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AUSTRALIA

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

I. OVERVIEW

A. Introduction

1. This report covers the centralized review of the 2004 greenhouse gas (GHG) inventory submission of Australia, coordinated by the United Nations Framework Convention on Climate Change (UNFCCC) secretariat, in accordance with decision 19/CP.8 of the Conference of the Parties. The review took place from 18 to 22 October 2004 in Bonn, Germany, and was conducted by the following team of nominated experts from the roster of experts: Generalists – Mr. Newton Paciornik (Brazil) and Mr. Bernd Gugele (European Community), Energy – Ms. Karen Treanton (International Energy Agency, IEA), Ms. Maria Lidén (Sweden) and Ms. Tetyana Gordiyenko (Ukraine), Industrial Processes – Ms. Ionela Draghici (Romania) and Mr. Teemu Oinonen (Finland), Agriculture – Mr. Len Brown (New Zealand) and Ms. Lilian Portillo (Paraguay), Land-use Change and Forestry (LUCF) – Mr. Mikhail L. Gytarsky (Russian Federation) and Ms. Kathryn Bickel (United States), Waste – Mr. Oscar Paz Rada (Bolivia) and Mr. Faouzi Ahmed Senhaji (Morocco). Mr. Mikhail L. Gytarsky and Mr. Newton Paciornik were the lead reviewers. The review was coordinated by Mr. Javier Hanna (UNFCCC secretariat).

2. In accordance with the "UNFCCC guidelines for the technical review of greenhouse gas inventories from Annex I Parties", a draft version of this report was communicated to the Government of Australia, 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 2004 submission, Australia has submitted a complete set of common reporting format (CRF) tables for the years 1990–2002 and a national inventory report (NIR). CRF tables 5.A, 5.B, 5.C, 5.D have not been provided due to the use of country-specific method; tables Summary 3, 7, 8(b), 9, 10 and 11 have been provided only for 2002. Notation keys are used throughout the tables. Australia has provided emission data trends for its UNFCCC reporting and its Kyoto Protocol reporting. In this review report all emissions data refer to the UNFCCC reporting. Where needed the expert review team (ERT) also used methodology reports available from the Australian Greenhouse Office web site, the previous 2003 and the 2000 submissions, additional information provided during the review and other information. The full list of materials used during the review is provided in annex 1 to this report.

C. Emission profiles and trends

4. In the year 2002, the most important GHG in Australia was carbon dioxide (CO_2), contributing 68.8 per cent to total[2] national GHG emissions expressed in CO_2 equivalent, followed by methane (CH_4)

[1] In the symbol for this document, 2004 refers to the year in which the inventory was submitted, and not to the year of publication.

– 23 per cent – and nitrous oxide (N_2O) – 6.6 per cent. Confidential emissions of CO_2 and N_2O from Mineral Products and Chemical Industry contributed 0.7 per cent to total national GHG emissions. In the year 2002, perfluorocarbons (PFCs) and hydrofluorocarbons (HFCs) taken together contributed 0.8 per cent of the overall GHG emissions in the country, while emissions of sulphur hexafluoride (SF_6) are reported as "not estimated" ("NE"). The Energy sector accounted for 71.3 per cent of total GHG emissions, followed by Agriculture (20.3 per cent), Industrial Processes (5.1 per cent) and Waste (3.4 per cent). Emissions from solvent and other product use are reported as "not applicable" ("NA") and "NE". Total GHG emissions (excluding LUCF) amounted to 520,965.88 Gg CO_2 equivalent in 2002 and increased by 23.2 per cent from 1990 to 2002. Total net GHG emissions (including LUCF) amounted to 539,155.14 Gg CO_2 equivalent and increased by 4.5 per cent from 1990 to 2002. The difference between the two emission trends is mainly due to a 65 per cent decrease of CO_2 emissions from forest and grassland conversion from 1990 to 2002.

D. Key sources

5. Australia has reported a key source tier 1 analysis, both level and trend assessment, as part of its 2004 submission. The key source analyses performed by the Party and the secretariat[3] produced similar results. The main difference between them is the inclusion of LUCF in the analysis by the Party and the use of a more disaggregated list of categories by the Party. The choice of subcategories is judged to be generally appropriate. The use of the country-specific category "Soil Disturbance" makes it difficult to include separated direct and indirect soil emission estimates in the key source analysis. The Party mentions in the NIR that the key source analysis is used in order to focus future improvement of the inventory, but the link between the key source analysis and future improvements could be made clearer in the NIR.

E. Main findings

6. The NIR submitted by Australia is broadly in conformity with the UNFCCC reporting guidelines, but Australia uses a structure for the NIR that is different from the outline recommended in the guidelines. The methodologies for estimating GHG emissions are generally consistent with the *Revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC Guidelines) and the *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance).

