 2,214 Mg. The main source of emissions in 1995 was insulation foam (76 per cent), followed by mobile refrigeration systems (11 per cent) and stationary refrigeration systems (8 per cent). Emissions of HFCs were not presented according to the different gases which make up this category and which have widely ranging global warming potentials (GWPs). In 1995, 251 Mg of SF₆ was emitted, in comparison with about 163 Mg in 1990, an increase of 54 per cent. This was attributable to its increased usage in insulated double glazing and car tyres. SF₆ is also used in the electric power sector, but leakage rates are very low. Small quantities of SF₆ emissions are also attributable to its use in semiconductor production and magnesium casting.

III. POLICIES AND MEASURES

24. Reporting of policies and measures improved considerably in the NC2, compared to the NC1. Tables were used to present all Federal-level policies and most measures adopted by the Länder and to illustrate policies employed at municipal level, more than 130 measures in total. For Federal measures, there was information about the type, its status and in some cases the expected GHG reduction up to 2020. The team noted that economic instruments constituted by far the most common type of measure, although regulation was also important. The NC2 describes German industry's voluntary commitment on climate protection, which was also the subject of in-depth discussions with the review team. This is one of the main pillars of CO₂ mitigation policy in the industry sector. The Federal Government announced the postponement of additional regulatory measures aimed at global warming prevention. Priority will instead be given to industry's initiatives as long as the commitments are fully met and CO₂ monitoring is applied without exception. Information programmes and research programmes also had prominence in the type of measure employed. In relation to CO₂, most measures were cross-sectoral. Of the directly targeted measures, most were in the forestry, residential and energy transformation sectors.

25. Lacking in the NC2, given the large number of policies and measures, was an indication of the relative importance of each. Furthermore, given a distinction between the establishment of many policies at the Federal level and application at the Länder level, it was difficult to gauge the extent to which policies are being implemented and monitored. At the request of the review team, the government officials provided a list of what they believe to be the 14 most important measures among those mentioned in the NC2. Some of them are discussed in more detail in what follows. Virtually all these measures target CO₂ due to its importance in the total mix of GHG gases.

26. Government officials believe that reports of the CO₂ reduction IWG and decisions of the Federal Government adopted on the basis of these reports facilitate the task of developing and implementing coherent national policies and measures in the field of climate change. While in many respects this appears to be true, the review team at times had difficulties in understanding how the consideration of climate change had been integrated into general policy making, especially taking into account Germany's complex administrative structure and reliance on voluntary agreements with industry.

A. Energy and transformation

27. Germany is the largest consumer of electricity in the EC with final electricity gross consumption of 545 TWh in 1996. The bulk was consumed by industry, 44 per cent, and by the residential and commercial sector, 53 per cent. Around two thirds of electricity companies are owned by public entities such as Länder and municipalities, with the rest in private ownership. Eight supra-regional companies generate, transmit and in some cases distribute electricity in one or several Länder. They account for about 80 per cent of electricity generation by public utilities and distribute directly about 40 per cent of electricity consumed. These supra-regional

companies are complemented by about 800 local municipal suppliers which also, in some cases, have interests in electricity generation. As a result of this structure, end-user prices vary widely across the country but, on average during the 1990s, these prices have been higher than in most OECD countries. Prices have been high, *inter alia*, due to a support for coal and a structure that limited competition, allowing municipalities to use pricing policies which provide funds for other areas such as public transport. Recent changes led to a decrease in prices.

28. In line with the EC directive concerning common rules for the internal market in electricity, which entered into force in February 1997, Germany is adapting its legislation toward market liberalization. Germany has been the largest hard coal producer and consumer in the EC and the largest lignite consumer and producer in the world. Relatively high-cost deep-mined coal production has resulted in domestic prices up to three times in excess of world prices and hence has required significant subsidization. A law passed in 1997 should progressively reduce hard coal subsidies over the period 1996 to 2005, from DM 9 billion to DM 5.5 billion. The most significant change has been the elimination of the Kohlepfennig (coal levy) paid by all consumers in the old Länder via their electricity bill. Subsidies have subsequently been paid directly from the Federal budget to coal companies. Long term exclusive contracts between coal companies and electricity generators ended in 1996, with the generators now free to choose their suppliers. Subsidies on coking coal for the steel industry have also been reduced. Lignite production is not subsidized, although during the 1990s some Länder have provided subsidies to lignite plant.

29. The revised 1994 act on supplying electricity from renewables required electricity suppliers to buy electricity from renewable energy plants in their area and set minimum payment levels for renewable-generated electricity in excess of long-term avoided costs. In 1998 a ceiling of 5 per cent of total electricity distributed was set on the purchase requirement. Overall, this support was expected to save 4,863 Gg of CO₂ in 2000. The Federal Government also gives direct subsidies to renewables. Funds of DM 100 million were allocated for the period 1995 to 1998 targeted at investment grants for the installation of solar collectors, heat pumps, hydroelectric plants, wind power plants, photovoltaic plants, biomass and biogas facilities. These policies, in particular, have promoted an increase in renewables, especially wind generation which increased from a capacity of 61 MW in 1990 to 3,000 MW in 1998, giving Germany the largest wind power capacity in the world. In 1999, a photovoltaic “100,000 Solar Roof” programme was started and additional funds for installation of renewable power facilities were allocated.

