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GREECE

REPORT OF THE INDIVIDUAL REVIEW OF THE GREENHOUSE GAS INVENTORY SUBMITTED IN 2004[1]

EXECUTIVE SUMMARY

1. This report covers the in-country review of the 2004 greenhouse gas (GHG) inventory submission of Greece, coordinated by the United Nations Framework Convention on Climate Change (UNFCCC) secretariat in accordance with decision 19/CP.8 of the Conference of the Parties. Greece submitted its annual inventory on 15 April 2004, consisting of common reporting format tables for the years 1990–2002 and the national inventory report. The review took place from 20 to 24 September 2004 in Athens, Greece, and was conducted by the following team of nominated experts from the roster of experts: Generalist – Mr. Art Jaques (Canada), Energy – Mr. Dario Gomez (Argentina), Industrial Processes – Ms. Irina Yesserkepova (Kazakhstan), Agriculture – Ms. Tajda Mekinda-Majaron (Slovenia), Land-use Change and Forestry – Mr. Nijavalli H. Ravindranath (India), Waste – Ms. Katarina Mareckova (Slovakia). Mr. Art Jaques and Ms. Irina Yesserkepova were the lead reviewers. The review was coordinated by Mr. Javier Hanna (UNFCCC secretariat).

2. In accordance with the "UNFCCC guidelines for the technical review of greenhouse gas inventories from Annex I Parties", a draft version of this report was communicated to the Government of Greece, which provided comments that were considered and incorporated, as appropriate, in this final version of the report.

3. In the year 2002, the most important greenhouse gas in Greece was carbon dioxide (CO_2), contributing 78.2 per cent to total[2] national GHG emissions expressed in CO_2 equivalent, followed by nitrous oxide (N_2O) – 10.3 per cent, and methane (CH_4) – 8.5 per cent. Perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF_6) taken together contributed 3 per cent of overall GHG emissions in the country. The Energy sector accounted for 77 per cent of total GHG emissions, followed by Agriculture (9.4 per cent), Industrial Processes and Solvent and Other Product Use (9.1 per cent) and Waste (4.5 per cent).

4. Total greenhouse gas emissions amounted to 134,983.30 Gg CO_2 equivalent in 2002 and increased by 26.1 per cent from 1990 to 2002. Tables 1 and 2 provide data on emissions by gas and by sector from 1990 to 2002. Over the period 1990–2002, CO_2 emissions increased by 27.4 per cent, mainly as a result of increased electricity production from fossil fuels and increased energy consumption in the residential and transport sectors. CH_4 emissions increased over the same period by 28.8 per cent, mainly because of a 87.7 per cent increase in emissions from solid waste disposal in landfills and a 35.8 per cent increase in fugitive emissions from solid fuels. Together, energy and solid waste emissions accounted for 68.3 per cent of total CH_4 emissions in 2002. Overall, N_2O emissions decreased by 1.2 per cent per cent over the same period, primarily because of a 9.2 per cent reduction in emissions from the Agriculture

[1] In the symbol for this document, 2004 refers to the year in which the inventory was submitted, and not to the year of publication.
[2] In this report, the term total emissions refers to the aggregated national GHG emissions expressed in terms of CO_2 equivalent excluding LUCF, unless otherwise specified.

sector, which accounted for 65.2 per cent of total N_2O emissions in 2002. Offsetting this decline in emissions, there was a 145 per cent increase in N_2O emissions from road transport, primarily as a result of an increase in the number of vehicles with three-way catalytic converters.

5. Actual emissions of HFCs increased by 327.6 per cent over the period 1990–2002, as would be expected as they result from the production and replacement of ozone depleting substances controlled under the Montreal Protocol, while emissions of PFCs declined by 65.7 per cent owing to controls implemented in the production of primary aluminium aimed at reducing the anode effect. It should be noted, however, that over the period 1990–2002 the emissions did not follow a consistent trend. They oscillated up and down, but for reasons of data confidentiality Greece was unable to provide the expert review team with an explanation for the changes. Potential emissions of HFCs were not estimated. The precursor gases carbon monoxide (CO), nitrogen oxide (NO_X) and non-methane volatile organic compounds (NMVOCs), and SO_2 are also covered. Emissions of sulphur hexafluoride (SF_6) were reported in the national inventory report as not estimated.

Table 1. Greenhouse gas emissions by gas, 1990–2002

GHG emissions	Gg CO_2 equivalent													Change from 1990–2002 %
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	
CO_2 (with LUCF)[a]	84,292	83,428	86,745	86,204	87,928	86,303	88,969	93,234	101,119	97,613	107,599	104,211	103,612	**22.9**
CO_2 (without LUCF)	82,818	82,844	84,443	84,540	86,428	86,705	89,041	93,637	98,289	97,594	103,429	105,506	105,504	**27.4**
CH_4	8,994	8,929	9,258	9,357	9,612	9,734	10,065	10,187	10,812	10,838	11,415	11,207	11,440	**27.2**
N_2O	14,144	13,895	13,628	13,270	13,408	12,865	13,437	13,882	13,901	13,655	14,494	13,993	13,962	**–1.3**
HFCs	935	1,107	908	1,638	2,209	3,369	3,916	4,194	4,053	4,156	4,281	3,845	3,999	**327.6**
PFCs	258	258	252	153	94	83	72	165	204	132	148	91	88	**–65.7**
SF_6[3]	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
Total (with CO_2 from LUCF)	**108,623**	**107,616**	**110,791**	**110,622**	**113,251**	**112,354**	**116,459**	**121,663**	**130,089**	**126,394**	**137,937**	**133,347**	**133,101**	**22.5**
Total (without CO_2 from LUCF)	**107,149**	**107,032**	**108,489**	**108,958**	**111,751**	**112,756**	**116,531**	**122,066**	**127,259**	**126,375**	**133,768**	**134,642**	**134,992**	**26.0**

[a] LUCF = Land-use Change and Forestry

Table 2. Greenhouse gas emissions by sector, 1990–2002

GHG source and sink categories	Gg CO_2 equivalent													Change from 1990–2002 %
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	
Energy	80,987	81,026	82,924	82,866	84,852	84,612	87,207	91,792	96,768	96,027	101,586	103,828	103,881	**28.3**
Industrial Processes	8,083	8,173	7,964	8,557	9,087	10,773	11,467	11,896	11,675	11,699	12,477	11,992	12,190	**50.8**
Solvent Use	170	176	172	169	162	153	151	152	151	159	145	155	155	**–8.9**
Agriculture	13,594	13,388	12,830	12,688	12,779	12,279	12,601	12,994	12,869	12,765	13,313	12,734	12,719	**–6.4**
LUCF[a]	1,607	638	2,522	1,827	1,639	-345	-8	-343	3,195	65	4,587	-1,233	-1,883	**–217.2**
Waste	4,182	4,215	4,379	4,514	4,732	4,881	5,041	5,172	5,431	5,678	5,829	5,872	6,038	**44.4**

[a] LUCF = Land-use Change and Forestry

6. The expert review team considers the national inventory submitted by Greece to be generally in conformity with the UNFCCC reporting guidelines and the *Revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC Guidelines), and the *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance). Greece's submission for 2004 consisted of a national inventory report and a complete set of common reporting format tables for all years from 1990 to 2002. The production of a national inventory report for the years 1990–2002, coupled with current and proposed actions aimed at improving data, demonstrates Greece's commitment to producing an inventory that adheres to the reporting principles of transparency, consistency, completeness, comparability and accuracy. Specifically, with a few exceptions, the national

[3] In the trend table 10 of the CRF, emissions of SF_6 are reported as 0.

inventory report and common reporting format tables cover all major sources and sinks as well as direct and indirect gases identified in the IPCC and UNFCCC reporting guidelines. The exceptions include estimates in the areas of land-use change and forestry (CO_2 from agricultural soils), some minor petrochemical products (explicit non-energy uses) in the Industrial Processes sector, fugitive emissions of SF_6 from electrical equipment, and N_2O and CO_2 emissions from oil and gas production. In addition, the reporting of emissions for a few sources is inconsistent: for example, emissions from ammonia production are not included for certain years for reasons of confidentiality, in the case of nitric acid production data are held constant for confidentiality reasons, and emissions from glass production are underestimated for some years because the available data set is not complete.

7. In general the inventory is transparent. The national inventory report describes each sector, the methods used, key sources and overall completeness on a sector-by-sector basis. In addition, a quantitative tier 1 assessment of uncertainties as required by the UNFCCC reporting guidelines is provided. However, there are some areas where the transparency of Greece's reporting can be improved, as described below:

a) Additional detail on the emission factors, model input parameters and activity data used and the rationales for their use should be included in the national inventory report;

b) The methodologies for most sectors are described; however, it is not clear from the national inventory report how and what specific quality assurance and quality control procedures are performed, nor is it clear what information was taken from the references listed in the report. The expert review team recommends that more explicit citations be used;

c) The methodology used for aluminium production cites the use of confidential information from industry and therefore does not provide sufficient background to explain how the estimates were derived. The expert review team did have access to these confidential records that provide details on the emissions provided by industry. Given the large fluctuations in emissions from year to year, the expert review team recommends that the Greek inventory team provide further explanatory information to explain the trends and the derivation of emissions in the national inventory report; and

d) Greece and the expert review team noted the apparent discrepancies between data on landing and take-offs (LTOs) and energy consumption; the expert review team recommends that these be further investigated.

8. Recalculations have been carried out in all sectors. In general these recalculations are described in the national inventory report but are not fully described in the common reporting format. They have been undertaken where new methods have been used, where corrections were required and where new sources and activity data were included. Overall, as a result of these recalculations, the figures for GHG emissions in 1990 are 2.2 per cent higher than in the previous inventory; the figures for CO_2 emissions have fallen because of the application of a higher-tiered method for a key source (cement production); the figures for CH_4 emissions have increased because of the inclusion of a new source (industrial waste water); and there is an increase in the figures for N_2O emissions resulting from the use of new methods and emission factors, as well as the inclusion of a new source of indirect emissions from agricultural soils. The overall effect on the trend is not significant since in most cases the recalculations were performed for the entire time series.

9. The National Observatory of Athens (NOA), on behalf of the Ministry for Environment, Physical Planning and Public Works (MEPPPW), has the overall technical responsibility for the national inventory, which is important in ensuring consistency across the inventory. However, the expert review team believes that an even closer relationship with other agencies and the establishment of formal agreements for data development and sharing are warranted. It noted the limited resources and data collection abilities of the Greek inventory team and commends them for the work they are doing.