7. The ERT noted that Australia produced an updated series of methodological workbooks for individual sectors with the aim to extensively document inventory methodologies. However, the transparency of the NIR could be further improved by including more detailed descriptions of methodologies used, taken, for instance, from the Australian methodology workbooks, and by including justifications for the use of country-specific methodologies. This applies, for example, to the categories CH_4 from Enteric Fermentation, N_2O from Manure Management and CH_4 from Solid Waste Disposal on Land.

8. The use of a country-specific category ("Soil Disturbance") which encompasses several IPCC categories (which could possibly be key sources as separate categories) means that Australia's estimates of emissions from N-fixing Crops, Crop Residue, Cultivation of Histosols and Atmospheric Deposition are more difficult to review and compare with those of other Parties.

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

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

F. Cross-cutting topics

Completeness

9. The inventory covers almost all the direct GHG emissions, by sources, and removal by sinks, including CO_2, CH_4, N_2O, HFCs, PFCs and SF_6 (SF_6 is reported only for 1996–2000). Estimates of the indirect GHGs (carbon monoxide (CO), nitrogen oxide (NOx) and non-methane volatile organic compounds (NMVOCs)) as well as sulphur dioxide (SO_2) have also been provided. The sources not reported in the inventory but included in the IPCC Guidelines have been summarized in the completeness table in the CRF. In particular, emissions of HFCs have been estimated only for the category Refrigeration and Air Conditioning Equipment, and SF_6 emissions from aluminium and magnesium foundries have not been estimated for 1990–1995, 2001 and 2002.

10. In addition, the reference approach tables for 1990–1999 are missing. Furthermore, N_2O from Indirect Emissions – Nitrogen Leaching and Run-off are reported as "NE" and CH_4 emissions from range-kept livestock are reported as negligible. "Not occurring" ("NO") is reported for pulse production in CRF table 4.F, although data on the production of beans, peas and lentils are available through the Food and Agriculture Organization of the United Nations (FAO) database.

11. The reporting of CO_2 emissions from soils is incomplete: Liming on Agricultural Soils and Cultivation of Organic Soils are not reported. Australia informed the ERT that it is investigating the extent of liming practice for possible inclusion in future submissions and that it is unlikely that cultivation of organic soils occurs.

Transparency

12. Australia's NIR is generally well documented, although it does not follow the outline of the UNFCCC reporting guidelines. All main areas are addressed in the NIR, although sometimes in a very brief way, for example, information on institutional arrangements and quality assurance/quality control (QA/QC).

13. In addition, there are no longer methodology supplements supporting the Australian inventory, as in the past. The supplements were all incorporated into a single set of updated methodology documents '*The Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2002*'.

14. Confidential data include emissions of CO_2 from Soda Ash Production and Use, Magnesia Production and Ammonia Production, and N_2O from Nitric Acid Production. Taken together, these account for 0.7 per cent of total national GHG emissions. The ERT was not able to assess the reporting of emissions from these categories and believes that these sources should be considered in more detail during an in-country review.

Recalculations and time-series consistency

15. The ERT noted that recalculations reported by the Party of the time series for 1990–2001 had been undertaken to take into account changes in methods, emission factors (EFs) and activity data (AD), and as a result of the addition of some sources. The recalculations have produced an increase in the estimates of GHG emissions in 1990 by 0.01 per cent, and a decrease in the estimates of emissions in 2002 by 0.13 per cent. The largest recalculations in percentage terms were made: (a) for 1990 CH_4 from Enteric Fermentation (+0.04 per cent, the reason for recalculation being the availability of new data on cattle in feedlots) and N_2O emissions from Agricultural Soils (+0.04 per cent, also because of the availability of new data on cattle in feedlots); and (b) for 2001 N_2O from Manure Management (+20.1 per cent, the reason for recalculation being new data on cattle in feedlots and the use of three-year averages). The reasons for the recalculations are well documented in the NIR and CRF table 8(b).

Uncertainties

16. Australia has prepared uncertainty estimates for all sectors but not for the GHG inventory as a whole. For most sectors the Monte Carlo and Latin Hypercube approaches were used, and for the LUCF

sector qualitative uncertainty estimates are provided. The ERT encourages the Party to provide more background information (references) on the uncertainty estimates and underlying assumptions in order to make them more transparent. The Party states that the uncertainty estimates are being reviewed and that it will be possible to calculate an uncertainty estimate for the inventory as a whole, as well as for the trends in emissions. The NIR states that uncertainty analysis is used for prioritizing further improvements but the link between the uncertainty analysis and further improvement is not made clear in the NIR.

Verification and quality assurance/quality control approaches

17. The Party mentions that tier 1 QC procedures are applied. It also states that it is putting in place QA/QC procedures that are consistent with the IPCC good practice guidance. During the review, Australia elaborated on this further and indicated that the Australian Greenhouse Emissions Information System (AGEIS) will help to avoid inconsistencies and transcription errors. The ERT encourages Australia to pursue these efforts. The Party also mentions that technical reviews of sectoral methodologies are ongoing. However, no overview information is provided on tier 2 QA/QC and verification activities in the NIR. No information on a QA/QC plan is included in the NIR.

