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Report of the individual review of the greenhouse gas inventory of Greece submitted in 2005*

* In the symbol for this document, 2005 refers to the year in which the inventory was submitted, and not to the year of publication.

CONTENTS

I. Overview

A. Introduction

1. This report covers the centralized review of the 2005 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. The review took place from 17 to 22 October 2005 in Bonn, Germany, and was conducted by the following team of nominated experts from the roster of experts: Generalists – Mr. Art Jaques (Canada) and Ms. Inga Konstantinaviciute (Lithuania); Energy – Mr. Matej Gasperic (Slovenia), Ms. Sophia Mylona (Norway) and Ms. Roberta Quadrelli (International Energy Agency (IEA)); Industrial Processes – Ms. Marisol Bacong (Philippines), Mr. Domenico Gaudioso (Italy) and Ms. Birna Hallsdottir (Iceland); Agriculture – Mr. Steen Gyldenkaerne (Denmark) and Mr. Vlad Trusca (Romania); Land Use, Land-use Change and Forestry (LULUCF) – Mr. Aquiles Neuenschwander Alvarado (Chile) and Mr. Nijavalli H. Ravindranath (India); Waste – Mr. Eduardo Calvo (Peru) and Ms. Sirintornthep Towprayoon (Thailand). Ms. Sirintornthep Towprayoon and Mr. Art Jaques were the lead reviewers. The review was coordinated by Mr. Matthew Dudley (UNFCCC secretariat).

2. In accordance with the "Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention", 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.

B. Inventory submission and other sources of information

3. In its 2005 submission, Greece submitted a complete set of common reporting format (CRF) tables for the years 1990–2003 and a national inventory report (NIR). Where needed the expert review team (ERT) also used previous years' submissions, additional information provided during the review and other information. The full list of materials used during the review is provided in the annex to this report.

4. In 2003, the most important GHG in Greece was carbon dioxide (CO_2), contributing 79.9 per cent to total[1] national GHG emissions expressed in CO_2 equivalent, followed by nitrous oxide (N_2O), 9.6 per cent, and methane (CH_4), 7.4 per cent. Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) taken together contributed 3.1 per cent of the overall GHG emissions in the country. The Energy sector accounted for 78.3 per cent of the total GHG emissions, followed by Industrial Processes (9.1 per cent), Agriculture (8.7 per cent), Waste (3.8 per cent) and Solvent and Other Product Use (0.1 per cent). Total GHG emissions amounted to 137,643 Gg CO_2 equivalent and had increased by 25.8 per cent from 1990 to 2003. Over the period 1990–2003, CO_2 emissions increased by 31 per cent, and CH_4 emissions increased by about 1.1 per cent, while emissions of N_2O declined by 6.5 per cent. The LULUCF sector represents a small net sink.

[1] In this report, the term total emissions refers to the aggregated national GHG emissions expressed in terms of CO_2 equivalent excluding LULUCF, unless otherwise specified.

C. Key categories

5. Greece has reported a key category tier 1 analysis, both level and trend assessment, as part of its 2005 submission. The key category analyses performed by the Party and the secretariat[2] produced similar results. There are some minor differences due to the fact that Greece has taken 1995 as the base year for fluorinated gases (F-gases), rather than 1990, as required under the Convention. As a result of suggestions provided by the ERT during the 2004 in-country review, several new categories have been added as key categories. The NIR indicates that as of 2004 a quality assurance/quality control (QA/QC) plan has been adopted and is currently being implemented. The ERT noted, as did the 2004 ERT, that, because the key category analysis uses a base year other than 1990, PFC emissions from aluminium production are excluded, yet they show a significant decline over the period 1990–2003. The ERT recommends that Greece use the 1990 estimates in its trend analysis and reiterates that PFC emissions from aluminium production should be considered a key category.

D. Main findings

6. Greece's inventory submission generally adheres to the UNFCCC "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories" (hereinafter referred to as the revised UNFCCC reporting guidelines). A full set of CRF tables (with the exception of table 11) for the years 1990–2003 is provided. It was clear to the ERT that Greece is focusing on improvements to the reporting of key categories as time and resources permit. The NIR is well laid out and follows the structure of the revised UNFCCC reporting guidelines, with few exceptions. The ERT noted that the NIR could be improved by the inclusion of additional explanations on data and choices of methodologies, and that the inventory would benefit from the use of higher-tier (tier 2) methods for some key categories. However, it recognizes that the Greek inventory team is aware of these deficiencies and is currently examining how best to address them. The NIR and the CRF tables are for the most part consistent. The ERT also noted that the Greek inventory, while showing improvement, still suffers from a lack of recent data (see table 1.8 in the NIR, which indicates that almost all the estimates for the year 2003 are provisional or only partial).

E. Cross-cutting topics

1. Completeness

7. Overall, the Greek inventory is complete. It covers all years, for all of Greece, for the six mandatory greenhouse gases, and includes an NIR and a complete set of CRF tables (with the exception of table 11), and estimates of emissions for all major sources. In addition, the inventory contains estimates for the whole time series 1990–2003 of the indirect greenhouse gases (nitrogen oxide (NOx), carbon monoxide (CO), non-methane volatile organic compounds (NMVOCs) and sulphur dioxide (SO_2)). The NIR identifies known sources that are missing and provides detailed explanations for this in most cases. Missing sources include Electrical Equipment – SF_6, CO_2 and N_2O emissions from Fugitive Emissions from Fuels, Soda Ash Production, Asphalt Roofing and Road Paving, which are not included either because of inconsistencies in data sources or because of lack of data. A number of other minor sources, such as Foam

[2] The secretariat identified, for each individual Party, those source categories which are key categories in terms of their absolute level of emissions, applying the tier 1 level assessment as described in the Intergovernmental Panel on Climate Change *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*. Key categories according to the tier 1 trend assessment were also identified for those Parties providing a full CRF for the year 1990. Where the Party has performed a key category analysis, the key categories presented in this report follow the Party's analysis. However, they are presented at the level of aggregation corresponding to a tier 1 key category assessment conducted by the secretariat.

