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## **EUROPEAN COMMUNITY**

Report on the in-depth review of the second national communication of the  
European Community

Review team:

Khaled Boukhelifa (Algeria)

Christo Christov (Bulgaria)

Robert Audet (Canada)

June Budhooram (UNFCCC secretariat, coordinator)

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## I. INTRODUCTION AND NATIONAL CIRCUMSTANCES

1. The European Community (EC) ratified the UNFCCC on 21 December 1993. Its first national communication (NC1) was submitted to the secretariat on 8 July 1996 and the second national communication (NC2) covering its 15 member States on 15 March 1999. The in-depth review of the NC2 was conducted between July 1999 and March 2000 and included a visit to Brussels from 28 June to 2 July 1999. The team comprised Mr. Khaled Boukhelifa (Algeria), Mr. Christo Christov (Bulgaria), Mr. Robert Audet (Canada) and Ms June Budhooram (UNFCCC secretariat, coordinator). The in-depth review was coordinated by the Directorate-General for Environment, Nuclear Safety and Civil Protection (DG XI) and involved discussions with several directorates of the Commission of the European Communities as well as with the European Environment Agency (EEA) and members of the European business community and non-governmental organizations, during which time the team was given a wealth of additional background information.

2. The EC, the only regional economic integration organization that is a Party to the Convention, was established by the Treaty of Rome in 1957. It is the legal entity under which the member countries of the European Union (EU) cooperate in the field of climate change, because the Union as such is not a legal entity. At the time of ratification, the Community comprised 12 member States (Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, and the United Kingdom of Great Britain and Northern Ireland). To date, its membership has expanded to include Austria, Finland and Sweden and may be enlarged even further in the coming years. It should be noted that each of the 15 member States has also ratified the Convention individually. The main institutions of the Community are the directly elected European Parliament, the Council of Ministers, consisting of ministers from each member State, the European Council where the 15 heads of State or Government meet twice annually, the European Commission which consists of 20 independent members, and the Court of Justice for ensuring that in the interpretation and application of the Treaty, and other EC legislation are observed.

3. The member States of the Community are diverse in terms of their national circumstances. The responsibility for applying adequate policies and measures lies largely with the member States. In 1995, the gross domestic product (GDP) of the EC expressed in constant 1990 prices, amounted roughly to 5,690 billion euros. Its economy is a rather heterogeneous entity composed of the economies of its member States, which differ greatly in size and whose levels of development vary considerably. Germany, France, Italy and the United Kingdom, the four member States with the highest GDP, account for 73 per cent of total GDP and are, therefore, largely determining the pace of economic development in the EC. With a population of around 370 million, average per capita GDP in the EC in 1995 amounted to around 15,300 euros (at 1990 prices). Three member States (Greece, Portugal and Spain) have a per capita GDP which is considerably lower than the average per capita GDP for the Community, ranging from 5,800 to 10,600 euros. These countries, however, show a significantly higher growth trend than the average of the EC and thus can be expected to catch up with the other countries of the EC, in part due to the structural funds these countries receive via the Commission.

4. Services, both market (including transport) and non-market, are the most important economic sectors in the EC. Together they account for two thirds of total gross value added (GVA). In the first half of the 1990s, growth in service sectors was considerably more dynamic than the average annual growth rate of all sectors. Manufacturing industries are the second most important sector while the energy sector has been growing swiftly in recent years.

5. The share of agriculture is currently decreasing in economic terms although land use of the Community at present is dominated by agriculture (27 per cent), forest (33 per cent) and grassland (18 per cent). Among member States, there are big differences in land use. Finland (69 per cent) and Sweden (62 per cent) have a high proportion of forest, while Ireland has the highest proportion of agricultural land (80 per cent). Following the accession of Austria, Finland, and Sweden, the EU has become the world's second largest paper and sawnwood producer, its foremost importer of forest products and the third largest exporter of forest products.

6. In October 1990, the EC adopted the target of stabilizing by 2000 its total carbon dioxide (CO<sub>2</sub>) emissions at their 1990 level and stated that this target would be achieved collectively by its member States, compared to an expected 12 per cent increase in emissions projected without additional actions. In 1991 the EC identified four major elements of a strategy to meet its stabilization target: a regulatory approach, fiscal measures, burden-sharing among member States and complementary action at national level. In June 1993, the Council of Environment Ministers adopted decision 93/389/EEC to establish a monitoring mechanism for anthropogenic CO<sub>2</sub> and other greenhouse gas (GHG) emissions (excluding gases controlled by the Montreal Protocol). The monitoring mechanism serves a double purpose of monitoring whether progress by the EC as a whole is sufficient to ensure compliance with GHG emission targets laid down by the EC itself and keeping a check on the fulfilment of its joint commitments under the UNFCCC. In April 1999, this was amended by Council decision 99/296/EC to allow for updating of the monitoring process, in particular the post-2000 monitoring of GHG emission limitations and reductions, its application to all anthropogenic GHGs not controlled under the Montreal Protocol and the expected requirements of the Kyoto Protocol. This instrument is expected to gauge accurately and regularly the extent of progress being made toward meeting the Community's commitments.

7. The Treaty of Amsterdam, signed in 1997, was an important milestone for climate change activities at the Community level. It entered into force on 1 May 1999, with a clause for strengthening sustainable development and environment concerns in policy-making and decisions of the European Parliament. It is expected that this will reinforce the Commission's initiatives on climate change.

8. On 8 March 2000, the Commission Communication entitled "EU policies and measures to reduce GHG emissions: Towards a European Climate Change Programme (ECCP)" (COM (2000) 88), which advocates a twin-track strategy for implementing the Community's 8 per cent reduction commitments under the Kyoto Protocol. One important pillar of the strategy includes targeted measures to reduce emissions from specific sources.

## II. INVENTORIES OF ANTHROPOGENIC EMISSIONS AND REMOVALS

9. The review of the European Community's GHG inventory was based on information presented in the NC2 and the annex provided on the emission inventories of each of its 15 member States. The review team also obtained updated information as contained in the "Annual European Community Greenhouse Gas Inventory 1990-1998" which is used in the preparation of this report. The NC2 provides a summary of inventories of GHG emissions and removals for 1990, 1994 and 1995 and for the gases CO<sub>2</sub>, CH<sub>4</sub> (methane), N<sub>2</sub>O (nitrous oxide), CO (carbon monoxide), NO<sub>x</sub> (nitrogen oxides) and NMVOCs (non-methane volatile organic compounds). Hydrofluorocarbon (HFC), perfluorocarbon (PFC) and sulphur hexafluoride (SF<sub>6</sub>) emission estimates for member States which had submitted these estimates to the EC monitoring mechanism and for these years were also included in the NC2. Emission and removal estimates in the NC2 were calculated on the basis of the national inventories of the 15 member States which use the 1995 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories as far as possible. The experts explained that details of activity data, for example energy consumption, and emission factors were not included in the NC2 since these had all been reported in national communications or within the national CORINAIR databases. Although the reporting of GHGs improved as compared with the NC1, inclusion of the standard data tables of activity and emission factors would have added more transparency to the NC2. Inventory data from member States are incomplete and were not presented.

10. The task of compiling the European Community (EU15) GHG inventory is fulfilled by the Commission, assisted by the European Environment Agency (EEA) and its European Topic Centre on Air Emissions (ETC/AE). These inventories are based on information submitted by the member States to the Commission under the GHG monitoring mechanism mentioned in paragraph 6 above and the member States' national communications and annual submissions to the UNFCCC secretariat, as available to the Commission and the CORINAIR inventory programme of the EEA by April 1999. EUROSTAT data from energy balances and harmonized emission factors derived by EUROSTAT, are used to estimate CO<sub>2</sub> emissions from fuel combustion, for validation of the national (member States) estimates of CO<sub>2</sub> for that category. All other emission factors are a combination of the IPCC and CORINAIR default values.

11. During the visit the team had a favourable impression of the quality of work being done at the Commission, especially in relation to the application of a new software package, CollectER/ReportER, for improved computerized processing of inventory data. There was also extended coverage of the new GHG gases in the software. More complete data on land-use change and forestry were also made available to the Commission by member States. These advances were made possible, in part, through improved contacts with national inventory teams.

12. Inventory experts pointed out that data collection has been the main difficulty faced by some member States in submitting emission inventory data on time. For some States, statistics in several sectors are available only with significant delays: for instance, energy statistics and fuel consumption data are published in many cases at the end of the following year, whereas industrial production statistics and agriculture and forestry statistics are generally published after two years or even more infrequently in some cases. For this reason, the years of the latest

emission data available from member States at the time of the EC inventory compilation were as follows: 1996 for Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Luxembourg, the Netherlands, Sweden and the United Kingdom, 1995 for Italy and Spain and 1994 for Portugal.

13. The review team learned that in compiling the inventories some methodological adjustments were made including the following: Greece was not included in aggregating data for land-use, land-use change and forestry as these data were not available at the time of compilation. Despite the special methodology used by Finland for land-use, land-use change and forestry calculations, these values were added to the total without any modifications. Temperature and electricity adjustments were removed from all inventories. The inventory experts pointed out that no other adjustments were made to the national member States' inventories in preparing the consolidated EC inventories. In this regard, the review team strongly recommended that an explicit description of all adjustments made to all national inventories in all activity areas in preparing the consolidated EC inventories be presented, to reduce the possibility of discrepancies and increase comparability of data.

