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Report of the individual review of the greenhouse gas inventory of Ireland 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 Ireland, coordinated by the United Nations Framework Convention on Climate Change (UNFCCC) secretariat, in accordance with decision 19/CP.8. The review took place from 16 to 21 April 2007 in Dublin, Ireland, and was conducted by the following team of nominated experts from the roster of experts: generalist – Mr. Justin Goodwin (United Kingdom of Great Britain and Northern Ireland); energy – Mr. Jerome Elliot (Bahamas); industrial processes – Ms. Maria Jose Lopez (Belgium); agriculture – Mr. Marcelo Rocha (Brazil); land use, land-use change and forestry (LULUCF) – Mr. Daniel Martino (Uruguay); waste – Ms. Kyoko Miwa (Japan). Mr. Justin Goodwin and Mr. Daniel Martino 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"(the UNFCCC review guidelines), a draft version of this report was communicated to the Government of Ireland.

B. Inventory submission and other sources of information

3. In 2006, Ireland submitted a complete set of common reporting format (CRF) tables for the years 1990–2004 and a national inventory report (NIR). The Party submitted revised emission estimates on 11 May 2007 in response to questions raised by the expert review team (ERT) during the course of the in-country visit. These revised values are based on revisions of the estimates of emissions of methane (CH_4) and nitrous oxide (N_2O) from manure management and N_2O from agricultural soils, which resulted in revision of the estimates of total GHG emissions for 2004, from 68,389 Gg carbon dioxide (CO_2) equivalent as reported originally by the Party to 68,237 Gg CO_2 equivalent. Where needed, the ERT also used the previous year's 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 Ireland was carbon dioxide (CO_2), contributing 66.3 per cent to total[1] national GHG emissions expressed in CO_2 equivalent, followed by methane (CH_4), 19.6 per cent, and nitrous oxide (N_2O), 13.2 per cent. Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) taken together contributed 1.0 per cent of the overall GHG emissions in the country. The energy sector accounted for 65.0 per cent of total GHG emissions, followed by agriculture (27.6 per cent), industrial processes (4.6 per cent) and waste (2.7 per cent). Total GHG emissions amounted to 68,309 Gg CO_2 equivalent and had increased by 23.2 per cent since 1990.

5. Tables 1 and 2 show the greenhouse gas 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 equivalent excluding LULUCF, unless otherwise specified.

Table 1. Greenhouse gas emissions by gas, 1990–2004[a]

GHG emissions	Gg CO_2 equivalent								Change
	Base year (Convention)	1990	1995	2000	2001	2002	2003	2004	from BY (Convention) to 2004 (%)
CO_2 (with LULUCF)	32 667.7	32 667.7	34 987.9	44 239.0	46 530.4	45 509.4	44 136.6	45 194.9	38.3
CO_2 (without LULUCF)	32 559.5	32 559.5	34 782.7	44 240.9	46 704.3	45 700.5	44 519.4	45 266.5	39.0
CH_4	13 303.6	13 303.6	13 721.9	13 448.5	13 250.1	13 221.5	13 824.0	13 372.8	0.5
N_2O	9 537.2	9 537.2	9 990.0	10 271.9	9 809.7	9 321.6	9 158.2	9 003.8	–5.6
HFCs	0.7	0.7	44.6	228.9	253.1	288.8	357.9	399.3	57 517.0
PFCs	0.1	0.1	75.4	305.4	296.0	212.4	228.8	196.4	210 823.3
SF_6	35.4	35.4	82.8	55.9	69.4	70.2	118.6	70.0	97.7

BY = Base year; LULUCF = Land use, land-use change and forestry.

[a] Ireland submitted revised estimates for all years in the course of the initial review on 11 May 2007. These estimates differ from the Party's GHG inventory submitted in 2006.

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

Sectors	Gg CO_2 equivalent								Change
	Base Year (Convention)	1990	1995	2000	2001	2002	2003	2004	from BY (Convention) to 2004 (%)
Energy	31 665.4	31 665.4	34 002.8	43 097.8	45 402.5	44 508.0	44 346.1	44 400.9	40.2
Industrial processes	3 166.4	3 166.4	3 062.8	4 186.7	4 294.3	3 734.4	3 050.9	3 169.7	0.1
Solvent and other product use	80.9	80.9	86.2	80.3	79.5	77.2	75.7	74.5	–8.0
Agriculture	19 063.0	19 063.0	19 857.1	19 535.9	19 128.7	18 889.4	18 983.9	18 830.0	–1.2
LULUCF	108.2	108.2	205.2	–2.0	–173.9	–191.1	–382.8	–71.6	–166.2
Waste	1 460.7	1 460.7	1 688.6	1 650.9	1 477.4	1 606.1	1 750.3	1 833.6	25.5
Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (with LULUCF)	**55 544.7**	**55 544.7**	**58 902.6**	**68 549.6**	**70 208.6**	**68 624.0**	**67 824.1**	**68 237.2**	**22.9**
Total (without LULUCF)	**55 436.5**	**55 436.5**	**58 697.4**	**68 551.5**	**70 382.5**	**68 815.1**	**68 206.9**	**68 308.8**	**23.2**

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

[a] Ireland submitted revised estimates for all years after the initial review on 11 May 2007. These estimates differ from the Party's GHG inventory submitted in 2006.

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D. Key categories

6. The key category analyses performed by the Party and the secretariat[2] produced similar results. Ireland has included the LULUCF sector in its key category analysis. There are a few differences in the results of these analyses, which can be explained by the different levels of aggregation used by the Party for the energy and agriculture sectors. The ERT acknowledges that Ireland has used key category analysis as a tool to support and guide the improvement of its inventory. The ERT encourages Ireland to complete a tier 2 key category analysis.