Blowing – F-gases, Solvents – N_2O, Agricultural Soils – CH_4, Wastewater Handling: Industrial – N_2O and Sludge – CH_4, are also not reported due to lack of activity data (AD) or estimation methodologies.

2. Transparency

8. In general the inventory is transparent. In line with the revised UNFCCC reporting guidelines, the NIR contains a general description of institutional arrangements, QA/QC procedures, uncertainty assessments, estimation methods, key category analysis, references to key category estimation methods, a summary of trends in emissions by gas, recalculations, explanations of the minor differences between the reference and the sectoral approaches, and a description of checks for completeness.

9. During the 2004 in-country review, the ERT noted that one area of particular importance that requires improvement is that of documentation. The ERT commends the Greek inventory team for the efforts made over the past year to implement some of the recommendations suggested by the 2004 review, and in particular to provide documentation related to the parameters used in various models. Nevertheless, 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 2005 centralized review, the ERT was hampered to some degree by the lack of clarity in some areas of the NIR. The ERT reiterates the previous recommendation that Greece should fully implement a formal QA/QC plan and central archiving system, and encourages the Party to improve the transparency of the NIR by providing more comprehensive information on the methodologies, AD and EFs used in the calculating the emissions estimates, and additional details on uncertainty calculations, time series, QA/QC and verification using the required reporting structure. The ERT noted that Greece indicates that it has developed a formal QA/QC system which is being implemented and that it informed the ERT of its plans to do so in 2004–05. The ERT commends Greece for implementing this system.

3. Recalculations and time-series consistency

10. The ERT noted that recalculations reported by the Party for the period 1990–2002 for all sectors had been undertaken to take into account changes in methodologies, or reallocations, or the inclusion of new sources. The major changes include updated AD for most sources along with updated EFs in the categories Manufacturing Industries and Construction, Mineral Products, and Domestic and Commercial Wastewater. The reasons for these recalculations are provided in the NIR and in general appear to the ERT to be justified. However, the ERT noted that additional explanatory material would be helpful, in particular in the Energy sector where there are significant changes. The recalculations resulted in an increase in the estimates of total CO_2 equivalent emissions in 1990, by 2.24 per cent, and a decrease of 1.06 per cent in the figures for 2002.

4. Uncertainties

11. Greece has used a tier 1 method as outlined in the Intergovernmental Panel on Climate Change (IPCC) *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance) to assess the uncertainty in the emissions inventory. No qualitative assessment of uncertainty is provided in CRF table 7. Uncertainties have been calculated using the default uncertainty values suggested in the IPCC good practice guidance, which were chosen on the basis of informed expert knowledge within Greece. Greece has not used the uncertainty analysis to perform a tier 2 key category analysis, or to systematically prioritize further improvements to the inventory. Overall, the uncertainty estimates for GHG emissions for 2003 for all gases and the overall trend uncertainty are typical of inventory uncertainties. In some cases it is not clear how and why some uncertainty values have been chosen, and the ERT therefore recommends that the Party provide additional information in its future NIRs.

5. Verification and quality assurance/quality control approaches

12. Greece began implementing a formal QA/QC plan in 2004. The elements of the plan, which is based on the ISO 9001:2000 standard, are described in the NIR. The NIR notes that since the 2004 in-country review QA/QC activities have focused on improving the archiving of the information used to develop the inventory, on the specification and adoption of procedures for cooperation between the National Observatory of Athens (NOA), the national inventory agency, and the government agencies involved, and on the development of a long-term inventory improvement plan. The ERT commends Greece for these activities, but noted that the NIR would benefit from a more detailed description of the various QA/QC activities being undertaken.

6. Follow-up to previous reviews

13. As noted, Greece underwent an in-country review in 2004. At that time the ERT recommended that Greece should provide additional documentation in order to further improve the transparency of the methods used, data and assumptions within the NIR; provide more detailed analysis of emission trends by gas and source/sink category; implement a QA/QC plan and a more formal central archiving system; implement a formalized data collection system and strengthen the relevant institutional capacities; continue to develop higher-tier methods and collect national data, especially for key categories; and provide more detail about the methods and assumptions used in the NIR. Greece has acted on many of these recommendations, as is evidenced by the inclusion of additional explanatory material in the NIR. The ERT commends Greece for adopting the approach of the IPCC *Good Practice Guidance for Land Use, Land-use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF), carrying out a key category analysis and QA/QC, and enhancing the transparency of the NIR compared to previous years. The ERT did, however, note that there still is room for improvement, particularly with respect to transparency.

F. Areas for further improvement

1. Identified by the Party

14. The NIR identifies several areas for improvement. Many of the improvements are related to the collection of AD which are at present not available.

