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Report of the individual review of the greenhouse gas inventory of Portugal submitted in 2006*

* In the symbol for this document, 2006 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 in-country review of the 2006 greenhouse gas (GHG) inventory submission of Portugal, coordinated by the United Nations Framework Convention on Climate Change (UNFCCC) secretariat, in accordance with decision 19/CP.8. The review took place from 21 to 26 May 2007 in Lisbon, Portugal, and was conducted by the following team of nominated experts from the roster of experts: generalist – Mr. Paul Filliger (Switzerland); energy – Mr. Dario Gomez (Argentina); industrial processes – Mr. Mauro Meirelles de Oliveira Santos (Brazil); agriculture – Ms. Anna Romanovskaya (Russian Federation); land use, land-use change and forestry (LULUCF) – Mr. Leandro Buendia (Philippines); waste – Mr. Eduardo Calvo (Peru). Ms. Anna Romanovskaya and Mr. Dario Gomez were the lead reviewers. The review was coordinated by Mr. Harald Diaz (UNFCCC secretariat).

2. In accordance with the "UNFCCC guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention" (hereinafter referred to as the UNFCCC review guidelines), a draft version of this report was communicated to the Government of Portugal, 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 2006 submission, Portugal submitted a complete set of common reporting format (CRF) tables for the years 1990–2004 and a national inventory report (NIR). Where necessary the ERT also used the previous (2005) submission, 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.

C. Emission profiles and trends

4. In 2004, the most important GHG in Portugal was carbon dioxide (CO_2), contributing 78.3 per cent to total[1] national GHG emissions expressed in CO_2 eq., followed by methane (CH_4), 13.4 per cent, and nitrous oxide (N_2O), 7.5 per cent. Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6) taken together contributed 0.8 per cent of the overall GHG emissions in the country. The energy sector accounted for 72.8 per cent of the total GHG emissions followed by agriculture, 10.3 per cent, industrial processes, 8.8 per cent, and waste, 7.6 per cent. Total 2004 GHG emissions amounted to 83,922.06 Gg CO_2 eq. and increased by 42.0 per cent from the base year to 2004. The steepest increase in emissions was observed in the industrial processes sector (an increase of 60.8 per cent), followed by the energy sector (51.8 per cent) and the solvent and other product use sector (45.7 per cent). The increases in the waste sector (7.9 per cent) and the agriculture sector (7.1 per cent) were much smaller. The LULUCF sector was a net source in 1990 (2,592.59 Gg CO_2 eq.) but a net sink in 2004 (–3,536.08 Gg CO_2 eq.). The trends and the variability of the trends are explained in the NIR and are reasonable.

5. Tables 1 and 2 show the GHG emissions by gas and by sector, respectively.

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

Table 1. Greenhouse gas emissions by gas, 1990–2004

GHG emissions	Gg CO_2 eq.								Change
	Base year Convention[a]	1990	1995	2000	2001	2002	2003	2004[a]	BY–2004 (%)
CO_2 (with LULUCF)	45 843.35	45 843.35	50 189.24	58 717.05	60 228.09	63 873.64	71 111.21	62 038.73	35.3
CO_2 (without LULUCF)	43 444.44	43 444.44	53 191.59	63 818.60	65 084.79	69 291.05	64 623.83	65 721.09	51.3
CH_4	10 257.02	10 257.02	11 402.79	11 461.58	11 361.23	11 644.65	12 093.52	11 356.75	10.7
N_2O	5 601.01	5 601.01	5 847.46	6 296.99	6 305.78	6 423.12	5 912.93	6 293.57	12.4
HFCs	NA,NE,NO	NA,NE,NO	51.64	306.95	392.77	496.49	607.03	683.66	NA
PFCs	NE,NO	NE,NO	NO	NO	NO	NO	NO	NO	NA
SF_6	NE,NO	NE,NO	6.00	8.33	9.27	10.24	11.52	13.26	NA

LULUCF = Land use, land-use change and forestry; NA = Not applicable; NE = Not estimated; NO = Not occurring.

[a] Portugal submitted revised estimates for 1990, 1995 and 2004 in the course of the initial review on 9 July 2007. These estimates differ from Portugal's GHG inventory submitted in 2006.

Table 2. Greenhouse gas emissions by sector, 1990–2004

Sectors	Gg CO_2 eq.								Change
	Base year Convention[a]	1990	1995	2000	2001	2002	2003	2004[a]	BY–2004 (%)
Energy	40 261.95	40 261.95	48 993.58	59 653.91	60 896.49	64 877.97	60 425.06	61 131.83	51.8
Industrial processes	4 611.04	4 611.04	5 807.95	6 189.77	6 764.41	7 234.66	7 200.93	7 415.18	60.8
Solvent and other product use	219.71	219.71	256.27	290.02	303.81	311.62	317.93	320.15	45.7
Agriculture	8 088.34	8 088.34	8 173.55	8 796.71	8 653.13	8 726.25	8 135.33	8 660.16	7.1
LULUCF	2 592.59	2 592.59	–2 791.03	–4 931.19	–4 735.98	–5 254.46	7 124.17	–3 536.08	–236.4
Waste	5 927.76	5 927.76	7 056.82	6 791.68	6 415.28	6 552.09	6 532.8	6 394.74	7.9
Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (with LULUCF)	61 701.39	61 701.39	67 497.14	76 790.90	78 297.14	82 448.14	89 736.21	80 385.98	30.3
Total (without LULUCF)	59 108.80	59 108.80	70 288.17	81 722.09	83 033.12	87 702.59	82 612.04	83 922.06	42.0

LULUCF = Land use, land-use change and forestry; NA = Not applicable.