E. Main findings

7. In 2004, total GHG emissions in Ireland amounted to 68,309 Gg CO_2 equivalent and had increased by 23.2 per cent since 1990. Energy is the dominant sector, contributing 65.0 per cent to total national emissions in 2004. CO_2 is the most important GHG, contributing 66.3 per cent to total national emissions in 2004. Ireland's inventory is generally complete and in accordance 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).

8. The overall completeness and quality of the inventory have been significantly improved since the last (2005) inventory submission. Major comments raised by previous review teams have been addressed as far as possible. The ERT identified some areas for improvement relating to the transparency of the inventory. Revisions to some estimates (to correct errors in the estimation methods) in the agriculture sector were considered and accepted by the ERT during the course of the review. However, there are still a number of issues of time-series consistency for sources in the energy sector due to a partial revision of the energy balance (the new energy balance has been applied to the 1990 and 2004 estimates and they are consistent).

F. Cross-cutting topics

1. Completeness

9. The inventory covers all years from 1990 to 2004, and generally all sectors and gases, including actual and potential emissions of HFCs, PFCs and SF_6 (the fluorinated gases (F-gases)). The ERT commends Ireland for submitting LULUCF tables in accordance with decision 13/CP.9 for the first time. Ireland has not submitted CRF table 7 (key categories). The ERT noted several categories for which GHG emissions occur in Ireland but for which emissions have not been estimated (e.g. minor sources in industrial processes and solvent and other product use (see para. 31), non-CO_2 emissions from biomass burning in forest fires (see paras. 61, 71), cultivation of histosols (see paras. 46, 57), N_2O emissions from soil disturbance associated with conversion to cropland (see paras. 61, 70), and N_2O emissions from wastewater (see paras. 73, 80). Ireland indicated during the review that it would consider including these missing sources for future revisions. The ERT noted reporting gaps in some sectoral tables (e.g. in the industrial processes sector) and in the summary and other tables of the CRF. The ERT encourages Ireland to provide estimates for all categories where emissions occur in the country, even if they are minor, by using simple but reasonable approaches, using expert judgement as necessary.

[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.

2. Transparency

10. The ERT noted that the quality of the 2006 submission is high in that it provided information in accordance with the UNFCCC reporting guidelines. However, the ERT had to request additional information and explanations in order to make a complete assessment of some categories for a number of sectors of the inventory (e.g. industrial processes (see paras. 32, 38, 39, 40, 41, 43, 44), agriculture (see paras. 46, 50, 55), land use, land-use change and forestry (see paras. 63, 67) and waste sectors (see paras. 78, 79, 81)). The additional information provided during the course of the review (see annex I) improved the ERT's understanding of methodology and emission factors (EFs) used to estimate emissions. The ERT recommend that Ireland enhance the transparency of reporting by including: improved descriptions of methodologies for categories in the industrial processes sector; explanation of trends (including inter-annual variations) and the impact of recalculations on trends; and to improve reporting of notation keys that were identified in a couple of instances to be neither consistent through the time series (e.g. CO_2 emissions for iron and steel are reported as not estimated ("NE") or not occurring ("NO") or "0.00" in the period 1990–2003), nor used. This is a particular problem for the earlier years of the time series.

11. The ERT encourages Ireland to correct the notation keys that were identified as incorrect in a number of source categories in energy, industrial processes, LULUCF and waste.

3. Recalculations and time-series consistency

12. The ERT concluded that Ireland's inventory is generally consistent, as defined in the UNFCCC reporting guidelines, and consistent with 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). The ERT noted that in general recalculations, along with revised estimates submitted by the Party during the in-country visit, had been generally undertaken for the whole time series. A revised energy balance for all years of the time series is reported in the NIR; however, only the 1990 energy emissions have been recalculated. During the in-country visit Ireland presented to the ERT a consistent emissions time series from the most recent (2007) submission of the inventory. The 2007 submission incorporates the entire time series of the revised energy balance.

13. Recalculations have been carried out and are reported in accordance with the IPCC good practice guidance. The rationale for these recalculations is provided in the NIR and in CRF table 8(b). They are due to improvements in methodologies and revisions to EFs and activity data (AD), and have been applied to the whole time series except for the revised energy balance. The effect of the recalculations is to increase the estimates of total national GHG emissions for 2003 by 1.0 per cent (excluding LULUCF). The major changes in the inventory for 2003 include the following. In the energy sector, estimated emissions of CO_2, CH_4 and N_2O have increased by 0.3, 314 and 0.2 per cent, respectively. The major change for CH_4 reflects the inclusion of 27.0 Gg CH_4 for natural gas (1.B.2(b)) where the value had remained unconfirmed, and therefore omitted, for the previous submission. In the industrial processes sector, estimated CO_2 emissions have decreased by 0.6 per cent, and estimated emissions of HFCs, PFCs and SF_6 have increased by 24.1, 2.3 and 18.4 per cent, respectively. In this case, the main reasons for recalculations are improvements to methodologies and the revision of AD. In the agriculture sector, estimated CH_4 emissions have increased by 7.7 per cent, and estimated N_2O emissions have decreased by 7.2 per cent, due to improved methodology. During the course of the review Ireland submitted revised agriculture emission estimates on 11 May 2007 to the ERT that rectified errors identified in spreadsheets. The recalculations in the waste sector have resulted in a decrease of estimated CH_4 emissions by 15.0 per cent.