Follow-up to previous reviews

18. The following issues have been raised by previous reviews and partly addressed by the Party: (a) although the information provided on methodologies and confidential data (reported as a separate category in the CRF) has improved in the NIR, it is still not enough to ensure the transparency of the inventory, particularly in the Chemical Industry category; (b) more information on QC has been provided but still no information on a QA/QC plan is included; (c) two CO_2 sinks are reported in the Australian methodology workbooks describing the methodology for Industrial Processes. Uptake of CO_2 is claimed to take place in the process of soda ash production and production of aluminium. However, the description of the first sink is limited. The methodology for the second is stated to be under revision. The ERT encourages Australia to finalize the review of the sink in Aluminium Production and to report on CO_2 uptake in Soda Ash Production and Use in more detail; (d) CH_4 emissions from range-kept livestock are not reported; (e) Australia is still working on updating its non-CO_2 EFs for mobile sources; (f) CO_2 emissions from soils are still insufficiently covered in the inventory: for example, in the cases of estimates of emissions from liming and for some forestry source categories, AD collection methods should enable both emissions and removals to be identified in cases when both could occur; and (g) the ERT encourages Australia to provide an enhanced characterization of AD for CH_4 emissions by type of municipal solid waste (MSW), because recycling programmes significantly affect the percentage of degradable organic carbon (DOC) of waste generated.

G. Areas for further improvement

Identified by the Party

19. The NIR identifies several areas for improvement. The Party states that future refinements of methodologies will be informed by the ongoing technical review of sectoral methodologies and data sources; priorities will be derived from the analysis of key sources and key trends, level of uncertainty, and comments received from previous reviews. Estimates under review include those for the Waste sector and for the category Prescribed Burning of Savannas for the entire time series in order to maintain consistency. The Party states that recalculations may also be necessary following consideration of new data, particularly for recent years, for the Energy, Industrial Processes and LUCF sectors. In addition, the Party states that it will provide quantitative uncertainty estimates for the GHG inventory as a whole in future.

Identified by the ERT

20. The ERT identifies the following cross-cutting issues for improvement: (a) the application of the NIR outline recommended by the UNFCCC reporting guidelines; (b) the provision of more information on institutional arrangements and QA/QC procedures (including the QA/QC plan); (c) improvement of the completeness of the inventory through providing estimates for the missing categories identified in the

completeness section of this report; (d) the inclusion in the NIR of more information on methods applied from the Australian methodology workbooks (e.g., for CH_4 from Enteric Fermentation, N_2O from Manure Management and CH_4 from Solid Waste Disposal on Land); (e) the provision of Energy sector reference approach calculations for the years 1990–1999; and (f) the inclusion of the LUCF CRF sectoral background data tables in future inventory submissions.

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

II. ENERGY

A. Sector overview

22. In 2002, the Energy sector contributed 71.3 per cent of total national GHG emissions. Fuel combustion contributed 65.5 per cent of total national GHG emissions and 93.1 per cent of the CO_2 emissions of Australia (excluding LUCF). The Energy Industries category contributed 38.3 per cent and Transport 15.2 per cent of total national GHG emissions. Emissions from fuel combustion increased by 32.5 per cent between 1990 and 2002, mainly caused by increasing fuel combustion within Energy Industries and Transport. N_2O emissions from Transport increased by 162.5 per cent between 1990 and 2002, and CH_4 emissions from Energy Industries increased by 383.6 per cent over the same period.

23. All the IPCC sources are addressed for the Energy sector and all years and gases are covered. Reference approach tables are not provided for the years 1990–1999. In general, the notation keys have been used appropriately. The ERT encourages Australia to provide documentation where sources are missing, for example, natural gas used in Road Transportation in 1990. If coal is used on the Railways, the ERT encourages Australia to revise the use of the notation key "NA".

24. The reporting of the Energy sector is transparent. Calculation methodologies are not documented in the NIR but can be found in reports available on an Australian web site. The methodology report provides country-specific EFs and documents the sources.

25. Small recalculations have been made for the Energy sector and are explained in CRF table 9.

26. A tier 2 method has been used to estimate the uncertainties. An aggregate uncertainty has been given for each gas, but the detail of the AD and EFs has not been provided. For CH_4 and N_2O the stationary uncertainties are very low. The ERT encourages Australia to provide documentation and references to support its choice of such low uncertainties.

B. Reference and sectoral approaches

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

27. The reference approach has been provided for the years 2000–2002. The differences between the sectoral and the reference approach are explained in the CRF documentation box. The differences vary between –2.6 per cent and +2.5 per cent for total CO_2 emissions. The ERT noted the explanation concerning ethane and would have liked to have a similar quantitative explanation for the other differences in emissions. The ERT also encourages Australia to provide reference approach calculations for the years 1990–1999 and to document the difference in estimations using the reference and sectoral approaches (as already reported for 1990 in CRF table 1.A(c)).

International bunker fuels

28. Data on international and domestic aviation and navigation fuel consumption are collected separately as a differential excise tax is placed on the fuel. As a result, there should be no problem with the domestic/international split.