30. Nuclear power was an important element in the German fuel mix. So-called “consensus” talks between the Federal and Länder governments, political parties, industry and trade unions broke down in 1995, owing to the wide divergence of opinions. Restrictive licensing policies are pursued in those Länder opposed to nuclear power. The more recent “consensus” talks aimed at the closure of Germany’s 19 nuclear stations, had not yet concluded at the time of the review and

it was not clear what course the future nuclear programme might take.²

31. Competition is being introduced into the gas as well the electricity market. Germany has the largest gas market in the EC, with natural gas making up about 8 per cent of electricity generation and 6 per cent of district heating in 1996. Gas represented around 33 per cent of final energy consumption in the residential/commercial sector, mostly for space heating and hot water, and around 28 per cent in industry. Germany is a producer of natural gas and has a good gas infrastructure allowing it access to import and export markets, so gas should be able to maintain and enhance its position in the fuel mix.

B. Industry

32. In March 1996, the Federation of German Industries (BDI), having completed extensive negotiations with the Government, stated in addition to its declaration of March 1995 the willingness of its members to make "special efforts" to reduce specific CO₂ emissions and specific energy consumption by 20 per cent, compared to 1990 levels, by 2005. Underlying this aggregate, specific industry commitments varied from a 16 per cent reduction by the iron and steel association to a 66 per cent reduction by the potash association. Specific energy consumption targets, which stipulate targets in terms of emissions per unit of output, allow for industry growth, although 12 industry associations also made commitments related to absolute CO₂ reductions. These agreements covered over two thirds of industry's final energy consumption and almost all of the emissions from electricity generation. An independent agency has been given the task of checking compliance with the commitments. The review team were presented with information from the first monitoring report on emissions from industry in the period 1990 to 1996. The second monitoring report was published in June 1999.

33. There are a variety of methodological difficulties in measuring the effects of voluntary agreements. The methods of recording data in industry changed in the early 1990s, as a result of statistics harmonization at the EC level. Furthermore, companies may belong to more than one association. An attempt was made to distinguish between the results of companies' efforts and what would have happened otherwise, the so-called "business as usual" (BAU) path. It can be observed that some sectors have agreed to reduce energy use and hence emissions by more than is expected under BAU forecasts, primarily based on trends, whereas for others the commitment does not match the forecast reduction, but that in nearly all cases the divergence between the commitment and BAU forecast is small. However, simple trend analysis is not sufficient as the monitoring agency notes that reductions due to compliance with other regulations, for example for air pollution control and changes in consumption due to changing energy prices as well as changes due to investments embarked upon before 1995, must also be taken into account. Some of the commitments relate to end-use sectors such as residential heating and so temperature needs to be taken into account. Furthermore, the business cycle also complicates short-term analysis.

² See footnote 1.

34. Some results of the agencies' analysis can be noted. The iron and steel industry is a large energy consumer in manufacturing industry. By 1996, a variety of actions had allowed it to achieve three fifths of its 16 to 17 per cent reduction target for 2005. An assessment shows that at least half of this reduction was due to factors independent of the voluntary agreement. The chemicals association is also one of the largest energy consumers. Mainly through efforts to improve energy generation by the construction of new power plants and fuel switching, by 1996 it had achieved around two thirds of its CO₂ reduction target of 30 per cent in 2005. The cement industry reduced its specific fuel energy consumption from 3,510 kJ/kg to 2,295 kJ/kg cement, while its reduction target was 2,800 kJ/kg cement by 2005. Most of this improvement in productivity was due to the commissioning of new plant and modernization of plant in the new Länder and not, therefore, attributable to the voluntary agreement. Between 1990 and 1996, the potash industry reduced its specific energy input by 49 per cent and its emissions of CO₂ by 66 per cent; so, it had achieved almost the whole of its reduction target. The paper industry ranks amongst the more energy-intensive growth industries. By 1996, it had already achieved around 80 per cent of the target to reduce specific CO₂ emissions by 22 per cent in 2005, compared to 1990. This was mainly due to energy savings implemented in the period 1990 to 1994 before the voluntary agreement was agreed, and the influence of restructuring in the new Länder. A similar pattern emerges for all of the agreements studied with a significant part of their targets having already been achieved by 1996.

35. The petroleum and gas industries have both been given targets which relate to end-use and have therefore initiated energy efficiency educational programmes for their customers. The public electricity supply association covers the bulk of generation and hence a significant amount of CO₂ emissions. In 1996, taking account of certain adjustments, the sector had achieved 80 per cent of its target to reduce emissions in the range of 8 to 10 per cent by 2005. This target is subject to the commissioning of a newly constructed nuclear power station which was still under consideration at the time of the review, and improvements in the output of all existing stations, otherwise the reduction "obligation" will be revised downward considerably. As a result of the report, officials noted there may be discussions about broadening the scope of the voluntary agreements and adjusting the targets. Industry does not face any specific penalties for failure to comply with voluntary agreements, but there appeared to be a general understanding that regulations or taxes were likely to be imposed if targets were not achieved.