10. Currently Greece has not implemented formal quality assurance/quality control procedures. However, a variety of informal quality control checks and reviews are in place and are documented in the national inventory report. During the review Greece informed the expert review team that a quality assurance/quality control plan has been prepared and that it would be implemented in the coming year. Details on the quality assurance/quality control plan were not transparent to the expert review team (as it is in Greek). However, the expert review team recommends that Greece implement a long-term plan that prioritizes areas for improvement, guided by the key source analysis and the results of uncertainty analysis. It also encourages Greece to establish a centralized archiving system, and to ensure that sufficient information and guidance are provided to other agencies to enable the inventory agency to document the a quality assurance/quality control procedures followed by others involved in the development of data used in the inventory, as required by the IPCC good practice guidance.

11. Given the contribution of the Energy sector to total emissions, a key issue for Greece is the need for improvements in the timeliness and reliability of energy data, as well as detailed information on the national energy balance and the types of final end use. Currently, the energy data required for developing the emissions estimates for the last year of the inventory are finalized only after the inventory is submitted. As a result, the emissions for most of the Energy sector are considered provisional in the final submission. This is clearly not in line with the IPCC good practice guidance. However, the NOA (the inventory agency), in collaboration with the Ministry for Development and Eurostat, is involved in a project entitled "*Harmonization of energy statistics used for CO_2 inventories*" to examine the energy balances for Greece. The results of this project, and of a related project, should be available for use in compiling the 2006 submission and are expected to provide an important source of activity data and information for improving the national inventory. In addition, the expert review team was informed that additional resources and a framework for collecting data and producing the national energy balance on an ongoing basis have been approved within the Ministry for Development. The expert review team commends these actions and recommends the continuation of these collaborative approaches between agencies involved in the preparation of the inventory and underlying data.

12. Greece underwent a centralized review in 2001. A number of improvements have resulted since that time. The production of a more comprehensive and transparent national inventory report structured according to the UNFCCC reporting guidelines and of a complete common reporting format time series for 1990–2002, and more extensive use of the IPCC Guidelines and the IPCC good practice guidance have all helped to produce a more complete, consistent, transparent and reliable inventory. In addition, as a result of comments provided in the previous review, the NOA has identified a number of areas requiring improvements in underlying data, methodologies and a quality assurance/quality control. Greece has produced, in general, a national inventory report which is relatively transparent in the explanations it gives of methods used, sources of data, institutional arrangements, uncertainties and the identification of key sources. However, the expert review team noted that improvements are needed, particularly in the areas of transparency and documentation of calculation procedures and all elements of the methodologies used. Information sources, assumptions made and reference sources are not always clearly explained either in the national inventory report or in the explanatory notes, and the expert review team recommends that additional details be provided in the next submission.

I. OVERVIEW

A. Inventory submission and other sources of information

13. Greece submitted a national inventory report (NIR) and a complete set of common reporting format (CRF) tables for the period 1990–2002 on 7 April 2004. During the review Greece provided the expert review team (ERT) with additional information sources. These documents are not part of the inventory submission but are in many cases referenced in the NIR. The full list of materials used during the review is provided in annex 1 to this report.

B. Key sources

14. Greece has reported a key source tier 1 analysis, both level and trend assessment, as part of its 2004 submission. The key sources analyses performed by Greece and the secretariat[4] produced similar results. The NIR gives a clear and transparent description of how the key sources have been determined. There are a few differences in the results of the key source analyses, which can be explained by Greece's use of a base year other than 1990 for the fluorinated gases (F-gases), the aggregation of animal production and direct emissions from soils together, and the exclusion of several sources that contribute to the trend uncertainty.

15. Priority areas for inventory improvements have largely been determined on the basis of those sources that are the largest contributors to the total inventory, not on the basis of a systematic key source analysis. In a number of areas identified by Greece and the ERT that warrant the use of higher-tier methods, limitations on the availability of activity data (AD) continue to prevent the development of higher-tier methods. Several key sources in the Industrial Processes and Waste sectors are currently estimated using a tier 1 approach. The ERT believes that Greece should improve the estimation of emissions from key sources, particularly where they are currently estimated using tier 1. A systematic key source analysis should be used to prioritize inventory improvements and development, and the ERT notes that this should be facilitated by the implementation of the quality assurance/quality control (QA/QC) plan and the recommendations that will come from the plan.

16. The ERT recommends the Party to investigate the following three sources, as they appear to be key sources:

a) N_2O from nitric acid production, owing to its trend;

b) CH_4 from waste-water handling, owing to its trend; and

c) PFCs from aluminium production owing to uncertainties and their trend.

17. SF_6 from fugitive leaks from electrical equipment is not likely to be a key source on the basis of a tier 1 analysis, but because it is not currently estimated it should be investigated further.

C. Cross-cutting topics

Completeness

18. In general the Greek inventory is complete. It covers all years, for the whole territory of Greece, for the six mandatory greenhouse gases and includes an NIR and a complete set of CRF tables, with the exceptions of table 8(b) Recalculations – Explanatory information and table 11. A few sources are not included, for example, in some categories in Land-use Change and Forestry (LUCF) (CO_2 emissions and removals from agricultural soils), some minor petrochemical products (explicit non-energy uses) in the Industrial Processes sector, fugitive emissions of SF_6 from electrical equipment, and N_2O and CO_2 emissions from oil and gas production. In addition, the reporting of emissions for a few sources is inconsistent, for example, emissions from ammonia production are not included for certain years for reasons of confidentiality, in the case of nitric acid production data are held constant for confidentiality reasons, and emissions from glass production are underestimated for some years because the available data set is not complete. These instances are discussed in detail in the sectoral sections below. The ERT also notes the limited use of notation keys in the CRF tables and the use of "0" for "not estimated" ("NE").

[4] The secretariat had identified, for each individual Party, those source categories which are key sources in terms of their absolute level of emissions, applying the tier 1 level assessment as described in the IPCC good practice guidance. Key sources according to the tier 1 trend assessment were also identified for those Parties providing a full CRF for the year 1990. Where Greece has performed a key source analysis, the key sources presented in this report follow Greece's analysis. However, they are presented at the level of aggregation corresponding to a tier 1 key source assessment conducted by the secretariat.

Transparency

19. In general the inventory is transparent. In line with the reporting guidelines, the NIR contains a general description of institutional arrangements, QA/QC procedures, uncertainty assessments and estimation methods, a key source analysis, references to key source estimation methods, a summary of trends in emissions by gas, recalculations, and explanations of the minor differences between the reference and the sectoral approaches. In addition, a quantitative tier 1 assessment of uncertainties as required by the UNFCCC guidelines is provided.

20. The ERT noted that one area of particular importance that requires improvement is that of documentation. In some areas, a more detailed explanation for the choice of a particular source of data, emission factor (EF) or model is needed to ensure full transparency and permit reconstruction of the estimates. During the in-country review, the ERT was provided with additional information and/or clarifications that enabled it to resolve most issues related to data and methodologies. Areas for improvement noted by the ERT include the need for more information to be included in the NIR, including specific references, explicit reporting of the underlying parameters used in models (e.g., COPERT III), AD and EFs, explanations for the rationale for choices of data, and in some cases explanations of methods. The ERT recommends that a formal QA/QC plan and central archiving system be implemented to ensure full transparency, noting that Greece informed the ERT of its plans to do so in 2004/2005.

Recalculations and time-series consistency

21. The ERT noted that recalculations of the entire time series 1990–2002 have been carried out in all sectors. In general these recalculations have been described in the NIR but not in the CRF, and they have been undertaken as the national energy balance data have been updated, where new methods have been used, where corrections were required, and where new sources and AD were included. Overall, as a result of these recalculations, the figures for GHG emissions for 1990 are 2.2 per cent higher than in the previous inventory, with a reduction in CO_2 emissions because of the application of a higher-tiered method for one key source (cement production), an increase in CH_4 emissions because of the inclusion of a new source (industrial waste water) and an increase in N_2O emissions resulting from the use of new methods and EFs and from the inclusion of a new source of indirect emissions from agricultural soils. In addition, the figures for CH_4 emissions from fugitive sources have been revised because of the change in EFs, the inclusion of one source category previously not estimated, and the availability of more complete estimates for some source categories. Overall, the impact on the trend is minimal, as emissions are approximately 2 per cent higher for all years.

22. In its 2004 NIR, Greece has noted that there will probably be a need to carry out further recalculations once a number of planned improvements are implemented and energy data are finalized. It was not always clear to the ERT how improvements to AD were to be made in the absence of specific studies and data collection activities. The ERT commends Greece for identifying the need for additional data and encourages the inventory team to work with other national organizations and institutions within Greece to obtain these data. The ERT was informed that for many large facilities the application of the European Commission directive on emissions trading, which will require standardized reporting of GHG information, to begin in 2006, is seen as offering an opportunity to improve the inventory. In addition, the ERT was informed that additional resources and a framework for collecting data and producing the national energy balance on an ongoing basis have been approved within the Ministry for Development. The results of this project, together with the results of a Eurostat-related project on "*Harmonization of energy statistics used for CO_2 inventories*" to examine the energy balances for Greece, should be available for use in compiling the 2006 submission and are expected to be an important source of AD and information for improving the national inventory on an ongoing basis. The ERT recommends that sufficient resources continue to be made available to produce accurate GHG estimates and underlying data from the Energy sector on an ongoing basis.

Uncertainties

23. Greece has used a tier 1 method as outlined in the IPCC good practice guidance to make an assessment of uncertainty in the emissions inventory. A qualitative assessment of uncertainty is provided in table 7 of the CRF. The uncertainty calculations were made using the default uncertainty values suggested in the IPCC good practice guidance, which were chosen on the basis of expert knowledge within Greece. This being the case, Greece has not used the uncertainty analysis to perform a tier 2 key source analysis, nor to systematically prioritize further inventory improvements. One area in which uncertainty estimates might be improved is in the Energy sector, as this sector is the dominant source of GHG emissions. Greece may wish to consider initiating an uncertainty analysis within the framework of the Eurostat project on national energy balances at the same time as improving the underlying data.

Verification and quality assurance/quality control approaches

24. Currently Greece does not have formal QA/QC procedures in place in accordance with the IPCC good practice guidance. A variety of informal QC checks and reviews (including internal and governmental reviews) are in place and are documented in the NIR. During the review Greece informed the ERT that a QA/QC plan has been prepared and that the inventory team plans to implement it in 2004/2005. Details on the QA/QC plan were not transparent to the ERT (as it is in Greek), but it has been developed in line with the International Standards Organisation (ISO) standards for QA/QC. As Greece implements its plan, the ERT recommends that a long-term plan also be included that prioritizes areas for improvement, guided by the key source analysis and the results of uncertainty analysis. The ERT also encourages Greece to establish a centralized archiving system and to ensure that sufficient information and guidance are provided to other agencies to enable the inventory agency to document the QA/QC procedures followed by others involved in the development of data used in the inventory, as required by the IPCC good practice guidance. Greece's current internal review deadlines are short (because of the requirements of the European Commission) and it is not possible to ensure that all feedback is received before the emissions inventory is submitted or to incorporate final data, so that incorporation of some feedback has to wait until submission of the next annual inventory. When work is subcontracted to other organizations there is a requirement that it be performed in accordance with the IPCC good practice guidance, including the QA/QC guidance.