[a] Portugal submitted revised estimates for 1990, 1995 and 2004 in the course of the initial review on 9 July 2007. These estimates differ from Portugal's GHG inventory submitted in 2006.

D. Key categories

6. Portugal has reported a tier 1 and tier 2 key category analysis, including both level and trend assessment, for the entire time series. Key category analyses are provided both with and without the LULUCF sector. The results of the key category analyses are a driving factor for the preparation of the inventory, particularly in the prioritization of resources and the selection of methodologies. The key category analyses performed by the Party and the secretariat[2] produced similar results. The Party's tier 1 analysis differs from the secretariat's analysis, mainly due to differences in the level of disaggregation. About 18 small sources are included in the tier 2 analysis because their uncertainties are high. The ERT encourages the Party to try to obtain more precise data of sources with high uncertainties (key categories in NIR table A-4.1 and 4.2 with uncertainties of 1,000–10,000 per cent) and recommends the Party to disaggregate the LULUCF and agricultural sectors as recommended 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) and in the IPCC *Good practice guidance for land use, land-use change and forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF).

E. Main findings

7. Portugal has submitted a complete set of CRF tables for the years 1990–2004 and included an NIR. The inventory is in line with the "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 UNFCCC reporting guidelines), and the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines). Inventory preparation is conducted by a competent team in the Portuguese Environment Agency. The know-how of numerous external experts is available to the team. The NIR is transparent but includes some information which was not required under the Convention and could therefore be excluded from the NIR in order to reduce its size. Key category analyses and uncertainty analyses are available. The uncertainty analyses could be improved by using a tier 2 method. Recalculations are carried out and are well documented in the NIR with some exceptions (wastewater handling). The quality assurance/quality control (QA/QC) system is well developed and documented, but requires further implementation. The LULUCF sector has been reported in accordance with the 2003 IPCC good practice guidance for LULUCF for the first time. A major pending issue is the inclusion of the LULUCF estimates from the autonomous regions of Madeira and the Azores. Portugal included LULUCF data of the two autonomous regions after the in-country visit.

F. Cross-cutting topics

1. Completeness

8. Portugal's inventory submission is generally complete. The ERT noted that the emissions and removals from the LULUCF sector in the autonomous regions of Madeira and the Azores are not covered. The ERT recommended the Party to study the sensitivity of the LULUCF sector to influences from the inclusion of these autonomous regions. Portugal included LULUCF data of the two autonomous regions after the in-country visit. The ERT noted that a number of sources are reported as

[2] The secretariat identified, for each Party, those source categories that are key categories in terms of their absolute level of emissions, applying the tier 1 level assessment as described in the IPCC *Good Practice Guidance for Land Use, Land-use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF) for the base year or base year period as well as the latest inventory year. Key categories according to the tier 1 trend assessment were also identified. Where the Party 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.

not estimated ("NE") in table 9 for all years (mostly N_2O and PFCs). The ERT recommended the Party to provide estimates for all sources (for PFCs from 1995 onward) and noted that a complete inventory will be important for future reviews during the commitment period.

2. Transparency

9. The NIR follows the UNFCCC reporting guidelines and provides much of the information required to assess the inventory. In order to reduce the size of the NIR, the ERT recommends the Party to delete all information concerning air pollutants (PM10, heavy metals) that do not form part of the Convention, provide overview tables (e.g. for emission factors (EFs) in the energy sector) and refer to these tables, and include information on QC in all the sectoral chapters of the NIR.

3. Recalculations and time-series consistency

10. The ERT noted that Portugal reported recalculations of the time series from the base year to 2004. CO_2 emission recalculations are mostly related to the LULUCF sector (related to the use of a new methodology) but some changes also refer to the energy sector, in particular the energy industries and transport, and to international bunkers. The majority of CH_4 emission recalculations refer to the waste sector, and more specifically to wastewater handling, but some also occur in the agricultural sector or are linked to wildfires. N_2O emission revisions are mainly related to manure management and agricultural soils. The recalculations are well documented in the NIR and, with some exceptions (wastewater handling), the rationale is explained and good overview tables are included. The recalculation of industrial wastewater handling is not explained in a transparent way and further methodological improvement should be carried out on this source. Portugal revised these estimates after the in-country visit. Differences between the NIR and the CRF were detected by the ERT but it was possible to discuss and resolve these during the in-country visit. The total effect of these recalculations (excluding LULUCF) is a 2.5 per cent increase in estimated total national emissions for 2003 and a 1.0 per cent increase for 1990. The recalculations have resulted in real improvements to the inventory.

4. Uncertainties

11. Portugal has provided an uncertainty analysis following the IPCC good practice guidance. Uncertainties have been estimated for all sources using a tier 1 analysis. The uncertainties are estimated using expert judgements or are taken from IPCC default values. Uncertainty analyses were provided for all years. The overall level of uncertainty is decreasing. The ERT recommends the use of a tier 2 uncertainty analysis which could deal with log-normal errors and correlations between sources.

5. Verification and quality assurance/quality control approaches

12. Portugal has elaborated a QA/QC plan in accordance with the IPCC good practice guidance and its implementation is in hand. This includes general QC procedures (tier 1) and, as a latest development which was presented during the in-country visit, source/sink category-specific procedures (tier 2) for 20 key categories covering 62 per cent of total emissions. The NIR and the initial report give a general overview of the QA/QC system. During the in-country review, this issue was discussed extensively and the ERT was provided with several documents (the Methodological Development Plan and documents on the QA/QC system, see the annex to this report). The ERT considers that the QA/QC system is well developed and well documented (although only in Portuguese), but has not yet been fully implemented. The ERT recommends the Party to include QC information in all the sectoral chapters of its next inventory report under the Kyoto Protocol and to develop a plan for domestic review by independent experts.