29. The fuel quantities for bunkers in table 1.A(b) do not correspond to those given in table 1.C for gas/diesel oil, residual fuel oil and jet kerosene. These should be the same values. During the review,

Australia indicated that the correct data are provided in table 1.C and that it is currently implementing QA/QC procedures to avoid such problems in the future.

30. The ERT notes that Australia has used preliminary data for 2002 in the inventory. However, there are quite large differences for jet kerosene and aviation gasoline between the information given in the CRF and the data published by the IEA. A similar problem arises for the data on international marine bunkers. The ERT recommends that Australia provide background information to support the data presented in the CRF.

Feedstocks and non-energy use of fuels

31. The ERT was impressed by the level of detail of the stored carbon calculation for the reference approach. From table 1.A(d) it was possible to determine which quantities were included with the Energy sector and which quantities were in Industrial Processes. However, much larger quantities are shown for stored carbon in table 1.A(d) than are shown for apparent consumption in table 1.A(b). During the review, Australia indicated that this was due to different data sources being used and that the new QA/QC procedures that it is implementing should help to avoid this type of discrepancy in future submissions.

C. Key sources

Stationary combustion: liquid fuels – CO_2

32. The CO_2 emissions and fuel consumption in the Chemicals source category are very low in 1999, and the implied emission factor (IEF) (41.18 t/TJ) is not in line with those reported for other years. The ERT suggests that Australia consider whether this needs to be corrected.

Stationary combustion: liquid fuels – CO_2, CH_4, N_2O

33. The IEFs for all gases (57.44 t/TJ for CO_2) from the Pulp, Paper and Print source category are low in 1996. Australia has indicated that this is due to an error in the data for liquefied petroleum gas (LPG). The ERT suggests that this be corrected in future submissions.

Mobile combustion: road vehicles: – N_2O

34. The IEF for gasoline increased by 153.6 per cent between 1990 and 2002 (it was 8.94 kg/TJ in 1990 and 22.66 kg/TJ in 2002). In its response to the 2004 previous review stages, Australia indicated that this has to do with the introduction of three-way catalytic converter technology. The ERT noted that Australia aims to revise these EFs through direct measurement over the next couple of years.

Mobile combustion: road vehicles – CO_2, CH_4, N_2O

35. The time series for natural gas used in road transportation fluctuates. No consumption is given for 1990 and there is a drop between 1994 and 1995. During the review, Australia indicated that the natural gas consumption data will be revised (although perhaps not for the 2005 submission) and that the appropriate notation keys will be used.

D. Non-key sources

Mobile combustion: road vehicles – CH_4

36. The 2002 IEF for diesel oil (8.23 kg/TJ) is 36.3 per cent lower than that for 1990. In its response to the 2004 previous review stages, Australia indicated that the EF is based on the US Environment Protection Agency EF and that it intends to review these EFs in the near future to reflect its current fleet characteristics.

III. INDUSTRIAL PROCESSES AND SOLVENT USE

A. Sector overview

37. In 2002, the Industrial Processes sector accounted for 5.1 per cent of total national GHG emissions in Australia. Emissions from the sector increased by 0.9 per cent between 1990 and 2002, most of the growth being due to increased emissions of HFCs. The inventory of the Industrial Processes sector is advanced and well documented. This can be verified by inspection of the Australian methodology workbooks, which explain the methodology used in preparing estimates for the sources in the sector. Tier 2 uncertainty estimates reported in the NIR are available for most of the subsectors. The reporting could be improved by giving more detail about the basis for the input data used in uncertainty analysis. Moreover, linking the uncertainty of the input to that of the output could provide valuable insight into those components of the inventory that need more study. The reporting would be further improved by including descriptions of QC measures in place. (This information could be incorporated into the Australian methodology workbooks which already describe the sources of AD.) Some of the sources (Soda Ash Production and Use, Magnesium Production, Nitric Acid Production and Ammonia Production) could not be reviewed due to confidentiality of data. These sources contributed 14.2 per cent of the sector's emissions in 2002 and could appropriately be the subject of a thorough review during the next in-country review. NMVOC emissions from solvent and other product use are reported in the CRF, while CO_2 emissions are reported as "NA" and N_2O emissions as "NE". The Chemical Industry and Metal Production source categories have been recalculated, but the effect on estimated emissions for the Industrial Processes sector as a whole is not significant, amounting to an average annual reduction of 2 Gg CO_2 over the period 1990–2000 (2001 was different – an increase of 53 Gg). The recalculated CH_4 emissions are 8 Gg CO_2 higher, on average, than the figures previously reported.

B. Key sources

Consumption of halocarbons and SF_6 – HFCs

38. Australia reports emissions of HFC-125, HFC-134a, HFC-143a from Refrigeration and Air Conditioning Equipment. These are the most common HFCs used as refrigerant as such (R-134A) or as part of a mixture (e.g., R-404A). However, emissions of HFC-23, HFC-32, HFC-152a and PFC-218 would also be expected, simply because these can be found in commonly used refrigerants such as R-23, R-407C, R-410A, R-401A, R-401B, R-401C, R-413A and R-403B. During the review, Australia explained that sufficient data had not been available to enable full speciation. Australia also reported that more detailed information will become available in future as a result of specific new legislation addressing the issue.