36. The team was of the opinion that the voluntary agreements constitute the backbone of the overall national climate change policy. It also noted the high level of independent monitoring of the voluntary agreements and its objective character. The team felt that this experience could be usefully replicated by other countries.

C. Transport

37. The German automobile industry made a voluntary commitment in association with the Federal Government to reduce the average fuel consumption of automobiles. This commitment is not part of the voluntary agreement described in section B above and thus is not subject to independent monitoring. Fuel consumption of new vehicles as of 2005 should be, on average,

25 per cent lower than in 1990. Furthermore, the industry stated its willingness to update this commitment and perhaps achieve an average fuel efficiency saving of over one third. German auto makers, together with the European automobile industry, made a voluntary commitment in association with the European Commission to reduce CO₂ emissions for new vehicles to an average of 140 g/km by 2008.

38. The first report of the CO₂ reduction IWG in 1990 proposed that future drafts and laws in the transport sector should describe the expected effect on traffic and the environment. The Federal Cabinet added a clause to the so-called Common Rules of Procedure in June 1995 that Federal ministries are to state in future laws and ordinances “if necessary... what effects on traffic are to be expected...”. It was recommended that the Länder and local authorities adopt similar regulations in their own legislative procedures.

39. The Federal Government provides significant public funds for transportation measures to encourage a modal shift from private motor cars. Budgeting and the development of Federal programmes for local public transportation are subject to approval of the Länder. Support has been provided for measures such as the construction of tramways, provision of central bus stations, creation of “park and ride” facilities, etc. Since 1992, alternative fuel vehicles have also been eligible for support.

40. In 1991 the mineral oil tax on petrol and diesel was increased. This should have some impact on miles driven. Furthermore, the additional revenue of approximately DM 8.5 billion was earmarked to reduce the debt of the German railways, prior to railway reform and to finance transport expenditure. Overall, CO₂ emissions could be 3,500 Gg lower in 2000 than otherwise as a result of this policy and 5,000 Gg lower in 2005. In January 1994, laws for the reform of the railways came into force which allow for the privatization of the railways. Consequent pressures to reduce costs could improve the competitiveness of rail, compared to road transport, especially for freight. However, the review team were not informed about the extent to which existing subsidies may be retained and hence the trends in the costs of different transport modes. There was a change in emphasis in the 1992 Federal Traffic Infrastructure Plan, for the period up to 2012 with, for the first time, more expenditure planned for the railway infrastructure than for national long-distance motorways with the intent that the railway should increase its share of the transport market. The German railway’s development concept, in 1996, set out plans for railway freight stations at 52 sites, at a cost of DM 4 billion in order to improve rail/ road transfer. By 2010 a far greater proportion of freight transport could travel by rail as a consequence. In 2005, the expected CO₂ emission reduction from this measure could be in the region of 1,000 Gg.

41. The mineral oil tax for gas-powered vehicles for public transportation was more than halved in 1996, with the expectation that taxes would return to pre-existing levels on 31 December 2000. Pure rape methyl ester which reduces CO₂ emissions when used as a substitute for diesel fuel is completely exempt from mineral oil tax.

42. Measures to improve traffic flow, particularly on motorways, through the use of variable speed limits and warning systems for traffic jams could reduce CO₂ emissions by around 600 Gg

in 2000 and this figure could double in 2005. Since 1993 there have been a series of pamphlets as part of an information campaigns by the ministries of transport and the environment to make drivers more aware of fuel-saving driving practices. Furthermore, the Driver Training Ordinance was amended so that driving schools are required to teach energy-conscious driving techniques and students' knowledge is tested during the driving test.

43. Many measures at the local level reflect concerns about air quality and congestion, but in part may also reduce CO₂ emissions. For example, research at Federal level on traffic abatement has been presented to local-level policy makers through information brochures.

44. A toll system for heavy trucks has been in force since January 1995. This followed an agreement between Germany, Denmark and the Benelux countries on a common charging system for certain roads. At the time of the NC2, Sweden was due to join the toll alliance. The maximum permissible toll for vehicles over 12 tonnes in weight was originally set at 1,250 ECU, but will be subject to twice-annual review. The extent to which these tolls may help to reduce freight traffic has not been estimated.

45. Taking into account a number of studies with various predictions about the growth of transport emissions, combined with the potential effect of the automobile manufacturers' voluntary agreement, in particular, the Federal Government believes that CO₂ emissions from transport should be stabilized by 2005.

D. Residential, commercial, institutional sector

46. Almost one third of German emissions in 1996 came from the buildings sector, as energy was used for heating, air-conditioning, hot water supply etc., in terms of final energy consumption the percentage was even higher. A package of regulatory and economic measures, in addition to information campaigns, has been adopted in this sector since 1990. The 1976 Energy Conservation Act provides the basis for regulatory measures and stipulates that the cost of any required investments must be recoupable through energy savings during the useful life of the building. Several ordinances have been issued under this Act which relate to thermal insulation and standards for heating systems. The amendment of the Heating Installation Ordinance, in June 1994, was mainly to incorporate the EC directive related to minimum efficiencies of oil- and gas-fired boilers used to heat buildings. This measure was expected to save around 4,800 Gg of CO₂ in 2000 and 9,700 Gg in 2005. A further amendment to the Thermal Insulation Ordinance came into force in January 1995. As a result, new buildings should be built with heating requirements around 30 per cent lower than before and the insulation levels in existing buildings should be improved. This could save around 3,500 Gg of CO₂ in 2000 and 7,000 Gg in 2005. Homeowners can receive subsidies of up to DM 500 per annum for an eight-year period for installing particular types of heat pumps, solar systems or heat recovery systems before they move in. Homeowners and purchasers of new homes can obtain annual support of DM 400 if their annual heating requirements are at least 25 per cent below the standards established in the Thermal Insulation Ordinance for so-called "low-energy" houses or homes.