13. The NIR presents a procedure for internal review of the inventory before submission; however, the ERT noted that QA by independent national experts was only documented in one case.

6. Follow-up to previous reviews

14. The Portuguese inventory is in a continuous state of development, which is managed by a competent team. Many improvements have been made in the past year. Major improvements occurred in the LULUCF sector, where quantifications of emissions and removals from land-use change, and of estimates of uncertainties for the LULUCF categories, have been reported for the first time. A tier 2 key category analysis using the results of the improved uncertainty estimates was also carried out for the first time. A revision of the methodology used for the estimates of international and national emissions from maritime and aviation activities was also performed in order to be more consistent with the IPCC guidelines; emissions are now based on origin-destination. A major pending issue is the inclusion of the LULUCF estimates of the autonomous regions of Madeira and the Azores, which was resolved after the in-country visit.

G. Areas for further improvement

1. Identified by the Party

15. The NIR identifies several areas for improvement covering all sectors, such as more extensive use of plant-specific EFs in the energy sector; revision of the clinker EF in the industrial processes sector; improved estimates of emissions from the application of fertilizers in the agricultural sector; revision of the carbon (C) content of soils in the LULUCF sector; and a better quantification of the amount of CH_4 recovered and flared in the waste sector. Future improvements are defined under the Methodological Development Plan, which is revised and agreed each year in the framework of the national inventory system.

2. Identified by the ERT

16. The ERT identified the following cross-cutting issues for improvement. The Party should:

(a) Improve the completeness of the inventory by covering all sources and sinks; in particular improve LULUCF estimates from the autonomous regions of Madeira and the Azores;

(b) Reduce the size of the NIR by deleting all information concerning air pollutants (e.g. PM10 and heavy metals) that are not part of the Convention, concentrate on country-specific methods (which should be described in more detail) and on relevant background information, and use references for standard methodological procedures;

(c) Continue to work on implementation of the QA/QC system, include information on sector-specific QC in all sectoral chapters of the NIR, and ask independent national experts to perform step-by-step reviews of the inventory parts;

(d) Include information on sector-specific QC in all sectoral chapters of the NIR;

(e) Improve the description of recalculations for industrial wastewater handling and HFC emissions;

(f) Continue to develop the integrated information technology (IT) system for the management of the national system (SIGA);

(g) Develop a tier 2 uncertainty analysis.

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

II. Energy

A. Sector overview

18. In 2004, emissions from the energy sector (61,131.83 Gg CO_2 eq.) constituted 72.8 per cent of the total national GHG emissions excluding LULUCF. Fuel combustion accounted for 98.0 per cent of emissions from the sector, and fugitive emissions for the remaining 2.0 per cent. Emissions of CO_2 accounted for 97.0 per cent of the sectoral GHG emissions, with CH_4 and N_2O emissions contributing 1.4 per cent and 1.6 per cent, respectively. Within the sector, the major categories were energy industries, transport, and manufacturing industries and construction, which contributed 35.5 per cent, 32.8 per cent and 17.6 per cent, respectively. Emissions from energy use in other sectors (1.A.4) contributed 12.0 per cent of sectoral GHG emissions.

19. Emissions are estimated and reported for practically all subcategories, except for GHGs from military fuel use and N_2O from flaring. During the review period, Portugal estimated emissions from the military use of jet kerosene and included these emissions in the revised estimates for the period 1990–2004 (see paragraph 30).

20. Overall, the energy sector inventory is presented in a transparent manner. The NIR includes descriptions of the methods used, sets of EFs and energy content values. The ERT noted, however, that the 2004 national energy balance is not provided. The ERT recommends that Portugal improve transparency in the NIR by:

(a) Avoiding repetition by presenting the common methodologies used to estimate GHG emissions from stationary combustion only once;

(b) Organizing the fuel parameters (e.g. lower-heating value, C content, oxidation factor and density) that are used through all subcategories in a single table;

(c) Including (at least) the energy balance for the current year, accompanied by an explanation of the differences in the classification between the activity data (AD) used for estimating emissions and the energy statistics of the national energy balance.

21. The recalculations reported in the original 2006 submission are well explained in the NIR and the CRF. Consistent methodologies are used throughout the time series. The emission estimates have been recalculated for all years from the base year to 2003, resulting in small changes between the 2005 and 2006 submissions. For 2003, the Party reported recalculations which result in an increase in total sectoral emissions of 2.1 per cent. This change is dominated by the increases in GHG emissions from oil and natural gas fugitive emissions, particularly those associated with the change in methodology for natural gas transport and delivery, and from the energy industries because of the introduction of plant-specific data for the major power plants in Madeira and the Azores.

22. No sector-specific QA/QC procedures are mentioned in the NIR. However, during the in-country visit the ERT was provided with information from a study that was carried out jointly by the Portuguese Environment Agency (APA) and the Directorate General for Energy and Geology (DGEG) (see the annex to this report). This study provides the results of a comparative assessment between plant-specific data for large point sources (i.e. data available to the APA in the context of the Large Combustion Plant Directive) and data for co-generation (available at the DGEG). In response to this comparative assessment, fuel consumption data for wood, wood products and diesel oil were revised and data concerning intermediate products and agreement on lower-heating values were reconciled. The ERT recommends that Portugal include a summary of this study in its future submissions.