Institutional arrangements

25. During the in-country visit, Greece explained the institutional arrangements for preparation of the inventory. The MEPPPW is the government body responsible for the development and implementation of environmental policy in Greece, and has designated the NOA as the national institution that has the overall technical responsibility for the compilation of the annual national inventory. Within this framework, the NOA is responsible for the choice of methodologies, data collection (AD and EFs, provided by statistical services and other organizations), data processing and archiving, as well as the implementation of general quality control procedures. In addition, a committee has been set up within the MEPPPW with a mandate to monitor the inventory preparation/compilation process so as to officially consider and approve the GHG inventory prior to its submission to the UNFCCC secretariat and ensure its timely submission. However, the ERT was informed that an official specification of the roles of and the cooperation between government agencies and other entities involved in the preparation of the annual inventory has still to be defined. In addition, given that the IPCC good practice guidance for Land use, Land-use Change and Forestry (LULUCF) was only recently completed, it is clear to the ERT that there will be a need for additional and ongoing capacity and resources to implement these new guidelines.

Record keeping and archiving

26. Greece has not as yet implemented a formal centralized archiving system, although it was able to provide the ERT upon request with information documenting the reasons for choice of methods, AD and EFs. The inventory agency at the NOA is responsible for documenting all sources of data and supporting information and, while no formal system is in place, certain relevant procedures are followed to ensure that EFs, reference materials and other information sources are archived. Upon request by the ERT, most

references and supporting material related to calculations and assumptions were provided by the inventory agency. However, in a few cases some of the information needed for a full assessment of some sources does not form part of the archive of the inventory agency, as this information is located in other organisations. This fact led to a lack of transparency in these few cases. The ERT notes that additional documentation and explanatory material could be incorporated into the electronic and "paper trail" archives and recommends that a more formal central archiving system be established.

Follow-up to previous reviews

27. Greece underwent a centralized review in 2001. The ERT was hampered at that time because an electronic copy of the NIR was late in being supplied, and it was therefore unable to undertake a thorough review. In addition, the ERT noted that some CRF tables have not been completed throughout the entire time series 1990–1999, and some others had not been fully completed. The ERT noted that a number of significant improvements have been undertaken since that time. In general, the production of a more consistent CRF time series for 1990–2002, more extensive use of the IPCC good practice guidance, the quantification of uncertainties and an NIR structured according to the UNFCCC reporting guidelines have all helped to produce a more complete, consistent, transparent and reliable inventory.

D. Areas for further improvement

Identified by the Party

28. The NIR identifies several areas for improvement. In its response to the issues raised during the review, Greece indicated that it is working to improve the timeliness and quality of its estimates in the Energy sector through a joint project with the Ministry for Development (energy compilers) and Eurostat to support activities for the emissions trading system and the monitoring of GHG emissions, which will also examine the energy balances for Greece. The results of this project, which should be available for use in compiling the 2006 submission, are expected to be an important source of AD and information for improving the national inventory. While the study with Eurostat will probably provide more detailed and accurate energy data for the period under review, it is not clear from the NIR how the data collection programme and energy balances will be improved over the long term. The ERT was informed that subsequent to the publication of the NIR another project has been initiated to improve the national energy balances and institute an ongoing data collection programme within the Ministry for Development. In addition, Greece has identified a number of other planned improvements in other areas of the inventory, many of which depend on the collection of AD which are currently unavailable. The ERT recommends that these collaborative approaches continue and that a more formal institutional arrangement between the agencies involved in the preparation of the inventory and the providers of underlying data be continued and enhanced.

Identified by the ERT

29. The ERT supports the need for research and improvements to data quality in the areas outlined by Greece. In addition the ERT identified the following cross-cutting issues for improvement. Greece should:

a) Provide additional documentation to further improve the transparency of methods used, data and assumptions within the NIR;

b) Provide more detailed analysis of emission trends, by gas and source/sink category;

c) Implement a formal QA/QC plan, including centralized documentation and archiving;

d) Implement a formalized data collection system and strengthen the relevant institutional capacities;

e) Continue to develop higher-tier methods and the collection of national data, especially for key sources;

f) Obtain more representative emissions data and EFs;

g) Improve the timeliness of data; and

h) Provide more details of the methods and assumptions used for the NIR.

30. Recommended improvements relating to specific source categories are presented in the relevant sector sections of this report.

II. ENERGY

A. Sector overview

31. In the year 2002, GHG emissions from the Energy sector (103,880.78 Gg of CO_2 equivalent) accounted for 77 per cent of the total emissions of Greece. This sector includes 10 key source categories: six sources for CO_2 (coal, oil and gas from Stationary combustion together with three mobile combustion sources – Road transportation, navigation and civil aviation); three sources for N_2O (coal and oil from Stationary combustion together with Road transportation from mobile combustion); and one source for CH_4 (Coal mining and handling, fugitive emissions). CO_2 emissions from civil aviation and N_2O emissions from road transportation were identified as key sources only by the trend assessment.

32. The emissions of relevant GHGs for the period 1990–2002 show increasing trends which are dominated by emissions from fuel combustion activities for CO_2 and N_2O and by fugitive emissions for CH_4. GHG emissions from the Energy sector in 2002 had increased by 28.3 per cent compared to 1990, while the average annual rate of increase for the period 1990–2002 was 2.2 per cent. Greece reports emission trends in the 2004 NIR and indicates that the Energy sector relies on fossil fuel combustion, particularly liquid and solid fuels. Although the share of natural gas in gross inland consumption was only 6 per cent in 2002, its consumption has increased rapidly since 1997 when it began to be imported. It is expected that its consumption will continue to grow since the promotion of natural gas is one of the policies being implemented to mitigate GHG emissions.

33. In 2002, a substantial proportion of GHG emissions in the sector (55.2 per cent) derived from Energy industries, followed by Transport (20.2 per cent), Other sectors (12.8 per cent), and Manufacturing industries and construction (10.3 per cent). Fugitive emissions from fuels contributed the rest (1.6 per cent) of total sectoral GHG emissions.

34. CO_2 emissions from the Energy sector represent an average 92.5 per cent of the total CO_2 emissions of Greece for the period 1990–2002. These emissions show an upward trend, from 76,471 Gg in 1990 to 97,811 Gg in 2002, and dominate the overall CO_2 emissions trend. Emissions in 2002 were thus 27.9 per cent higher than in 1990. The source category with the greatest percentage increase is Other sectors (52.9 per cent), followed by Transport (32.2 per cent) and Energy industries (27.3 per cent). Greece indicates in the NIR that this increasing trend is mainly attributed to increased energy consumption in the residential and transport sectors and increased electricity production.

35. The Energy sector contributed about 16.3 per cent of total CH_4 emissions in 1990 and almost 18.8 per cent in 2002. The trend in total CH_4 emissions increased from 69.07 Gg in 1990 to 102.32 Gg in 2002, representing growth of 48.1 per cent. In 2002, most of the CH_4 emissions (69.2 per cent) arose from fugitive emissions occurring in Coal mining and handling. The trend in CH_4 fugitive emissions from consumption of natural gas shows a sharp increase of more than 300 per cent from 1997 to 2000, primarily as a result of increasing natural gas imports.

36. The Energy sector contributed on average a quarter of total N_2O emissions for the period 1990–2002. The emissions show an increasing trend from 9.89 Gg in 1990 to 12.65 Gg in 2002, representing an increment of 27.9 per cent. Although energy industries contributed on average 57.7 per cent to the N_2O emissions of the Energy sector, the increasing trend in N_2O emissions is significantly related to the Transport sector, whose incremental variation from 1990 to 2002 amounts to

145 per cent. Greece explains in the NIR that this increase is mainly attributed to the Transport sector as a result of the increasing number of vehicles with catalytic emission control.

Completeness

37. The NIR and the CRF contain estimates of emissions for all direct and indirect GHGs related to fuel combustion. Estimates of emissions from fuel combustion activities for 2001 and 2002 are reported as provisional because there is a two-year time lag between the beginning of the development of a new inventory and the issuing of the final version of the corresponding national energy balance. The ERT encourages Greece to make the necessary efforts to reduce the time lag between the availability of the final energy balances and the final compilation of the inventory.

38. Fugitive emissions are only estimated for CH_4. Greece reports in the CRF that fugitive emissions of CO_2 from Surface mines, CH_4 from Solid fuel transformation, and CO_2 and N_2O from Venting and flaring were not estimated because of lack of AD and/or estimation methodologies. Fugitive emissions of CO_2 from Oil and natural gas were not estimated mainly because of the lack of the AD needed to apply the methodological approach proposed by the IPCC good practice guidance.

Transparency

39. The methodological approach, the AD and the EFs used to estimate emissions for the Energy sector are presented in the NIR in a fairly transparent manner. The CORINAIR methodology was used for stationary combustion and the COPERT III model for road transportation. Lower-tier methods were used for fugitive emissions. To improve transparency it is recommended that the level of disaggregation of each subcategory be more explicitly reported. The ERT suggests that Greece include in its future NIRs the overall national energy balance of the current submission year and tables summarizing the values and the origin of the EFs used in calculations for all subcategories of the Energy sector.

Recalculations and time-series consistency

40. In 2001, recalculations for the overall Energy sector resulted in increases in the figures for CO_2 (0.1 per cent), CH_4 (0.7 per cent) and N_2O (2.3 per cent). For fuel combustion, emissions from agricultural machinery were reallocated from Transport to Agriculture, the AD of combined heat–power (CHP) industrial units were revised, and the 2001 emissions were allocated in the corresponding category. Estimates of emissions from international aviation were also recalculated, which resulted in a decrease of 4.5 per cent in the figures for CO_2 emissions and an increase of 1.8 per cent in the figures for CH_4 emissions.