4. Uncertainties

14. Ireland has provided a tier 1 uncertainty analysis for each category and for the inventory as a whole, following the IPCC good practice guidance. Uncertainties have been reduced compared with

previous years through the introduction of higher-tier methods and re-evaluation of the uncertainty values for some sectors. The ERT encourages Ireland to address the relatively high uncertainties for the oil energy balance, and recommends that the Party engage with key data providers on uncertainty analysis as a means to improve the accuracy of the inventory and to prioritize improvements.

5. Verification and quality assurance/quality control approaches

15. Ireland has developed a quality assurance/quality control (QA/QC) plan in accordance with the IPCC good practice guidance. This includes general QC procedures (tier 1) as well as source/sink category-specific procedures (tier 2) for key categories and for those individual categories in which significant methodological and/or data revisions have occurred.

16. Overall responsibility for QA/QC activities is with the Office of Climate Licensing and Resource Use (OCLR). During the in-country visit Ireland presented its data collection, processing, archiving and QA/QC activities to the ERT. Within the OCLR team decisions are taken relating to the division of work and the allocation of responsibilities for the different sectors of the inventory, and this produces a common understanding of individual tasks in the annual compilation and reporting cycle. Core inventory calculation and QA/QC procedures are conducted on a round-robin basis so that the inventory experts involved in the checking and the QA/QC documentation for any given sector are not also the compilers. The ERT recommends that the above procedures and practices be documented in the NIR of Ireland's next inventory submission.

6. Follow-up to previous reviews

17. Ireland has made significant improvements to its inventory following previous reviews. These improvements include moving to tier 2 methods for some important agricultural sources, the development of a comprehensive LULUCF inventory, and improved estimates for the F-gases and plant-level data for a number of energy and industrial processes categories, as well as an improved QA/QC system.

G. Areas for further improvement

1. Identified by the Party

18. The NIR identifies several areas for improvement that reflect recommendations in previous reviews and Ireland's own initiatives. They include: further implementation of the institutional arrangements and QA/QC; improving the oil energy balance; and further improvements to the agriculture sector estimates, with a focus on the methane emissions model, N_2O measurement studies, and process modelling of N_2O emissions.

2. Identified by the ERT

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

(a) Include in the NIR additional information provided to the ERT during the course of the review (see annex I) on methodology descriptions; missing references for country specific EFs; and rationale for selection of default EFs and parameters;

(b) Provide a detailed explanation of its emission trends and the drivers of the trends;

(c) Further formalize agreements with non-government data providers where possible;

(d) Proceed to formalize agreements with key data providers covering the provision of information, core requirements on the uncertainty and accuracy of the data, and quality control;

(e) Improve the coverage of QA/QC procedures across the inventory.

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

II. Energy

A. Sector overview

21. In 2004, GHG emissions in Ireland from the energy sector amounted to 44,401 Gg CO_2 equivalent, or 65.0 per cent of total national GHG emissions. Emissions in this sector increased by 40.2 per cent between 1990 and 2004. The dominant gas in the sector is CO_2, which accounted for 96.1 per cent of total energy sector emissions in 2004, while CH_4 and N_2O represented 0.4 and 3.4 per cent, respectively. Emissions from fuel combustion represented 99.7 per cent of total emissions from the sector. Of this, energy industries, transport and other sectors in 2004 contributed 35.5, 28.3 and 24.9 per cent, respectively. The residential subsector contributed 16.0 per cent of total sectoral emissions and fugitive emissions, a relatively minor source, 0.3 per cent.

22. In Ireland's 2006 submission for the energy sector, the estimates for 1990 and 2004 have been improved with the use of a revised energy balance, and all GHGs are reported for the key source categories. The CO_2 EFs are mostly country-specific and determined directly from information on the carbon content and net calorific values of the fuels used in stationary and mobile sources. The inventory is complete, with the exception of minor sources for a number of source categories under oil (1.B.2a) which are reported as not estimated ("NE"). The ERT encourages Ireland to improve the transparency of the inventory by reporting units for peat in CRF table 1.A(b).

23. AD in the major energy use categories, such as energy industries and manufacturing, industry and construction, are verified using data obtained from the European Union (EU) emissions trading scheme (ETS). The ERT encourages Ireland to explain the differences between the energy data in the CRF and the corresponding data from the International Energy Agency (IEA).

24. Ireland has included the revised energy balance for 1990 and 2004 in the emission estimates, but has not recalculated intermediate years. However, differences were observed in the implied emission factor (IEF) between the 2006 and 2005 submissions with respect to the following: solid fuel used in energy industries (there is a 4 per cent difference for solid fuels for 1990 between the 2005 and 2006 submissions); and other non-specified liquid fuels used in manufacturing industries and construction (there is a 7.6 per cent difference between the 2005 and 2006 submissions). Ireland is encouraged to provide explanations for these differences in its next inventory submission.

25. The ERT noted that the 2006 inventory is more complete than that for 2005 as estimates for non-ferrous metals (solid and gaseous fuels) and solid fuel use in manufacturing industry and construction have been added. However, no explanation for this change is given in the NIR. Ireland is encouraged to provide explanations for the addition of new sources in its future NIR submissions.

B. Reference and sectoral approaches

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

26. Ireland reports differences between the reference and the sectoral approach of 1.4 and 2.6 per cent for CO_2 emissions and apparent fuel consumption, respectively, for 2004. The differences occur mainly with respect to emissions from liquid fuels. The ERT noted that there is only a limited explanation of this difference in the NIR; it provides explanations only at an aggregate level and at the level to which EFs are applied in the reference approach. The ERT encourages Ireland to provide a more detailed description of relevant differences in its next inventory submission.

