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Report of the individual review of the greenhouse gas inventory of New Zealand 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.

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Annex

I. Overview

A. Introduction

1. This report covers the in-country review of the 2006 greenhouse gas (GHG) inventory submission of New Zealand, coordinated by the United Nations Framework Convention on Climate Change (UNFCCC) secretariat, in accordance with decision 19/CP.8. The review took place from 19 to 24 February 2007 in Wellington, New Zealand, and was conducted by the following team of nominated experts from the roster of experts: generalist – Mr. William Irving (United States of America); energy – Mr. Dario Gomez (Argentina); industrial processes – Mr. Kiyoto Tanabe (Japan); agriculture – Mr. Steen Gyldenkaerne (Denmark); land use, land-use change and forestry (LULUCF) – Ms. Maria Jose Sanz Sanchez (Spain); waste – Mr. Eduardo Calvo (Peru). Mr. William Irving and Mr. Eduardo Calvo were the lead reviewers. The review was coordinated by Ms. Katia Simeonova and Mr. Javier Hanna (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", (hereinafter referred to as UNFCCC review guidelines), a draft version of this report was communicated to the Government of New Zealand, which provided comments that were considered and incorporated, as appropriate, in this final version of the report.

B. Inventory submission and other sources of information

3. In its 2006 submission, New Zealand submitted a complete set of common reporting format (CRF) tables for the years 1990–2004 and a national inventory report (NIR). Where needed the expert review team (ERT) also used previous years submissions, additional information provided during the review and other information. The full list of materials used during the review is provided in the annex to this report.

4. After the in-country review, following the recommendations of the ERT, New Zealand submitted a complete set of revised CRF tables for the years 1990–2004.

C. Emission profiles and trends

5. In 2004, the most important GHG in New Zealand was carbon dioxide (CO_2), contributing 45.3 per cent to total[1] national GHG emissions expressed in CO_2 equivalent,[2] followed by methane (CH_4), 36.1 per cent, and nitrous oxide (N_2O), 17.6 per cent. Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6) taken together contributed 0.9 per cent of the overall GHG emissions in the country. The agriculture sector accounted for 49.7 per cent of the total GHG emissions followed by energy (42.1 per cent), industrial processes (5.6 per cent), waste (2.5 per cent) and solvent and other product use (0.1 per cent). Total GHG emissions amounted to 75,167.94 Gg CO_2 equivalent and increased by 21.4 per cent from the base year (1990) to 2004.

6. Tables 1 and 2 show the greenhouse gas emissions by gas and by sector, respectively.

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[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.

[2] In this report, the values for total and sectoral emissions for the complete time series, and in particular for the base year and in 2004, reflect the revised estimates submitted by New Zealand in the course of the review. These estimates differ from New Zealand's GHG inventory submitted in 2006.

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

GHG emissions	Gg CO_2 equivalent								Change
	Base year Convention[a]	1990	1995	2000	2001	2002	2003	2004[a]	BY–2004 (%)
CO_2 (with LULUCF)	6 381.63	6 381.63	11 974.06	10 716.53	12 417.32	11 683.90	11 796.46	9 483.95	48.6
CO_2 (without LULUCF)	25 462.57	25 462.57	27 205.10	31 038.82	33 034.37	33 026.34	34 632.73	34 049.36	33.7
CH_4	25 595.99	25 595.99	25 895.59	26 942.80	27 130.77	27 163.22	27 150.91	27 230.09	6.4
N_2O	10 429.48	10 429.48	11 203.09	12 109.62	12 485.99	12 824.95	13 079.53	13 264.95	27.2
HFCs	NA, NO	NA, NO	145.27	246.99	440.95	619.83	728.63	597.13	NA
PFCs	515.60	515.60	147.50	59.25	59.25	88.40	93.30	87.70	–83.0
SF_6	12.33	12.33	15.01	12.19	12.31	13.15	17.52	21.49	74.2

Note: LULUCF = Land Use, Land-use Change and Forestry; NA = not applicable; NO = not occurring.

[a] New Zealand submitted revised estimates for the complete time series in the course of the initial review on 5 April 2007. These estimates differ from New Zealand's GHG inventory submitted in 2006.