47. Several additional measures are listed in the NC2. A housing modernization programme of the KfW - Reconstruction Loan Corporation has provided low-interest loans for renovation and modernization of housing in the new Länder. The loans were provided from the Federal budget. As of August 1996 almost DM 15 billion was invested in energy-saving measures, covering over 40 per cent of the apartments in the new Länder and resulting in expected CO₂ savings of 6,200 Gg in 2000. A separate loan programme just for CO₂ reduction in existing buildings in the old Länder was financed by the Federal Government up to 1996 with a total volume of loans of DM 1 billion and then additional funding was committed by the Reconstruction Loan Corporation. By the time the NC2 was published over 77,000 apartments had received such finance and savings of 1,900 Gg of CO₂ in 2000 were anticipated. A special joint programme entitled "Economic Recovery in the new Länder" subsidizes up to 20 per cent of the cost of modernizing heating systems, thermal insulation and other housing related energy saving measures. In 1991 and 1992, the Federal authorities provided around DM 1.5 billion for this programme for about 880,000 dwellings, with the expectation that approximately 1,400 Gg of CO₂ will be saved in 2000, although it was not clear to the team whether the so-called rebound effect had been taken into account in these estimates. Tax breaks were also provided over the period 1991 to 1998 for expenditure on building modernization in the new Länder. Furthermore, measures to assist in clarifying the ownership of property and to reduce bad debts of housing associations should allow for greater investment in modernization.

48. The Federal Ministry for Regional Planning, Building and Urban Development established a research programme to cover the period 1994 to 1998, during which model houses were to be developed and tested for their energy saving properties. Various pilot programmes exist to test the feasibility of using photovoltaic systems and solar water heating systems in buildings. This Ministry has also produced brochures for householders about saving energy and more detailed guides for experts who are modernizing buildings. An ordinance for the amendment of the fee table for architects and engineers enacted in March 1994, provided financial incentives for them to increase their services related to CO₂ reduction through efficient energy use.

49. The fourth IWG report envisaged a further 16,000-24,000 Gg CO₂ reduction from buildings by 2005, compared to 1990 by continuing and, if necessary, expanding existing regulations, stepping up financial assistance for a number of programmes and reducing barriers to the uptake of energy efficiency investment. Partly motivated by job creation, as of March 1997, an additional DM 5 billion was allocated to the Reconstruction Loan Corporation for its two main programmes.

E. Agriculture and forestry

50. Forest conservation is regulated by the Federal Forest Act and laws of the Länder. State investment subsidies have been provided throughout the 1990s for afforestation. In 1991 an additional 20-year "afforestation bonus" was offered for afforestation of agricultural land, which resulted in a doubling of the annual afforestation rates to between 6,000 and 7,000 ha. Thereafter, the rate fell to around 5,000 ha, a level which is expected to be maintained for several years.

Measures to increase biomass in existing forest are unlikely to have a significant impact on CO₂ sequestration. Several measures exist to support the use of wood as a fuel.

51. Although the contribution of agriculture to total energy-related CO₂ emissions did not exceed 3 per cent, this sector is a major contributor to emissions of methane (about one third) and of N₂O (also about one third). Among the measures targeting these latter gases, improvement of feed for ruminants and guides for utilization of fertilizers have been mentioned. Government officials expressed the opinion that emissions from agriculture would continue to decrease, mainly due to the implementation of the EC Common Agricultural Policy.

F. Waste management

52. In line with the EC directive on waste, Germany is implementing measures to increase CH₄ collection and flaring. The Waste Management Act should result in priority being given firstly to waste avoidance followed by greater waste recycling and energy recovery. Furthermore, Federal funds have been made available for the development of improved processes for waste incineration.

53. The Technical Instructions for Waste from Human Settlements ensure the efficient use of resources and supplement action undertaken under the Waste Management Act. It is expected that intensified recycling could reduce CO₂ emissions from waste by 15,000 to 24,000 Gg per year by 2005.