2. International bunker fuels

27. Ireland estimates GHG emissions from domestic and international bunkers separately. Currently it estimates domestic emissions based on aircraft movements. However, Ireland's revised energy balance provides separate estimates of fuel consumption for domestic and international aviation.

3. Feedstocks and non-energy use of fuels

28. A significant amount of natural gas feedstock was formerly used in ammonia production in Ireland, but the company concerned ceased operations in 2002. Ireland does provide a brief explanation about naphtha in the NIR, but it is not clear how this fuel is handled in the inventory. The ERT encourages Ireland to provide a more detailed description of these estimates in its next inventory submission.

C. Key categories

Fuel combustion: Solid fuels CO_2

29. The EF is among the highest of reporting parties. The Party explained in its NIR that the high value is due to an apparent incompatibility between peat energy use as given in the energy balance and the CO_2 emissions estimates received for peat-fired plants due to an incomplete accounting of peat consumption. The ERT recommends that the Party improve the accounting of peat consumption for this fuel category.

III. Industrial processes and solvent and other product use

A. Sector overview

30. In 2004, the industrial processes sector accounted for 4.6 per cent of total national GHG emissions. Emissions from this sector increased by 0.1 per cent between 1990 and 2004. This minor increase in the trend arises from the development of the mineral products industry (mainly cement production) and, to a lesser extent, increases in F-gases consumption that offset the closure of ammonia and nitric acid plants in Ireland. The only ammonia and nitric acid production plants existing in Ireland closed down in June 2002. Production of cement has increased in recent years as two new plants have opened. Consumption of F-gases that are replacing ozone-depleting substances has also increased since 1994. In 2004, CO_2 from mineral products contributed 79.0 per cent of the emissions of the sector, and HFCs from the consumption of halocarbons and SF_6 contributed 12.6 per cent (the F-gases collectively contributed 21.0 per cent).

31. Emissions are reported for most sources and gases, except for asphalt roofing, road paving with asphalt, glass production, pulp and paper, and food and drink, for which no emissions have been estimated (they are reported as "NE"). In the solvent and other product use sector, emissions from the direct use of N_2O for anaesthesia have not been estimated ("NE" is reported). The ERT encourages Ireland to include estimates of these missing sources in its next inventory submission and to use the verified CO_2 emission estimates that are available through the European Union (EU) emissions trading scheme (ETS) where possible for missing sources. Even if missing sources are only minor, their inclusion will make the inventory more complete.

32. The 2006 CRF is generally transparent. The ERT noted several instances where the use of the notation keys is inconsistent through the time series (CO_2 emissions for iron and steel are reported as "NE", not occurring ("NO") or "0.00" in the period 1990–2003) or they are not used at all; this is more evident in the earlier years of the time series. Ireland is encouraged to use the notation keys consistently across the time series and to improve transparency by reporting explanatory information on the use of the notation key "NE" in CRF table 9(a), particularly for the other subcategories.

33. QA/QC procedures have been applied in this sector for the 2006 submission. Data on mineral products have been verified for recent years within the framework of the implementation of the EU ETS and specific studies have been commissioned for the F-gases and solvent and other product use (non-methane volatile organic compounds (NMVOCs)).

34. Ireland has applied IPCC good practice guidance for key categories of the industrial processes sector. The ERT commends Ireland for implementing higher-tier methods to the extent possible for the first time in the 2006 submission for the cement and lime production source categories. Data for these categories are obtained directly from the operators, which corresponds directly to the higher-tier method recommended by the IPCC good practice guidance. Ireland has revised, recalculated and updated emission estimates for all categories in this sector. Higher-tier methods have also been applied to the time series to the extent possible. The ERT encourages Ireland to explore alternatives to the current method (extrapolations) of estimating F-gas emissions as a means to ensure time series consistency. Further, Ireland is encouraged to improve the documentation of the current F-gas methodology in the next inventory submission.

35. The ERT requested additional information and explanations from the Party during the in-country visit in order to make a complete assessment of some categories. The additional information provided during the course of the review (see annex I) improved the ERT's understanding of methodology and EFs used to estimate emissions. The ERT recommends that Ireland consider improving the transparency of the industrial processes inventory by including much of this information in the NIR, with a specific reference to methods, EFs, trends and impact of recalculations on the time series, inter-annual variations, uncertainties, verification and category documentation.

36. Ireland applies the IPCC good practice guidance for its uncertainty estimates using a tier 2 Monte Carlo analysis for the category consumption of halocarbons and SF_6, while tier 1 analysis is used for all other categories in this sector.

37. Ireland plans to continue outsourcing contracts for the F-gas estimates and to use the verified CO_2 emission estimates for cement and lime production that are available through the EU ETS. The ERT encourages Ireland to improve the studies on F-gases using national data and avoiding using extrapolation when possible, as well as to use the verified CO_2 emission estimates that are available through the EU ETS for sources that are currently missing. Even if these are only minor sources, their inclusion will make the inventory more complete.

B. Key categories

1. Cement production – CO_2

38. The methodology used is based on information recently acquired from the four cement plants in conjunction with information obtained from the implementation of the EU ETS. CO_2 emissions have been verified since 2003 using this information. In the 2006 submission, Ireland has updated all the estimates using data on process CO_2 emissions disclosed by the cement plants for 1990–2004 and AD for 2003–2004. Even though the cement plants are reporting CO_2 emissions, information on the quantities of cement or clinker produced has not been disclosed for the period 1990–2002; this is not described in the NIR. The ERT encourages Ireland to review and clarify this methodology in its next inventory submission.