41. The recalculation of fugitive emissions of CH_4 for the period 1990–2000 resulted in significant increases in the figures for CH_4 emissions for the overall Energy sector (e.g., by 16.4 per cent in 1990 and 22.1 per cent in 2000). These changes are primarily a result of two sets of recalculations. Fugitive emissions from surface mines were recalculated using the CH_4 EF proposed by the IPCC good practice guidance instead of the average of those suggested by the IPCC Guidelines and CORINAIR that has been used before. The most significant change concerns the recalculations for the oil and natural gas systems, which involved: (1) the inclusion of emissions from venting and flaring, which were not estimated previously; (2) the completion of emissions estimates for Transport and Refining/storage of crude oil and petroleum products; (3) the completion of emissions estimates for the production/processing of natural gas; and (4) a change in the EF used for the calculation of emissions from the transmission and distribution of natural gas. Most of these changes were recommended by earlier reviews. All these modifications had already been introduced in the 2003 submission, which contained the inventory for the year 2001.

B. Reference and sectoral approaches

Comparison of the reference approach with the sectoral approach and international statistics

42. CO_2 emissions from fuel combustion were calculated using the reference and the sectoral approaches. For the year 2002, there is a difference of 0.6 per cent in the CO_2 emissions estimates. Over

the whole time series the differences in CO_2 emissions and fuel consumption as between the reference and the sectoral approach are always less than 1.5 per cent.

International bunker fuels

43. The allocation of fuel consumption between domestic and international transportation is based on the data of the national energy balance, as declared by oil trading companies. It is not known whether this allocation is consistent with the definitions of Domestic and international activities in aviation and navigation specified in the IPCC good practice guidance. Greece states in the NIR that the approaches for the allocation between Domestic and international transportation will be investigated in collaboration with the responsible agencies, namely the Ministry for Development and the Civil Aviation Service. The ERT encourages Greece to investigate this since the precise allocation of fuel consumption is crucial to the accuracy of the emissions estimates for Civil aviation and navigation.

44. Emissions are calculated using the IPCC tier 2a methodology and default EFs for International aviation (using energy consumption data and air traffic data), and the CORINAIR methodology and EFs for International navigation.

Feedstocks and non-energy use of fuels

45. The non-energy use of bitumen, lubricants, naphtha, natural gas, other oil products and petroleum coke is taken into account in both the reference and the sectoral approach using mostly IPCC default values for the fraction of carbon stored. The non-energy use of lignite in the chemical industry in the period 1900–1991 is also taken into account.

46. In the sectoral approach, CO_2 emissions resulting from the non-energy use of fuels as a reducing agent in the production of metals and as feedstock in the chemical industry are estimated and reported in an aggregated manner for each fuel type using mostly IPCC default values for the fraction of carbon stored. Greece states in the NIR that the estimation is done in this way because of a lack of disaggregated AD. The CO_2 emissions from the use of these fuels are also estimated and reported in the Industrial Processes sector, implying double counting of emissions. Greece acknowledges this fact in the NIR and indicated to the ERT that the inventory team will use the information derived from the projects on improvements to the national energy balance to obtain a more disaggregated treatment of the manufacturing industries and deal with this situation. Until this information becomes available, the ERT recommends that Greece avoid double counting by assessing to what extent the CO_2 emissions are counted twice and allocating the relevant CO_2 emissions either to the Energy or to the Industrial Processes sector.

Country-specific issues

47. Geothermal energy production is reported as a potential source of fugitive emissions. However emissions were not estimated because of the lack of a methodology for estimating them and of information on the characteristics of the geothermal fields.

C. Key sources (fuel combustion and fugitive emissions)

Stationary combustion: solid fuels – CO_2

48. Domestic lignite of relatively low heating value accounts for more than 90 per cent of the solid fuels used in Greece and is mainly consumed in steam turbines to generate electricity. Lignite of higher heating value, other bituminous coal and coke oven gas are also combusted for energy purposes. IPCC default values are used for carbon content and fraction of carbon oxidized by fuel type, except for lignite used for electricity generation. The heating values of both types of lignite vary year by year relative to the characteristics of the different mining fields, and the corresponding values are derived from the national energy balance. The carbon content of the lignite used for electricity production is based on a report of the Public Power Corporation of Greece (PPC), published in 1994, which is referenced in the NIR. The resulting CO_2 EFs for lignite used for electricity are among the highest of reporting Parties and

outside the range of the IPCC default values. During the in-country review, Greece indicated to the ERT that the carbon content of this type of lignite was compared with the carbon content reported in recently published scientific literature (Fott, 1999) and the value was within the range of similar types of coal for the European region. The ERT recommends that Greece include this level of detail as explanatory information in its future NIRs and make efforts to update this key parameter.

Stationary combustion: liquid fuels – CO_2

49. For Manufacturing industries and construction, there is insufficient information regarding the technological structure of energy consumption in the sector, and certain assumptions, which are summarized in the NIR, were therefore made in order to allocate AD in the different subcategories. Emissions from chemicals, pulp, paper and print, Food processing, beverages and tobacco are reported in an aggregated manner under the last subcategory (Food processing, beverages and tobacco). As noted in the NIR, this allocation implies that non-energy consumption and the related CO_2 emissions are also reported under this subcategory. In the light of this last feature, the ERT recommends that Greece, as a first step, reallocate these emissions estimates to the Chemicals subcategory, where the use of liquid fuels as feedstocks should be reported. In addition, the ERT recommends that Greece make every effort to ensure that double counting of emissions from non-energy use of fuels does not occur and to investigate further the possibility of allocating fuel combustion and emissions for the above-mentioned source categories correctly.

Stationary combustion: gas – CO_2

50. Although the share of natural gas combustion (6 per cent) is relatively low compared to that of solid and liquid fuels, the consumption of gaseous fuels and related CO_2 emissions have increased by more than 3,000 per cent since 1990. In its response to the previous 2004 review stage and during the in-country review, Greece indicated that this is caused by the introduction of imported natural gas since 1997. The ERT recommends that Greece include a discussion concerning the consumption pattern of gas fuels since 1990 in its future NIRs in order to improve transparency.

51. The CO_2 implied emission factors (IEFs) for gaseous fuels in Manufacturing industries and construction (38.55–52.73 t/TJ) across the entire time series have been identified as outliers, and the values are among the lowest of reporting Parties. In its response to the previous 2004 review stage, Greece reported that the low IEFs are related to the fact that non-energy consumption and the related CO_2 emissions are also included. The ERT reiterates its earlier recommendation on avoiding double counting of CO_2 emissions associated with ammonia production.

52. The use of natural gas as feedstock shows an important variability that may be associated with the behaviour of the time series for the CO_2 IEFs in the Manufacturing industries and construction. During the in-country review, Greece indicated that this variability is typical of the chemical industry of the country. It is recommended that Greece present a brief discussion of this issue in future NIRs in order to improve transparency.

Stationary combustion: solid fuels – N_2O

53. The values of the N_2O IEFs (15.94–17.65 kg/TJ) for solid fuels of energy industries have been identified as outliers. They are among the highest of reporting Parties and they are an order of magnitude higher than the IPCC default EF. During the in-country review, Greece informed the ERT that the N_2O EF is the average of the lowest and highest values suggested in the CORINAIR methodology. Stationary combustion of fossils fuels is dominated by lignite consumption in thermal power plants, and the allocation of this energy consumption by technology was made on the basis of PPC data on the installed capacity and the characteristics of electricity production plants. It is recommended that Greece make an effort to select from the regional EFs those that are more appropriate for each technology type in thermal power generation and to present in its future NIRs a summary of these together with the non-CO_2 EFs used and the rationale for their selection.

Mobile combustion: Road transportation – CO_2 and N_2O

54. The COPERT III model was used for the estimation of emissions from road transportation. The NIR does not include a discussion on the key assumptions and input data that were used to run the model. To improve transparency, it is recommended that Greece provide this information in its future NIRs, including at least a summary of the relevant AD, the EFs used and the decisions adopted for the key features of the model, such as fuel use balance and catalyst deterioration.

55. N_2O emissions from diesel consumption show a decreasing trend in the period 1999–2000 that does not correlate with the fuel consumption pattern. It is recommended that Greece exploit the capabilities of the COPERT III model fully in order to explore the underlying causes of this emission pattern.

56. Emissions of N_2O from natural gas in Road transportation are not estimated. The ERT encourages Greece to include these emissions in future submissions in order to improve completeness.

Mobile combustion: Navigation – CO_2

57. CO_2 emissions are estimated using CORINAIR EFs and consumption of liquid fuels, including lubricants, retrieved from the national energy balance. The emissions associated with the use of lubricants are reported with those corresponding to diesel oil. It is recommended that Greece make an effort to obtain the carbon content of the fuels used in order to comply with the IPCC good practice guidance recommendations.

Mobile combustion: Civil aviation – CO_2

58. CO_2 (as well as CH_4 and N_2O) emissions are estimated according the tier 2a method based on aircraft movements, as suggested by the IPCC Guidelines. Default EFs, consumption of liquid fuels retrieved from the national energy balance and LTO data provided by the Civil Aviation Service are used to calculate these emissions. As noted in the NIR, the time series of fuel consumption and the LTO data show inconsistencies. The ERT encourages Greece to make efforts to reconcile this information by focusing on improving fuel consumption information since, as the IPCC good practice guidance states, there is no gain in inventory quality by moving from tier 1 to tier 2 if fuel consumption data are not complete.

59. Emissions from aviation gasoline and jet kerosene are reported together and assigned to the latter. Greece indicated to the ERT that this is done because the consumption of gasoline is much lower than that of jet kerosene (it is only 5 per cent of the total of the two). Considering that consumption data are available for both fuels, the ERT recommends that the emissions from these fuels be estimated and reported separately to improve accuracy and comparability.

Fugitive emissions: Coal mining and handling – CH_4

60. CH_4 emissions from surface mining of lignite are calculated according to the tier 1 methodology suggested by the IPCC using the EF recommended by the IPCC good practice guidance in the absence of data on overburden depth. The ERT commends Greece on its efforts in obtaining information in order to derive country-specific EFs as recommended by the IPCC good practice guidance.

D. Non-key sources (fuel combustion and fugitive emissions)

Mobile combustion: Road Transportation – CH_4

61. Emissions of CH_4 from Natural gas in road transport are not estimated. The ERT encourages Greece to include these emissions in future submissions in order to improve completeness.

Fugitive emissions: oil and gas operations – CO_2, N_2O

62. These emissions are reported as "NE" in the CRFs for the period 1990–2002. It is recommended that Greece make efforts to estimate and report these emissions, particularly in view of the increasing consumption of natural gas in the country.

E. Areas for further improvement

Identified by the Party

63. In the NIR Greece reports plans for improvements in the three main areas of the Energy sector. They involve the incorporation of revised national energy balances (1990–2000); work to obtain fuel consumption data in a more disaggregated manner, particularly for Manufacturing industries and construction; the investigation of the allocation between domestic and international transport; and improving the availability of country-specific information to estimate fugitive emissions.