2. Identified by the ERT

15. The ERT identifies the following cross-cutting issues for improvement. Greece should:

(a) Provide more comprehensive information on the methodologies, AD and EFs used in calculating the emissions estimates to further improve the transparency of inventory; and

(b) Present more explanatory information related to source-specific uncertainties, QA/QC and verification in the NIR.

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

II. Energy

A. Sector overview

17. In 2003, the Energy sector in Greece accounted for 78.3 per cent of total national GHG emissions. Fuel combustion contributed 77.1 per cent to total national emissions and 92.6 per cent to total CO_2 emissions. Total Energy sector GHG emissions increased by 31.8 per cent from 1990 to 2003, and by

3.7 per cent from 2002 to 2003. The most important source categories in the sector are Energy Industries and Transport, contributing 54.2 and 20.3 per cent, respectively, to the Energy total. The tier 1 key category analysis revealed that there are 10 key categories in the Energy sector.

18. The NIR and the CRF tables provide estimates for all gases in the required time period and are generally complete. The methodologies used are CORINAIR for Stationary Combustion, the COPERT III model for Road Transportation, and a tier 1 method for Fugitive Emissions. The overall transparency of the inventory is satisfactory, with a few notable exceptions mainly concerning the way non-energy fuel use is allocated between the Energy and Industrial Processes sectors. Although the notation keys are used extensively in the CRF tables, there are still several empty cells (e.g. in table 1.A(b)). Furthermore, some notation keys are used incorrectly or are not clearly explained, either in the appropriate documentation box (e.g. the notation keys in table 1.B.1) or in table 9 – Completeness. The ERT recommends that the Party address these issues in order to improve both the completeness and the transparency of its reporting. For the same purpose, Greece could also consider including in the NIR a complete national energy balance (i.e. a matrix of all products/sectors) for the base year (1990) and the most recent year instead of the information provided in Annex II where detailed information is presented for lignite, natural gas, heavy fuel oil, diesel and gasoline, while the rest of the fuels are grouped as other solid and liquid fuels.

19. Time-series inconsistencies were detected in some subsectors: biomass consumption in Manufacturing Industries and Construction (Food, Beverages and Tobacco), as well as in Other sectors (Agriculture, Forestry, Fisheries); and liquid and solid fuels consumption in the Residential sector. The ERT recommends that the Party explain these inconsistencies, and also comment further on the fact that consumption of biomass in the Residential sector is shown as constant throughout the time series. In addition, the Party should provide in the NIR detailed explanations of all inter-annual trends, especially with regard to the Iron and Steel, Non-ferrous Metals and Chemicals subsectors.

20. Recalculations have been performed for the years 1990–2002 for Stationary Combustion and Road Transportation. Although the Party states in the NIR that these are mostly due to revisions to the national energy balance, in the CRF tables recalculations are also attributed to the updating of EFs following methodological changes. To avoid confusion, the Party is recommended to provide, in both the NIR and the CRF tables, a consistent justification for the recalculations. In addition, the relatively large effect of the recalculations on the estimates of CO_2 emissions from stationary combustion for 1990 and 1991 needs to be explained more clearly.

B. Reference and sectoral approaches

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

21. Both reference approach and sectoral approach calculations for CO_2 emissions from fuel combustion are given for all years. For 2003, the Party attributes the difference between the two approaches – of about 2.4 per cent – mainly to statistical differences for Liquid Fuels. However, the ERT suggests that an additional reason for the difference could be discrepancies resulting from the way in which non-energy fuel use is treated in the inventory. It is therefore recommended that the Party investigate this and report on it in its next submission.

2. International bunker fuels

22. International bunker fuel emissions are estimated as follows: for International Aviation, the IPCC tier 2a methodology and default EFs are used, while for International Navigation, the CORINAIR methodology and EFs are used. According to the NIR, the allocation of fuel consumption between domestic and international transport is based on data contained in the national energy balance, as declared by the oil companies, while the allocation of aircraft landings and take-offs (LTOs) between domestic and international aviation is based on data from the Civil Aviation Service. Some inconsistencies between the

time series of LTOs and energy consumption are acknowledged in the NIR and, more generally, Greece plans to further investigate the issue of fuel allocation between domestic and international transportation. The ERT welcomes this intention.

3. Feedstocks and non-energy use of fuels

23. Inconsistencies between the AD and the emissions reported were detected in the Manufacturing Industries and Construction sector, in particular for liquid and gas fuels in the Chemicals subsector, where the implied emission factors (IEFs) reported are much lower than the default values. The ERT recommends that the Party examine thoroughly the allocation of the non-energy use of fuels throughout the sector and provide more transparent documentation on this matter.

4. Country-specific issues

24. In CRF table 1.B.2, geothermal energy production is reported as a potential source of fugitive emissions, but emissions are reported as "not estimated" ("NE") and this issue is not addressed at all in the NIR. It is recommended that the Party discuss this issue in the NIR of its future submissions.

C. Key categories

1. Stationary combustion: Solid fuels – CO_2 and N_2O

25. The issue of the carbon content of lignite was described at length in the 2004 review report, as it appears to be particularly high when compared to the default values. The ERT encourages Greece to submit more complete documentation on the sources for the EF for lignite and, as recommended in the 2004 review report, make efforts to update this key parameter.

26. According to the NIR, there was an increase of 33 per cent in residential fuel consumption between 1995 and 1996. In addition, a rather significant inter-annual increase (11 per cent) in fuel consumption in Energy Industries was detected between 1999 and 2000. It is recommended that the Party provide additional information in the NIR on the reasons for such variations.