2. Consumption of halocarbons and SF_6 – HFCs

39. Ireland reports recalculations for the major sources of HFCs (refrigeration, air conditioning and aerosols) for all years of the time series. The recalculations are based on a revised methodology which has been applied to all years from 1995 to 2004, and a splicing technique for the years 1991–1994. This has increased the estimates of 1995 emissions from this category by 115 per cent. During the in-country

visit Ireland informed the ERT that the basis of the revised methodology is three studies on the F-gases. However, the methodology applied was not fully documented in these studies. Ireland informed the ERT that data for the years 1991–1994 were obtained through a combination of interpolation between 1990 and 1995 for stationary refrigeration and air conditioning, international production data for foams, and United Kingdom data for aerosols adjusted for size of population. The ERT recommends that the documentation on these methods be improved in Ireland's next inventory submission, including explanations of the underlying assumptions (from the studies) and of the inter-annual fluctuations.

C. Non-key categories

1. Lime production – CO_2

40. In its 2006 submission, Ireland has used plant-specific data disclosed by operators in the context of the EU ETS for 2004. The plant-specific EFs were used to recalculate the time series 1990–2003. The ERT encourages Ireland to provide information on the data sources and on the assumptions made to estimate AD, and explanations of the trend, in the NIR to improve transparency.

41. Emissions arising from captive lime production are not estimated. The Party informed the ERT that there is captive lime production in sugar production facilities but that there are no process emissions from this activity. The ERT encourages Ireland to include in the NIR a justification as to why captive lime production is not included in the lime production estimates.

2. Limestone and dolomite use – CO_2

42. Ireland has reported for the first time CO_2 emissions for limestone and dolomite use for the period 1990–2004. Estimates of CO_2 process emissions from bricks and ceramics production plants were obtained recently from the EU ETS. CO_2 emissions from the use of limestone in a new peat-burning power station are included in this source. The 1990 CO_2 IEF (0.07 t CO_2/t limestone) is considered by the ERT to be very low (it is the lowest of all reporting Parties except for 1990, when it is the second-lowest) and is outside the IPCC default range (0.44–0.48 t CO_2/t limestone). The ERT concluded that the CO_2 IEF reflects the IEF for bricks and ceramics production in Ireland up to 2000, and after 2000 it includes emissions from limestone use for environmental applications in a peat-burning power station. Bricks and ceramics manufacturing plants use limestone as a raw material and not for external applications. In order to improve the time-series consistency of the emission estimates and comparability with other Parties' inventories, the ERT recommends Ireland to reallocate bricks and ceramics production data to the subcategory other under mineral products (2.A.7).

43. The ERT encourages Ireland to provide more information in the NIR on the methodology applied, the assumptions made for estimating AD and the data sources used.

3. Other use of solvents – NMVOCs

44. Other use of solvents is the major source of emissions in the solvent and other product use sector. No information on this source is provided either in the NIR or as explanatory information in the documentation box of the CRF table.

IV. Agriculture

A. Sector overview

45. In 2004, the agriculture sector in Ireland accounted for 27.6 per cent of total national GHG emissions (18,830 Gg CO_2 eq.). In 1990 the share was 34.4 per cent (19,063 Gg CO_2 eq.). Emissions from the sector decreased by 1.2 per cent between 1990 and 2004. The main drivers of the decrease were general agriculture policies and economic activities. Ireland submitted revised estimates to the ERT during the review based on revisions of the estimates of emissions of CH_4 and N_2O from manure

management and agricultural soils and N_2O from agricultural soils, which resulted in revision of the estimates of total sector emissions for 2004, from 18,982 Gg CO_2 equivalent to 18,830 Gg CO_2 equivalent.

46. The agriculture inventory is complete, with the cultivation of histosols the only exception. The ERT recommends that Ireland include emissions from this category in its next inventory submission.

47. The ERT acknowledged that the estimates of emissions from enteric fermentation and manure management have been significantly improved by the implementation of a tier 2 method for estimating CH_4 emissions. The time series has been recalculated. Other improvements identified by the ERT are: the treatment of the source categories enteric fermentation and manure management at a more disaggregated level; the use of official annual statistics (without three-year averaging); consistent application of nitrogen (N) excretion rates, officially adopted by the Department of Agriculture for implementation of the EU Nitrates Directive, for all animals; and the full utilization of reliable data on animal waste management systems and other farm-level practices from Ireland's NH_3 inventory.

48. Ireland uses the IPCC good practice guidance methodology (tiers 1a and 1b) to estimate N_2O emissions from agricultural soils. The ERT notes the effort made in developing a tier 2 NH_3 inventory and the continuing investigation of N_2O emission models and encourages the Party to use detailed activity data (Tier 1b method) to the maximum possible extent while that development takes place.

B. Key categories

1. Enteric fermentation – CH_4

49. In 2004, this category accounted for 49.0 per cent (439.7 Gg CH_4) of total sectoral emissions and 13.5 per cent of total national emissions. Emissions decreased by 1.1 per cent between 1990 and 2004.

50. The ERT notes the improvement that Ireland has made by using a tier 2 method to estimate CH_4 emissions from dairy and non-dairy cattle for the first time in this submission. The method is based on a net energy system for cattle. This method (and the underlying AD and EFs) is consistent with the IPCC good practice guidance. The ERT recommends that Ireland improve the documentation of this method in the NIR by providing information and explanations on the collection of AD (e.g. descriptions of the two different censuses) and the estimation of country-specific EFs (e.g. for the cattle herd).

51. In accordance with the IPCC good practice guidance, a tier 1 method has been used for all other livestock categories. However, the ERT encourages the Party to make efforts to continuously improve the collection of detailed AD and the derivation of country-specific factors for some of these categories.