Identified by the ERT

64. The plans for improvements summarized above involve the interaction of the inventory team with numerous data providers in the government and private sectors. The ERT encourages the Party to allow the inventory team to play a key role not only in obtaining the information required for compiling the inventory but also in trying to reconcile the data provided by different information sources and further strengthen the data QA/QC procedures.

III. INDUSTRIAL PROCESSES AND SOLVENT USE

A. Sector overview

65. In the year 2002, the share of the Industrial Processes sector in total national GHG emissions was 9.0 per cent. Emissions from this sector increased by 50.8 per cent between 1990 and 2002. Greece intends to use 1995 as the base year under the Kyoto Protocol for F-gases (HFCs, PFCs and SF_6). In 1995 emissions from the Industrial Processes sector (10,773.23 Gg of CO_2 equivalent) were 33.3 per cent higher than in 1990 (8,082.72 Gg of CO_2 equivalent).

Completeness

66. The 2004 inventory submission of Greece includes 10 source categories of emissions for the Industrial Processes sector from the list of the sources which are recommended by the IPCC Guidelines. A number of sources are reported as "NE" because of lack of data. CO_2 emissions in the category Mineral Products are estimated for the subcategories Cement, Lime Production and Glass. CO_2 emissions are not estimated from the following subcategories: Limestone and dolomite use; Soda ash production and use; Asphalt roofing; and Road paving with asphalt. CO_2 and CH_4 emissions are reported as "NE" for Ammonia production for the whole period. In the Metal production subcategory, emissions from ferroalloys production are not estimated. HFC emissions are estimated only for Production of Halocarbons and SF_6 and Refrigeration and air conditioning equipment. Potential emissions for the ozone depleting substances (ODS) substitutes are not calculated because of lack of export/import data. For this last subsector only emissions from refrigeration and air conditioning are reported. The other sources are reported as "NE".

Transparency

67. For most of the emission sources in the Industrial Processes sector the AD are transparent. The exception is those sources where AD are confidential because only one manufacturer exists in the country. AD are not reported for aluminium production for reasons of confidentiality; however, the emissions data are included in the NIR. For this category, CO_2 emissions from primary aluminium production fluctuated slightly during the period 1990–2002, while PFC emissions changed significantly. AD for HCFC-22 production are also not reported for the same reason, although data on HFC-23

emissions are provided. As for the chemical industry, there is no information on the production of ethylene, dichloroethylene and styrene, and the emissions are therefore reported as "NE". In these cases the information provided on AD is not sufficiently transparent. However, for other sources, suitable references for the methodologies applied, and the AD and EFs used for calculation of GHG emissions by source are presented and are transparent.

Recalculations and time-series consistency

68. Recalculations are reported for Cement production because Greece has changed the methodology from IPCC default to tier 2 according to the IPCC good practice guidance. CO_2 emissions from lime production have also been recalculated because the lime content in the final product has been changed from 100 per cent to 95 per cent in accordance with the IPCC good practice guidance. In addition, new data on the production of hydrated lime became available in 2004. Recalculations for these two sources have been made for the whole reporting period. For Steel production the emissions have been calculated for the first time and are therefore reported in the CRF recalculation tables. Emissions of PFCs from Aluminium production for 2001 were corrected because there was a transcription error. As a result of the recalculation, the figures for 2004 are 12.6 per cent more than those for 2003. Recalculations have also been done for HFC-23 emissions for 2001 from Production of Halocarbons and SF_6 as new data on HCFC-22 production became available. This has resulted in current estimates of HFC-23 being 15 per cent lower than previous ones.

69. The trend observed in emissions for the whole Industrial Processes sector demonstrates substantial fluctuations during the period 1990–2002. These are the result of fluctuations in industrial production, and principally to changes in Cement production, which is the largest source of emissions in the Industrial Processes sector in Greece, as well as in the other key sources of emissions. Total emissions from the sector increased by 3.9 per cent per year on average for the period reported, reaching a minimum value of 7,964 Gg CO_2 equivalent in 1992 and a maximum value of 12,477 Gg CO_2 equivalent in 2000.

Uncertainties

70. The combined uncertainty as reported by the Party for Cement production is estimated as 2.8 per cent. For HFC-23 emissions the uncertainty is 70.7 per cent, and for ODS substitutes it is the highest among the Industrial Processes sources at 200.1 per cent. The uncertainty of PFC emissions from aluminium production is estimated to 1.4 per cent, resulting primarily from measurement errors.

Verification and quality assurance/quality control approaches

71. No specific information related to verification and the QA/QC plan is included in the chapter of the NIR on Industrial Processes.

B. Key sources

Cement production – CO_2

72. CO_2 emissions from cement production are a key source in the Industrial Processes sector defined both by level (the largest in the sector) and by trend (the third-largest) assessment. This source category accounted for 56.8 per cent of total industrial emissions and 5.1 per cent of total national emissions. The average growth of these emissions was 2.6 per cent per year. The relative change between 1990 and 2002 is +33.4 per cent.

73. In its 2004 submission Greece started to apply a tier 2 methodology for estimating emissions, which is appropriate and in line with the IPCC good practice guidance, using data for clinker production. The statistical data on clinker production were available only for the period 1993–2001. To obtain AD for the missing years (1990–1992 and 2002), Greece used linear extrapolation. The EFs applied are the IPCC defaults. The lime content in clinker is the IPCC value (65 per cent). For the cement kiln dust (CKD) correction factor Greece used the IPCC value, which is 1.02.

74. As a result of recalculations following a change in the methodology, the values for 1990 reported in the 2004 NIR were 23.2 per cent lower than those reported in 2003, and the values for 2000 were 6.5 per cent lower than those reported in 2003 (these were, respectively, the largest and the smallest differences resulting from the recalculations). In the previous review it was noted that there are significant fluctuations in emissions values from Cement production between 1999 and 2000. In its response, Greece explained this by the increased construction activity caused by significant infrastructure investments and the country's preparations for the 2004 Olympic Games.

75. Greece is planning to improve its calculations of emissions from cement production by applying the missing AD as soon as they become available. The national values of the CKD and the lime content in clinker will also be further investigated.

Production of halocarbons and SF_6 – HFCs (HFC-23)

76. This source is reported as the second-largest key source in the Industrial Processes sector according to level assessment and the largest by trend assessment. In 2002, HFC-23 emissions accounted for 26.2 per cent of total GHG emissions from the Industrial Processes sector and 2.4 per cent of total national emissions. Compared to the 1990 level, HFC-23 emissions from this source had increased by 241.6 per cent by 2002, with an average annual growth of 18.6 per cent. The significant growth in HFC-23 emissions started in 1992 and reached its maximum in 1997, and the increase reached 336 per cent over this period. After this large increase the level of emissions was stabilized before 2000, and then began to decline slightly. The ERT recommends the Party to include detailed explanations in the NIR for these important changes in trend.

77. Greece indicates in the NIR that HFC-23 emissions are estimated on the basis of production statistics and default EFs. The ERT encourages Greece to further investigate the possibility of applying the methodology of the IPCC good practice guidance, based on measurement data, for estimating HFC-23 emissions, as this is a key source. For confidentiality reasons the AD are not reported in the CRF.

Consumption of halocarbons and SF_6 – HFCs

78. HFC emissions from the consumption of halocarbons and SF_6 are the second-largest key source in the Industrial Processes sector defined by Greece according to the trend assessment, and the third-largest by level assessment. HFC-32, HFC-125 and HFC-134a emissions are reported from this source. These halocarbons are used as chlorofluorocarbon (CFC) substitutes according to the restrictions imposed by the provisions of the Montreal Protocol. Data are provided since 1993, when their consumption started to grow abruptly. The NIR includes only domestic refrigeration and air conditioning equipment. This source became a key source because of its significant contribution to trend, although its share in total national emissions is low (only 0.6 per cent in 2002, while it accounted for 6.6 per cent of total emissions from the Industrial Processes sector in the same year). Nevertheless, since 1993 the emissions from this source have increased by a factor of 25.7 (2,471 per cent) – equal to an average of 334.2 Gg of CO_2 equivalent annually.

79. Greece has used the IPCC tier 2a methodology, based on leakage per equipment type which occurs under assembly, operations with equipment and disposal. Greece explained that potential emissions cannot be calculated because of lack of export/import information and detailed sales data per gas, and this does not permit Greece to perform a cross-check on emissions. The AD were obtained from market surveys for the years 1993–2000. Data for the years 2001–2002 were estimated by extrapolation. For mobile air conditioning it was assumed that the share of cars with air conditioners increased from 65 per cent to 100 per cent from 1995 to 2002. The ERT recommends Greece to make the necessary efforts to improve the completeness of its reporting of ODS substitutes.

Nitric acid production – N_2O

80. N_2O emissions from nitric acid (HNO_3) production are the fourth most important key source in the Industrial Processes sector according to the trend assessment. They contribute 4.6 per cent of total

GHG emissions from the sector and 0.4 per cent of total national emissions. However, since 1998 AD on nitric acid production are not available for reasons of confidentiality, and for this reason Greece reports constant values from 1997 onwards. Emissions from nitric acid production declined by 20.6 per cent over the reporting period.

81. Greece has applied the IPCC default methodology and averaged the default EFs recommended by the IPCC for calculation of N_2O emissions. The EF used was 4.5 kg N_2O/t of HNO_3. The data availability problem may be overcome if the manufacturer can provide emissions data for the most recent years, starting from 1998. The ERT encourages Greece to resolve this problem of data availability to ensure that consistent trends are reported in line with the IPCC good practice guidance.

C. Non-key sources

Ammonia production – CO_2

82. The main problem in this source is related to the accounting of fuel as feedstock, since for years when non-energy emissions have been estimated they are also likely to be included as part of energy emissions and potentially double counted in the Energy and Industrial Processes sectors (for further elaboration on this see section II of this report). The ERT recommends that Greece avoid double counting by assessing to what extent the CO_2 emissions are counted twice and allocating the relevant CO_2 emissions either to the Energy or to the Industrial Processes sector. It also recommends the use of the notation key "included elsewhere" ("IE") instead of "NE" for this source.

Iron and steel production – CO_2

83. Secondary steel production is a source of CO_2 emissions from the consumption of electrodes in electric arc furnaces. These emissions are also probably reported in the Energy sector under the 1.A.2 subcategory, and thus counted twice. The Party explained that this is to be revised, since the national energy balance does not provide information on fuel use as a reducing agent, and the ERT encourages the Party to make this revision.