23. Uncertainties have been assessed for all subcategories using the tier 1 approach and following the recommendations of the IPCC good practice guidance. However, the ERT noted that no use is made

of the country-specific information available from the results of the comparative assessment (see paragraph 21). The ERT encourages Portugal to explore the use of country-specific information (based on the results of the comparative assessment and/or other results) for its future uncertainty analyses.

B. Reference and sectoral approaches

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

24. In the original 2006 inventory submission, the estimates for CO_2 emissions in 2004 are 1.2 per cent higher in the reference approach than in the sectoral approach. By type of fuel, the differences are 1.3 per cent for liquid fuels, 1.5 per cent for solid fuels and 1.8 per cent for gaseous fuels. The explanations provided in the documentation box of the CRF and in the NIR focus on the different estimates for large point sources and feedstock emissions.

2. International bunker fuels

25. Fuel consumption in international aviation and navigation is estimated differently in the sectoral and reference approaches. International bunker fuels in the reference approach are taken from the national energy balance, which uses a definition based on the carrier's flag that is not in line with the IPCC good practice guidance. Since fuel consumption for both domestic aviation and domestic navigation is estimated in a reliable manner according to the IPCC good practice guidance, the ERT recommends that international fuel consumption estimated, as suggested in paragraphs 34 and 36 below, be used in both approaches. The ERT also recommends that Portugal provide the corresponding explanation in the documentation box of CRF table 1.C.

3. Feedstocks and non-energy use of fuels

26. In the reference approach, the non-energy use of naphtha, lubricants, bitumen and residual fuel oil is taken into account. IPCC default values are used for the fraction of C stored in lubricants and bitumen, and country-specific values are used for naphtha and residual fuel oils. In the sectoral approach, the use of refinery gas for energy purposes is accounted for while the emissions associated with the use of lubricants are not. The use of coal as a reducing agent in blast furnaces is accounted for in the energy sector. The ERT recommends that Portugal continue to make efforts to improve the estimates of emissions from feedstock use.

C. Key categories

1. Stationary combustion: liquid fuels, biomass – CO_2, CH_4, N_2O

27. The ERT noted that plant-specific fuel consumption data are used to estimate part of the emissions from energy industries and manufacturing industries and construction, which can be considered as a methodological refinement according to the IPCC good practice guidance. Key issues concerning the inclusion of this type of data, namely the statistical relationship between the AD for individual plants and the whole subcategory, time-series consistency and recalculations back to 1990, are dealt with adequately. The ERT commends Portugal on its efforts to implement a system that is capable of dealing with these estimations. However, the ERT identified some options for improvement. The ERT recommends the Party to:

(a) Continue its efforts to harmonize parameters (i.e. lower heating value, CO_2 EFs, and plant-specific data versus fuel consumption from the national energy balance);

(b) Avoid unnecessary unit conversions (i.e. from energy units to physical units to energy units);

(c) Critically assess possible underestimations/overestimations that may lead to bias;

(d) Assess the consistency of the linkages between GHG inventories, annual reporting from companies and emissions trading.

28. The Party may also wish to consider the preparation of a background document on the use of plant-specific data in GHG inventories.

2. Manufacturing industries and construction: other fuels – CO_2

29. An updated value of the CO_2 EF for the combustion of old tyres in the cement industry was received from the DGEG during the in-country visit. The CO_2 EF that was used to estimate these emissions in the 2006 submission is 99.8 t CO_2/TJ. The new EF reported to the DGEG by the operator of the only plant in Portugal that uses old tyres for energy purposes is 85 t CO_2/TJ. During the review period, Portugal estimated these emissions using the newly-reported EF and included these emissions in the revised estimates for the period 1990–2004. For 2004, this led to a decrease in the estimate of 4.44 Gg CO_2 from 29.92 Gg $CO_2$to 25.48 Gg CO_2.

3. Road transportation: liquid fuels – CO_2

30. CO_2 emissions are estimated using a country-specific lower-heating value and the default hydrogen-carbon ratio provided by the COPERT III model. The ERT recommends that Portugal improve the consistency of the inventory by using the country-specific C content for each fuel that corresponds to the country-specific lower-heating value.

4. Military fuel use: liquid fuels – CO_2, CH_4, N_2O

31. Emissions from military fuel use are not included in the Portuguese national inventory. However, the energy balance under services (*Serviços*), which includes the military, reports the following use of fuels: liquid fuels in the period 1990–2004; city gas in the period 1990–2001; and natural gas in the period 1997–2004. During the in-country visit, the ERT recommended the Party to estimate the emissions from military fuel use. In the case of mobile combustion, the ERT also recommended the Party to make efforts to follow the IPCC good practice guidance (sections 2.4 and 2.5) concerning the differentiation between domestic, international and multilateral operations. In the course of the review, Portugal informed the ERT that the only fuel use that had not been accounted for in the 2006 submission was the military use of jet kerosene. Portugal estimated these emissions using a tier 1 approach with IPCC default EFs, assuming that all jet kerosene was used for domestic purposes. The resulting emissions were included in the revised estimates for the period 1990–2004 and, for 2004, led to an increase in the estimate of 40.70 Gg CO_2 eq.

D. Non-key categories

1. Public electricity and heat production: other fuels (waste incineration) – CO_2, CH_4, N_2O

32. The use of urban solid waste for electricity generation in the period 1999–2004 is estimated and reported in the waste sector. The ERT recommended the Party to reallocate these emission estimates to the energy sector. In the course of the review, Portugal provided the ERT with a detailed estimation of all the GHG emissions associated with the incineration of urban waste with energy recovery, with a disaggregation for its biogenic and non-biogenic components. These emissions were reallocated to the energy sector in the revised estimates for the period 1990–2004.