Aluminium production – CO_2, PFCs

39. The CO_2 emissions are reported as net emissions, taking into consideration the CO_2 sequestration in Bayer liquors. The estimated sequestration (of –62 Gg in 2002) accounts for the apparently low IEF for Aluminium Production. Australia is encouraged to finalize the review of its methodology for this source, and to report on the results in its future submissions.

40. Emissions of PFCs from primary aluminium have been dramatically reduced. The NIR does not explain what has caused these reductions. During the review, however, Australia explained that reductions have taken place thanks to an improved process of monitoring and control. An explanation of the drivers behind the trend would improve the documentation of the inventory.

Iron and steel production – CO_2

41. These CO_2 emissions are estimated based on coke consumption in Iron and Steel Production, and natural gas in hot briquetted iron production, using plant-specific EFs. CO_2 emissions from coke consumption were previously reported under the Energy sector. Following a recommendation from the previous 2000 in-country review, these emissions are now reported in the Industrial Processes sector.

C. Non-key sources

Lime production

42. The AD (for commercial and in-house lime production) for 2001 differ by 5.7 per cent between the 2003 and 2004 submissions. The difference is not explained in the recalculation table 8 of the CRF, nor is it explained in the NIR. During the review, Australia indicated that data of better quality had become available since the 2003 submission.

IV. AGRICULTURE

A. Sector overview

43. In 2002, the Agriculture sector contributed 20.3 per cent of total national GHG emissions in Australia. Emissions from this sector increased by 11.1 per cent between 1990 and 2002. The Party's reporting is consistent with the IPCC categories apart from the use of the country-specific category "Soil Disturbance" which includes some direct and indirect soil categories.

44. The NIR provides an overview of the sector and a brief description of methodologies and emission factors. Detailed methodological information and references to underpinning research can be obtained from the Agriculture methodology workbook referenced in the NIR. The ERT noted that the description of QA/QC activity should be further elaborated in the NIR and encourages Australia to make more detailed description of it in its next inventory submission. The ERT further noted that Australia is currently undertaking efforts to improve consistency of emissions estimates from savanna burning.

45. Emissions have been recalculated as a result of new data becoming available on cattle populations in feedlots and a re-analysis of data on areas of savanna burning.

46. A quantitative analysis of uncertainty based on the Monte Carlo technique is provided. Estimated uncertainty in emissions from livestock is reported as between –5.3 per cent and +6.1per cent. The ERT considers these values unusually low. The assumptions underlying the Monte Carlo analysis should be reported in the NIR.

47. The ERT noted that Australia's choices of methodology and EFs are based on decisions from the Livestock Working Group (LWG). In response to questions by the ERT, Australia provided additional background information from the LWG. To increase transparency and facilitate review, the ERT recommends that Australia include summarized justifications of the LWG decisions in the NIR.

B. Key sources

Enteric fermentation – CH_4

48. Australia uses a tier 2 methodology and enhanced livestock characterization, which is consistent with the IPCC good practice guidance. A country-specific methodology for Dairy Cattle and Non-Dairy Cattle is applied. Australia provided additional information to the ERT during the review, explaining that the country-specific methodology was adopted because it provided more information on the effects of the feed quality on methane emissions than the IPCC default methodology. To increase transparency and facilitate review, the ERT encourages Australia to include this additional justification in the NIR.

49. CH_4 emissions from Enteric Fermentation decreased by 4.8 per cent from 1990 to 2002. Emissions decreased from 1990 to 1996 but rose by 2.5 per cent from 1996 to 2002. The NIR details how changes in the livestock population (cattle and sheep) have generated this trend in emissions.

Manure management – N_2O

50. N_2O emissions increased by 160.8 per cent from 1990 to 2002. The ERT encourages Australia to provide a brief description of the factors underlying the trend in emissions.

51. The nitrogen (N) excretion rates (Nex) for Dairy Cattle, Non-Dairy Cattle, Sheep and Swine differ significantly from the IPCC default values. The NIR states that the Nexs produced by the country-specific methodology are consistent with observed values; however, the ERT encourages Australia to provide additional information in the NIR to support this statement.

Direct emissions from agricultural soils – N_2O

52. N_2O emissions increased by 126.3 per cent from 1990 to 2002. The AD in the CRF show that there is more activity in the subcategories Synthetic Fertilizers and Animal Wastes Applied to Soils. To increase transparency, Australia may wish to provide more information in the NIR describing the reasons for the increase.

Animal production – N_2O

53. The N_2O IEF for animal production (0.004 kg N_2O-N/kg N) is the lowest of all reporting Parties. The ERT notes that the Australian value is based on the results of country-specific study and is broadly consistent with results from similar soils. However, given that the country-specific value is the lowest of all Parties and lies outside the IPCC default range (0.005–0.03 kg N_2O-N/kg N), the ERT recommends that Australia includes in the NIR additional supporting information for the country-specific EF.