14. One notable adjustment made to the inventory was the addition of a source category, "final non energy consumption (FNEC)" or feedstocks, since inconsistencies exist between the detailed IPCC approach to calculating energy-related CO<sub>2</sub> emissions and the IPCC reporting instructions (reference approach). Officials pointed out that the national communications of most member States do not explicitly describe their approach to calculating potential and actual emissions from feedstocks. Therefore, for reasons of consistency, EUROSTAT estimates were used for each of the member States for feedstock emissions. It should be noted that in 1997 EUROSTAT changed its approach to reporting potential feedstock emissions. This revised methodology has been applied in the NC2 for data since 1990.

15. The degree of uncertainty in emission estimates which are required by the guidelines for preparing national communications, was partially quantified in the NC2. Inventory experts at the Commission expressed the opinion that, based on current data, any attempts to quantify the uncertainties of emission estimates would result in unreliable figures except for CO<sub>2</sub>, which was assigned an uncertainty level of +/- 3 per cent. The uncertainty of non-CO<sub>2</sub> GHG emission estimates was reported as being "considerably higher", with varying degrees of uncertainty as a result of often inadequate underlying data and little more than basic understanding of the fundamental processes that result in GHG emissions and sinks and the assignment of emission factors for these activities. As a general guide to interpreting inventory results, the uncertainty in emission estimates was reported in the NC2 as increasing in the following manner: "CO < NO<sub>x</sub> < CH<sub>4</sub> < NMVOC < N<sub>2</sub>O". Studies are being carried out with the aim of lowering the overall uncertainty in EC inventories.

16. The Commission has identified some elements which need further clarification regarding the presentation of summary information on GHGs, detailed worksheets for fuel combustion, land-use, land-use change and forestry, agriculture, and the submission of national inventories from member States to the UNFCCC secretariat on an annual basis. It expects that the common reporting format will improve the situation in the future. Additionally, in the context of the

revised European Council decision 99/296 - for a monitoring mechanism on CO<sub>2</sub> and other greenhouse gas emissions - which entered in force on 1 May 1999, the Commission intends to discuss with member States in the near future, possible ways of ensuring timely submission of the EC inventory to the UNFCCC by 15 April each year. This implies that member States will be required to complete their own inventories by 31 December of the previous year. Other issues to be further addressed in the near future by the Commission include:

- (a) Transparent reporting of the methods used for preparing the inventory;
- (b) Consistency and transparency in recalculation of time-series of greenhouse gas inventories;
- (c) Comparison of national estimates of CO<sub>2</sub> emissions from fuel combustion with the estimates obtained using the IPCC reference approach;
- (d) Transparent reporting of adjustments to inventories related to climate variations or trade patterns of electricity;
- (e) Transparent reporting of national estimates of CO<sub>2</sub> emissions from feedstocks and from domestic and international aviation and marine bunker fuels, once a formal methodology of allocation of these bunker fuels is established and adopted.

17. CO<sub>2</sub> emissions for 1990 were updated from 3,285,620 Gg in the NC1 to 3,351,150 Gg in the NC2, representing a difference of 2 per cent, which experts explained reflects improvements in understanding and improved methodologies for GHG emissions. Since the publication of the NC2 1990 CO<sub>2</sub> emissions have been revised even further to 3,320,481 Gg. The updated inventories provided during the review indicate that total net emissions of GHGs (without land-use change and forestry) in 1998, estimated at 3,850,906 CO<sub>2</sub> equivalent were 15 per cent lower than 1990 emission levels of 3,944,290 CO<sub>2</sub> equivalent. The energy sector was by far the largest contributor to emissions in 1998 accounting for 82 per cent of the total. Forestry constituted a sink of 203,641 CO<sub>2</sub> equivalent in 1998. On a CO<sub>2</sub> equivalent basis, emissions of CO<sub>2</sub> accounted for 81 per cent of total emissions in 1998, followed by CH<sub>4</sub> with 10 per cent, and N<sub>2</sub>O at 9 per cent. The contribution of "new gases" in 1998 was negligible.

#### **A. Carbon dioxide**

18. It can be observed in table 1 that, between 1990 and 1998, total anthropogenic emissions of CO<sub>2</sub> registered no significant change from the 1990 level of 3,320,481 Gg to 3,327,520 Gg in 1996, an increase of 0.2 per cent. By sector, the bulk of CO<sub>2</sub> emissions, 33 per cent, originated in energy transformation, the largest contributor being electricity generation, which is mainly fossil-fuel-based, followed by transport, which accounted for 24 per cent, manufacturing 18 per cent, the residential and other sectors 20 per cent of CO<sub>2</sub> emissions and industrial processes 4 per cent. The main reductions came from a fuel consumption shift from coal to gas in Germany and the United Kingdom. Notable decreases in CO<sub>2</sub> emissions between 1990 and

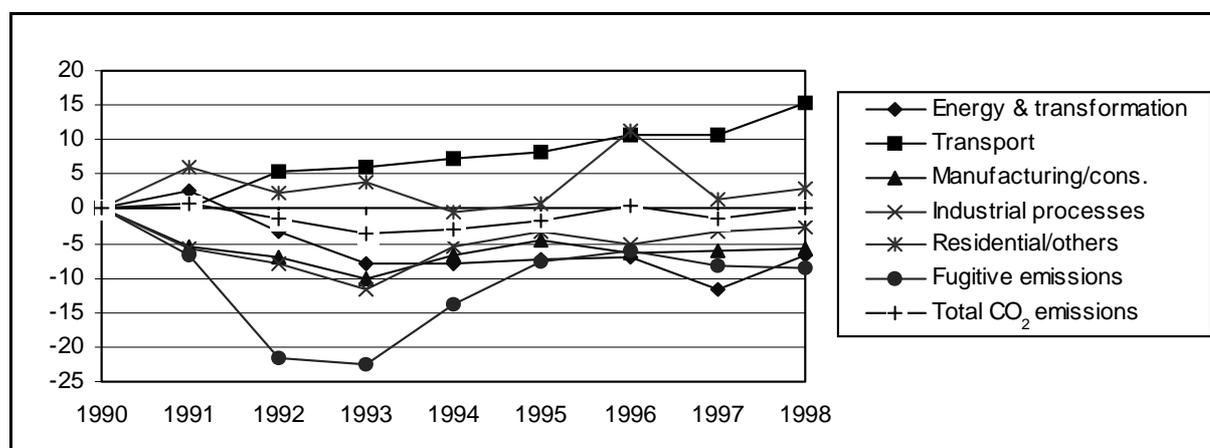
1996 were registered in the manufacturing and industrial processes sectors and from fugitive emissions. Conversely, transport emissions continued to increase throughout the decade.

19. As required by the UNFCCC reporting guidelines, CO<sub>2</sub> emissions from international marine and aviation bunkers were reported separately. Data show that in 1990 a total of 166,631 Gg of CO<sub>2</sub> emissions originated from international bunkers. Of this total, most (64 per cent) came from marine bunkers (107,813 Gg) and the rest from aviation 58,818 Gg. In 1998, CO<sub>2</sub> emissions from bunkers increased significantly to 221,924, a 33 per cent decrease from 1990 levels, with a marked increase in both marine and aviation bunkers in 1998 to 132,927 Gg and 88,997 Gg respectively. Experts at the Commission noted that for future commitments, emissions from international aviation and shipping will not be part of the assigned amounts until the second commitment period under the Kyoto Protocol. Until such time, bunkers have been reported separately and the EC like other Parties to the UNFCCC, has agreed to take action to limit or reduce these emissions working through the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO).

**Table 1. Carbon dioxide emissions and removals by source, 1990-1998 (Gg)**

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Energy/transformation	1 169 746	1 202 003	1 129 804	1 076 402	1 076 011	1 084 325	1 089 228	1 031 825	1 090 412
Transport	692 346	694 004	729 389	734 907	742 131	748 803	766 744	766 322	798 166
Manufacturing/construct.	635 832	600 808	591 243	571 925	594 131	606 384	595 737	596 566	599 878
Industrial processes	150 780	142 119	138 750	133 357	142 395	145 803	142 946	145 713	146 815
Residential/other sectors	632 981	671 277	647 251	656 832	629 095	638 214	703 780	641 496	652 164
Fugitive emission	25 405	23 724	19 926	19 683	21 901	23 489	23 859	23 341	23 205
Other	13 391	14 701	12 586	12 241	11 716	13 280	13 601	73 721	16 880
<b>Total</b>	<b>3 320 481</b>	<b>3 348 636</b>	<b>3 268 949</b>	<b>3 205 347</b>	<b>3 217 380</b>	<b>3 260 298</b>	<b>3 335 895</b>	<b>3 278 534</b>	<b>3 327 520</b>
Bunkers	166 631	166 127	172 359	182 295	180 485	184 424	195 064	209 675	221 924
LUCF removals	- 214 686	-224 081	- 212 359	218 018	- 207 837	- 203 838	- 192 320	- 197 064	- 203 641

20. Total forest area of the EC in 1997 was estimated at 130 million hectares, accounting for 36 per cent of its total land area. Around 90 million hectares are considered as exploitable forests managed for wood production and non-wood goods. Sink capacity in the EC decreased from 214,686 Gg in 1990 to 203,641 Gg in 1998, an reduction of 5 per cent. Experts explained difficulties encountered in compiling the EU15 inventory from national data on land-use change and forestry and said that work is in progress to have more methodologically consistent reporting and valuation of sinks in the future. Emissions of CO<sub>2</sub> resulted from deforestation arising from urbanization and industrial uses, and the creation of large-scale infrastructure. In addition, European forests are exposed to serious threats from air pollution, fires, climatic change and attacks from parasites and diseases. Experts pointed out that these factors adversely affect tree vitality on almost one third of Europe's forests and ultimately sink capacity.