2. Civil aviation: liquid fuels – CO_2, CH_4, N_2O

33. A tier 2 approach is used to estimate the emissions from civil aviation based on detailed information on arrivals and departures, distances travelled, fuel consumption, landing and take-off (LTO) and other parameters. The available data allow Portugal to be mostly in line with the IPCC good practice guidance. The only information that is lacking if the inventory team is to meet all the criteria to

differentiate between domestic and international flights (table 2.9) concerns the movement of passengers or cargo at intermediate stops. The ERT commends Portugal on its efforts to improve these emission estimates and recommends it to identify in its future NIRs the missing AD that would enable it to make the split between domestic and international fuel consumption.

34. Domestic fuel consumption for jet kerosene is estimated in a reliable manner using the tier 2 approach, while that for aviation gasoline has larger uncertainties; however, it has been estimated using the best available information for the period 1990–2004. For each fuel, the ERT recommends that Portugal estimate international fuel consumption as the difference between total fuel consumption reported in the energy balance and the domestic fuel consumption estimated using the tier 2 approach.

3. Navigation: liquid fuels – CO_2, CH_4, N_2O

35. Emissions from domestic navigation are estimated in a way that is similar to the tier 2 approach used for emissions from civil aviation. The only information that is lacking if the inventory team is to be able to fulfil all the criteria of the IPCC good practice guidance with regard to differentiating between domestic and international marine transport (table 2.8) concerns the movement of passengers or cargo at intermediate stops. The ERT commends Portugal on its efforts to improve these emission estimates and recommends that it identify in its future NIRs the missing AD that would enable it to make the split between domestic and international fuel consumption.

4. International bunker fuels: marine, liquid fuels – CO_2, CH_4, N_2O

36. International navigation is estimated using a tier 2 approach that is not in line with the IPCC good practice guidance. The ERT recommends that Portugal estimate international fuel consumption as the difference between total fuel consumption reported in the national energy balance and the domestic fuel consumption estimated using the tier 2 approach.

III. Industrial processes and solvent and other product use

A. Sector overview

37. In Portugal, industrial processes contributed 7,415.18 Gg CO_2 eq., or 8.8 per cent of the total national GHG emissions, in 2004. The dominant gas was CO_2 (82.3 per cent of total sectoral GHG emissions), mainly from mineral products, followed by HFCs (9.2 per cent), N_2O (8.2 per cent) and CH_4 (0.2 per cent), while SF_6 contributed 0.2 per cent. The major source of CO_2 emissions was cement production (58.0 per cent), followed by ammonia production (28.1 per cent) and lime production (7.2 per cent). All the N_2O emissions came from nitric acid production at three sites. Between the base year and 2004, emissions of all GHGs increased, with emissions of HFCs increasing by the largest percentage (1,224.0 per cent) as a consequence of substitution of ozone depleting substances (ODS). CO_2 emissions increased by 51.2 per cent, CH_4 emissions by 42.7 per cent and N_2O emissions by 6.7 per cent.

38. Recalculations were carried out for the entire time series for HFC emissions related to refrigeration, air conditioning equipment and foam blowing; for CO_2 emissions from steel production; for CO_2 emissions related to the consumption of limestone, dolomite and carbonate by the ceramic industries; for CO_2 emissions related to the production of monomers; and for SF_6 emissions from electrical equipment.

39. Emissions from solvent and other product use were only estimated for non-methane volatile organic compounds (NMVOCs) and their CO_2 eq. emissions, which had a 0.4 per cent share of the total 2004 emissions. These have increased by 45.7 per cent since the base year, but have maintained their share. No recalculations have been made for this sector.

40. The NIR was transparent apart from a few inconsistencies in the CRF tables which were resolved during the review. There is one outstanding inconsistency with regard to PFC emissions, where CRF table 9 states "NE" for related consumption in the most recent years, but CRF table 2(II)s2 states not occurring ("NO").

41. Portugal provided key category assessments for 2004 using both tier 1 and tier 2 methodologies. The analysis below is based on tier 1 methodologies.

B. Key categories

1. Cement production – CO_2

42. This is the largest source in the industrial processes sector. It has a single EF (IPCC default) and clinker production is used as AD. Information on these data comes from the plants, because the National Statistical Office (INE) does not provide them. All the six plants recycle all the cement kiln dust (CKD) in their processes. The ERT recommends the Party to develop a country-specific lime (CaO) content in clinker and to verify the fact that all CKD is recycled during the process in the plants.

2. Ammonia production – CO_2

43. The second largest CO_2 source belongs to a single ammonia production plant and has an EF that is not comparable with those of other Parties because an uncommon feedstock, namely vacuum residual fuel oil (VRF), is used to produce hydrogen for the process. VRF has higher C content (86 per cent) than ordinary natural gas. There have been large fluctuations in AD that broadly follow market fluctuations, with an overall increase.

3. Nitric acid production – N_2O

44. These emissions are from three plants of the same type with no abatement technology. The N_2O EF is derived from monitoring data from just one of them. This EF is in the upper range limit for this type of medium pressure installation, according to IPCC good practice guidance.

4. ODS substitutes – HFCs

45. The HFC emissions estimates have been extensively revised since the last submission. A recalculation of SF_6 emissions was also made. This source and its sub-sources were not significant in the base year, but have the highest rates of increase, which is in line with the general tendency among developed countries. AD were derived from a complex model based on a tier 2a methodology.

46. During the review, the Party informed the ERT that some mistakes that had been discovered in part of the time series, and that some important information had become available. The ERT recommends the Party to increase the coverage of these sources and to improve its estimates.