IV. PROJECTIONS AND EFFECTS OF POLICIES AND MEASURES

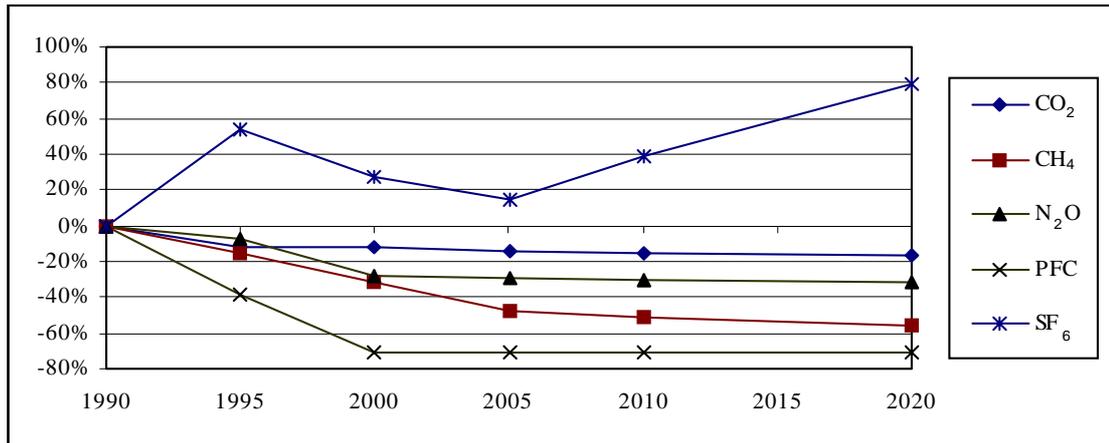
54. The NC2 provides future emission estimates for all of the direct greenhouse gases over the period 2000 to 2020. The reporting of emission projections improved considerably compared to the NC1. However, there was little information about the underlying assumptions or how the projections were produced, so the review, in part, considered this aspect in more detail although limited additional information was provided. Furthermore, there was no sensitivity analysis to consider the effects of changes in major assumptions such as oil prices or GDP growth forecasts.

55. The unification of Germany has created unique problems for energy modellers. Typically, energy and hence emission projections are based on consideration of past behavioural relationships between economic output and energy consumption, for example. Aside from the fact that data had not been collected on the same basis in the new and old Länder, previous relationships are unlikely to hold. This created an added degree of uncertainty.

56. The Government does not make projections of energy demand or emissions. The NC2 reports the projections of several independent institutions, commissioned by various Federal ministries, but which the Government does not endorse. Nevertheless, these are used to guide policy-making. Four institutions together developed GHG emission projections called "Policy scenarios for climate change", whilst two additional institutions provided an "Overall economic assessment of CO₂ reduction strategies". Both projects involved a "with measures" and a

“without measures” scenario. For the sake of simplicity, these can be labelled projects A and B respectively. Detailed CO₂ modelling work was done for the period up to 2005, whilst post-2005 projections were based solely on the continuation of emission trends. Figure 4 shows how most GHG emissions were projected to decrease compared to the base year according to the “with measures” scenario.

Figure 4. Projected percentage change in emissions compared to 1990



57. Additional information was provided about project A. The “without measures” scenario assumes that no GHG mitigation measures are in place over the forecast period, whereas the “with measures” scenario assumes that all agreed climate protection measures implemented as of 1996 are taken into account, to the extent possible. The NC2 presents the results of these two scenarios. Subsequent to publication of the NC2, the project team produced a further scenario called “with additional measures”. This was constructed because neither of the other scenarios would result in a 25 per cent reduction of CO₂ emissions by 2005 i.e. the emission target set by the Government. The scenario work was based on the energy consumption and emission projections provided by the Prognos Institute, on behalf of the Federal Ministry of Economics in 1995. Some of the assumptions underlying the Prognos work were made available during the review. The effect of high economic growth on energy demand is offset to a large extent by assumptions about improved energy efficiency owing to technology improvement, by a shift from heavy to light industry and a shift from coal to gas in electricity production. Coal production capacity is expected to be maintained in the old Länder beyond 2005, but run down in the new Länder. The possible impact of energy market liberalization was not taken into account.

58. The Prognos data were adjusted to eliminate emissions from bunkers. To obtain a “without measures” projection a correction was made for the likely effect of measures in the Prognos work. To obtain the “with measures” scenario the Prognos projection was adjusted for the estimated effects of those measures which it had not included. The final step was to consider additional policies which could bring about achievement of the Government’s stated objectives. Different methods were used to estimate the effects of climate protection measures, depending on the sector concerned, the measures involved and the availability of data. An attempt was made

to consider both the possible overlap between policies and potential complementarity, although it was not clear to the review team how this was done. On the whole, expert judgement was used to assess the effects of qualitative measures such as information or research programmes. Price elasticities were taken into account in considering the possible implications of taxes, subsidies and loan programmes. Detailed technical and economic data, along with the bottom-up IKARUS model, were used to calculate the effects of regulations and standards, primarily in the building and transport sectors.

59. The IKARUS model was used to both quantify the effectiveness of measures in place as of mid-1996 and examine further measures necessary to reduce CO₂ emissions by 25 per cent in 2005, compared to 1990. IKARUS is made up of a highly detailed database, containing technical, economic, emissions and structural data, a variety of optimization models covering space heating, transport, industry and district heating for example, and linkages to a macroeconomic model. Data are collected on primary energy such as fossil fuels, conversion to secondary forms of energy such as electricity and final end-use. It uses linear programming to minimize costs.