**Figure 1. Carbon dioxide emissions, percentage change from 1990, by major source**

## B. Methane

21. Emissions of CH<sub>4</sub> (which are reported as having a high degree of uncertainty) in the EC were around 16.4 per cent lower in 1998 compared to 1990, as seen in table 2. These emissions are dominated by those from enteric fermentation in livestock, which accounted for 36 per cent of these emissions in 1998. Most of this reduction in emissions was a direct result of a reduction in cattle numbers, which fell by 2 per cent, and dairy cows, which fell by 6 per cent, in the EC as a whole and improvements in manure management methods over this period. Land filled municipal waste is the second largest source of CH<sub>4</sub> emissions in the EC. Although emissions from this sector accounted for 30 per cent of total CH<sub>4</sub> emissions in 1998, it should be noted that they fell by 24 per cent between 1990 and 1998. This decline was a result of measures by most countries to limit the amount of waste sent to landfills and to capture CH<sub>4</sub> from new and existing landfill sites. Landfills currently account for about 90 per cent of total CH<sub>4</sub> emissions from waste.

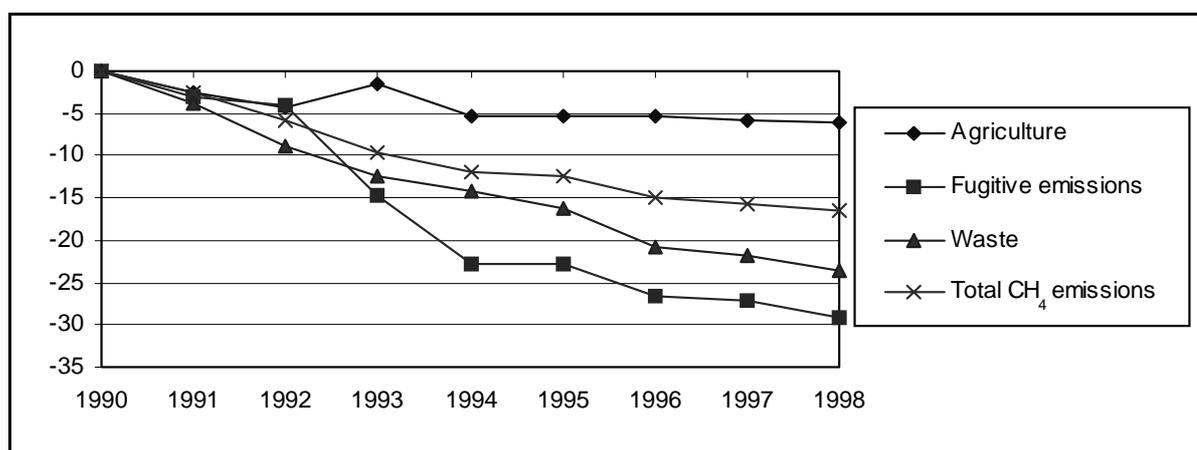
**Table 2. Methane emissions by sector, 1990-1996 (Gg)**

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Agriculture	9 074	8 851	8 686	18 928	8 593	8 594	8 581	8 556	8 527
Fugitive emissions	4 024	3 897	3 859	3 433	3 106	3 109	2 953	2 930	2 853
Waste	6 865	6 604	6 264	6 016	5 891	5 752	5 443	5 363	5 250
Other	982	1 037	890	551	833	865	843	788	868
<b>Total</b>	<b>20 945</b>	<b>20 389</b>	<b>19 699</b>	<b>18 928</b>	<b>18 423</b>	<b>18 320</b>	<b>17 820</b>	<b>17 637</b>	<b>17 498</b>

22. A further reduction in CH<sub>4</sub> emissions came from fugitive emissions at oil and natural gas installations and coal mines. These emissions have also been declining since 1990, having experienced a reduction of 30 per cent from 4,024 Gg in 1990 to 2,853 Gg in 1998. Experts explained that this was a result of deep coal mines being shut down, an effect of the EU-wide energy liberalization policy, as well as an improvement in CH<sub>4</sub> recovery techniques in mines.

Fugitive emissions from the oil and gas sector also fell due to the gradual upgrading of gas distribution pipework in many member States. Solid fuel accounted for 60 per cent of fugitive  $\text{CH}_4$  emissions from hydrocarbon production and oil use in 1990. In 1998, its participation was reduced to 47 per cent.

**Figure II. Methane emissions, percentage change from 1990, by major source**



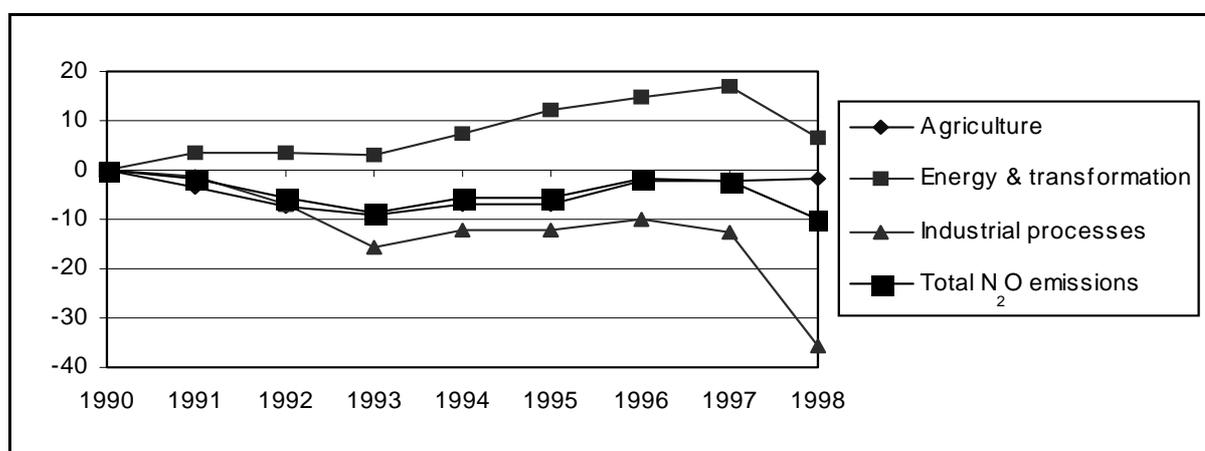
### C. Nitrous oxide

23. It can be seen from table 3 that  $\text{N}_2\text{O}$  emissions (which are reported as having a high degree of uncertainty) fell by 10 per cent between 1990 and 1998. The most significant amount of  $\text{N}_2\text{O}$  emissions, 60 per cent, comes from agriculture, which registered a 6 per cent reduction between 1990 and 1998 owing to a decrease in the use of nitrogenous fertilizers. Another important consideration was the application of different emission factors at national level for these activities. Further reduction in  $\text{N}_2\text{O}$  emissions came from energy-intensive industries and a fall in the output of commercial fertilizer. A process change in the manufacture of adipic acid in several member States also reduced  $\text{N}_2\text{O}$  emissions from industrial processes by almost 35 per cent between 1990 and 1998.

24. Conversely,  $\text{N}_2\text{O}$  emissions from transport, although small, almost doubled between 1990 and 1998 from 40 Gg to 68 Gg. Experts explained that the increased market penetration of cars with catalytic converters was at the root of this rise. It is a direct reflection of the disproportionate growth of emissions from transport compared to other sectors, and further growth in these emissions can be expected as strong growth in road traffic is expected in the coming years.

**Table 3. Nitrous oxide emissions by sector, 1990-1996 (Gg)**

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Agriculture	713	689	660	648	664	662	696	699	701
Energy and transformation	167	173	173	172	179	187	192	195	178
Industrial processes	357	352	332	301	314	313	322	312	230
Others	49	50	50	51	54	54	53	50	51
<b>Total</b>	<b>1 286</b>	<b>1 264</b>	<b>1 215</b>	<b>1 172</b>	<b>1 211</b>	<b>1 216</b>	<b>1 263</b>	<b>1 256</b>	<b>1 160</b>

**Figure III. Nitrous oxide emissions, percentage change from 1990, by major source**

#### D. New gases

25. According to the NC2, HFC-23 emissions are produced mainly during HCFC-22 production, and other HFCs are used in refrigeration and foams, while PFCs and SF<sub>6</sub> are generated in primary aluminium and magnesium production respectively. Some SF<sub>6</sub> is also used as an insulator in electricity distribution switchgear. The NC2 presented data only for those member States that had submitted these estimates to the EC monitoring mechanism at the time of the preparation of the NC2. National data had not been collected from Greece, Ireland, Luxembourg, Portugal and Spain.