5. Lime production – CO_2

47. In 1990–2004, there was a large increase in this source due to a combination of increases in AD (+119 per cent) and in the EF (+12 per cent). The change in the production profile (a greater share of quicklime with a higher EF than the other types of lime) led to this increase in the overall EF. This source also includes auto-production of lime in the paper and pulp industry and in the iron and steel industry.

C. Non-key categories

Iron and steel production – CO_2

48. The Party indicated that there may have been some double counting in the emissions from steel production using basic oxygen furnaces (BOFs) and electric arc furnaces (EAFs), as carbon monoxide

(CO) emissions have already been accounted for in CO_2 emissions from decarbonization of pig iron. There was also a mistake in the CO_2 EF, which was missing the correction from C to CO_2. These problems were resolved as result of the review.

IV. Agriculture

A. Sector overview

49. In 2004, emissions from the agriculture sector amounted to 8,660.16 Gg CO_2 eq. and accounted for 10.3 per cent of total national GHG emissions. The emissions increased by 7.1 per cent between 1990 and 2004. In 2004, CH_4 and N_2O contributed 52.5 per cent and 47.5 per cent, respectively. Portugal identified the following key categories in its tier 2 key category analysis: N_2O from agricultural soils; CH_4 from enteric fermentation (cattle, sheep); CH_4 from manure management (swine); N_2O from manure management (solid storage); and CH_4 from rice cultivation. This is in general agreement with the secretariat's key category analysis. The ERT encourages the Party to disaggregate the emissions from agricultural soils into its subcategories for future key source analyses. In 2004, the sectoral contributions of agricultural soils, enteric fermentation, manure management, rice cultivation and field burning of agricultural residues accounted for 40.5 per cent, 34.8 per cent, 20.2 per cent, 4.1 per cent and 0.4 per cent of sectoral emissions, respectively. Prescribed burning of savannas does not occur in Portugal.

50. From 1990 to 2004, sectoral CH_4 emissions increased by 12.2 per cent, and N_2O emissions increased by 1.9 per cent. The general trend is explained by the increase in cattle and poultry numbers, and by the growth in crop production. In contrast, CH_4 emissions from manure management decreased by 1.6 per cent, due to a reduction in the swine population. In the NIR and during the in-country review, Portugal provided clear explanations of the drivers for GHG emission trends in the period 1990–2004.

51. Following revisions of the AD on livestock numbers, synthetic fertilizers and manure applied to soils, as well as revisions to methodologies for enteric fermentation and manure management, and the development of country-specific data on the shares of manure management systems, climatic zones and nitrogen (N) excretion rates, Portugal recalculated the relevant emission estimates for the entire time series for the 2006 submission. The recalculations are explained in the NIR and additional information was obtained by the ERT during the in-country visit. The impact of the recalculations on GHG emission trends is that while previous submissions showed a decreasing trend in emissions from agriculture for the period 1990 to 2003, the 2006 submission reports slightly but constantly increasing sectoral emissions for the same period.

52. Portugal reports complete estimates of all GHGs and sources for the agriculture sector, with descriptions, as recommended by the IPCC good practice guidance and the Revised 1996 IPCC Guidelines. The ERT noted that Portugal's uncertainty analysis does not account for correlated emissions in the sector. The Party may wish to consider the possibility of accounting for correlated emissions (see paragraph 32 and sections 6.3 and 6.5.4 to 6.5.7 of the IPCC good practice guidance).

B. Key categories

1. Enteric fermentation – CH_4

53. The ERT noted that the numbers given for sheep for 1990–2004 are 37.7 to 46.6 per cent lower than the Food and Agriculture Organization of the United Nations (FAO) data. The differences between the national inventory and the FAO data are not explained in the NIR. In the course of the review, the Party informed the ERT that the FAO estimates of sheep were based on incorrect data. The correct number of sheep was obtained from the INE and used by the Party in the GHG inventory. The ERT encourages Portugal to explain the difference in population numbers in the NIR of its next submission.

54. The ERT noted that the same digestibility value (60 per cent) is used for all dairy cattle. However, animals kept on pasture may have different diets from those kept in stalls. The ERT encourages the Party to carry out further work to clarify this issue and to revise the methodologies and parameters if appropriate for the whole time series. Portugal reports an additional subcategory to those in the IPCC good practice guidance and the Revised 1996 IPCC Guidelines: the subcategory rabbits. The ERT commends the Party for this effort. However, the ERT noted that the AD include only the number of breeding females. In the course of the review Portugal clarified that the EF (volatile solid (VS) production per animal) was obtained from international sources (French National Institute for Agricultural Research) and refers to the production of VS per female cage in husbandry production, including growing animals and males. Portugal may wish to include these clarifications in the NIR of the next submission.

2. Manure management – N_2O

55. The ERT noted that there is no clear justification of the new country-specific N excretion rates provided in the NIR, and that these country-specific rates largely disagree with the IPCC default values. In the course of the review, the Party confirmed the country-specific N excretion rate for swine and revised the N excretion rates for adult sheep and lambs – from 7.0 and 2.1 kg N/head/yr to 9.2 and 2.8 kg N/head/yr, respectively. The revision of the estimates resulted in an increase in estimated N_2O emissions from sheep in 2004 from 294.5 Gg CO_2 eq. to 386.0 Gg CO_2 eq. The ERT recommends the Party to explain in its next inventory submission the differences between the country-specific parameters and the default values.