2. Stationary combustion: Gaseous fuels, liquid fuels – CO_2 and N_2O

27. The Party acknowledges that natural gas consumption in the Residential sector for 1998 is reported as "not occurring ("NO") and will investigate this issue further.

28. The ERT detected that the Party includes non-energy use of gaseous and liquid fuels in the AD of the sectoral approach (e.g. in the Chemicals subsector). As previously suggested, the ERT recommends that Greece undertake additional analysis in order to explain the allocation of non-energy fuel use in its inventory. The Party is further encouraged to include in the Energy sector only AD for fuels which are combusted.

3. Mobile combustion: Road transportation – CO_2 and N_2O

29. In response to the recommendations of the 2004 in-country review report, Greece has provided in the NIR detailed information on the vehicle fleet, EFs, and other parameters used as input to the COPERT III model. The Party reports the use of natural gas in road transportation since 2002; however, this is not reflected in the information about the vehicle fleet provided by the Party for this sector in the 2005 NIR (e.g. in tables 3.17–3.18). This issue needs to be addressed properly in the NIR. The Party is also encouraged to calculate CH_4 and N_2O emissions from consumption of natural gas in the Transport sector.

4. Fugitive emissions: Solid fuel – CH_4

30. The Party acknowledges in the NIR that for fugitive emissions from surface mining activities it is not possible to estimate a country-specific EF for CH_4 owing to a lack of measurement data. However, since this is a key category, the ERT recommends that efforts be made to develop a country-specific EF and that Greece provide an appropriate discussion on this in the NIR.

D. Non-key categories

1. Other sectors – all gases

31. According to the NIR, forestry and fisheries are not accounted for under Other Sectors. The ERT recommends that the Party make efforts to obtain the necessary AD in order to report these subsectors appropriately in its future submissions.

2. Fugitive emissions: Oil and gas operations – CH_4, CO_2 and N_2O

32. Fugitive emissions from several oil and gas operations are reported as "NE" or "included elsewhere" ("IE"). The notation keys are not explained in the relevant documentation box. Moreover, in table 9 – Completeness, Greece tends to explain the notation key "IE" as if it meant "NE". To improve the completeness and transparency of its inventory, the ERT recommends that the Party calculate these emissions and explain the use of the notation key "IE" clearly at the appropriate points.

III. Industrial Processes and Solvent and Other Product Use

A. Sector overview

33. In 2003, the Industrial Processes sector contributed 9.1 per cent of Greece's total national GHG emissions. Emissions from the Industrial Processes sector increased by 45 per cent between 1990 and 2003. The ERT notes that the overall increase in emissions for the Industrial Processes sector is underestimated because 1995 rather than 1990 has been used to calculate the change. The ERT reiterates that Greece uses the 1990 estimates in its trend analysis. Four gases are reported as contributing to the emissions from the sector, CO_2 being the major contributor. The respective contributions of the four gases are: CO_2, 63.3 per cent; HFCs, 32.9 per cent; N_2O, 3.2 per cent; and PFCs, 0.61 per cent. CO_2 has consistently been the major GHG in the Industrial Processes sector. However, its contribution has decreased over the years, from 78 per cent in 1990 to 63 per cent in 2003. This can be attributed to the significant increase in HFC emissions in 1995. The contribution of N_2O emissions to the Industrial Processes sector emissions increased from 10.8 per cent in 1990 to 32.9 per cent in 2002 and 2003, and the contribution of HFCs increased by 20 per cent from 1990 to 2003. N_2O and PFC emissions show a declining trend, with reductions in 2003 compared to the 1990 levels of 44 per cent and 70 per cent, respectively.

34. Greece has included 10 categories of emissions for the Industrial Processes sector. CO_2 from limestone and dolomite use is included for the first time in the 2005 inventory submission for the years 1990–2003. For most sources in the Industrial Processes sector, the methods and data used are transparent, with the exception of sources for which AD are confidential: these are hydrochlorofluorocarbon (HCFC)-22 and aluminium production, for which emissions are reported directly to the national inventory agency.

35. Recalculations of emissions have been performed for Cement Production, Lime Production, Limestone and Dolomite Use, Nitric Acid Production, Iron and Steel Production, Production of Halocarbons and SF_6, and Consumption of Halocarbons and SF_6. The Industrial Processes emissions show substantial fluctuations over the period 1990–2003. These are mostly due to fluctuations in emissions from

the category Mineral Production. The lowest value for Mineral Production, 8,532 Gg CO_2 equivalent, occurs in 1992, while the highest, 13,637 Gg CO_2 equivalent, is reported for 1999.

36. Uncertainty estimates are reported for Cement Production (2.8 per cent), Lime Production (29.2 per cent), Nitric Acid Production (100.1 per cent), Iron and Steel Production (7.1 per cent), Aluminium Production – PFCs (1.4 per cent), HCFC-22 Production (70.7 per cent) and ozone depleting substances (ODS) substitutes (200.1 per cent). The uncertainty analysis is based on the tier 1 methodology of the IPCC good practice guidance.

37. QA/QC activities are not reported in each source category in the Industrial Processes sector. However, planned activities are reported for Lime Production, Limestone and Dolomite Use, Glass Production, Ammonia Production, Nitric Acid Production, Production and Consumption of Halocarbons and SF_6, and Solvents and Other Product Use. In general, the plans involve validation/verification of the consistency and accuracy of official production data as compared to plant-specific data, and filling in the gaps in the AD time series.