26. Inventory experts explained that the comparability and comprehensiveness of data is impaired by the insufficiency of information. Additionally, most member States, among them Austria, Belgium and Finland, reported potential emissions while Germany and the Netherlands provided actual emissions. Moreover, several methods for estimating actual emissions are used among member States. All these factors add to the uncertainties associated with emission estimates, together with the fact that it is not clear whether national reported data include all possible emission sources and to what extent these gases are used or produced.

27. Estimates of HFC and SF<sub>6</sub> emissions were still being finalized at the time of the review and are expected to be available in 2000. However, preliminary data presented to the team using data reported by 10 member States show that the largest contribution to total fluorocarbon emissions in 1995 came from HFCs (64 per cent) followed by SF<sub>6</sub> (25 per cent) and third PFCs (11 per cent). Country trends indicate that in 1995 Germany and the United Kingdom had the highest HFC emissions, amounting to 2.21 Gg and 1.96 Gg respectively. PFC emissions in 1995 ranged from zero emissions in Austria to 0.35 Gg in the Netherlands. Germany registered the highest emission levels of SF<sub>6</sub> in 1995, at 0.25 Gg, while Finland had a level of zero.

### III. POLICIES AND MEASURES

28. Outlined in the NC2 are the policies, measures and mitigation benefits of the Commission's 1991 strategy to limit CO<sub>2</sub> emissions and improve energy efficiency with the objective of stabilizing CO<sub>2</sub> emissions in the Community. Key policy actions taken by the Commission thus far are also presented for CH<sub>4</sub> and N<sub>2</sub>O. While the team felt that the Commission had adhered to the UNFCCC reporting guidelines for the most part, detailed information on the estimated effect of some measures on reducing GHG emissions had not been provided. These were not ranked in order of importance and there were no Community-level policies and measures aimed at reducing HFC, PFC and SF<sub>6</sub> emissions. A clearer definition of each policy or measure, the instruments used, the expected result, the status of implementation and data to support the progress, would have made this chapter more transparent.

29. Each member State is currently required to develop, publish, implement and periodically update national programmes for reducing national anthropogenic emissions of CO<sub>2</sub> in accordance with the UNFCCC. With the amended monitoring mechanism, member States will report also on the other major GHGs. The Commission annually evaluates the national programmes, in order to assess whether progress in the Community as a whole is sufficient to attain its stabilization objective. So far, two evaluation reports have been presented by the Commission, the first in 1994 and the second in 1996. While there has been improvement in the quality of member States' reporting since the first evaluation report, the Commission concluded that the information provided is still not sufficient to evaluate progress towards the Community's stabilization target in a satisfactory way. This incomplete evaluation was used in the preparation of the NC2, significantly affecting the comprehensiveness and quality of information presented therein.

30. Overall, with the additional information provided during the review on the Commission's post-Kyoto strategy (i.e. subsequent to the third session of the Conference of the Parties), the team was better guided in its evaluation of current GHG policies and measures. The team learned from the presentations about the new comprehensive integrated approaches to reduce all six GHG emissions set out in the Treaty of Amsterdam. In addition to the amended GHG monitoring mechanism which is intended to comprehensively monitor and report on the progress of GHG abatement policy initiatives across sectors, the team learned that some specific programmes were periodically reviewed by the Commission to gauge their progress in achieving their objectives.

31. Measures taken at the Community level constitute a necessary framework and component of national initiatives. In October 1991, the Commission presented an overall strategy to limit CO<sub>2</sub> emissions and the EC climate change strategy to improve energy efficiency, with the objective of stabilizing CO<sub>2</sub> emissions in the Community by the year 2000 at the 1990 level. In June 1992, a mutually reinforcing package of measures and programmes was proposed by the Commission to the Council (COM (92) 246 final). The package rested on four pillars: the EC energy technology programmes and trans-European networks; fiscal measures; complementary national programmes, and a monitoring mechanism for CO<sub>2</sub> and other GHGs. The initial outline of this strategy was described in the NC1. An update on the extent of implementation of these programmes was provided in the NC2.

32. The Commission regards increased taxes on energy prices as crucial for meaningful mitigation of GHG emissions. In 1992, the Commission proposed the introduction of a mandatory Community-wide energy and CO<sub>2</sub> tax. Following discussions in the Council of Environment Ministers, the proposal was modified in 1995 to allow for a transitional period when member States would be free to set their own tax rates, including zero rates, while respecting a harmonized tax structure. This Council was not able to reach an agreement on this proposal, and in March 1996 it invited the Commission to bring forward new proposals related to taxation of energy products. The Commission presented such a proposal in March 1997 extending the scope of the existing Community-wide excise system beyond mineral oils to also cover natural gas, coal and electricity. It also recommend that member States avoid any increase in the overall tax burden by offsetting such increases by reductions in labour taxation. Currently five member States, Austria, Denmark, Finland, the Netherlands and Sweden, have CO<sub>2</sub> taxes. Italy has a proposal before its parliament and others have made statements of intent to follow suit.

33. Further elements of the EC strategy focus largely on CO<sub>2</sub> emission reductions from the energy, transport and industry sectors. The non-energy sector is also targeted, but to a lesser extent, with the reduction of CH<sub>4</sub> emissions from agriculture and increase in CO<sub>2</sub> sequestration by forests.

34. Since 1998, the Commission has adopted an update on the energy technology programme, "Energy Dimension of Climate Change", intended to achieve a 15 per cent reduction for a basket of six greenhouse gases in 2010 compared to 1990 in the energy sector, in line with the Community's target under the Kyoto Protocol. A number of potential areas of action, including energy efficiency and energy saving, power and heat production and integration with other policies, the role of technology and innovation, and fiscal instruments are discussed in the NC2.

#### **A. Carbon dioxide**

35. Among member States, the sources of CO<sub>2</sub> are sectoral quite diverse and emission levels vary considerably but common features are the growing role of transport and uncertainty about the future evolution of the electricity system. GHG emissions by fuel type also vary from country to country. All countries with the exception of the Netherlands and the United Kingdom

are highly dependent on fossil fuel imports, although France and Sweden are dependent on imports mainly for transport but not for power generation. Energy use and production is still by far the most important source of CO<sub>2</sub> emissions in the EU, representing almost 80 per cent of 1990 total CO<sub>2</sub> emissions. Almost 66 per cent of the energy sector's CO<sub>2</sub> emissions originates from electricity and heat production.

36. Integrating energy and environment matters has been a major component of energy policy development in the 1990s within the Community. The joint Energy and Environment Council meetings of October 1990, December 1991 and April 1993 were crucial in developing the Community energy policy priorities contained in the Energy Policy White Paper of 1995. The Council and the Parliament are presently considering the Commission's proposal for a Community Energy Framework Programme, whose objective will be to contribute to sustainable development through improved competitiveness, securing energy supplies and achieving acceptable environmental quality. The Fifth Framework Programme on Research, Technological Development and Demonstration (the RTD Framework Programme) supports the achievement of these objectives. The NC2 mentions six energy-related programmes, in energy efficiency (SAVE), the power sector, renewable energy (ALTENER), regional and urban energy management, labelling and energy efficiency requirements for household electric appliances, and the JOULE-THERMIE Programme.

37. The Special Action Programme for Vigorous Energy Efficiency (SAVE) is a Community-wide programme aimed at improving energy efficiency and as a consequence reducing CO<sub>2</sub> emissions, in industry, commerce and the domestic sector. It consists of four components: directives (which are mandatory for member States) and standards, financial support for the creation of energy efficient infrastructures, information exchange and PACE - a Community electricity action programme, now integrated into SAVE. The budget for the programme for 1990-1995 was 35 million euros. Under the framework directive, member States have implemented to date programmes in various areas including the minimum insulation standards for new buildings, energy certification of buildings, and billing of heating costs based on actual consumption. The Commission also promoted third party financing for public sector investments. Other programmes included the inspection of boilers and energy audits for businesses with high energy consumption.

38. In its first five years, the SAVE programme, which ended in late 1995, concentrated on improving practices and procedures for improving energy efficiency. Phase II of the programme extended these initiatives for another five years until 2001 with a total budget of 45 million ECU, the emphasis being on technological retrofitting. In 1996, a common position was reached requiring an initial overall energy efficiency improvement of 15 per cent compared with average consumption rates, within three years, which was agreed by the Energy Council in May 1999. Experts pointed out that, although energy intensity in terms of energy per unit of GDP improved by 0.6 per cent per annum between 1990 and 1997, the economic potential for improvement is far from being exhausted. At the time of the review, an evaluation of SAVE, its implementation and its impact in terms of avoided CO<sub>2</sub> and other GHG emissions was in progress.