2. Manure management – CH_4

52. In 2004, CH_4 emissions from this category accounted for 12.0 per cent of total sectoral emissions and 3.3 per cent of total national emissions, having decreased by 2.6 per cent since 1990.

53. Ireland has used a tier 2 method to estimate CH_4 emissions from cattle (dairy and non-dairy) manure management. A tier 1 method has been used for all other relevant livestock categories. Both methods are consistent with the IPCC good practice guidance, and Ireland uses appropriate country-specific or default EFs and AD.

3. Manure management – N_2O

54. In 2004, N_2O emissions from this category accounted for 2.2 per cent of total sectoral emissions and 0.6 per cent of total national emissions, having increased by 1.2 per cent since 1990.

55. Ireland has used a tier 1 method to estimate N_2O emissions from this category. Nitrogen excretion rates have been applied for all animal categories for which annual census data are published by

the Central Statistics Office. These rates are used and endorsed by the Department of Agriculture and Food and by the Irish Agriculture and Food Development Authority (TEAGASC) for national use and as guidance for farmers in relation to implementation of the EU Nitrates Directive. The ERT recommends Ireland to provide more documentation on the NH_3 inventory and the linkages between the NH_3 inventory and N_2O emissions in the NIR of its next inventory submission. Additionally, documentation on the Farm Facilities Survey undertaken by TEAGASC and the Department of Agriculture in 2003 to establish baseline data on Ireland's farm manure management practices and facilities should be provided in the NIR.

4. Direct soil emissions – N_2O

56. In 2004, this category accounted for 15.7 per cent (9.6 Gg N_2O) of total sectoral emissions and 4.4 per cent of total national emissions. Emissions decreased by 2 per cent between 1990 and 2004.

57. Emissions from the cultivation of histosols are reported as "NO". However, the ERT noted that 5,950 ha of organic soils are reported in cropland remaining cropland (LULUCF sector). The ERT recommend Ireland to revise the AD for this source and, if applicable, estimate N_2O emissions from this category.

5. Pasture, range and paddock manure – N_2O

58. In 2004, this category accounted for 14.8 per cent (9.1 Gg of N_2O) of total sectoral emissions and for 4.1 per cent of total national emissions. Emissions decreased by 0.7 per cent between 1990 and 2004. The amount of organic N input is large in Ireland as cattle are only kept under cover for relatively short periods and because the large sheep populations are mostly not housed.

6. Indirect soil emissions – N_2O

59. In 2004, this category accounted for 7.2 per cent (4.4 Gg N_2O) of the total sectoral emissions and 2 per cent of total national emissions. Estimates of the nitrogen loads in Ireland's rivers, reported under the Convention for the Protection of the Marine Environment of the North-East Atlantic (known as the OSPAR Convention) (NEUT, 1999), suggest that approximately 10 per cent of all N used in Irish agriculture is lost through leaching. This level of leaching is also indicated by farm budget studies.

V. Land use, land-use change and forestry

A. Sector overview

60. In 2004, the LULUCF sector in Ireland was a net sink of 71.60 Gg CO_2 equivalent. The sector evolved from being a net source during the period 1990–1997 to being a net sink thereafter. This sink effect was largely driven by the category forest land remaining forest land, which had a net removal of 671.29 Gg CO_2 in 2004. The cropland and grassland categories were net sources (of 171.93 and 430.50 Gg CO_2, respectively). Conversion of grassland to cropland and application of agricultural lime were the main sources in these land-use categories.

61. Ireland has reported the inventory categories of LULUCF according to decision 13/CP.9 for the first time in its 2006 submission. The ERT noted the efforts made by Ireland to improve its coverage of sink and source categories, as well of relevant carbon pools. The ERT encourages Ireland to include in the NIR an explanation of how the LULUCF categories map on to the categories of the Revised 1996 IPCC Guidelines. Ireland has provided a complete set of CRF tables for the LULUCF sector as required by decision 13/CP.9, covering the entire period 1990–2004. The data reported in the NIR and the CRF tables did not include estimates for the categories emissions of N_2O from disturbance associated with land-use conversion to cropland (5(III)) and emissions of CH_4 and N_2O from biomass burning (5(V)). These activities do occur in Ireland and, although they are not extensive, an effort should be made to report them in future submissions to improve the completeness of the inventory. CO_2 is the only gas for

which emissions and removals have been estimated for the time series. Relevant CH_4 and N_2O emissions were either not estimated or indicated as included elsewhere. Ireland is recommended to report emissions of non-CO_2 gases in its next submission.

62. Ireland has used tier 2 and some tier 3 methods for estimating carbon (C) stock changes in forest land. For all the other categories, tier 1 methods have been used. These emission estimates are largely derived from the National Forest Inventory, data from Coillte (the state forest company) and various other sources, and use of the CARBWARE model. The ERT noted that Ireland has allocated increased resources to implementing the LULUCF inventory.

63. During the in-country visit, Ireland provided the ERT with information and documentation on the choice of methods, AD and EFs, on assumptions made, and on the CARBWARE model used for estimating carbon stock changes in forest land. The ERT recommends that the Party improve the transparency of its LULUCF inventory by including in the NIR clearer descriptions of the methods and assumptions used, including more precise references to annexes or relevant supporting material; and tables with complete time-series data for key AD (e.g. annual area of plantation, annual volume of wood harvest, etc.).