3. Rice cultivation – CH_4

56. In CRF table 4.C, organic amendments applied to soils are reported as "NO" and the scaling factor for organic amendments is not used. During the in-country visit, the ERT recommended the Party to investigate whether the practice of incorporating rice residues (or their fraction) into soils exists in Portugal and to report appropriate estimates for CH_4 emissions from rice fields. In the course of the review, the Party provided a revised estimate which resulted in an increase of estimated CH_4 emissions from rice fields in 2004 of 138.9 Gg CO_2 eq. (from 193.4 Gg CO_2 eq. to 332.3 Gg CO_2 eq.), and an increase of estimated GHG emissions from field burning of residues of 5.1 Gg CO_2 eq. (from 2.4 to 7.5 Gg CO_2 eq.).

4. Agricultural soils – N_2O

57. The ERT noted that trend extrapolations were used to obtain the missing data on the consumption of synthetic fertilizers and the $Frac_{GASF}$ for 1990–1991 and 2001–2004. The ERT noted, however, that the trends are not stable. During the in-country visit, the ERT recommended the Party to calculate the arithmetic mean values during the period using reliable statistical data and to use this value as an estimate for all missing years. As a result of the review process, Portugal provided revised estimates for the consumption of synthetic fertilizers and $Frac_{GASF}$, which led to an increase in estimated N_2O emissions from synthetic fertilizers applied to agricultural soils in 2004 of 133.6 Gg CO_2 eq. from 1,404.0 Gg CO_2 eq. to 1,537.6 Gg CO_2 eq.

58. For the 2006 submission, the Party obtained country-specific data on the fraction of manure stored in anaerobic lagoons that was applied to soils (80 per cent). The remaining fraction (20 per cent) was not accounted for in the inventory. The ERT supports the intention of the Party to estimate N_2O emissions from this fraction for the entire time series in the subcategory leaching and run-off and to report the results in its next submission. The revisions of this estimate resulted in an increase in estimated 2004 N_2O emissions from leaching and run-off of 30.1 Gg CO_2 eq. from 1,035.4 Gg CO_2 eq. to 1,065.5 Gg CO_2 eq.

V. Land use, land-use change and forestry

A. Sector overview

59. In 2004, the LULUCF sector in Portugal represented a net sink of 3,536.08 Gg CO_2 eq., offsetting 4.2 per cent of the total national GHG emissions. In 1990, the sector was a net source of 2,592.59 Gg CO_2 eq. In the years that followed, the sector continued to sequester C and gradually became a net sink. The sector was a considerable source of emissions in 2003 due to forest fires. The sector returned to being a net sink in 2004. The largest source of CO_2 emissions in 2004 was land converted to settlements, while forest land and grassland acted as C sinks.

60. The CRF includes estimates for 2004 of CO_2 emissions/removals in all C pools from all the six land-use categories of the LULUCF sector, N_2O emissions from disturbance associated with land-use conversion to cropland, as well as CH_4 and N_2O emissions from wildfires in forest land. Direct N_2O emissions from N fertilization of forest land have been estimated together with agriculture, as it was not possible to separate the AD (fertilizer sales are not individualized). Non-CO_2 emissions from drainage of soils and wetlands were reported as "NO" while CO_2 emissions from the application of agricultural lime were reported as "NE".

61. Recalculations made by Portugal in 2006 have been very useful in increasing the accuracy and transparency of the inventory. These recalculations include improved estimates of the changes in C stocks in forest land, where below-ground biomass was considered in addition to the previous practice of estimating only C stock changes from above-ground biomass. Portugal has improved its calculation of annual losses due to wildfires by considering the fraction of biomass not affected by disturbance (a tier 3 approach).

62. Portugal identified the following key categories, based on tier 1 and tier 2 approaches: CO_2 emissions/removals from forest land (5.A); CH_4 emissions from forest land (5.A); CO_2 emissions/removals from cropland (5B); and CO_2 emissions/removals from land converted to settlements (5.E.2).

B. Key categories

1. Forest land – CO_2

63. In 2004, as in previous years, the value of the implied emission factor (IEF) for the net C stock change in living biomass from land converted to forest land (12.56 Mg C/ha) and in soils from cropland converted to forest land (11.23 Mg C/ha) were the highest of all reporting Parties. These values were neither justified nor explained in the NIR. During the in-country visit, the ERT recommended Portugal to check the methodology and parameters used in estimating the changes in C stocks in living biomass and soils, in order to justify the high value of the IEF for the whole time series. In the course of the review, Portugal informed the ERT that the problem lies in reporting the annual area converted to forest land. In response to a recommendation by the ERT, Portugal revised the area converted to forest land (from 9.81 kha to 137.17 kha) in CRF table 5.A, with unchanged net emissions/removals from this subcategory. Portugal clarified that the problem did not affect the reported emission estimates.

2. Cropland – CO_2

64. The ERT noted the absence of an estimate of CO_2 emissions from the application of agricultural lime. The ERT recommends, for the sake of completeness of the inventory, that Portugal provide an estimate of CO_2 emissions from liming in cropland and grassland.

3. Settlements – CO_2

65. In 2004, as in previous years, the value of the implied emission factor (IEF) for the net C stock change in soils for forest land converted to settlements (–69.9 Mg C/ha) was the lowest IEF value of all reporting Parties. This value was neither justified nor explained in the NIR. The ERT recommended Portugal to review the methodology applied and the parameters used in estimating the changes in C stocks in soils, in order to justify the low value of the IEF for the whole time series. In the course of the review Portugal stated that the problem lies in reporting the annual area converted to settlements. In October 2007, Portugal submitted a revised GHG inventory for the period 1990–1995 and 2004, with corrected annual area, and assured the ERT that the correction did not affect the total emission estimates reported.