39. An important part of the EC energy policy is the integration of national energy markets so as to ensure security of energy supply, reduce costs and improve competitiveness, which in turn will improve the efficiency of EU energy industries and reduce prices for energy consumers, while helping producers to gain a competitive edge in generation. In 1990, a Community procedure (directive 90/377/EEC) was set up to ensure price transparency for the final industrial consumers of gas and electricity. At the same time, transit directives were also introduced (directives 90/547/EEC and 91/296/EEC) for electricity transmission grids and natural gas pipelines supplying electricity and gas to non-neighbouring countries. In a second phase, the conditions for granting and using permits for the exploration and production of hydrocarbons (directive 94/22/EC) were set out, providing that member States grant all EU companies equal and non-discriminatory access in these activities. The third phase of the integration concerned the establishment of common rules for the internal electricity and natural gas market. A directive (96/92/EC) containing these rules was adopted at the end of 1996 and entered into force on 19 February 1997 for electricity markets and generation, transmission, consumption and access to networks. The Energy Council, on 8 December 1998, also reached a unanimous political agreement on a common position for the internal market for natural gas. The next step is for the European Parliament to adopt a common position on this matter, after which a directive may be adopted. At the time of the review the matter was still before the Parliament.

40. With regard to electricity and gas markets, some member States such as Finland, Sweden and the United Kingdom have already liberalized. Others, such as Germany, the Netherlands and Spain are in the process of doing so. In spite of the different progress levels that member States have achieved, the intention is that all member States will restructure these two energy markets in the future. Particular attention is also given to the cogeneration of heat and electricity, which has increased the efficiency of fuel use from 30-40 per cent to 70-80 per cent for particular installations. Currently only 9 per cent of energy production comes from cogeneration. A strategy for action to increase this participation to 18 per cent by 2010 was adopted by the Commission and endorsed by the Council and Parliament in 1999.

41. In liberalizing energy markets, changes have taken place in the supply of fuels used for electricity and heat generation. There is substitution of oil and coal with natural gas. Coal is being substituted, in part due to reform of domestic coal policies, including the freeing of coal prices by elimination of price supports and minimum purchase obligations and removal of budgetary subsidies to coal production and transportation. The demand for natural gas has increased steadily since 1990 and supply networks have expanded accordingly, given that combined cycle gas turbines are relatively quick to build and more efficient than coal plants. At current gas prices, gas plants have become the most economic option for capacity increase or replacement.

42. Nuclear energy represents more than 30 per cent of electricity production in the EU and consequently contributes to lower external energy dependency. Under the EURATOM treaty, the Commission plays a role in the development of nuclear energy in so far as making provisions concerning the supply and safeguard of nuclear material and on nuclear trade. Most policies regarding the participation of nuclear energy in the energy balance are the responsibility of the member States and for this reason information in the NC2 on the nuclear energy programme was

qualitative in nature, making any assessment of the programme on GHG emissions difficult. However, according to the experts, nuclear power is still a very sensitive issue within the Community, fuelled by a strong opposition from many member States. Current plans suggest that installed nuclear capacity in the Community is likely to increase only slightly in the next few years, with a negligible impact in reducing CO<sub>2</sub> emissions. The experts told the team that many of the plants have a remaining life of about 20 years. Information was vague on what will happen during those 20 years, or what role nuclear power will play in the future, or what will replace it once these plants are decommissioned.

43. The promotion of cleaner energy, and renewables in particular, has been a major issue of energy policy at Community level. The objective of the ALTENER programme is to foster greater market penetration of renewables (small hydro, wind, solar, biomass, biogas, and geothermal). Under phase I of the programme (1993-1997) 40 million ECU were allocated by the Commission. Its specific objectives were to increase the contribution of renewable energy in the primary energy balance from 4 per cent in 1991 to 8 per cent by 2005 and 12 per cent by 2010 (excluding large hydro). These targets corresponded to tripling the production of electricity from renewable energy by 2010. The programme also intended to increase the share of biofuels used by vehicles. An interim report was published in 1997 on the performance of this first phase. Although it did not address the impacts on GHG emissions, other objectives such as the increased participation of renewables in the primary energy balance were reported as being on track. The second phase commenced in 1998 with added actions to promote further penetration of renewable energy sources as well as new actions on implementation, follow-up and monitoring of the programme.

44. A recent initiative on renewable energy by the Commission, which was presented during the review, is the Community's strategy and action plan, Energy for the Future: Renewable Sources of Energy. This comprehensive, integrated programme sets an objective of 12 per cent for the contribution of renewable sources of energy to the energy supply balance by 2010. It is estimated that the programme will require the investment of around 30 billion euros, with some 75-80 per cent coming from the private sector. The fifth Environmental Action Plan also gives due consideration to renewable energy and proposes support measures for these initiatives, including fiscal incentives.

45. The main objective of the Commission's Regional and Urban Energy Management Programme is to define and put into effect a series of measures designed to improve demand management and give regional and local authorities more responsibilities for areas related to energy consumption and production. The team felt that this programme could have positive effects in reducing GHG emissions, given that an estimated 1,600 decentralized coordinating agencies could become involved as focal points in this endeavour for networking and managing these services. The NC2 reported that 141 agencies had already been set up since 1992 and in 1997 the Commission financed the creation of 31 agencies each with ECU 150,000 for their first three years of operation.

46. In the EC, the share of transport CO<sub>2</sub> emissions was reported to have increased from 19 per cent in 1985 to 24 per cent of total CO<sub>2</sub> emissions in 1998. While economic growth in

this period led to 26 per cent growth of GDP in the Community as a whole, emissions from transport grew by 15 per cent between 1990 and 1998. Experts explained that one fifth of the CO<sub>2</sub> emissions growth was due to a modal shift from more energy-efficient modes of transport to road transport, especially for freight, as a consequence of economic growth and a reduction of real road transport prices. It was also pointed out that the average fuel efficiency of road vehicles decreased in the same period due to a shift towards heavier cars. Urban road traffic is responsible for about half of the emissions from road transport. Air traffic which generated about 3 per cent of CO<sub>2</sub> emissions in 1998, recorded a steep increase of 38 per cent between 1990 and 1998. In spite of this increase, experts pointed out that the average fuel efficiency in aircraft has increased due to advanced technologies and operational improvements. Road and air transport are therefore two main focal areas for reducing CO<sub>2</sub> emissions in the Community because of its share in emissions in the case of the former and unprecedented growth trends in the case of the latter. Air traffic growth is projected to increase at 5 per cent per annum over the next 15 years and aviation fuel growth by only 3 per cent annually in the same period.

47. To this end, the Commission has formulated a series of instruments for combatting CO<sub>2</sub> emissions under its Common Transport Policy. The NC2 listed several initiatives including the Road Fuel Taxation Scheme; pushing for a modal shift to rail through its White Paper on "A strategy for Revitalizing the Community's Railways"; encouraging more public transport in its Green Paper on "The Citizen's Network"; and its 1996 CO<sub>2</sub> and Cars programme. With respect to the Cars programme, its overall objective is to achieve an average value of 120g CO<sub>2</sub>/km for newly registered cars, corresponding to a reduction of 25 per cent of CO<sub>2</sub> emissions from passenger cars between 2005 and 2010. The programme comprises three initiatives: agreements with the car manufacturing industry on fuel economy improvements; fuel-economy labelling of cars; and the promotion of car fuel efficiency by fiscal measures.

48. To date, work on the first two initiatives is completed. The Commission has already drafted agreements with the European, Japanese and Korean car manufacturers. All three agreements consist of a requirement for a quantified CO<sub>2</sub> emission objective for cars sold in the EU. The objective is to reach 140g CO<sub>2</sub>/km by European car manufacturers in 2008, and by the Japanese and Korean car manufacturers by 2009, through technological developments and related market changes. Commission experts have estimated that total CO<sub>2</sub> emissions could be reduced by 2.6 per cent compared to 1990, in member States. The third initiative of the Cars programme includes a proposal for the introduction of a fiscal framework for the promotion of fuel efficiency as well as an increase in fuel taxation implemented in combination with a vehicle-tax incentive and better consumer education to strengthen market demand for more fuel-efficient cars. On the road fuel taxation scheme, there was a proposed Community directive in discussion to raise the minimum rates for excise duties on motor fuel in three steps in 1998, 2000 and 2002. Experts told the team that reaching an agreement in Council had been difficult due to the wide divergence of opinions among member States.

49. During the review, experts presented a new comprehensive and integrated programme entitled "Transport and CO<sub>2</sub> - Developing a Community Approach", which is currently before the European Parliament for approval. This programme was developed in the framework of sustainable transportation targets, primarily for CO<sub>2</sub> and to the extent possible, for the other five

gases covered by the Kyoto Protocol. The programme includes policies for improving logistics, initiatives to reduce CO<sub>2</sub> emissions from passenger cars, the revitalization of railways, the promotion of public transport, short-sea shipping intermodal transport, fiscal measures in aviation, and the introduction of fair and efficient pricing in all modes of transport. On freight transport, the Commission has proposed new rules for rail transport which aim at revitalizing this transport mode. In addition, the programme also lays down long-term policies and solutions for the development of alternative propulsion technologies, notably hybrid car technology and fuel cells. In 1999, the Commission also produced a Communication on Air Transport and the Environment (COM (1999) 640), which includes a commitment to work within ICAO to develop policies and measures to limit or reduce GHG emissions from international aviation.