B. Key categories

1. Forest land remaining forest land – CO_2

64. The area of forest land increased from 370 to 522 kha over the period 1990–2004, a 41 per cent increase. The area of forest land remaining forest land increased from 195 kha in 1990 to 242 kha in 2004 (a 24 per cent increase) and the area of land converted to forest increased from 175 kha in 1990 to 281 kha in 2004 (a 60 per cent increase). According to information from CARBWARE provided by the Party during the in-country visit, the policies implemented during the period led to an increase in the area of annual afforestation from an average 7.7 kha/year in the ten-year period 1980–1989 to 15.6 kha/year in the period 1990–2004. The forest land category was a net sink in every year of the period 1990–2004, with net annual CO_2 removals tending to increase, from 768 Gg CO_2/year in the period 1990–1993 to 1,285 Gg CO_2 in the period 2001–2004.

65. Ireland reports net changes of carbon stocks in living biomass instead of reporting increases and decreases separately, as recommended by the IPCC good practice guidance. This is due to constraints in the availability of data. The ERT recommends that Ireland report increases and decreases of carbon stocks in living biomass separately in its future submissions.

66. Carbon stocks in forest C pools for which country-specific data are still not available have been estimated conservatively using tier 1 methods with a number of assumptions leading to underestimations of C gains and overestimation of losses. The ERT noted the efforts being made by the Party to develop country-specific factors and methods in order to improve the accuracy of the estimates in the future.

67. The C stock factors chosen for estimating C stock changes in the litter carbon pool in forest land for age classes higher than 20 years (0.8 and 1.3 tC/ha/year for broadleaf and conifers, respectively) are not the IPCC default values, as indicated in the NIR. The values selected (taken from the IPCC good practice guidance for LULUCF) correspond to a transition period of 20 years, while a transition period of 50 years (0.3 and 0.5 tC/ha/year for broadleaf and conifers, respectively) should have been selected. The Party expressed that the values were correctly derived from national information, but were wrongly referenced to as IPCC default values. However, documentation supporting the choice of country-specific factors has not been provided during the review. The ERT encourages the Party to improve the documentation of these factors in future submissions.

2. Grassland remaining grassland – CO_2

68. Changes in the soil organic carbon pool have been estimated using a simplified version of the tier 1 method: a single combination of adjustment factors for land-use management and inputs has been used for the whole of Ireland. Subcategories of grassland have been identified (unimproved pasture, improved pasture, rough grazing), but no management systems have been identified for these land-use subcategories (management practice may include seeding of productive species, soil tillage, irrigation, fertilization, etc.). The area of each grassland subcategory should be attributed to different management systems (e.g. unique combinations of different practices). Adjustment factors should be applied at a disaggregated level (i.e. for each combination of land-use subcategory and management system). The ERT encourages Ireland to provide more disaggregated estimates for this category in its future submissions.

C. Non-key categories

1. Cropland remaining cropland – CO_2

69. Changes in the soil organic carbon pool have been estimated using a simplified version of the tier 1 method: a single combination of adjustment factors for land-use management and inputs has been used for the whole of Ireland. Neither land-use subcategories of cropland nor the prevailing management systems for cropland (e.g. crop rotations, soil tillage, crop residue management, irrigation, fertilization, etc.) have been identified. Cropland area should be attributed to different land-use subcategories (e.g. perennial crops, annual crops, set-aside land, etc.) and management systems (e.g. unique combinations of different practices). Adjustment factors should be applied at a disaggregated level (i.e. for each combination of land-use subcategory and management system). The ERT encourages Ireland to provide more disaggregated estimates for this category in its future submissions.

2. Disturbance associated with land-use conversion to cropland – N_2O

70. This source is reported as not occurring for grassland conversion category. However, this is inconsistent with the fact that this land-use change does occur in Ireland, as reported in CRF table 5.B. This source should therefore be estimated. Ireland reports AD showing an increase with time in the conversion of land to cropland. This land–use conversion category was almost negligible in 1990, but now covers almost 70,000 ha in 2004. The associated emissions should be reported.

3. Forest fires – CH_4 and N_2O

71. This mandatory source was not reported. Forest fires occurring on managed land must be reported even if they are accidental. Forest fires do occur in Ireland, although not over large areas.

VI. Waste

A. Sector overview

72. In 2004, emissions from the waste sector contributed 2.7 per cent (1,834 Gg CO_2 eq.) to total national GHG emissions. They increased by 25.5 per cent between 1990 and 2004.

73. Solid waste disposal on land is the largest source of CH_4 emissions, and has been a key category throughout the period 1990–2004. In 2004 it contributed 12.5 per cent (1,678 Gg CO_2 eq.) to the total CH_4 emissions of Ireland, which represents a slight increase from 2003 (when emissions amounted to 1597.16 Gg CO_2 eq., or 11.6 per cent of national total CH_4 emissions). Net CH_4 emissions from this category increased by 5.1 per cent between 2003 and 2004. Although the amount of recovered landfill gas has increased since 2003 (by 10.4 per cent, or 79.9 Gg CO_2 eq.), CH_4 emissions from the category are still showing a steadily increasing trend. N_2O emissions from human sewage and CH_4 from sludge have been estimated, while N_2O from wastewater handling has not been estimated. CH_4 emissions from

wastewater are reported as not occurring based on the assumption that all wastewater sent to municipal wastewater plants is treated aerobically. Incineration of non-biogenic waste is reported as not estimated as Ireland assumes that waste incineration is not widely used and emissions are therefore negligible. Incineration of biogenic waste is reported as not occurring.

74. CH_4 emissions from sewage sludge have been estimated for the first time in 2004. Emissions from this activity are allocated to solid waste disposal on land, wastewater handling, and agricultural soils, and their inclusion represents a major improvement in the completeness of the inventory compared to the previous submission. Ireland has also reported flaring of landfill gases for the period 2001–2003 for the first time.