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

Sectors	Gg CO_2 equivalent								Change
	Base year Convention[a]	1990	1995	2000	2001	2002	2003	2004[a]	BY–2004 (%)
Energy	23 588.51	23 588.51	25 035.14	28 916.15	30 861.95	30 872.35	32 260.78	31 663.32	34.2
Industrial processes	3 291.24	3 291.24	3 404.98	3 590.67	3 865.13	4 066.01	4 351.65	4 197.35	27.5
Solvent and other product use	41.54	41.54	44.95	47.12	47.43	48.36	48.36	48.36	16.4
Agriculture	32 498.88	32 498.88	33 707.07	35 652.39	36 237.15	36 650.63	36 967.97	37 349.63	14.9
LULUCF	–18 977.92	–18 977.92	–15 084.32	–20 215.70	–20 513.36	–21 243.87	–22 742.19	–24 482.63	29.0
Waste	2 492.77	2 492.77	2 272.70	2 096.74	2 048.28	1 999.96	1 979.78	1 909.28	–23.4
Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (with LULUCF)	**42 935.03**	**42 935.03**	**49 380.52**	**50 087.38**	**52 546.58**	**52 393.43**	**52 866.35**	**50 685.31**	**18.1**
Total (without LULUCF)	**61 912.95**	**61 912.95**	**64 464.84**	**70 303.07**	**73 059.93**	**73 637.30**	**75 608.54**	**75 167.94**	**21.4**

Note: LULUCF = Land use, land-use change and forestry; NA = not applicable.

[a] New Zealand submitted revised estimates for the complete time series in the course of the initial review on 5 April 2007. These estimates differ from New Zealand's GHG inventory submitted in 2006.

D. Key categories

7. The key category analysis performed by the Party and the secretariat[3] produced similar results. In the base year (1990) category 1.B.2 oil and natural gas – CO_2 was identified by the secretariat according to level but not by New Zealand although this category is already identified as key in both analyses according to the trend (2004). For 2004 category 5.G other (combined cropland/grassland/forest land for liming) was identified by the secretariat but not by New Zealand. New Zealand indicated in its response to previous review stages that this was an omission and that it will correct the gap in the next submission. Table A1.2 of the NIR displays key category results for 2004 but is labelled incorrectly as 1990 which lead to some confusion and perceived discrepancies with the CRF. The results of the key category analysis are a driving factor for the preparation of the inventory particularly in the prioritization of resources and methodological complexity.

E. Main findings

8. New Zealand's GHG inventory system is well-developed and the inventory is prepared according to the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention Part I: UNFCCC reporting guidelines on annual inventories" (hereinafter referred to as the UNFCCC reporting guidelines) and the 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). New Zealand's inventory is particularly strong in the area of institutional arrangements, archiving, and in methodological approaches to emissions from enteric fermentation and manure management. Where the ERT has noted areas for improvement during the review these are summarized in the conclusions related to specific sectors and categories.

F. Cross-cutting issues

1. Completeness

9. The inventory is complete in terms of years, geographic coverage, sectors, source/sink categories and gases. Some minor categories such as waste incineration are reported as not estimated ("NE"). The ERT considers that the NIR could be improved through inclusion of brief explanations indicating why according to expert judgement some categories are assumed to be negligible. This would increase transparency and provide useful information to future ERTs.

2. Transparency

10. The NIR provides much of the information necessary to assess the inventory. In some cases the ERT had to request additional clarifying information and explanations for a complete assessment of some categories (e.g. stationary combustion, transport, cement production, aluminium production, enteric fermentation and agricultural soils). For example the NIR is unclear with respect to the allocation of emissions between the energy and industrial process sectors (e.g. iron and steel production ammonia production). Also the NIR was in some instances ambiguous in the identification of methodologies used for certain categories (e.g. tier identification for cement production, the nature of the use of the OVERSEER model for manure management). The ERT recommends that New Zealand follow up on questions of NIR transparency on a category by category basis, taking into consideration

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[3] 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.

category-specific recommendations contained within this and previous review reports. Improved transparency of the NIR will facilitate future reviews particularly centralized and desk reviews.

11. The CRF is generally transparent, but could be improved through more consistent use of notation keys, particularly for the inclusion and allocation of emissions between the energy and industrial processes sectors.

3. Recalculations and time-series consistency

12. The ERT noted that recalculations were reported by New Zealand of the time series from 1990 to 2004 in its original 2006 submission. New Zealand reported the total effect of these recalculations as a 0.4 per cent increase for 2003 and a 0.6 per cent increase for 1990. The major changes include: methodological improvements (e.g. tier 2 for manure management), inclusion of previously missing categories (e.g. soda ash use), reallocation of emissions (e.g. CO_2 emissions from urea production have been allocated to the ammonia production category) and revisions to official energy statistics. Estimates in the LULUCF sector were also recalculated because of updated carbon yield tables, leading to a more significant change in net removals between the 2003 and 2004 inventories. The rationale for all of these recalculations is provided in the NIR, and these recalculations have resulted in real improvements to the inventory.