D. Areas for further improvement

Identified by Party

84. The main improvements identified in this sector involve gaining access to all the AD needed to estimate emissions for all industrial sources and all years. Greece recognizes this problem and hopes to gather the appropriate data, or surrogate data, in order to solve it.

Identified by the ERT

85. The ERT recommends that representatives from the industrial sector and related national institutions be involved more widely in the inventory process in order to facilitate access to the relevant AD, to help in defining national EFs, and to take into account the introduction of new technologies with different levels of GHG emissions.

86. In the case of confidentiality of data, the ERT believes that it should be possible to establish a process for industrial sources (e.g., manufacturers) to provide the inventory team with the calculated or measured emissions data and relevant information about the methods used for these purposes. It is also recommended that data on HFCs which should be available from national reports on ODS substitutes be used for the relevant estimations and verification in this source category.

87. The ERT also believes that in many cases it is possible to use international statistical data on industrial production in order to check the emissions data and export/import data and calculate potential emissions from the consumption of halocarbons and SF_6. Parties reporting actual emissions should also report potential emissions for those sources, where the concept of potential emissions applies, for reasons of transparency and comparability.

88. The ERT recommends the development of a sector-specific QA/QC plan for the Industrial Processes sector according to the recommendations of the IPCC good practice guidance.

IV. AGRICULTURE

A. Sector overview

89. In the year 2002, the Agriculture sector contributed 9.4 per cent of total national emissions. Between 1990 and 2002 emissions from the sector declined by 6.4 per cent, mainly because of a decline in N_2O emissions from agricultural soils (9.4 per cent). This happened because consumption of synthetic fertilizers fell due to new agricultural practices and the higher price of nitrogen (N) fertilizers.

Completeness

90. The CRF includes estimates of all gases and sources of emissions from the Agriculture sector, as recommended by the IPCC Guidelines.

Transparency

91. The information on EFs and sources of some AD provided in the NIR and in the additional information tables in the CRF is not sufficient to support the inventory estimations. Significant improvements are required to the documentation of AD and some country-specific parameters used for calculating emissions from N-fixing crops and crop residues. Additional information tables should be provided where possible.

92. Because Greece is using three-year averaging for the animal population, the ERT recommends that, in the interests of greater transparency and comparability with the annual international statistics, annual animal population data be reported in the NIR.

Recalculations and time-series consistency

93. Greece reports recalculations of CH_4 and N_2O emissions for Enteric fermentation, manure management and animal production for 1996–2000, as updated AD (animal population) for the years 1997–1999 have been provided by the National Statistical Service of Greece. The Party has also recalculated emissions for all years for the following sources:

a) Enteric fermentation and manure management, because of the separation of the buffalo population from the cattle population;

b) Rice cultivation, because of the use of a new EF from the IPCC good practice guidance (20 g CH_4/m^2) and because updated data on cultivated area have become available;

c) Direct soil emissions, because of a change of methodology for the calculation of emissions from N-fixing crops and crop residues and the use of a more accurate value for $Frac_{BURN}$; and

d) Field burning of agricultural residues, because of a change in the fraction of crop residues burned in the field.

94. Recalculations have changed the figures for emissions of CH_4 in the base year (1990) by –1.6 per cent and for emissions of N_2O by +47 per cent. In the last year recalculated, 2001, the figures for emissions changed by –1.95 per cent for CH_4 and by +43.94 per cent for N_2O. The most important reason for these changes is the recalculation of N_2O emissions from agricultural soils, which produced increases of 49.4 per cent in 1990 and 46.4 per cent in 2001.

95. The accuracy of the estimates and the consistency of the time series have been improved.

B. Key sources

Animal production – N_2O

96. Animal production is the most important key source category in the Agriculture sector and contributed 2.6 per cent to total national GHG emissions and 40.1 per cent to the emissions from agricultural soils in 2002. In the Party's key source analysis Animal production was not identified as a key source because it was included in the Direct soil emissions source category.

97. N_2O emissions from pasture, range and paddock are calculated according to the IPCC good practice guidance. The fraction of livestock N excreted and deposited onto soil during grazing is missing in the additional information table of the CRF. The ERT recommends that the Party estimate it and report it under $Frac_{GRAZ}$.

Indirect emissions – N_2O

98. This source was not reported in previous submissions. In this sense the Party has made an important improvement to the inventory, and all emissions estimates are reported according to the IPCC good practice guidance for the whole period 1990–2002. This source contributes 2.4 per cent of total national GHG emissions.

Enteric fermentation – CH_4

99. The emissions estimates are based on a tier 1 methodology and default EFs for Eastern Europe and developed countries. According to the IPCC good practice guidance, a tier 2 methodology must be used with a country-specific EF for significant sub-source categories, and the ERT encourages the Party to make the necessary efforts to do this. In Greece sheep are responsible for 50.6 per cent of CH_4 emissions from enteric fermentation, and cattle are the second-largest source, with 27.5 per cent. Enteric fermentation from sheep accounts for 1.1 per cent of total national GHG emissions and Enteric fermentation from Cattle for 0.6 per cent.

100. The annual milk production of dairy cattle has been used by Greece to evaluate whether the use of a default EF for dairy cattle is suitable. There is no information about these data in the NIR or the CRF. To improve transparency, the ERT recommends the inclusion of this information in the NIR for all years.

101. Because of an error in the CRF tables for 1990 (the number of animals from 1991 was included in the table by mistake), all IEFs for CH_4 from enteric fermentation and from manure management appear inconsistent. This error has no effect on the emissions estimates and will be corrected in the next submission.

102. The IEFs for buffalo change from year to year (the changes are in the range of –5.4 to +1.1 per cent), although it is reported that default values have been used for the estimation. This apparent inconsistency has occurred because the values have not been reported in the CRF tables with the same accuracy as was used in the calculations. This apparent inconsistency also occurred for other animal categories and in other sources, although to a lesser extent. The ERT recommends that, in order to improve both transparency and accuracy, the values reported in the CRF should match the values derived from the calculation spreadsheets.

Direct soil emissions – N_2O

103. Direct N_2O emissions from soils contribute 1.5 per cent of total national GHG emissions. Synthetic fertilizers are the source of 81.1 per cent of direct N_2O emissions. The trend in emissions declines significantly (by –27.6 per cent from the base year) and shows large inter-annual fluctuations (–16.7 per cent between 1994 and 1995, and +16.8 per cent between 1999 and 2000). There is insufficient information regarding the source of the fertilizer consumption data in the NIR. During the in-country review the Party explained that very detailed fertilizer consumption data were provided by the

fertilizer producer industry directly and this information has not been published. However, the Food and Agriculture Organization of the United Nations (FAO) statistics show a similar trend with fewer fluctuations, and the use of data from FAO seems more appropriate in this case.

104. The IEF for emissions from N-fixing crops and crop residue (0.00055 and 0.00007) is very low compared to the IPCC default value (0.0125). This is because the N-fixing crop production and crop residue data in the CRF tables are in kg of dry biomass/year and not in kg of N/year, as required in the CRF. This is not considered to be an error, nor does it affect the emissions estimates. The Party uses a tier 1b methodology and crop-specific parameters. For greater transparency, the ERT recommends that Greece report in the NIR all data used and also report in the CRF additional information table the average values for $Frac_{NCRBF}$, $Frac_{NCRO}$ and $Frac_{R}$.

105. Emissions from cultivation of histosols are reported as "NE" but no explanation is provided in the NIR. During the in-country review, Greece explained that this is a minor source. The ERT recommends that additional explanatory information be provided about the reasons for not including Emissions from cultivation of histosols, both in table 9 of the CRF and in the NIR.

C. Non-key sources

Manure management – CH_4, N_2O

106. This source contributes 6.1 per cent to emissions from the Agriculture sector and 0.6 per cent to national GHG emissions. It covers CH_4 and N_2O emissions from solid and liquid systems of animal waste management. Data regarding the allocation of manure management systems are based on expert judgement and have been provided by experts of the Ministry of Agriculture. The ERT recommends that more transparent documentation of this data source be included in the NIR and that these data be included in the CRF additional information tables to improve transparency.

D. Areas for further improvement

Identified by the Party

107. The Party identifies many necessary improvements to the inventory in the NIR. Some have been made according to the recommendations of previous review reports. Greece is planning to examine the possibility of developing country-specific EFs for Enteric fermentation from sheep, as this contributes 50.6 per cent to the key source, as well as evaluating the availability of new data regarding the allocation of manure management systems and the possibility of developing country-specific values for crop/residue ratio and $Frac_{BURN}$.

Identified by the ERT

108. The ERT's major concern is the availability of updated AD. During the in-country review the Greek experts informed the ERT that no published statistical data for agriculture for the years 2000–2002 were available. The most recent final data available are for the period 1990–1999[5], while data provided. The Statistical Service considers crop production and cultivated areas for the years 2000 and 2001 provisional. AD for animal population for the period 2000–2002 as well as AD for crops in 2002 have been extrapolated on the basis of the trend of the past decade. For this reason all emissions estimates for the past three years (2000–2002) are provisional. The Party is encouraged to find a way of obtaining agricultural data from the National Statistical Service or other institutions at an earlier stage of preparation of the inventory in order to avoid waiting for publication of the official data.

[5] National Statistical Service of Greece. *Agriculture Statistics of Greece, 2003*.

V. LAND-USE CHANGE AND FORESTRY

A. Sector overview

109. The total geographic area of Greece is 13.19 million ha, of which forests and other wooded lands account for 6.5 million ha (49.3 per cent). Further, 3.35 million ha is reported as productive forests, and other wooded land accounted for 3.15 million ha. In Greece there is ban on land use conversion of forest and grasslands. The contribution of the LUCF sector to total national GHG emissions has varied widely, particularly over the three most recent years (2000–2002). In 2002 it was a net sink of 1,891.79 Gg of CO_2 (1.4 per cent of CO_2 emissions), while in 2000 it was a source of 4,169.74 Gg of CO_2. For five years over the period 1990–2002, including 2001 and 2002, it was a net sink. In the base year (1990) it was a source of 1,473.59 Gg of CO_2 (1.5 per cent of CO_2 emissions). The major sources of AD and EFs as referenced in the NIR are the First National Forest Inventory (NFI, 1992), the annual report of the Forest Service (Ministry of Agriculture), and the Report of Criteria and Indicators for Sustainable Forest Management (2000). The NFI studies were conducted for the period 1963–1985.

110. Greece has not yet adopted QA/QC procedures for the LUCF sector. It has plans to adopt QA/QC procedures for LUCF, along with other sectors, and to adopt the IPCC good practice guidance for the LULUCF) sector for the next inventory. No verification procedures have been adopted by Greece to verify AD and EFs.