75. Ireland reports recalculations for the entire waste sector time series to reflect revised population statistics. This has resulted in an 8.3 per cent increase in estimated 1990 emissions for the sector, mainly due to the inclusion of sewage sludge, while emissions in 2003 decreased by 15 per cent, mainly due to the inclusion of CH_4 recovery with flaring.

76. No description of uncertainties is given in the NIR. Considering the high uncertainties of this source and the fact that the inventory relies on data covering many individual landfill sites under different local authorities, the ERT encourages Ireland to give further information in the NIR about the sector-specific QA/QC measures taken.

B. Key categories

Solid waste disposal on land – CH_4

77. CH_4 recovery from landfill sites for renewable energy has been reported since 1997. Flaring has also been reported since 2001 (recovery data developed for the European Pollution Emissions Register, EPER, have been obtained from the EPA waste management section). CH_4 recovery with these activities has been subtracted from the CH_4 generation from solid waste disposal sites. CH_4 recovery has offset the overall increasing trend in CH_4 generation from this category. Ireland recognizes that there is a gap between the amounts of flared gas estimated by top-down and bottom-up analysis, and is working to resolve this issue. The ERT encourages Ireland to complete this work for subsequent submissions.

78. Ireland uses a country-specific tier 2 method to estimate the CH_4 production potential of municipal solid waste (MSW) sent to landfill in accordance with the IPCC good practice guidance. While Ireland reports in the NIR the typical CH_4 production pattern in solid waste disposal sites and provides a table of annual potential CH_4 production, Ireland is encouraged to provide a more detailed explanation in its next inventory submission on how the production pattern in Figure 8.1 of the NIR was developed from a first order decay model. This information is necessary to support an expert review of this category, and enable ERT to understand how it differs from the first order decay method of the IPCC good practice guidance.

79. Ireland reports a fraction of degradable organic carbon content in MSW of 0.24 in the 2004 CRF table. Ireland informed the ERT during the in-country visit that this high value is due to national circumstances. The ERT encourages Ireland to follow IPCC good practice guidance by documenting country-specific factors, and to present the information on the MSW breakdown and rationale for the decision to use this high value in its next inventory submission.

C. Non-key categories

Wastewater handling – CH_4 and N_2O

80. For 2004, emissions from this category amounted to 24.2 Gg CO_2 equivalent, having increased by 65 per cent over the time series. CH_4 emissions from industrial wastewater sludge increased by 144 per cent over the same period. N_2O from human sewage is estimated, while N_2O from wastewater

handling has not been estimated. Ireland informed the ERT that it does not estimate N_2O emissions from wastewater as no method is prescribed by the revised 1996 IPCC guidelines, nor does it consider new methods included in recently published recognized international scientific literature as suited to national circumstances. The ERT encourages Ireland to provide an explanation in CRF table 9(a) and the NIR on the use of the notation key not estimated.

81. The ERT concluded that the description on the methodology to estimate CH_4 and N_2O emissions from this category could be improved. During the in-country visit, the Party provided additional information and explanation that improved the ERT understanding on table 8.2 of the NIR and how calculations are performed. Elements of the calculation (e.g. the conversion of kg to m^3 and of kg BOD to total organic waste) are not clear in the NIR. Ireland is recommended to include additional information in the NIR to improve the transparency of the methodology.

VII. Conclusions and recommendations

82. Ireland has made significant improvements to its inventory since the 2005 submission, most of them in response to recommendations made by the ERT. Some major improvements include: recalculations in the energy sector to include improved energy balance data; the use of higher-tier methods in the agriculture, LULUCF and waste sectors; the reporting of LULUCF in accordance with decision 13/CP.9 for the first time; and general improvements in the completeness and transparency of the inventory.

83. Ireland has submitted a complete set of CRF tables for years 1990–2004 and a comprehensive NIR. The inventory generally covers all categories for the entire inventory time series 1990–2004 with exception to a number of minor source categories for which GHG emissions are not estimated, and is complete in terms of geographical coverage.

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

- Improve the transparency of the inventory by:
    - (a) Structuring the presentation of the NIR according to the UNFCCC reporting guidelines;
    - (b) Including a reasonable amount of information presented to the ERT during the in-country visit in the NIR of its next inventory submission;
    - (c) Providing detailed explanations of emission trends in the NIR, including the identification of the main drivers underpinning the trend;
    - (d) Providing detailed descriptions of the rationale for the selection of EFs or methodology; appropriate referencing in the NIR of country-specific methods and EFs; and detailed descriptions of the models and model parameters used directly, or in part, in the generation of an emission estimate;
- Prepare formalized procedures within the inventory team for the recording and prioritization of future improvements to the inventory, including a procedure for engaging key data providers in this process;
- Include in its next inventory submission information on the institutional arrangements underpinning the National Atmospheric Inventory System.

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

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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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. FCCC/SBSTA/2004/8. Available at <http://unfccc.int/resource/docs/2004/sbsta/08.pdf>.

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B. Additional information provided by the Party

Responses to questions during the review were received from Mr. Michael McGettigan, Mr. Paul Duffy and Mr. Bernard Hyde, all from the Irish Environmental Protection Agency (EPA), were received by the ERT, along with additional material provided during the course of the in-country visit. The following information was provided.

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EPA report of National Inventory Report 2006.

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National Waste Database, Report 1998 (2000) and 2001 (2003). Environmental Protection Agency.

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Yan T, Agnew, RE, Gordon FJ and Porter MG. 2000. Prediction of methane energy output in dairy and beef cattle offered grass silage-based diets. *Livestock Production Science* 64:253-263.

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