50. The team noted that this comprehensive programme may, if implemented, have a significant impact in reducing CO<sub>2</sub> and other GHG emissions from transport. However, its net impact in reducing overall GHG emissions may be diminished as experts said that there is a general trend for consumers to purchase bigger cars and minivans, and transport demand to increase as the tendency is to drive more as consumers use less petrol for achieving the same mileage.

51. Although the NC2 contained information on the control of polluting emissions from industrial installations with direct consequences on human health or the ecosystem, such as acidifiers, carbon monoxide and volatile organic substances, most CO<sub>2</sub> emission reductions in industry within the Community are achieved through energy efficiency improvements largely driven by industry competitiveness rather than by climate change concerns. One notable initiative is the system of voluntary agreements. These are mainly coordinated at a national level. The experts added that some reductions were achieved by industries but they were uncertain of the amount of CO<sub>2</sub> avoided at the Community level. While generally opposed to energy taxes, European businesses have taken these agreements as their firm commitment to reducing GHG emissions from the sector. To date, some businesses have achieved GHG reductions under these agreements but this has not been quantified at EC level. Early reports show that between 1990 and 1995 fuel and power consumption decreased by 3.3 per cent while CO<sub>2</sub> emissions decreased by 8.1 per cent. One recent example of unified efforts is the Chemical Industry Council, representing more than 40,000 chemical companies. It has put in place the Voluntary Energy Efficiency Programme (VEEP 2005) to reduce its specific energy consumption by 20 per cent between 1990 and 2005. The experts told the team members that DG XI is in the process of restructuring its work on voluntary agreements to ensure greater participation and improve the monitoring and reporting from its partners.

52. As households account for a sizeable share of domestic electricity consumption, the Labelling and Energy Efficiency Requirements for Household Electric Appliances have been vital in promoting energy efficiency as part of the SAVE programme.

53. An important initiative mentioned in the NC2 is the THERMIE programme. This is a component of the JOULE-THERMIE programme, with multiple objectives including energy supply security, economic and social cohesion, improving competitiveness and employment, cooperation with central and eastern Europe and the Commonwealth of Independent States, and

environmental protection. It focuses on the cost-effective, environment-friendly and targeted demonstration and promotion of clean and efficient energy technologies in the fields of renewable energy technologies, rational use of energy in industry, building and transport and more efficient use of solid fuels and hydrocarbons. The programme ended in 1998 at a total expenditure of 566 million ECU. At the time of the review, the experts gave an update on the programme but could not provide a clear status of implementation, or an assessment of the impact in reducing CO<sub>2</sub> emissions.

54. There is a wide variety of forest types in terms of bioclimatic and soil conditions in the EC. Their ecological characteristics range from a sub-Mediterranean zone to the Arctic belt and from coastal plains to the Alpine zone. Forest land in the EC is 65 per cent privately owned. As there are about 12 million private forest owners, privately owned forests tend to be highly fragmented with most holdings smaller than 5 hectares. Ownership varies widely within the Community. In Greece and Ireland, the State owns about two thirds of forest land, while in Belgium, France, Germany, Italy, Luxembourg and Spain, local communities play an important role as forest owners.

55. While treaties of the European Union make no provision for a comprehensive common forest policy, the management, conservation and sustainable development of forests are vital concerns addressed under the Common Agricultural Policy (CAP). A number of important actions within existing Community policies are reported in the NC2 as having considerable impact on forests. EC regulations under the CAP also explicitly aim at carbon sequestration, which has a direct benefit in reducing GHG emissions in the forest sector through CO<sub>2</sub> sequestration. The main programme is the afforestation of agricultural land. Forestry experts mentioned that in general the forest is in a good state and expanding at a regular pace (from 118 million ha. in 1985 to 130 million ha in 1995). At the same time, direct and indirect linkages exist between Community and national forestry policies, given that member States are responsible for planning and implementing national forest programmes. They have access to the Community-wide European Agricultural Guidance and Guarantee Fund, which co-finances 50 per cent of the cost of land afforestation for farmers. From 1993 to 1997, the available budget was 1,325 million ECU and some 43 programmes were initiated. Between 1993 and 1997, over 500,000 hectares of agricultural land were afforested and around 26,000 farmers took advantage of the scheme. The programme also provides assistance for silvicultural improvement of existing forests.

56. Funds are also allocated to forest fire protection and the protection of forests against atmospheric pollution, insects and disease. Research is also being done through the fifth RTD framework programme in the areas of forest carbon cycle interaction, forest biodiversity, production and management, diseases and pest protection. In March 1999, the Agriculture Council reached an agreement concerning the agricultural aspects of Agenda 2000, which included a new regulation on support for rural development giving more autonomy to member States as regards the application of forestry measures. It will be up to member States to decide what degree of support is given to afforestation of agricultural land. The implementation of this scheme was previously mandatory. The new regulation also calls for the member States to

control and evaluate (ex ante and ex post) the success of measures undertaken under their forestry programmes. Appropriate systems are currently being developed to this end.

## **B. Methane**

57. CH<sub>4</sub> emissions accounted for 10 per cent of total GHG emissions in the EU15 in 1998. The largest source of these emissions in member States was agriculture, which was responsible for 49 per cent of all anthropogenic CH<sub>4</sub> emissions. These emissions originated principally from enteric fermentation in the digestive tract of ruminant livestock (cattle and sheep) and from the anaerobic decomposition of livestock manure, followed by crops, mainly rice. The other major CH<sub>4</sub> source is landfills, which accounted for 30 per cent in 1998. CH<sub>4</sub> emissions from coal mining and natural gas production, transmission and distribution (16 per cent) made smaller but still significant contributions.

58. Although at the time of the preparation of the NC2 no specific mitigation policies for non-CO<sub>2</sub> gases were agreed at the Community level, a strategy for reducing CH<sub>4</sub> emissions was developed in 1997 which aims at formulating actions for the waste and agriculture sectors. These actions are also expected to reduce N<sub>2</sub>O emissions. The Community has overall competence in devising and regulating policies for the agriculture sector, through its CAP. The CAP determines the levels and methods of production, which directly affect GHG emissions. The overall Commission budget for the sector in 1997 was in excess of 40 million euros, almost half of the total Community budget. The new programme for reducing CH<sub>4</sub> emissions will focus on improving feed efficiency and animal productivity, reducing the number of livestock and improving the quality of livestock waste.

59. The extent to which landfills are currently deployed within overall waste management strategy in member States is, in part, linked to available waste management resources and in part to national or regional laws and regulations. Many member States still rely on landfill as the major alternative for treatment and disposal of solid waste. However, the Community has in place several binding legislative measures to regulate waste in the European Union, which were well documented in the NC2. New Council directives adopted in April 1999 require member States to fit all new and existing landfills which receive biodegradable waste with a landfill gas collection system. The directives also introduce CH<sub>4</sub> reduction targets for landfilling of 25 per cent for 2006, 50 per cent for 2009 and 75 per cent for 2016 compared to 1995 levels.

60. A breakdown of CH<sub>4</sub> emissions from coal mining by country shows that Germany currently produces the most methane from coal mining, followed by Spain, the United Kingdom and France. Emissions have already fallen by a third since 1990, due mainly to the closure of many deep coal mines in Germany and the United Kingdom. Coal production is expected to decline further due to liberalization of energy markets. Upgrading of the gas transmission and distribution networks and improved CH<sub>4</sub> recovery techniques at oil and gas production sites are expected to further reduce growth in these emissions.

### **C. Nitrous oxide**

61. The major sources of N<sub>2</sub>O emissions in the EU are agriculture, industrial processes and fuel combustion. A reduction in the use of mineral fertilizer by one third cut the total amount of N<sub>2</sub>O emissions from nitrate and ammonium fertilizer between 1990 and 1996. A large part of this reduction was an important effect of the CAP which triggered incentives for extensive farming using less nitrogenous fertilizer. In industrial processes, N<sub>2</sub>O emissions from the production of nitric acid have already fallen since 1990 as several plants have been shut down. A Community-wide regulation which was introduced in 1993 limits emissions in new plants to 7 kg of N<sub>2</sub>O per tonne of nitric acid produced, which has resulted in the use of the best technology. In the case of adipic acid manufacture, facilities have been installed in several EU countries to eliminate N<sub>2</sub>O emissions by thermally breaking them down to oxygen and nitrogen.

### **D. The new gases**

62. During the review, a wealth of information was provided on possible areas for reducing the production of the new gases within the activities to develop the Commission's post-Kyoto climate strategy and to identify cost-effective policies and measures for meeting its reduction target for these gases. A study prepared at the request of the Commission in 1999 on the reduction potential of these gases lists several abatement options and their reduction potential for all three gases. These include the reduction and prevention of leakage of the new gases during installation, use, refill and maintenance of equipment; recycling or reuse of discarded agents, development of modified components of installations using less or no HFCs or PFCs; and incineration. Process modifications in the aluminium industry, and leakage reduction and recycling of SF<sub>6</sub> were also identified as a priority. Experts also explained that in the future other emission sources may become important, as the increasing demand for certain applications such as stationary and mobile air-conditioners, and specific applications for SF<sub>6</sub> may warrant the production of these gases. Work is under way at the Commission to improve data and further analyse possible options in collaboration with industry to identify the reduction potential for the new gases.