Completeness

111. The CRF includes estimates of most gases, sources and sinks from the LUCF sector, as recommended by the IPCC Guidelines. The indicator used for the LUCF sector in tables 7 of the CRF for all the years is "PART" (partially completed), which indicates an incomplete inventory. Greece has estimated categories 5.A, 5.B and 5.D partially, while estimates for category 5.C have not been made. This is mainly due to the absence of AD on the land areas involved – forest and grassland conversion for 5.B, managed area abandoned for regeneration for 5.C, and area under different soil types or different management systems or subjected to change over the years for 5.D. The ERT encourages Greece to initiate monitoring of AD on area changes under different categories. All cells of the CRF tables have been filled in with either values or notation keys.

Transparency

112. The information provided in the NIR is not completely transparent on methods, AD and EFs. For example, methods for estimating the annual growth rate of biomass and sources of forest and grassland converted and other wooded land area subjected to wildfire are not provided. The wide fluctuation in GHG emissions reported is not adequately explained, although it is addressed in the NIR (e.g., figure 7.4 of the NIR).

Recalculations and time-series consistency

113. Greece has reported recalculations for the LUCF sector resulting from the inclusion of Emissions from grassland burning and correction of the EF used for estimating N_2O from Grassland burning. The trend of recalculation is not adequately reported. However, the share of GHG emissions, particularly CO_2 from Forest and grassland conversion, is marginal compared to the share of other categories and the recalculations are therefore unlikely to have an impact on the national inventory.

Uncertainties

114. Uncertainty estimates are not reported for the sector estimates.

B. Sink and source categories

Changes in Forest and other Woody Biomass Stocks

115. Greece has adopted the IPCC default method for estimations. CO_2 uptake has been estimated only for the productive forests, which accounts for 3.35 million ha. Other wooded land, which accounts

for 3.15 million ha, is not included for estimation in this category. However, this latter category is included for estimating GHG emissions in category 5.B where emissions resulting from wildfires are estimated. The ERT believes that other wooded lands, being so extensive, should be included in category 5.A. Data on annual growth rates are provided by the NFI, but the method used in the NFI for deriving these data is not explained. It is necessary to provide briefly in the NIR the method adopted to estimate annual increment in biomass. CO_2 removals from forests are estimated to be 4,005 Gg CO_2 in 2002. The forest biomass increment is reported to be constant for the whole period 1990–2002. The Party explained that this assumption was made due to the lack of detailed, frequently updated and disaggregated forest statistics. However, it is important for Greece to refer to other studies or to conduct studies to estimate the changes in area as well as annual growth rates. Default values could be used for mean annual growth rates for other wooded land.

116. The relative change in net CO_2 emissions/removals between 1990 and 2002 is very high, at –9,556 per cent, and this is not adequately explained. Fuel wood use and commercial harvest have varied over the years. There is a sharp reduction in both in the two most recent years. Fossil fuels and electricity seem to be replacing fuel wood. However, in the Energy sector biomass consumption (largely wood-based) seems to have increased during 2001 and 2002, which is in contrast to the trend of a sharp reduction during the same years reported in 5.A for LUCF. This needs to be reconciled to ensure consistency.

Forest and Grassland Conversion

117. Greek laws prohibit land-use change and the conversion of forest, grassland and other wooded lands. Thus no emissions resulting from land-use changes are reported for Greece. The ERT suggests that land-use area changes should be monitored and emissions reported, since it is likely that land use is being changed. High variations in areas subjected to wildfire and the resulting GHG emissions are reported but the source of the data is not explained. The ERT recommends that Greece provide adequate explanatory information, such as the sources of AD, particularly because of the wide fluctuations in area burnt, and EFs used, even if default values are used. There is confusion about CO_2 or CO_2 equivalent emissions. CO_2 emissions are reported in the NIR even though there is no land-use change. CO_2 emissions are reported in the CRF for 5.B, and it is not clear if they are from soil or biomass. The text is confusing. Thus there is a need for clarification of what is reported under CO_2 in CRF table 5. GHG emissions from forest and grassland conversion have been recalculated due to the inclusion of grassland burning and the correction of the EF for N_2O. More explanation is needed as to why it was not estimated earlier and the data sources used. Different default values are used for Converting biomass to carbon (0.45 in 5.B and 0.5 in 5.A). The ERT believes that national values could be developed or a single carbon fraction could be used. Emissions due to wildfires in forests, other wooded lands and grasslands are reported under 5.B, although they are not considered as means to change land use[6]. According to the NIR, a) CO_2 emissions refer only to the oxidation to the atmosphere of all carbon contained in aboveground biomass in the inventory year; and b) CH_4 and CO emissions were estimated as ratios to carbon fluxes emitted during burning, and N_2O and NOx emissions as ratios to total nitrogen. Nitrogen content was calculated based on the nitrogen-carbon ratio (N/C was taken as 0.01 from the IPCC Guidelines).

Abandonment of Managed Lands

118. CO_2 uptake due to Abandonment of managed lands is reported to be occurring as a result of urbanization, but because of lack of AD and carbon accumulation factors the CO_2 uptake is not reported. The ERT suggests that Greece could initiate studies to monitor area abandoned, using default data, initially, and plan to develop nationally derived CO_2 accumulation rates.

CO_2 Emissions and Removals from Soils

119. CO_2 emissions and removals from soils are not reported for land-use change or changes in management practices because of lack of data. However, CO_2 removals in soils due to afforestation since

[6] NIR, page 108.

1994 are reported. The ERT recommends Greece to consider initiating studies to monitor land-use or management changes and studies of soil carbon density in mineral soils. If area data are obtained, default EFs could be used in the short term, and in the long term field studies could be initiated to derive nationally relevant emission/removal factors for soils. No mention is made in the NIR of organic soils and lime application. Greece could report the extent of or status of organic soils and lime application, even if they are insignificant or do not occur.

120. The average annual soil carbon uptake value is an outlier (very high at 2.31 tC/ha/yr). The ERT recommends that an improved value or an IPCC default value be used.

C. Areas for further improvement

Identified by the Party

121. The NIR has identified several options for improvement of the GHG inventory for the LUCF sector. Topping the list is the adoption of the IPCC good practice guidance for the LULUCF sector for the next submission. Development of national biomass expansion factors (BEFs) would help estimate different biomass pools and whole tree biomass, including branches, stumps and roots. There is a plan for collecting data on the forest condition of other wooded land. Attempts are to be made to obtain information on abandonment of crop land and deforestation near urban centres from the National Land Survey and Forest Maps. Several international efforts (such as CarboEurope, CarbonInvent) are also expected to provide AD and EFs.

Identified by the ERT

122. The GHG inventory for the LUCF sector in Greece is characterized by the use of IPCC default methods, and lack of AD and EFs. The inventory is incomplete because of lack of AD and EFs for some categories (5.B, 5.C and 5.D), lack of estimates of uncertainty, and absence of QA/QC procedures. Moreover, explanations of methods, the sources of AD and EFs, the wide fluctuations in emissions due to wildfire or the stable forest carbon increment for 12 years need to be more detailed. Adoption of the IPCC good practice guidance for the LULUCF sector would require full and consistent accounting of all land categories, all carbon pools and non-CO_2 gases, based on key source/sink category analysis. Further, adoption of the IPCC good practice guidance approach will overcome the methodological inconsistencies. The ERT believes that Greece could focus on the following in particular: (1) initiating studies to monitor AD on area subject to land-use change, area abandoned and area regenerating, other wooded land subjected to wildfire and so on even if land-use conversion is banned by law; (2) initiating studies to generate emission and removal factors (biomass and soil carbon) for other wooded land, abandoned land regenerating, and land under different use and different management systems; (3) initiating QA/QC procedures and estimating uncertainty using the IPCC good practice guidance; and (4) explaining in the NIR all the methods used and sources of AD and EFs. More data on land use, land-use change, biomass, soil carbon density and growth rates for different land categories could be given in the NIR.

VI. WASTE

A. Sector overview

123. In the year 2002, emissions from the Waste sector represented 4.5 per cent of total GHG emissions in Greece. In 1990 the share was 3.9 per cent. Emissions from this sector are expected to increase over the next few years due to the increasing share of municipal waste going into managed sites, a steadily increasing waste generation rate, and the inclusion of missing categories in the inventory.

124. The Waste sector has one key source – solid waste disposal on land, which contributed 67.2 per cent in 1990 and 87.4 per cent in 2002 to total emissions from the sector. CH_4 and N_2O emissions from waste-water handling are small, accounting together for 0.6 per cent of the national total and 12.6 per cent of Waste sector emissions in 2002. The contributions from waste-water handling are likely to be slightly higher when complete estimates are reported (e.g., when sewage sludge treatment is included).

125. Data on population[7] are provided by the National Statistical Service of Greece, while the main sources of information for the rest of the necessary data and parameters are the MEPPPW, various research studies and international databases. The MEPPPW and local management authorities have conducted specific studies on different variables (waste composition, waste production, etc.). These studies are not, however, developed on a continuous basis.

126. The ERT was informed that there is no legal framework in place to require the regular collection and reporting of information to the MEPPPW or any other national institution from landfill operators, waste-water plant operators or local authorities.

Completeness

127. All the CRF tables (from 1990 to 2002) for the Waste sector have been completed. The CRF tables include estimates from the Waste sector, as recommended by the UNFCCC reporting guidelines, for CH_4 emissions for Managed and unmanaged sites, and for Waste-water handling, and N_2O Emissions from human sewage. CH_4 Emissions from sludge, N_2O emissions from industrial waste-water treatment and emissions from waste incineration are not estimated. Nor is the amount of methane recovered. The Waste chapter of the NIR contains basic information on methods, EFs and AD.

Transparency

128. Methodologies, assumptions, background data and studies for estimating emissions are appropriately summarized in the NIR, but more detailed clarifications may be needed for AD and country-specific parameters since these data are based on many different studies. The ERT recommends that the NIR include overview tables with more detailed disaggregation of all input data used for calculations and more precise references to the information sources.

129. All sources of information and Excel files with calculations are archived at the National Observatory of Athens Institute for Environmental Research and Sustainable Development, and were made available to the ERT. Background documentation is in Greek.

Recalculations and time-series consistency

130. CH_4 emissions from solid waste disposal on land and Waste-water handling have been recalculated in the 2004 submission for the period 1990–2002 following updating of the population data series.[8] Because of this recalculation, the figures for CH_4 emissions from solid waste disposal on land in 1990 increased by 0.003 per cent and those for 2001 by 0.19 per cent, and the figures for CH_4 emissions from waste-water handling in 1990 increased by 11.27 per cent and those for 2001 increased by 40.85 per cent. N_2O emissions from waste-water handling (Human sewage) were included in this submission for the first time.