B. Key categories

1. Cement production

38. Cement Production – CO_2 is identified as a key category on both level and trend assessment both by Greece and by the UNFCCC secretariat. Greece calculates CO_2 emissions from cement production according to the tier 2 method on the basis of clinker production. The methodology takes into account both the calcium oxide (CaO) content and magnesium oxide (MgO) content of the clinker. Activity data are collected from all plants on an individual basis. The methodology and AD are clearly explained and well documented in the NIR. Since its last submission Greece has carried out recalculations which further improve the emissions estimates for Cement Production, and it is commended for these improvements.

2. Limestone and dolomite use – CO_2

39. Limestone and Dolomite Use – CO_2 is identified as a key category according to the trend assessment performed by Greece. Emissions are estimated using the IPCC default method and the default EF. The estimates include limestone use in metal production and ceramics production. Dolomite use is not accounted for, and this is not explained in the NIR. Activity data are not available for the whole time series, but the rationale for the way in which data groups are filled in is consistent with the IPCC good practice guidance. The significant increase in emissions between 1999 and 2000 is explained in the NIR as being due to the coming into operation of a new unit.

3. Aluminium production – PFCs

40. Aluminium Production – PFCs is identified as a key category according to the trend assessment performed by the UNFCCC secretariat. PFC emissions are estimated using the tier 3b Pechiney overvoltage method. The AD used to obtain the EF for PFCs per tonne aluminium produced are obtained from the aluminium industry and are based on measurements. Production data are reported as confidential. Greece is encouraged to verify the emissions estimates. The fluctuation in the time series is clearly explained in the NIR.

4. Nitric acid production – N_2O

41. Nitric Acid Production – N_2O is a key category according to the trend assessment performed by Greece. Emissions are estimated using plant-specific production data and default EFs provided by the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines) for units operating under atmospheric pressure (4.5 kg N_2O/t nitric acid). Due to lack of AD, the Party reports the same N_2O emissions for 2003 as for 2002. No reference is made in

the NIR to the availability of NOx abatement technologies and their effect on N_2O emissions. For its next submission, the Party should check whether emissions and destruction data are available at the plant level. Emissions estimated using AD need to be calculated using AD from the same year.

5. ODS substitutes – HFCs and PFCs

42. Emissions of HFCs and PFCs from ODS substitutes are a key category. Only emissions from refrigeration and air conditioning equipment are reported. For stationary equipment, it is assumed that the use of F-gases as refrigerants started in 1993 (in 100 per cent of new equipment, both domestic production and imports); for mobile air conditioning, it is assumed that F-gases have been used since 1995. Only HFC-32, HFC-125 and HFC-134a are considered. Emissions are estimated according to the tier 2a methodology described in the IPCC good practice guidance. However, the NIR states that Greece is unable to estimate potential emissions (tier 1 methodology) for consumption of halocarbons and SF_6. Potential emissions are reported as not estimated "NE". For all other sources, emissions are reported as "NE".

6. By-product emissions: Production of HCFC-22

43. HFC-23 emissions from this source account for 25.4 per cent of the total GHG emissions from the Industrial Processes sector and 2.4 per cent of total national emissions. It is reported as the second largest key category in the Industrial Processes sector according to the level assessment. There was significant growth in HFC-23 emissions in 1994, and they reached their maximum in 1999 (at 540 per cent of 1990 levels). In 2003, the emissions reported are 341 per cent of the 1990 level. The Party reports similar HFC-23 emissions in 2002 to 2003. For confidentiality reasons, Greece reports only total emissions of HFC-23 and no AD are available in the NIR or the CRF. In the 2005 NIR Greece indicates that the emissions reported are based on production statistics and a reference EF rather than on the collection and elaboration of on-site measurement data, as recommended by the IPCC good practice guidance.

C. Non-key categories

Iron and steel production

44. The Party reports in the 2005 NIR that CO_2 emissions from iron and steel production are calculated using the tier 2 method, which requires information on amounts of scrap input, reducing agent, and the electrode consumption. These AD, however, are not provided in the 2005 NIR or the CRF, and it is not clear how the emissions have been calculated. Greece is encouraged to provide more detailed information on the AD used for the estimation and to allocate consumption of solid fuels to the specific activities in order to allow a check of the estimates reported under Industrial Processes and to ensure there is no double counting.

IV. Agriculture

A. Sector overview

45. In 2003, emissions from the Agriculture sector in Greece amounted to 11,998 Gg CO_2 equivalent, or 8.7 per cent of the total national GHG emissions. From 1990 to 2003, emissions decreased by 11 per cent, mainly as a result of a decline in N_2O emissions from agricultural soils, which was in turn caused by a reduction in the amount of synthetic fertilizers applied to soils. The submission is complete in terms of gases, sources and years covered; some additional CRF information tables are not filled in or are only partially filled in (additional information linked with tables 4.A, 4.B(a) and 4.D); and the notation key "NO" is presented in table 4.E Prescribed Burning of Savannas as this category does not occur in Greece.