60. Compared to the 1990 level, project A shows CO₂ emissions about 54,000 Gg or 5 per cent lower in 2000, around 3 per cent lower in 2005, increasing 1 per cent beyond the 1990 level by 2010 and increasing by approximately 11 per cent in 2020. Underlying the “without measures” scenario to 2000, emissions growth of around 5 per cent in the residential sector and 25 per cent in the transport sector is expected, compared to 1990. Over the same period emissions are expected to fall around 28 per cent in industry, 6 per cent in power generation, approximately 31 per cent in district heating and 51 per cent in other energy-consuming sectors.

61. These reductions are driven primarily by developments in the new Länder. When measures are incorporated, the CO₂ reduction between 1990 and 2000 is around 120,000 Gg or 12 per cent. By 2005, CO₂ emissions may be around 15 per cent lower, falling to 16 per cent below the 1990 level in 2010 and 17 per cent lower by 2020. In the “with measures” scenario, by 2000, the largest contribution to the reduction, in absolute terms, of 71,000 Gg comes from the energy and transformation sector, followed by the industry sector which reduces by 53,000 Gg, and other combustion-related emissions with around 33,000 Gg, whilst transport emissions, excluding bunkers, increase by around 38,000 Gg. When additional measures are taken into account, CO₂ emissions could be 154,000 Gg or 15 per cent below the 1990 level by 2000 and about 27 per cent lower in 2005. A comparison between the results of the three scenarios in 2000 and 2005 is shown in table 4.

Table 4. Projections of carbon dioxide emissions, percentage change in 2000 and 2005 compared to 1990

	Without measures		With measures		With additional measures	
	2000	2005	2000	2005	2000	2005
Industry	-28	-28	-31	-37	-32	-42
Commercial	-7	-4	-19	-26	-20	-38
Residential	5	8	-10	-14	-15	-30
Transport*	25	27	21	20	17	3
Power stations	-6	-2	-10	-10	-14	-21
District heating plants	-31	-37	-30	-36	-30	-34
Other energy	-22	-56	-51	-56	-54	-63
Total energy	-5	-3	-12	-15	-15	-27
Industrial processes	-5	-7	-6	-8	-7	-21
Total emissions**	-5	-3	-12	-14	-15	-27

* Including bunkers

** Excluding bunkers

62. Project B, which excludes non-energy sources, indicates that CO₂ emissions may be 83,000 Gg or about 8 per cent lower in 2005 than 1990, without further measures. (A comparative figure is not given for 2000.) The project B “with measures” scenario includes all measures approved by the Federal Government from 1991 to 1994 and German industry’s voluntary commitments to CO₂ reductions. This indicates that CO₂ emissions will be reduced by about 170,000 Gg or 17 per cent by 2005, compared to 1990. The divergence in results may be due, in part, to an assumption in project A that economic growth will average 2.4 per cent between 1990 and 2005, compared to 1.8 per cent according to project B. The former assumes that growth in the new Länder will be particularly vigorous. Furthermore, project B appears to have assumed more substantial improvements in energy efficiency and greater constraints on transport sector emissions. Both projects share a common assumption that population will grow by about 4 million over the period 1990 to 2005 to reach around 83 million. The NC2 provides a comparison of these results with those of other institutions. In the “without measures” scenario, these vary from a fall in emissions in 2005 of around 8 to 18 per cent, compared to 1990. The most optimistic result, from the IKARUS model, is understandable because this is a detailed “bottom-up” technology model which tends to assume that all cost-effective energy efficiency investments are made whilst, in practice, there are often many barriers to their implementation. The team noted that oil price assumptions in project B were high relative to current trends and that lower real prices could result in future emissions being higher than estimated.

63. The Federal Ministry of Transport provided the review team with separate projections of road traffic and fuel consumption. Officials noted that emissions could be lower than those reported in the “with measures” projections of the NC2. According to fuel producers, mileage is expected to increase relative to 1995 levels up to 2010 and then stabilize or decline whilst over the period fuel consumption decreases. The team found it difficult to see how these optimistic projections could materialize in view of the current upward trend in transport emissions.

Another study showed that road traffic in Germany was expected to continue on the trend observed between 1980 and 1995 such that annual vehicle-kilometres of both cars and goods vehicles could increase from around 600 billion to almost 800 billion in 2010.

64. Non-energy related CO₂ emissions were given separate consideration in project A. Without measures, a continuation of trends in production processes results in a 2.1 million tonne or 8 per cent decrease by 2005 and a 16 per cent decrease by 2020, compared to 1990. In contrast, the implementation of measures results in a 10 per cent reduction by 2005 and a 19 per cent reduction by 2020, compared to 1990. Policies to enhance recycling of glass and aluminium, in particular, have the greatest direct effect on emission reductions

65. The projections section of the NC2 does not report on sink absorption. However, the policies section notes that conservation of existing forests is expected to save 30,000 Gg of CO₂ per annum from 2000 to 2020, in line with the inventory data for 1990 to 1995. This estimate is considered to be conservative. Furthermore, expected CO₂ savings from support for new afforestation are 600 Gg in 2000, 1,000 Gg in 2005, 1,300 Gg in 2010 and 2,000 Gg in 2020. So, a small increase in CO₂ removals is predicted over this period.