131. CH_4 emissions from solid waste disposal on land increased by 87.7 per cent between 1990 and 2002. This is one of the highest increases among Annex I Parties; however, information provided to the ERT in general does not contradict the estimated values. The data used for calculations are partly interpolated; some assumptions made might lead to slight overestimation, but actual inconsistencies have not been identified. The trend might show up differently[9] if Greece were using the first-order decay (FOD) method for managed landfills.

132. There is an unusual drop in CH_4 emissions from waste-water handling in the past five years. However, the ERT was informed that the implementation of a European Commission directive since 1999 had resulted in 70 per cent of the population being served by aerobic treatment systems by 2001. That proportion was only 32 per cent in 1999. The projection for 2006 is that 95 per cent of the population will be covered by aerobic treatment systems.

[7] The population census is conducted every 10 years.
[8] The latest population census was conducted in the year 2001.
[9] The basic method tends to overestimate emissions.

Uncertainties

133. Uncertainty information is not included in the Waste chapter of the NIR, but it is included in section 1.7 and annex IV of the NIR. The uncertainties of CH_4 emissions are provided for Managed and unmanaged sites (41.8 per cent and 73 per cent, respectively), and Waste-water handling (42.4 per cent). No information on N_2O emissions uncertainty is provided.

Verification and quality assurance/quality control approaches

134. The Waste chapter of the NIR does not include specific information related to QA/QC approaches or procedures. According to information provided by Greece during the review, there are comparisons of modelled estimates with data sets obtained from regional authorities and international data sources. Experts from landfill sites and waste-water management are consulted when developing country-specific indicators and parameters. The ERT recommends the Party to keep track of expert judgement in line with the IPCC good practice guidance.

B. Key sources

Solid Waste Disposal Sites – CH_4

135. Methane emissions have been estimated for managed and unmanaged disposal sites separately. Greece has used the IPCC default method and IPCC default values. According to the IPCC good practice guidance, the tier 2 methodology should be applied for the estimation of emissions from solid waste disposal on land as it is a key source. However, Greece informed the ERT that its application is not yet feasible because the detailed historical data required are lacking.

136. The lack of an integrated national system for the systematic collection of waste data has resulted in the Greek inventory team having to make additional efforts to obtain reasonable results. Additional difficulties arise from the fact that a large number of unmanaged sites exist: in 1987 almost 4,690 unmanaged solid waste disposal sites (SWDS) were registered as referenced in the NIR (MEPPPW, 1987). In spite of positive developments in this sector, 2,182 unmanaged SWDSs were still operating in 2000 as referenced in the NIR (MEPPPW, 2001).

137. The amount of municipal solid waste (MSW) generated has been calculated by multiplying population by waste generation rate. Permanent population at the prefecture level was disaggregated into urban, semi-urban and rural, while foreign visitors and overnight visitors were taken into consideration, as well as the number of immigrants. The NIR does not provide information on how tourists have been transferred into the population data in table 8.5 provided in the NIR. Modelled population trends in Excel sheets were provided to the ERT. The ERT recommends that Greece include detailed information on the population types used for its calculations in the NIR.

138. The inventory team has developed simple models to calculate waste generation rates with data collected in surveys. The MSW generation rate is based on two surveys published by the MEPPPW, as referenced in the NIR, one in 1998 (data collected for 1991 and 1997 for 13 counties) and one in 2001 (data collected for 1995, 1997 and 2001 for 13 counties).

139. Different MSW generation rates (from 0.8 to 1.1 kg/capita per day) have been applied for urban, semi-rural, rural, and tourists (2.1 kg/capita per day), but the information provided in the NIR is not transparent enough and it is not possible to follow up the calculation of municipal waste generated. For the estimation of generation rates for the years before and after 1997, the MSW generation rate was assumed to change annually by 0.028 kg/capita per day, while a higher value (annual increase by 0.035 kg/capita per day) was applied for selected urban areas.

140. At the national level, there is a lack of official records regarding the composition and quantity of MSW generated. Recent estimates of the composition of MSW at the national level exist only for 1997 as referenced in the NIR (MEPPPW, 1998). Measurements in some regions have been carried out, although they refer to different time periods as referenced in the NIR (e.g., ULAPA 1996; MEPPPW, 1999).

141. There are slight inconsistencies between the CRF table 6.A and the NIR. Additional information on the differences reported in the NIR on the fraction of MSW disposed of in solid waste disposal sites would be helpful (MSW_f =1 in the CRF, but is around 0.93 according to the data in tables 8.6 and 8.9 of the NIR). The ERT was informed that the waste not disposed of in this manner is recycled.

Waste-water treatment – CH_4

142. Greece has applied the IPCC default method and parameters. Emissions are calculated according to the IPCC Guidelines, based on population data (for municipal waste-water handling) and industrial production data (for industrial waste-water handling) and not on volume of waste-water treated in the various facilities. Information on the share of the population served by aerobic treatment was available for the years 1990, 1993, 1996, 1999 and 2001, and projections for 2006 only.

143. Emissions are estimated separately for municipal and industrial waste water, but not estimated for sludge. Greece explained that the reason is the lack of information on sludge.

144. Municipal waste-water emissions are calculated as a whole in spite of fact that part of the water is treated in plants and part in pits, septic tanks, and other small anaerobic systems. Greece is encouraged to estimate and report emissions separately for population not connected to the treatment plants.

145. The NIR refers to the IPCC Guidelines default value of 0.25 kg CH_4/kg biochemical oxygen demand (BOD) when calculating maximum methane-producing capacity (B_0). The ERT encourages the Party to follow the IPCC good practice guidance, check whether the value used for calculation could be 0.60 kg CH_4/kg BOD, and modify its calculations accordingly.

146. Methane emissions from source category 6.B.1 Industrial waste-water handling have been estimated for the first time in the 2004 submission.

C. Non-key sources

Human sewage – N_2O

147. Greece has applied default IPCC methods and parameters. The AD (population) include tourists; however, it is not clear how the population data have been derived. Protein consumption has been obtained from the FAO database. The value provided in the database is one of the highest among Annex 1 Parties. Greece may wish to examine this value if this calculation method is to continue to be used in the future. N_2O emissions from source category 6.B Human sewage are estimated for the first time in the 2004 submission.

Waste incineration – CO_2, CH_4 and N_2O

148. Emissions are reported as "NE". There are no licensed waste incineration plants in the country and therefore MSW may not be incinerated.

D. Areas for further improvement

Identified by the Party

149. The regular collection of data for the two biggest landfills, which represent approximately 75 per cent of total waste disposed annually to managed solid waste disposal sites, has been initiated as a priority. Methane recovery at landfills is a relatively recent practice. Greece also plans to obtain data on methane recovery from landfill operators, and this information should be included in its 2005 submission.

150. A new incineration plant for hospital waste was put into operation in 2003 and data should be available for inclusion in the 2005 submission.

151. There have been discussions within the MEPPPW on establishing a central information system to support implementation of European Commission directives on solid waste as well as the UNFCCC reporting requirements. The ERT commends this effort.

152. Greece is considering applying the FOD method for estimating emissions from managed solid waste disposal sites in the next submission. The ERT encourages this effort.

Identified by the ERT

153. Greece has managed to develop a complete inventory for municipal solid waste disposal based on population data and country-specific MSW generation rates. The national experts deserve credit for the efforts made in estimating indicators to complete the time series for waste emission calculations. Nevertheless, more studies might be required to improve the reliability of assumptions made and in order to replace IPCC default values with country-specific values.

154. Information on AD (population) in the NIR should be provided according to categories (urban, semi-rural, rural, tourists, immigrants) for which different waste generation rates are applied. The ERT urges Greece to include all parameters needed for documentation of calculations in the NIR in a more transparent manner (tables).

155. The ERT encourages Greece to estimate emissions for all missing source subcategories (CH_4 from sludge, and N_2O from waste-water handling). There are a limited number of industrial waste-water plants in the country with anaerobic treatment, and Greece is encouraged to obtain the information needed to estimate any relevant GHG emissions.

ANNEX 1: MATERIALS USED DURING THE REVIEW

A. Support materials used during the review

2003 and 2004 Inventory submissions of Greece. 2004 submission including a set of CRF tables for 1990–2002 and an NIR.

UNFCCC secretariat (2004). "Report of the individual review of the greenhouse gas inventory of Greece submitted in the year 2001 (2001 Centralized review)". FCCC/WEB/IRI(3)/2001/GRC (available on the secretariat web site http://unfccc.int/national_reports/annex_i_ghg_inventories/inventory_review_reports/items/630.php).

UNFCCC secretariat. "2004 Status report for Greece" (available on the secretariat web site http://unfccc.int/files/national_reports/annex_i_ghg_inventories/inventory_review_reports/application/pdf/gre04.pdf).

UNFCCC secretariat. "Synthesis and assessment report of the greenhouse gas inventories submitted in 2004. Part I": *F*CCC/WEB/SAI/2004 (available on the secretariat web site http://unfccc.int/resource/webdocs/sai/2004.pdf) and Part II – the section on Greece) (unpublished).

UNFCCC secretariat. Review findings for Greece (unpublished).

Greece's comments on the draft "Synthesis and assessment report of the greenhouse gas inventories submitted in 2004" (unpublished).

UNFCCC secretariat. "Handbook for review of national GHG inventories." 2004 (unpublished).

UNFCCC secretariat. "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories", "Part II: UNFCCC reporting guidelines on national communications" and "Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention." FCCC/CP/1999/7 (available on the secretariat web site http://unfccc.int/resource/docs/cop5/07.pdf).

UNFCCC secretariat. "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories" and "Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention." FCCC/CP/2002/8 (available on the secretariat web site http://unfccc.int/resource/docs/cop8/08.pdf).

UNFCCC secretariat. Database search tool – *Locator* (unpublished).

IPCC. *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, 2000* (available on the following web site: http://www.ipcc-nggip.iges.or.jp/public/gp/gpgaum.htm).

IPCC/OECD/IEA. *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, volumes 1–3, 1997* (available on the following web site: http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm).

B. Additional materials

Responses to questions during the review were received from Mr. Dimitrios Lalas (NOA) including additional material on the methodology and assumptions used.

Council Directive of 21 May 1991 concerning urban waste-water treatment (91/271/EEC).

Fott, P. (1999). "Carbon EFs of coal and lignite: analysis of Czech coal data and comparison to European values", *Environmental Science and Policy*, 2(3), 347–354.

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