## **IV. PROJECTIONS AND THE EFFECTS OF MEASURES**

63. As in the NC1, the NC2 included projections for Community-wide CO<sub>2</sub> emissions for 2000, which were estimated by adding the data from the individual member States. These were based on submissions from member States in their first national communication to the UNFCCC and updates which were officially communicated to the Commission before July 1995. These have been adjusted to be consistent with the 1990 baseline reported in the NC1. The NC2 also provided individual national CO<sub>2</sub> emission projections for 2000 as well as a "modified projection" replacing country GDP growth rates given by member States with rates that are consistent with the projected Community growth rate and fuel import prices (particularly for crude oil). As data were not available for HFCs, PFCs and SF<sub>6</sub> in 1990, projections of these gases are not contained in the NC2. Projections for bunker fuels were also omitted.

64. The projections team explained that, as a “without measures” emission scenario was not submitted by all countries, this scenario was not presented in the NC2. It should be noted that member States presented projections in their own communications, and these were examined separately during the in-depth reviews of the individual member States. These reports indicated that the trend in CO<sub>2</sub> emissions varied, ranging from achieving stabilization by 2000 for three countries, Germany, Luxembourg and the United Kingdom, to some growth over 1990 CO<sub>2</sub> emission levels in others. A wealth of detailed information on models, assumptions and preliminary projections for the other gases, CH<sub>4</sub>, N<sub>2</sub>O and the new gases were provided during the review. These are presented here only as an indication of one of many possible scenarios as they are subject to change as new information becomes available.

65. The main NC2 modelling exercise was conducted by a research agency called COHERENCE. The group worked in close coordination with representatives from government departments, a number of experts, representatives from academia, and stakeholders. Projections experts explained that the current method of compiling projected GHG emissions data gives only indicative results, as models and assumptions that have been used differ from country to country, thereby entailing some degree of inconsistency and incomparability.

66. The updated "business as usual" scenario presented in the NC2 was developed only for CO<sub>2</sub> from energy use. A "with measures" scenario was presented to the team during the review. Member States have used widely different models and methods of estimating the impact that measures would have. Only four member States clearly quantified each measure included in this scenario. All countries have measures that remain to be implemented and for some member States such measures constitute the major part of CO<sub>2</sub> strategy. Greece, Ireland, Portugal and Spain all have 'objectives' that take account of their expected economic growth. Emission levels in these countries will depend more on the level of economic growth achieved in the years up to 2000 than on implementation of the measures in their national CO<sub>2</sub> strategies.

67. In preparing the "with measures" scenario, the TRENEN model was used to examine the efficiency of different policies in the transportation-energy-environment domain. It comprises two models, the TRENEN urban and TRENEN interregional models. They comprise three components: a demand module, a supply module and a price equilibrium module. The demand module models growth in transport demand by geographical zones (urban or regional) versus available transport alternatives. In the price equilibrium module, generalized prices are computed for the different types of transport services taking into account three important elements: a producer price for different vehicle-km (output from the supply module), a transportation time cost and a tax (or in some cases a subsidy) which is incorporated to correct for such external costs as air pollution, marginal congestion costs, noise, accidents and road damage. The supply module models choices made by car producers and suppliers of other inputs such as fuel and car maintenance, on a profit maximization basis, subject to constraints imposed by government. Safety and environmental regulations are also taken into account.

68. The MIDAS model, which was developed with Community funding by DG XII (Directorate-General for Science and Research and Development) was used to derive scenarios for GHG emissions from energy production and use. These emissions were calculated and

projected on the basis of the EUROSTAT energy balances and emission factors. MIDAS combines an econometric approach for calculating energy demand and a process engineering approach for the energy supply side. The MIDAS model determines market clearing prices for fuel supply in power generation and the corresponding investment requirements. DG XVII (Directorate-General for Energy) is finalizing a major modelling analysis based on the newly developed PRIMES model for modelling GHG production from various energy systems.

69. The energy systems of member States are modelled using Community totals coupled with substantive dialogue among forecasting teams of member States. Model results are then discussed with energy experts. The team learned that, while the projections of the NC1 and the NC2 were based on the same model, the aim of the exercise was different for the NC2. The four scenarios included in the NC1 were undertaken as part of the preparation for the Energy White Paper for the Community, which was aimed at formulating a robust energy policy across a wide range of socio-economic developments and their energy repercussions. It included the environmental consequences of energy development. On the other hand, the modelling results (updated "business as usual") in the NC2 were simply an update of the "business as usual" scenario presented in the NC1, which assumed the continuation of an energy policy based on energy efficiency, energy technology, penetration of renewable energy and support for better energy management at the local and regional level. It also assumed that Community programmes such as SAVE, JOULE-THERMIE and ALTENER would be continued. The modelling assumptions did not include new carbon or energy taxes. According to the "business as usual" scenario, CO<sub>2</sub> emission trends are forecast to grow compared to 1990 levels, by 2 per cent in 2000, by 6 per cent in 2005 and by 8 per cent in 2010.

70. While the compilation of member State forecasts shows CO<sub>2</sub> emissions stabilizing by the year 2000, the Commission concluded in the second evaluation report that, while current emissions reported at the time were below 1990 levels, it cannot be excluded that Community emissions will increase within the range of 0-5 per cent by 2000 over the 1990 level. Experts explained that difficulties were encountered in presenting a Community forecast for 2000 based on information from member States, due to the differences in methodology and assumptions, the insufficient information provided in the national reports about the effectiveness of measures, and the high level of uncertainty related to the implementation of measures. A more accurate assessment of the CO<sub>2</sub> emissions will be contained in the next evaluation report under the EU Monitoring Mechanism.

71. In 1999, a study entitled "Economic Evaluation of Quantitative Objectives for Climate Change" was completed by DG XI of the Commission. Part of this study included a 1998 ECOFYS study titled "Emission Reduction Potential and Costs for Methane and Nitrous Oxide" in the EU-15 and strategies for mitigating climate change focussed principally on reducing CO<sub>2</sub> emissions. In 1999, DG XI also launched three studies to consider non-CO<sub>2</sub> GHG gases and to examine their reduction potential and costs. The issues dealt with in these studies included the following:

- (a) Reductions in the emissions of HFCs, PFCs and SF<sub>6</sub> in the EU, June 1998;

- (b) Options to reduce CH<sub>4</sub> emissions, September 1998;
- (c) Options to reduce N<sub>2</sub>O emissions, September 1998.

72. The gases covered for agriculture in the studies were mainly N<sub>2</sub>O and CH<sub>4</sub>. The driving forces are livestock numbers, feed conversion efficiency, crop yields and fertilizer use, land-use set-aside, financial endowments of the different schemes, uptake by member States and technological improvements. Projections were prepared based on forecasts for key agricultural products and using a combination of econometric methods, statistical analyses, specific assumptions, and expert judgements. Experts explained that there are a lot of uncertainties associated with these projections, such as how to reflect the diversity of EU agriculture, and that more research is needed to reduce these uncertainties. A plausible baseline scenario estimated an increase in crop yields of 20 per cent between 1990 and 2010, an increase in the production of white meat by 15-30 per cent, a stable beef production but a decrease in milk production of 25 per cent, a 10 per cent set-aside rate for land after 2006, and a large share of the EU budget going to environmental developments for the agriculture sector. These lead to a reduction of 5 per cent for N<sub>2</sub>O emissions and 5-10 per cent for CH<sub>4</sub> by 2010 in agriculture.

73. In analysing CH<sub>4</sub> emissions from waste, the specific targets for reducing the total amount of biodegradable municipal waste going to landfills in the future as set in the directive which came into force in 1999 were applied. These targets were as follows: by 2006, biodegradable municipal waste going to landfills must as far as possible be reduced to 75 per cent of the total amount by weight of biodegradable municipal waste produced in 1995; by 2009, a reduction of to 50 per cent and by 2016, a reduction to 35 per cent. Countries having more than 80 per cent of waste currently Land filled may be given an additional four years to comply with the directive.

74. Initial results for total CH<sub>4</sub> emissions in the EU15 show that projected baseline emissions in 2010 are estimated at 19 Mt, compared to NC2 1990 estimates of 24 Mt, a 21 per cent decrease in total CH<sub>4</sub> emissions. Similarly, results show the projected baseline of N<sub>2</sub>O emissions for 2010 estimated at 1000 Gg, roughly the same level as 900 Gg, in 1990.