66. Expert judgement about the effect of technical measures was used to produce projections of other gases. The substantial projected reduction in CH₄ emissions of 1,790 Gg or about 32 per cent by 2000, 51 per cent by 2010 and 56 per cent by 2020, compared to the 1990 level, can be attributed to a number of factors. Even without measures, emissions would decrease as a result of falling livestock numbers and reduced coal production. Implementation of landfill policies, which prescribe mitigation measures for new landfills and improvements in existing landfills to reduce emissions is expected to reduce emissions, from this source by at least 652 Gg or 37 per cent by 2000 and 83 per cent by 2010. A large decrease in CH₄ emissions from coal mines is also expected, of 536 Gg or 44 per cent by 2000 and 56 per cent by 2020, not just because of pit closures but also owing to increased recovery of pit gas. Other reductions should result from a halving of emissions from natural gas distribution networks by 2010, owing to accelerated modernization and through increased use of CH₄ generated by the storage of livestock manure as fertilizer. The projection assumes that about half of the reduction potential, estimated at one third of emissions from storage of animal excrement, will be attained.

67. N₂O emissions could be 28 per cent lower in 2000 than in 1990, according to the “with measures” projection. Whilst transport emissions double to 2000 owing to increased market penetration of cars with catalytic convertors, emissions from industrial processes fall to around a quarter of the 1990 level, as a result of the voluntary agreement with the adipic acid manufacturers, whilst emissions from other energy sources and agriculture fall modestly. There has been a downward trend in emissions from agriculture and the Fertilizer Act, in force since 1996, should further reduce nitrogen inputs to the soil. By 2010, total N₂O emissions could be 31 per cent lower, compared to the 1990 base year, but are then likely to remain unchanged up to 2020.

68. Over 90 per cent of PFC emissions have been generated by aluminium production. Emissions from this source decreased between 1990 and 1996 through technical improvements and capacity reductions. The projections assume that the industry's voluntary aim to reduce emissions by 50 per cent compared to 1987 by 2005 is achieved. Emissions are expected to decrease from the 1990 level of 397 Mg by around 70 per cent by 2000. As the modernization of aluminium smelters should be complete by 2000, PFC emissions should be stable thereafter to 2020. Without measures, it was assumed that HFCs completely replace all chlorofluorocarbons in which case total emissions would increase around 50-fold from 1990 to 2007 from 200 Mg to 9,500 Mg, and then stabilize at that level. By 2000, emissions from foam propellants and stationary refrigeration systems are expected to account for the bulk of emissions. As air-conditioning in cars becomes more popular, mobile systems could account for about a quarter of emissions in 2010. Trends in SF₆ are mainly influenced by the market development of soundproof windows and luxury car tyres. Without measures, emissions are expected to increase by around 28 per cent, from 163 Mg in 1990 to about 208 Mg in 2000, and to 226 Mg by 2010.

V. EXPECTED IMPACTS OF CLIMATE CHANGE AND ADAPTATION MEASURES

69. The NC2 presented a comprehensive overview of research efforts on the impacts of climate change in recent years. Research has focused on climate-sensitive regions such as coastal and mountain areas and on both ecologically and economically sensitive areas including agriculture and silviculture, hydrology of groundwater and inland bodies of water. The team was informed that seasonal shifts in precipitation or unusually intense dry periods could cause significant changes in plant coverage in affected regions. A lack of precipitation, especially during the main growing season, would reduce harvests and cause ecological damage to forests and wetlands. The experts stressed that minor increases in the frequency of extreme weather events involving heavy rainfall along with periods of thawing could result in considerably magnified groundwater run-off, causing river widening and increased flooding. However, increased temperatures may result in higher evaporation thereby greatly reducing regional run-off, in which case water availability, inland shipping, coolant-water supply in power plants and, to a lesser extent, hydropower might all be affected.

70. Development of adaptation strategies and measures has already begun in the area of coastal protection. In addition, recent consideration has gone toward the consequences of possible climate change on forests and agriculture, the resultant effects on agricultural markets in Europe, and the need to adapt accordingly.

VI. FINANCIAL ASSISTANCE AND TECHNOLOGY TRANSFER

71. The NC2 provides a detailed description of Germany's contributions to multilateral institutions and lists several climate change related bilateral programmes. Within these programmes, the team was informed that most of the bilateral cooperation with developing countries is focused on the energy, transport, industry, agriculture and forestry sectors. DM 300.7 million was allocated to measures aimed at reducing CO₂ emissions in the energy sector in Armenia, Burkina Faso, China, Egypt, Ethiopia, Georgia, Indonesia, Malawi, Pakistan,

and Thailand. Silviculture projects in 29 non-Annex I countries accounted for a further DM 151.4 million. In relation to industry, efforts were concentrated on providing cleaner process technologies as well as end-of-pipe technologies, where appropriate. In Indonesia and Mexico DM 4 million were contributed toward the expansion of urban public transport systems. Germany's contribution to multilateral funding amounted to DM 3.88 billion in 1995. Its contribution to the Global Environment Facility was DM 390 million for the commitment period 1994 to 1997.