46. The information presented in the CRF tables and the NIR is consistent, and the CRF tables are internally consistent as regards methodologies, EFs and sources of AD over the entire time series. The

livestock data presented in the Agriculture sector show some minor differences when compared with the data of the Food and Agriculture Organization of the United Nations (FAO) database and EUROSTAT data. The livestock data used for the period 2001–2003 are mentioned in the NIR as being provisional but no further explanation is provided. The ERT identified an inconsistency in the AD in that three-year averages are used for all livestock population characterizations, except for sheep, where one-year data have been used. The Party is recommended to use a consistent livestock characterization and to correct the CRF documentation box where a three-year average appears for all animals.

47. The methodologies used are in general consistent with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance, but more detailed information is needed to explain some of the methodological approaches (e.g. the methodology used for estimating crop residues in agricultural soils). Activity data have been taken mainly from the National Statistical Service and partly from international statistical databases (e.g. FAO for synthetic fertilizers). To improve transparency, the ERT recommends that Greece provide further documentation on the source of the data provided to the FAO.

48. The Party has performed a key category analysis which is entirely consistent with the one performed by the secretariat. A general description of the QA/QC activities is provided in the introduction chapter of the NIR, but no detailed QA/QC information is provided in the sector overview or at the individual source level. A list of references is included at the end of the NIR. No information on sectoral archiving and documentation procedures is provided in the NIR.

49. Greece has made a good many improvements in the Agriculture sector following the 2004 in-country review, correcting almost all the problems identified, and has provided a more comprehensive NIR. Almost the entire sector has been recalculated on the basis of the comments of the 2004 in-country review report. Recalculations have been done mainly for Enteric Fermentation – CH_4, Manure Management – CH_4 and N_2O, Agricultural Soils – N_2O, and Field Burning of Agricultural Residues - CH_4 and N_2O. The Party plans to improve its next submission by updating AD and recalculating emissions in the categories Enteric Fermentation and Manure Management, and by developing country-specific values to improve the estimates of emissions from the field burning of agricultural residues. There are no planned improvements for the key categories related to agricultural soils.

B. Key categories

1. Enteric fermentation – CH_4

50. The Party has estimated CH_4 emissions from enteric fermentation using the IPCC tier 2 method for sheep and IPCC tier 1 for all other animal species. Taking into account that cattle account for about 28 per cent of total CH_4 emissions from enteric fermentation, the Party is recommended to use IPCC tier 2 methods for cattle, and document this in the NIR.

51. Country-specific EFs have been derived for sheep, and the IPCC default values for Eastern Europe (due to the milk yield of 2,500–3,300 litres per cow per year) or for developed countries have been applied to the other animal species. The dairy cattle milk yield is not presented in the additional information (for tier 2) for the period 2001–2003, and the assumptions made in choosing the Eastern Europe EF is not sufficiently documented based on the different statistical information on milk yield in the NIR compared with data in the publication “General Secretariat of National Statistics Service of Greece” (National Statistical Service of Greece, 2005). The Party is recommended to include milk production data for all years (inclusive of milk used on farms) in the NIR for all milk production animal species to improve transparency.

52. Some minor gaps were identified in the CRF tables. Greece should use the notation key “NE” instead of “not applicable” (“NA”) for average daily energy intake and methane conversion factor for most

animal species. Greece is encouraged to provide additional information in the NIR in order to give a more complete description of the methodological approach.

2. Agricultural soils – direct N_2O emissions

53. The Party reports the use of tier 1a and 1b methodologies and IPCC default EFs to estimate N_2O emissions from agricultural soils, as recommended by the IPCC good practice guidance. Activity data on the amount of synthetic fertilizers applied to soils have been derived from the FAO database, as recommended in the 2004 review report, due to the inconsistency of the data provided by the industry in Greece's previous submissions. The Party has performed recalculations for this source category, with the result that the trend in N_2O emissions shows a decline (as expected): these N_2O emissions are now estimated to have decreased by 43 per cent between 1990 and 2003. The AD on dry matter, carbon (C) and nitrogen (N) fractions and the EFs used are the ones suggested by the IPCC good practice guidance. No planned improvements are mentioned in the NIR for this key category.

54. The amount of crop residues reported as returned to soil appears to the ERT to be the total amount of crop residues in table 4.F, regardless of the fact that 10 per cent is assumed to be burned (default value). Where data are available, the Party is encouraged to calculate the crop residues for all crops cultivated in Greece, providing additional data in the NIR to explain the calculation of crop residues, and to present detailed crop statistics in the NIR. The additional information table with partitioning fractions is not completely filled in.

55. In response to the 2004 review report, Greece has provided emissions estimates for the cultivation of histosols for the entire time series. The estimates are based on the assumption that the cultivated area is constant and use the default EF from the Revised 1996 IPCC Guidelines.

3. Agricultural soils – indirect N_2O emissions

56. Greece reports the use of the tier 1a methodology suggested by the IPCC good practice guidance together with default EFs. Indirect emissions have also been recalculated for the entire time series subsequent to the 2004 review, but sufficient information is not presented in the NIR to explain the recalculations. The ERT recommends that Greece provide additional information on the recalculations and any planned improvements.

57. Greece uses the IPCC default value of 0.3 for leaching, which may not be appropriate for Mediterranean countries. The Party is encouraged to develop country-specific data for N leaching and run-off in calculating indirect emissions from agricultural soils.

C. Non-key categories

Manure management – CH_4 and N_2O

58. The Party has applied an IPCC tier 1 methodology along with default EFs, which is in line with the IPCC good practice guidance. The table with additional information on animal waste management systems (AWMS) is not filled in. Notation keys are not provided for the AD in CRF table 4.B(a). In the documentation box a three-year average appears for all animals except sheep.