Prescribed burning of savannas – CH_4, N_2O

54. Both the CH_4 and the N_2O emissions increased by 81.9 per cent between 1990 and 2002. The NIR states that different sources of AD (fire) were used before 1994 and that the methodology is "not necessarily consistent". The ERT notes that Australia reports in the NIR that it is undertaking development work to improve the consistency of emissions estimates from this source.

Other agricultural soils – N_2O

55. "Soil Disturbance" is a country-specific category aggregating direct soil emissions from N-fixing Crops, Crop Residue, Cultivation of Histosols and indirect emissions from Atmospheric Deposition. Australia provided additional information on this country-specific category to the ERT, stating that it considered that the methodology provided a better estimate than the IPCC methodology and that comparability was still possible at the aggregate level. The ERT noted Australia's view but recommends that, to facilitate comparability and the review of one key source or possibly two key source categories for Australia, the Party provide a comparison of the emissions from "Soil Disturbance" with the IPCC categories.

56. Emissions from "Soil Disturbance" are reported for the years 1990–2002; however, the notation keys are inconsistent between years, for example, N-fixing Crops are reported as "NA" for 1990 and "included elsewhere" ("IE") for 2002, and Atmospheric Deposition is reported as "NE" for 1990 but "IE" for 2002. The ERT recommends that Australia eliminate these inconsistencies.

C. Non-key sources

Indirect emissions – N_2O

57. AD and emissions for the category Indirect Emissions – Nitrogen Leaching and Run-off are reported as "NE". Australia provides an explanation, but the ERT considers that additional scientific justification is required for not estimating this category and encourages Australia to include the additional information in the NIR.

Manure management – CH_4

58. Australia states that emissions of CH_4 from range-kept livestock are assessed to be negligible given the high-temperature and low-humidity environment of Australia. The ERT noted the low methane emissions expected under aerobic degradation of manure. To increase transparency, the ERT encourages Australia to include climatic information for land used for range-kept livestock farming. Australia may

also wish to consider carrying out in-situ research on emissions from range-kept manure to generate country-specific data, and including this information in its future submissions.

Field burning of agricultural residues – CH_4, N_2O

59. "NO" is reported for pulse production in CRF table 4.F, whereas data on the production of beans, peas and lentils are available through the FAO database. In response to the ERT's questions, Australia noted that it will review the estimate.

V. LAND-USE CHANGE AND FORESTRY

A. Sector overview

60. For the LUCF sector, Australia has submitted a GHG inventory under the UNFCCC as well as indicative estimates compliant with the Kyoto Protocol. Only the UNFCCC accounting is considered in the present report. In 2002, LUCF was a net source of emissions amounting to 18,189.26 Gg CO_2 equivalent and accounted for 3.4 per cent of net GHG emissions. Between 1990 and 2002, emissions from the sector decreased by 80.5 per cent. Australia reports on CO_2 and non-CO_2 emissions attributed to Forest and Grassland Conversion, "Prescribed burning and wildfire in forests" (reported as 5.E Other), removals in Changes in Forest and Other Woody Biomass Stocks and CO_2 Emissions and Removals from Soil. Abandonment of Managed Lands is reported as "NA" due to negligible regrowth because of land degradation and salinity. The CRF background data tables are not provided.

61. Australia uses country-specific accounting tools and emission and conversion factors for estimating emissions and removals, which generally correspond to the IPCC tier 2 and 3 methods. A model-based tool entailing data from resource censuses, field studies and remote sensing, and the National Carbon Accounting System (NCAS) are used to estimate emissions from the category Forest and Grassland Conversion. However, it is unclear from the NIR how the emissions and removals are accounted for with the use of the NCAS. In line with the previous 2000 in-country review, the ERT encourages Australia to describe in its future submissions how the NCAS is used in the inventory of the LUCF sector. The ERT further noticed that the data in the NIR are insufficient to allow it to reconstruct the inventory and the emission trends, and encourages Australia to include in the NIR more information in order to allow for reconstruction of the estimates and trends for the LUCF sector.

62. According to the NIR, Australia has applied the IPCC good practice guidance for Land Use, Land-use Change and Forestry (LULUCF) tier 1 QC for its GHG inventory. The ERT also noted that key source analysis was carried out for the LUCF sector, which is consistent with the IPCC good practice guidance for LULUCF. Forest and Grassland Conversion was identified as a key source. Based on the sensitivity analyses applied, a low uncertainty is reported for this category. Qualitative uncertainty assessments have been made for other categories for which uncertainties are medium (Changes in Forest and Other Woody Biomass Stocks and Other) and high (CO_2 Emissions and Removals from Soil). CRF Table 8(a) indicates that recalculations have been performed for the category Changes in Forest and Other Woody Biomass Stocks for the years 1995–1998 and 2000–2001. In response to questions from the ERT, Australia noted that the recalculations were based on revised AD. To improve the transparency of its reporting, the ERT encourages Australia to explain the reason for the recalculations in its future inventory submissions.