VI. Waste

A. Sector overview

66. In 2004, waste contributed 6,394.74 Gg CO_2 eq. or 7.6 per cent of the total GHG emissions. The dominant GHG is CH_4, which contributed 91.1 per cent of sectoral emissions, almost two-thirds from solid waste disposal on land and one-third from wastewater treatment processes, followed by N_2O, 8.9 per cent, and CO_2, 0.03 per cent. The major source of CH_4 emissions is solid waste disposal on land (58.0 per cent), followed by wastewater treatment processes (42.0 per cent); almost all N_2O emissions come from wastewater treatment processes (99.8 per cent). In 1990–2004, emissions of CH_4 and N_2O increased by 6.4 per cent and 27.9 per cent, respectively, whereas CO_2 emissions from incineration decreased by 80.6 per cent.

67. The ERT noted that reporting of emission estimates for the waste sector is generally complete, with minor gaps due to the absence of statistics on waste composting. The methodologies and EFs are transparently described, but reporting on AD could improve in transparency. Recalculations were made for the sector in 2005 and all categories were recalculated following recommendations by a previous review with revised estimates of CH_4 and N_2O from solid waste disposal on land and wastewater handling. Sector-specific QA/QC procedures have not been implemented. Uncertainties have been calculated for all emissions and are high for all categories. Portugal has provided key category assessments for 2004 using both tier 1 and tier 2 methodologies. The analysis below is based on tier 1 methodologies. During the in-country review, host-country experts informed the ERT that several improvements are forthcoming, including the metering of gas flared and recovered from solid waste disposal on land, and a new survey and database for wastewater management.

B. Key categories

1. Solid waste disposal on land – CH_4

68. The methodologies correspond to tier 2 of the IPCC good practice guidance. The EFs used are IPCC defaults. During the review process, Portugal submitted recalculated estimates using the degradable organic carbon fraction (DOC_F) value recommended by IPCC good practice guidance (0.6). The AD are appropriate even though they are based to a great extent on estimates.

2. Domestic and commercial wastewater treatment – CH_4

69. For domestic and commercial wastewater treatment, Portugal has used projections to estimate the emissions for the period 2000–2004, taking into account the effects of population increases and technological changes. The ERT recommends the Party to improve the method by adopting country-specific parameters for biochemical oxygen demand (BOD) associated parameters (SBF, the fraction of BOD that readily settles, and FTA, the fraction of BOD in sludge that degrades anaerobically) using available surveys and estimations.

3. Industrial wastewater treatment – CH_4

70. For industrial wastewater treatment, there is a lack of transparency because the method used is not consistent with the IPCC good practice guidance. During the review process, Portugal reviewed the methodology used in this category, recalculated its results and improved the transparency of its reporting.

4. Industrial wastewater treatment – N_2O

71. Emissions of N_2O from industrial wastewater treatment were estimated on an inhabitants-equivalent basis, instead of using comprehensive data on wastewater characteristics. The ERT encourages Portugal to enhance its knowledge of wastewater characteristics.

C. Non-key categories

1. Human sewage wastewater treatment – N_2O

72. For N_2O from human sewage, Portugal used a variable emission factor over the period 1990–2004, reflecting changes in dietary protein consumption. However, Portugal has used the EF for rivers and estuaries even when discharging only into estuaries. The ERT recommends Portugal to apply the EFs according to protein consumption and place of discharge.

2. Waste incineration – CO_2, CH_4, N_2O

73. Municipal waste incineration facilities started operation in 1999. Emissions from their energy recovery systems are reported in the waste sector. The ERT recommended the Party to follow the reporting guidelines more closely and allocate these emissions to the energy sector (see paragraph 32). Only small amounts of clinical waste are incinerated (of 27 incinerators, only two are still functioning). The ERT was informed that no hazardous waste is incinerated in Portugal. No data on sludge management through incineration were available. The amount of emissions from this category is negligible (2.0 Gg CO_2 eq.).

3. Other – open burning of industrial solid waste on land – CO_2, CH_4, N_2O

74. A small amount of industrial solid waste is treated by open burning. GHG emissions from this source (1.2 Gg CO_2 eq. in 2004, mainly N_2O) were reported under the category other (6.D). The ERT reiterated the recommendation of a previous review that these emissions should be reallocated to solid waste disposal on land – other.

VII. Conclusions and recommendations

75. Portugal has submitted a complete set of CRF tables for 1990–2004 and an NIR which has been compiled in accordance with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance. During the in-country review, the ERT and Portugal agreed changes to some categories in the energy, industrial processes, agriculture, LULUCF and waste sectors.

76. In the course of the review, the ERT formulated a number of recommendations relating to the completeness and transparency of the information presented in Portugal's 2006 submission. The key recommendations[3] are that Portugal should:

(a) Work on the completeness of the inventory by covering all sources and sinks and in particular improve the LULUCF estimates of the autonomous regions of Madeira and the Azores;

[3] For a complete list of recommendations, the relevant sections of this report should be consulted.

(b) Provide more transparency in the NIR on the description of methodologies, especially for country-specific methods, paying particular attention to the tasks of centralized review teams, which will need to draw conclusions on the basis of the NIR;

(c) Further strengthen the implementation of its QA/QC plan at all the agencies involved in the preparation of the inventory, include specific QC information in all the sectoral chapters of the NIR, and develop a plan for review by independent national experts;

(d) Reduce the size of the NIR by deleting all information concerning air pollutants that are not covered in the Convention or the Kyoto Protocol;

(e) Continue to develop the integrated IT system for the management of the national system (SIGA);

(f) Develop a tier 2 uncertainty analysis.

Annex

Documents and information used during the review

A. Reference documents

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