59. The Party has performed recalculations for the period 1997–2002 following the recommendations of the 2004 review, based on the available information on livestock populations. The result shows minor differences when compared with the values shown in the 2004 submission. The ERT recommends Greece to provide more information in the NIR about the EFs used.

60. Data on AWMS are partly taken from the Revised 1996 IPCC Guidelines and partly country-specific. The 90 per cent of the swine population assumed to be in liquid system AWMS is very

high for a Mediterranean country and not consistent with the Revised 1996 IPCC Guidelines' reference manual value of 32 per cent. The poultry population is divided between pasture range and paddock AWMS and other systems. The ERT recommends that additional explanatory information be provided in the NIR on the other systems for manure management.

61. The Party is planning to examine the available information regarding manure management systems for each animal species and to use it to provide a more appropriate basis for the estimation of emissions. Greece should provide more information in the NIR regarding the AWMS used in the country for each animal species, as requested by the 2004 in-country review.

V. Land Use, Land-use Change and Forestry

A. Sector overview

62. Greece has adopted the IPCC good practice guidance for LULUCF according to decision 13/CP.9 and has reported emissions and removals using the relevant CRF tables. Greece has recalculated the inventory for all the years from 1990 to 2002 using the approach of the IPCC good practice guidance for LULUCF.

63. In 2003, Greece reports the LULUCF sector as a net sink, of 5,528.53 Gg CO_2 equivalent, compared to total national emissions (without LULUCF) of 137,643.40 Gg CO_2 equivalent. The size of the sink has increased from 3,193.27 Gg CO_2 equivalent in 1990 to 5,528.53 Gg CO_2 equivalent in 2003. The size of the sink has fluctuated from year to year, but it is stable, at around 5,298 to 5,528 Gg CO_2 per year, during the years 2001–2003. Interestingly, the adoption of the approach of the IPCC good practice guidance for LULUCF has converted the LULUCF sector of Greece into a sink for all the years 1990-2003; according to the Party's 2004 estimates, made using the Revised 1996 IPCC Guidelines, the sector was a source for eight years out of 13. There is a sharp increase in the size of the sink in the years 2001–2003, compared to 2000 or 1990. There are discrepancies between the NIR tables and the CRF tables, for example, table 7.1 of the NIR and CRF tables 5 and 5(V) for N_2O. N_2O emissions are not reported for 2003 and earlier years. The change from being a source from many years to being a net sink for all years is partially explained in table 7.5 of NIR, but only in general terms. Given the importance of the impact of the switch to using the approach of the IPCC good practice guidance for LULUCF, a detailed explanation of the specific categories or calculation procedures which have contributed to making the LULUCF sector a sink for all years would be very useful. However, the implications for the overall trend are not large since the size of the sink is about 5,528 Gg CO_2 equivalent in 2003 compared to total national GHG emissions of 137,643.40 Gg CO_2 equivalent.

64. Estimates for all relevant gases for all land-use categories are reported using the new LULUCF CRF tables. The NIR reports the completeness status of LULUCF emissions (table 1.8) as "partially covered". A key category analysis has been carried out and is presented in NIR, but is not reported in CRF table 7. The estimates are nearly complete for Forest Land. However, soil organic carbon of forest land is reported in Cropland Remaining Cropland. Although a large area – of 1.77 million hectares – is reported under Grassland, no emissions or removals of CO_2 are reported. N_2O emissions from fertilizer application are neither reported as "NO" in LULUCF nor as "IE" in Agriculture. The approach of the IPCC good practice guidance for LULUCF and the equations used are adequately described in the NIR. CH_4 and N_2O emissions are reported as being estimated in table 7.4 of NIR but are not reported in CRF tables 5 and 5(V) for Grassland. QA/QC procedures have been adopted and are described in the NIR for this sector.

65. The methods used are adequately explained in the NIR. Wherever data are not available, this is stated and emissions are not reported. The wide variability in GHG emissions, especially emissions due to wildfires, is not adequately explained. The size of the sink for Forest Land has increased suddenly since

2001 and the reason for this is not adequately explained, apart from a comment to the effect that it is due to variation in area subject to wildfire.

66. Uncertainties are estimated to be high for the LULUCF sector, ranging from 67.3 to 112.8 per cent for different land-use categories (table 1.7). Since the uncertainties are so high, efforts to reduce them could be considered.

67. Greece is to be complimented not only for adopting the complex approach of the IPCC good practice guidance for LULUCF correctly, but also for the improved transparency of its reporting in this sector and for the levels of completion, the adoption of QA/QC procedures, and the estimation of uncertainty, as compared to previous years. These issues were identified in earlier reviews, particularly the in-country reviews, but have to a great extent been addressed in the 2005 inventory.

B. Sink and source categories

1. Representation of land areas

68. A table giving the areas under different land-use categories could be given in the NIR along with a land-use change matrix in order to enhance both the NIR and the transparency of the estimates in the CRF.

2. Forest land

69. N_2O emissions are estimated in NIR table 7.1 and CRF table 10 for Forest and Cropland, but are not reported in CRF tables 5 and 5(V). It would be useful to give the methodological reason for not reporting soil organic C changes in Forest Land, as well as the reason why dead organic matter changes from being a source to a sink. The inconsistency in methodology regarding "complete destruction of forest biomass in fire" and "carbon stock changes in dead wood in areas affected by wildfires are significant" could also be explained (section 7.2.2.1).