63. The ERT noted that major improvement of the overall inventory of the sector is expected when the NCAS becomes fully operational. The ERT encourages Australia to proceed with development of the NCAS, along with the inclusion of necessary information in the NIR, to improve the quality of the GHG inventory.

64. To improve the transparency of the NIR, the ERT encourages Australia to adopt the structure for the LUCF sector that is recommended in the UNFCCC reporting guidelines for NIRs.

B. Sink and source categories

Changes in forest and other woody biomass stocks – CO_2

65. Australia reports on emissions and removals under category 5.A.5 Other because the CRF format is found to be incompatible with the national forest categories. In 2002, this category represented a net sink of 4.0 per cent of the total net GHG emissions of Australia. Net removals decreased by 11.3 per cent between 1990 and 2002 as a result of increased harvesting and reduced increment. Appendix B to the NIR includes IPCC sectoral tables describing the calculation of annual growth and withdrawal of biomass. However, in line with the findings of the 2000 in-country review, the ERT noted that no explanation is provided on the annual growth rates and expansion factors used, making it impossible to assess the correctness of the estimates. The data on harvest in CRF table 5 should be provided in a more transparent way to allow for cross-checks with the data in appendix B to the NIR. The ERT noted that biomass increments are calculated individually for the individual states and aggregated to produce a national total. To improve transparency, the ERT encourages Australia to report individual state biomass data or information on the range and variation across the states. In its future inventory submissions, Australia is encouraged to document the annual growth and expansion rates used in the calculations. The ERT also encourages Australia to enhance transparency in reporting on CO_2 emissions from wood harvesting in the NIR and the CRF.

Forest and grassland conversion – CO_2, CH_4, N_2O

66. Australia reports emissions of above- and below-ground biomass under category 5.B.5 Other because the CRF format is found to be incompatible with the national forest categories. In 2002, these emissions amounted to 7.8 per cent of total net GHG emissions and were 65.0 per cent lower than in 1990. Although the NIR indicates that the 2002 estimates for this category were averaged from the 2000 and 2001 values and should be treated with caution, the reason for a notable decrease in emissions relative to the base year is not clearly documented. The ERT encourages Australia to explain the decrease in emissions and the estimates for this key source.

Abandonment of managed lands – CO_2

67. Emissions and removals from Abandonment of Managed Lands are assumed to be negligible in Australia because of land degradation following abandonment. AD on land area abandoned are provided in the methodology appendix for LUCF. However, Australia noted in communications with the ERT that these data are out of date and not reliable, and that this is an area for future research.

Emissions and removals from soil – CO_2

68. Under this category Australia reports on CO_2 removals due to improved pastures and minimum tillage. No other emissions and removals are reported for this category because no national methodology or data are available. In 2002, the CO_2 removals accounted for 0.8 per cent of net national GHG emissions and had remained stable since the base year. The ERT encourages Australia to obtain data and estimate CO_2 emissions and removals from soils. It also encourages Australia to document the basic methods and underlying assumptions used for estimating removals from pasture improvement and minimum tillage. In response to questions from the ERT, Australia noted that liming does occur on agricultural lands and it is investigating the extent of the practice for possible inclusion in future submissions. Australia also noted that it is unlikely that cultivation of organic soils occurs. The ERT recommends that it include this information in its future submissions.

Other – CH_4, N_2O

69. Non-CO_2 emissions from "Prescribed burning and wildfire in forests" are reported under this category, being 0.4 per cent of net national GHG emissions in 2002. Being strongly dependent on wildfire events, the overall emissions trend has increased by 35.7 per cent since the base year.

VI. WASTE

A. Sector overview

70. In 2002, the Waste sector contributed 3.4 per cent to the total national GHG emissions of Australia. Of this amount, 89.0 per cent came from the category Solid Waste Disposal on Land. Emissions from the sector increased by 15.0 per cent from 1990 to 2002 and by 3.1 per cent from 2001 to 2002 as a result of increases in population and waste disposal. The most important GHG in the sector is CH_4, emissions of which increased by 15.0 per cent between 1990 and 2002.

71. The methodologies, assumptions and data sources used for emissions estimation are summarized in the NIR but not sufficiently to allow for replication of the calculations. The country-specific methodologies are well documented, although their application is not always clear.

72. Australia has provided recalculated estimates of Waste sector emissions between the 1996–1997 financial year and 2001 as a result of the revision and updating of the population statistics. However, the NIR does not mention the impact of this change on estimated emissions from the sector.

73. CH_4 recovery from solid waste started to be noteworthy in financial year 1992–1993, and the effect on CH_4 net emissions began to be significant in 1996. In 1998, CH_4 recovery increased to around 11 per cent of the CH_4 generated and it remained stable until 2002.