75. Emission estimates and projections for the new gases have been collected from the member States. Projections concerning future emissions differ among countries, while Austria, Belgium and Denmark did not present emission projections for the years 2000 and 2010. The Commission is currently developing an analysis based on common assumptions about growth rates of emissions and existing policies and measures, to determine the efforts required to move from the "business as usual" scenario to the level of emissions allowed by the Kyoto Protocol, should it enter into force. The analysis will be updated to include the three new gases and recent information on CH<sub>4</sub> and N<sub>2</sub>O. This is expected to become available in developing the EU strategy to comply with the Kyoto Protocol.

76. Based on the information presented to the team during the review, there was consensus by the review team that work on projecting GHG emissions and overall data coverage has improved at the Commission and that in preparation for complying with the Kyoto Protocol, this area of work will be considerably strengthened.

## V. EXPECTED IMPACTS OF CLIMATE CHANGE AND ADAPTATION

77. The NC2 provided complete coverage of all key sectors vulnerable to an enhanced greenhouse effect, including hydrological regimes and water resources, sea-level rise, distribution of pests, fire risks, and Mediterranean desertification, among others. Details of a number of studies of climate change impacts and possible measures for adapting to these impacts at Community level were also included.

78. The team noted that most of the work undertaken by the Community focuses on increasing the understanding of impacts through intensive research. The second, third, fourth and recently formulated fifth framework programmes on research and development contain specific programmes related to the quantification of possible climate change impacts on economic sectors. There are also some ongoing EC-funded projects to examine the implications of climate change, including the Agriculture Research Programme, and the European Programme on Climatology and Natural Hazards. Work is also being done in collaboration with member States through universities, cooperative research centres, and other organizations. After reviewing the Community's activity in research and observation, the team agreed that the Commission has a comprehensive programme on all aspects of climate change and that the reporting guidelines have been respected in this area.

79. Of particular importance are the achievements of the fourth framework programme (1994-1998), which were reported in the NC1, and the aims of the fifth framework programme (1998-2002). With a budget of 12.3 billion euros (and an additional 800 million euros), the fourth framework programme focussed on 15 specific programmes, of which two are directly related to climate change and other environmental issues.

80. The budget for the fifth framework programme has been increased to 14.9 billion euros, of which 14 per cent is allocated directly to energy, the environment and sustainable development. The Commission recognized that greater flexibility in implementing programmes and improved coordination was required to ensure greater success of these programmes. The effects of this improvement were noted in the field of research on climate change and biodiversity. Research in these areas is oriented towards problem solving and policy formulation. In addition, the new focus on the socio-economic aspects of the environment is a step in the right direction and consistent with the sustainable development objectives of the Commission. The team noted that climate research and modelling concentrate on the methodological aspects of carbon budgets and forests and the creation of research networks. The development of most of these studies are in tandem with the broad scientific objectives of the UNFCCC and the IPCC.

## VI. FINANCIAL ASSISTANCE AND TECHNOLOGY TRANSFER

81. The NC2 describes action taken by the Commission in providing financial assistance and facilitating technology transfer related to climate change. Its contribution in both areas has been channelled through multilateral development institutions, as well as bilateral initiatives undertaken in developing countries. Although its financial assistance is reported on an annual

basis, the review team noted that the NC2 did not specify what part of these resources was "new and additional", as required by the UNFCCC guidelines for the preparation of national communications. The Commission experts consider any increase in the annual budget for financial assistance and transfer of funds as new and additional. The review team felt that this information in the NC2 represented an improvement over the NC1 and that it met with the reporting guidelines.

82. The Community is not a member of the Global Environment Facility (GEF), although its member States are. The Community does, however, co-finance GEF projects. There are also major cooperation programmes with central and eastern European States (PHARE), countries with economies in transition, and developing countries through the Lomé Conventions, among others. Under these regional programmes, activities cover energy efficiency and clean energy technologies, renewable energy, agriculture and forestry, capacity-building and other technical assistance.

83. The Commission, through other regional programmes such as SYNERGY, a programme for cooperation with non-EU member States, has provided financial and technical support for Mediterranean countries, Central and Latin America and some African countries, in areas related to the prevention of climate change such as energy efficiency, adaptation and renewable sources. Improvements within the PHARE programme were made in funding projects with central and eastern European States on a multi-annual basis since 1997 and in enhancing the country-driven nature of technical assistance to these countries. The budget allocated to this programme in 1997 was 6.9 million euros, covering 41 projects; 10 per cent of total funds concerned environmental issues. The TACIS programme for newly independent States and Mongolia was revised in 1999 to include environmental matters in its coverage and it also provides assistance in developing countries for activities related to mitigating climate change.

## **VII. EDUCATION, TRAINING AND PUBLIC AWARENESS**

84. A cornerstone of EC policy is the raising of public awareness on climate change issues, with the goal of attaining far-reaching public and member State commitment to reducing emissions and changing behaviour. The overall strategy in this regard is set at the Community level but many tasks are the responsibility of member States. These tasks are carried out with wide consultation and involvement of non-government agencies, at all stages of the decision-making process via green papers and white papers.

85. The Community provides research centres and universities with funds to produce material and host seminars and conferences on the scientific results of climate change. The Community also produces regular reports on the action it has taken to expand public awareness, both in its member States and overseas. The SYNERGY programme, for example, contains a specific plan of action for further developing community understanding through both national information programmes and the entire education system. The fifth framework programme (1998-2002) also contains initiatives to develop a user-friendly information society and 20 per cent of its budget of 3,600 million euros is allocated to this end. Education and public awareness programmes form an integral part of this endeavour.

## VIII. CONCLUSIONS

86. As a whole, the EC is apparently on course to keep its CO<sub>2</sub> emissions in 2000 below 1990 levels. Performance in this respect has varied among member States, ranging from stabilization by 2000 for three countries, Germany, Luxembourg and the United Kingdom, to some growth over 1990 levels in other countries. Experts at the Commission expressed their concern about the general trend of emissions, which after falling in the early 1990s, increased again in the middle of the decade. If this trend continues, more concerted action will become necessary at both member State and Community level to move towards the Kyoto Protocol target of attaining an overall reduction of 8 per cent for the basket of six GHGs in the commitment period 2008-2012 compared to 1990. This becomes particularly important when taking into account the time lag between political decisions at the Council level and implementation of policies and measures at the member State level.

87. Although measures taken at the Community level constitute a useful complement to national initiatives, a main constraint to the Commission in meeting GHG emission commitments has been that responsibility for taking adequate measures lies with its member States, a condition which affects the pace of adoption and implementation of planned policies and measures. Progress in this regard has been slow. In addition, for many of the policies and measures implemented by the Commission, an analysis of the GHG emission reduction achieved as a result of these policies was not done.

88. While CO<sub>2</sub> emissions in EC member States originate from relatively diverse sources, the major sources of these emissions continue to be the energy sector and transport. Sectoral emission levels vary considerably from country to country but the common feature in spite of electricity liberalization efforts GHG emissions may be increasing. In addressing this issue, the Council produced a document entitled "Preparing for the Implementation of the Kyoto Protocol" in May 1999, in which it identified the following climate-related areas for further work: a strategy for incorporating environmental concerns and sustainable development issues in formulating energy policy; preparation of an action plan for the energy efficiency programme; access of electricity from renewable energy sources to the internal power market. Decisions in the field of taxation, energy and transport have been pending since the NC1. Similarly, while the Commission recognizes that effective and ambitious environmental agreements may constitute a basis for important emission reductions in specific industrial subsectors, the progress made with voluntary agreements in member States needs to be quantified and the agreement system should be strengthened if objectives are not met.

89. Preliminary projections to 2010 indicate that CO<sub>2</sub> emissions are expected to increase by 8 per cent and CH<sub>4</sub> emissions to decrease by 21 per cent, while N<sub>2</sub>O emissions will not exceed their 1990 levels in 2010. While the NC2 does not describe additional policies which would reduce GHG emissions by 2010, experts mentioned that further emission reductions are possible but have yet to be quantified in economic terms. The review team felt that with the launching of the European Climate Change Programme on 8 March 2000, current policy measures would be reinforced, especially in energy and transport. Technical working groups have been established under this Programme to undertake preparatory work on the basis of which the Commission will

develop sectoral policy proposals. Other new initiatives reported during the review include the proposal for a directive on the promotion of renewable energy sources in the context of the internal electricity market, the proposal for a directive on complementary fuel specifications for 2005, a revision of the Common Transport Policy, the preparation of a green paper on urban transport, and an Action Plan for Improved Energy Efficiency, among others.

90. Overall, the review team formed the impression that EUROSTAT has a good system in place to collect data. Many problems in reporting and monitoring GHG emissions and the effectiveness of various policies and measures with impact on GHG emissions still existed under the previous monitoring mechanism. It is believed that with the amended monitoring mechanism which came into force on 1 May 1999, the Commission will be able to adequately measure and analyse the progress or lack of progress in reducing emissions as well as in adopting policies and measures at national and Community level, as part of its preparations for implementing the Kyoto Protocol.

91. The Commission has advanced considerably in funding and supporting project- related GHG emission reductions through investments and technology transfer and capacity-building in climate change. The review team felt that the level of public awareness about environmental issues in the EU is high. The Commission's information campaigns to date have targeted, to a large extent, government institutions, academia and specific sectors. Some initiatives are still in the pipeline to raise awareness in other sections of society.

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