72. In an effort to introduce modern technologies to developing countries, the Reconstruction Loan Corporation was established to support small and medium-sized German companies in this endeavour by providing them with long-term loans on favourable terms. To date, approximately DM 35 million has been provided annually and the team was informed that the Government intended to increase this amount in 1998. The German Appropriate Technology Exchange programme of the German Society for Technical Co-operation (GTZ) is continuing to promote technologies for renewable energy systems, recycling of waste, waste-water and waste treatment and methods to conserve resources in the agricultural sector in Latin America, Africa and Asia.

VII. RESEARCH AND SYSTEMATIC OBSERVATION

73. The NC2 provided a very thorough description of climate change research and systematic observation in Germany and the team was informed that the Federal Government allocated DM 700-770 million for this purpose for the period 1996-2001. Additional funds are provided by the Länder, but it is very difficult to differentiate between research and spending at the Federal and Länder levels. Most funds are directed, in the medium term, toward nuclear energy safety which should receive DM 385 million annually, and energy savings, which should receive DM 134 million annually until 2001. Over the longer term, the main focus of financing will be on electricity production options, including renewables, which should receive DM 200 million annually until 2005. The IKARUS model has been useful in guiding researchers on technology options and the most cost-effective opportunities for GHG mitigation and for prioritizing future research funding.

74. Although the NC2 notes that ways of achieving transport emission reductions are among the most important areas for future research, officials noted that no additional public funding is available for research into technical improvements.

75. The review team was informed that there is a need for greater coherence and a long-term focus to systematically pool all research and development activities in Germany. As this has not yet been possible, the Government will continue to undertake a significant level of research and development without excluding any potentially important options for addressing climate change. It also sees research as an important way of safeguarding Germany's importance in technology development and of promoting export opportunities for national industries.

VIII. EDUCATION, TRAINING AND PUBLIC AWARENESS

76. Both the Federal Government and the Länder have carried out several initiatives related to public awareness and environmental education. In general, they have structured their administrations to cover both planning and public awareness issues related to the environment. From the information provided, the team felt that the efforts of the Federal Government and the Länder in raising public awareness about climate change had been generally good. This especially applies to the Länder with regard to environmental education in schools.

77. Many programmes are run at the local authority level, including energy-saving promotion. In addition, the private sector has also made significant contributions to heightening the public awareness of climate change issues. According to the host country officials, information campaigns were especially active in 1997, in the period preceding the third session of the Conference of the Parties to the Convention.

IX. CONCLUSIONS

78. The NC2 contained substantial amounts of information, presented generally in keeping with the UNFCCC reporting guidelines. It was the impression of the team, however, that although the NC2 was strong and comprehensive in facts and figures it was weaker on analysis. This drawback was partially offset by the additional information made available to the review team both during and after the visit, in particular the decision of the Federal Government of 6 November 1997 on the climate protection programme and the report entitled, "Causes of the Trend in CO₂ Emissions in Germany between 1990 and 1995." The two documents, as well as some other supplementary information, were available in English, which was an advantage.

79. In relation to the inventory, following unification, significant efforts were made and are continuing to harmonize the activity data between the old and new Länder. Historic differences in approaches to data collection and estimation of emission factors and the resultant need for expert judgement somewhat reduced the transparency of the inventory. Nevertheless, the team was of the opinion that in general the GHG inventory was of high quality and that the procedures for collecting and processing activity data serve as a good basis for the future national system required by the Kyoto Protocol.

80. Germany has undergone significant changes in the 1990s. Patterns of production, employment and energy use have changed considerably in the new Länder, whilst the old Länder have also experienced major changes in some sectors. This has resulted in a major reduction in emissions of GHGs, mainly due to economic restructuring in eastern Germany, and there is a strong likelihood that Germany will meet the UNFCCC aim of returning GHG emissions to the 1990 level by 2000. The effects of unification, along with policies which limit emissions, even though many are not directly motivated by climate change concerns, resulted in a lowering of CO₂ emissions by about 10 per cent between 1990 and 1996.

81. Although there are a large number (over 130) of policies and measures applying to emissions of GHGs, it was not always clear to the team to what extent climate change concerns had been integrated into policy-making. It was not clear, in particular, on what basis the optimistic forecasts for the stabilization of transport emissions by 2005 provided by the Ministry of Transport were arrived at. The reluctance of the Government to make projections of either energy or GHG emissions and its resultant reliance on the highly varied outputs of different institutions involved in projections and scenarios would appear to complicate policy-making when judging the extent of additional efforts required to meet future targets. Policy options are constrained to the extent that EC harmonization is limited in relation to taxation, in particular. Consequently, there has been a heavy reliance on voluntary agreements and, whilst industry has made significant reductions under these agreements, analysis indicates that to a large extent the reductions are not in excess of normal expectations. Besides, some of the reductions had already taken place before the voluntary agreements with industry were formally concluded. According to the projections presented, with existing policies and measures, CO₂ emissions could be reduced by 14 to 17 per cent by 2005 and by about 25 per cent by 2005 with additional measures. It is worth mentioning that these projections do not take into account the phasing out of nuclear power in Germany, as decided in late 1998, and will probably need to be adjusted accordingly.

82. BMU, as the leading Government agency responsible for climate-related issues, has made commendable efforts in bringing together various stakeholders and in informing the general public. Its reports and publications are widely available and are posted on the Ministry's Web site.