3. Cropland

70. The size of the CO_2 sink in Cropland Remaining Cropland is not increasing but decreased during the period 2000–2003, even though the area under tree crops is increasing (figure 7.8). Even though the area under cropland (total as well as arable or annual) is declining in Greece, and the area under tree crop is increasing (figure 7.8), the CO_2 emissions from soils in the category Cropland are reported as constant (at 20.65 Gg). This inconsistency requires explanation.

4. Grassland

71. N_2O emissions are estimated in table 7.1 for Grassland in the NIR and in CRF table 10 but are not reported in CRF table 5. Furthermore, N_2O emissions are estimated in NIR table 7.11 but are not reported in CRF table 5(V). Reporting of changes in soil organic C in grassland should be included in the Grassland sector only.

5. Wetland, settlements and other land

72. Emissions and removals are not estimated or reported for these categories because they do not occur, or because the scale of the emissions/removals is marginal, or because of lack of data. Greece could explore the possibility of incorporating areas of settlement in its future inventories.

6. Suggestions for improvement for the future

73. Greece could attempt to provide a table showing area under different land-use categories as well as a land-use change matrix for its future inventories. Greece is encouraged to report dead organic matter and soil organic C from Land Converted to Forest Land in the Forest Land category rather than elsewhere (they

are reported as "IE"). Since forest fire seems to be a key factor determining the net GHG emissions or removals in the Forest sector, it is desirable for Greece to generate nationally relevant data rather than relying on the IPCC default values for biomass, density, biomass expansion factor (BEF), fraction of biomass transferred to dead organic matter, and so on. Greece should double-check the use of the notation keys "NO", "NE" and "IE" for all the tables in the CRF and the NIR and correct the inconsistencies. For example, in CRF table 5.A, net change in soil C for Land Converted to Forest Land is neither "0.00" nor "NE": it is in fact reported under Cropland Remaining Cropland and should be described as "IE" in table 5.A. The AD on conversion of land from one category to another also need to be improved in order to enhance the accuracy of the estimates in the LULUCF sector.

VI. Waste

A. Sector overview

74. In 2003, the Waste sector in Greece accounted for 3.8 per cent of total national GHG emissions. The overall trend is stable: in 2003, emissions amounted to about 97 per cent of base year (1990) emissions. The trend is related to economic activity: the effects of sustained growth in emissions between 1990 and 1998 have been offset by better management practices (methane flaring at disposal sites and aerobic waste-water treatment). The reporting of emissions from the sector is not complete due to lack of information on waste incineration and a lack of methodologies for N_2O from industrial waste water. More detailed information about the recalculations would improve the transparency of Greece's inventory. The ERT recommends that a description of the QA/QC procedures specific to the Waste sector be included in Greece's future NIRs. Uncertainty analysis is included for all the sectors considered except for N_2O from human sewage. Greece plans to improve the coverage of sectors and to enhance consistency with the IPCC good practice guidance for LULUCF. The ERT recommends that Greece include clinical waste incineration and waste used for cement production. Greece has improved the comparability of the inventory by using the IPCC good practice guidance updated maximum methane potential for Domestic and Commercial Wastewater Handling. The main sources of information for the sector are the Ministry for the Environment, Physical Planning and Public Works (MEPPPW) and the National Statistical Service of Greece.

75. The Waste sector has one key category by both level and trend analyses: Solid Waste Disposal on Land – CH_4; and two more by the trend analysis: Solid Waste Disposal on Land – CO_2 and Wastewater Handling – CH_4. The three together accounted for 92.8 per cent of total emissions from the sector in 2003.

B. Key categories

1. Solid waste disposal on land – CH_4

76. This key category has been recalculated for all years to take into account new data on methane recovered and flared. This has led to a reduction in the estimated emissions for the whole time series.

2. Solid waste disposal on land – CO_2

77. Table 8.4 in the NIR reports Solid Waste Disposal on Land – CO_2 as "not occurring", although it is a key category by the trend analysis.

3. Waste-water handling – CH_4

78. The estimates have been recalculated for both Domestic and Commercial Wastewater Handling and Industrial Wastewater Handling. In the first case, this has been done to apply the IPCC good practice guidance maximum methane producing potential (Bo) of 0.6 kg CH_4/kg (biochemical oxygen demand

(BOD)), thus enhancing the comparability of the inventory. Industrial emissions have been recalculated slightly for 2002 due to data becoming available for sources that were previously not included.

C. Non-key categories

1. Waste-water handling – N_2O

79. N_2O emissions from industrial waste water are not included in the NIR.

2. Waste incineration – CO_2

80. Information about Waste Incineration is not included in the NIR.

3. Waste incineration – N_2O

81. Information about Waste Incineration is not included in the NIR.

Annex

Documents and information used during the review

A. Reference documents

IPCC. Good practice guidance and uncertainty management in national greenhouse gas inventories, 2000. Available at <http://www.ipcc-nggip.iges.or.jp/public/gp/english/>.

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B. Additional information provided by the Party

National Observatory of Athens (NOA). Additional information provided by Ms. Katerina Papagiannaki (Agriculture and Waste) and Mr. Yannis Sarafidis (Energy and Industrial Processes).

National Statistical Service of Greece (NSSG). Greece in figures - 2005. Available at <http://www.statistics.gr/eng_tables/hellas_in_numbers_eng.pdf>.

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