74. The country-specific methodology includes the consideration of open dumps in rural areas. However, Unmanaged Solid Waste Disposal Sites are reported as "NA" in the CRF. For transparency reasons, estimates for each category of waste should be given and disposal practices should be reported in the NIR.

75. CH_4 emissions from sludge generated by waste-water treatment are not reported, although they are included in the country-specific methodology provided by Australia. The ERT encourages Australia to report on CH_4 emissions from waste-water treatment in its next inventory submission.

76. Waste Incineration is also reported as "NA", except for solvents (2 per cent of solvent production is incinerated) for which only CO_2 emissions have been estimated (CH_4 and N_2O are reported as "NE"). Australia is encouraged to provide estimates for all gases and possible sources and explain why these notation keys have been used for emissions from Waste Incineration.

B. Key sources

Solid waste disposal on land – CH_4

77. Australia has used a country-specific tier 2 methodology which is different from the IPCC tier 2 method. This methodology is not described in the NIR so as to allow replication of the emissions estimate calculations. The CH_4 generation rate constant and the oxidation factor are reported as "NA" in the additional information table 6.A. The fraction of DOC in municipal solid waste (needed to calculate the CH_4 potential of landfilled waste) and DOC degraded are also reported as "NA". Similar comments were made by the ERT in the 2000 centralized review report. Australia is encouraged to explain why these notation keys have been used to report on CH_4 emissions from solid waste disposal on land.

78. CO_2 emissions are reported as "NE". The ERT recommends that they be reported for the sake of completeness.

79. The distinction between managed and unmanaged solid waste disposal sites, and between residual and non-residual wastes, is not clear. To improve the transparency of its reporting, the ERT encourages Australia to document the distinction between these source categories in its next inventory submission.

80. Data for recovered methane and uncertainty calculations need to be documented for the sake of transparency in the NIR. The trend fluctuations of CH_4 emissions from Solid Waste Disposal on Land between 1994 and 1998 should be explained.

C. Non-key sources

Waste-water handling – CH_4

81. A combination of IPCC and country-specific default values has been used to estimate CH_4 release from Waste-water Handling and the IPCC default methodology (tier 1) has been used for estimating N_2O from Human Sewage.

82. In the Australian methodology, the choice of some factors is not explained (e.g., Fan (fraction of biochemical oxygen demand (BOD) load anaerobically treated), Efm (methane emission factor), Fmr (fraction of methane recovered), and Fiwtp (fraction of industrial BOD to domestic and commercial BOD)). The ERT recommends Australia to provide information on the reasons for the choice of these factors.

ANNEX 1: MATERIALS USED DURING THE REVIEW

A. Support materials used during the review

2000, 2003 and 2004 Inventory submissions of Australia. 2004 submission including a set of CRF tables for 1990–2002 and an NIR.

UNFCCC secretariat (2001). "Report of the individual review of the greenhouse gas inventory of Australia submitted in the year 2000 (Centralized review)". FCCC/WEB/IRI(3)/2000/AUS (available on the secretariat web site <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/inventory_review_reports/application/pdf/auscentrev.pdf>).

UNFCCC secretariat (2002). "Report of the individual review of the greenhouse gas inventory of Australia submitted in the year 2000 (In-country review)". FCCC/WEB/IRI(2)/2000/AUS (available on the secretariat web site <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/inventory_review_reports/application/pdf/ausincountrep.pdf>).

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

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

UNFCCC secretariat. Review findings for Australia (unpublished).

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

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

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

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

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

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

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

B. Additional materials

Responses to questions during the review were received from Mr. Rob Sturgiss (Australian Greenhouse Office) including additional material on the methodology and assumptions used:

Australian Greenhouse Office (2002). Greenhouse gas emissions from land use change in Australia: An integrated application of the National Carbon Accounting System.

Blaxter K.L. and J.L. Clapperton (1965). Prediction of the amount of methane produced by ruminants, *Br. J. Natur.*, 19: 511–522.

FAOstat web site <http://apps.fao.org/faostat/collections?version=ext&hasbulk=0&subset=agriculture>.

Gonzalez-Avalos E. and L.G. Ruiz-Suarez (2001). Methane EFs from cattle manure in Mexico, *Bioresource Technology*, 80: 63–71.
National Greenhouse Gas Inventory Committee (2002). Australian methodology for the estimation of greenhouse gas emissions and sinks 2002. Agriculture. Australian Greenhouse Office.

Web pages:
Australian Greenhouse Office. "Australian methodology workbooks – Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2002" (available on the following web site: <http://www.greenhouse.gov.au/inventory/methodology/index.html>).

Casada, M.E., and L.M. Safley, Jr. 1990. Global methane production from livestock wastes. In Global Climate Change Symposium. April 9, 1990, 69-78. R.I. Bruck, ed. College of Agriculture and Life Sciences. NC-ARS. Department of Agricultural Communications. Box 7603, NCSU, Raleigh, NC 27695-7603. (available on the following web site: <http://www.usgmrl.ksu.edu/eru/publications/personnel/casada.html>.

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