4. Uncertainties

13. The information provided in the NIR on uncertainties is appropriate and as required by the UNFCCC reporting guidelines. New Zealand’s tier 1 uncertainty estimates have been provided according to the IPCC good practice guidance. An additional external assessment of uncertainties by a consultant, which was not included in the 2006 submission but rather presented during the review applied a simplified tier 2 analysis, and identified five specific data inputs for which targeted improvements could lead to maximum gains in accuracy for the total inventory: (1) N_2O from agricultural soils (specifically emission factors (EFs) for pasture, range, paddock $EF_{3,}$ EF_{PRP}); (2) N_2O from fertilizer application (EF_1); (3) CH_4 from enteric fermentation (emission per unit food intake); iv) forest areas; and v) activity data for fuels consumed in the energy sector.

5. Verification and quality assurance/quality control approaches

14. New Zealand has elaborated a quality assurance/quality control (QA/QC) plan in accordance with the IPCC good practice guidance, and commissioned an external review of the plan. The plan 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. The national inventory compiler also serves as the QA/QC coordinator. Prior to submission, the inventory is reviewed by staff within the Ministry for the Environment who have not been involved with the preparation process. Following the annual submission, a post-inventory review is undertaken to recommend improvements.

15. The QA/QC plan indicates that all key categories undergo tier 1 QC checks each year and tier 2 procedures periodically. Non-key categories undergo tier 1 QC checks periodically as well. At least one expert QA review takes place each year, depending on the size of the category, comments from reviews, and methodological changes. In addition, Statistics New Zealand carries out its own QA/QC procedures on primary data.

16. The ERT notes that, while the QA/QC plan is in line with the IPCC good practice guidance the existence of a number of minor errors and inconsistencies discovered in the reporting of previous review stages and during the in-country review indicate that the plan has not yet been fully implemented. This conclusion is relevant for all of the sectors and for the cross-cutting requirements (e.g. key category analysis NIR text). The ERT recommends that New Zealand intensify the time and resources directed at implementing the QA/QC plan, with the aim of reducing the number of minor errors and inconsistencies.

It should be noted that the ERT does not believe that these minor errors affect the calculation of base year emissions.

17. The ERT also notes that New Zealand benefits from good relationships with data providers in the government and private industry, and with consulting firms and experts. The ERT recognizes that these data providers improve the quality of the New Zealand inventory, and make it possible to implement higher tier methods, but recommends that New Zealand request QA/QC information on these data and conduct QA/QC where it is missing, to be fully consistent with the IPCC good practice guidance.

6. Follow-up to previous reviews

18. New Zealand has made improvements to the inventory, such as: including estimates for all LULUCF categories for all years; including estimates of CO_2 from soda ash use; and implementation of tier 2 for CH_4 from manure management.

G. Areas for further improvement

1. Identified by the Party

19. The NIR identifies a general process for improvements to the inventory. New Zealand's separate National Inventory Improvement Plan 2006/2007 includes a detailed list of planned improvements. These proposed improvements include: peer review assessments of recent EF development for emissions of N_2O and CH_4 in agriculture; and QA of energy sector activity data (AD), increased transparency of methodologies for CO_2 emissions from industrial processes (e.g. cement, and iron and steel production).

2. Identified by the ERT

20. The ERT identifies the following cross-cutting issues for improvement. The Party should:

(a) Improve the implementation of the QA/QC plan;

(b) Provide more precise descriptions in the NIR of methodological, AD and reporting choices to improve transparency.

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. The energy sector is the second largest contributor of New Zealand's GHG emissions. In 2004, emissions from the energy sector (31,663.32 Gg CO_2 equivalent) constituted 42.1 per cent of the total national GHG emissions. It is the fastest growing sector; the emissions in 2004 were 34.2 per cent above the 1990 level. The categories contributing most to this increase are CO_2 emissions from road transportation and public electricity and heat production. The analyses carried out by the Party and the secretariat both identified seven key categories, namely: six categories for CO_2 (solid, liquid and gaseous fuels from stationary combustion, road transportation, civil aviation and oil and natural gas) and CH_4 emissions from road transportation that were identified as key categories only by the trend assessment. CO_2 fugitive emissions from geothermal operations have been identified as a key category only in the Party's trend assessment.

23. The CRF tables contain emission estimates for all direct and indirect GHGs from the majority of the categories of the energy sector. Fuel combustion emissions in manufacturing industries and construction are only disaggregated for iron and steel and chemicals. For manufacturing industries and construction category, it is recommended that New Zealand revise the use of notation keys to

differentiate between non-occurring subcategories and those that have been included elsewhere. Certain subcategories under fugitive emissions were reported as “NE”, based on expert opinion. Some data is reported as confidential in 1.A.2.c (chemicals) and 1.B.2.b.iii (natural gas transmission). The ERT encourages New Zealand to reconsider whether it is necessary to maintain data confidentiality in the CRF tables and, if this is the case, to provide additional information in the NIR to facilitate the review, for example indexed or relative information.

24. Overall, methodological approaches, AD and EFs used to estimate emissions for the energy sector are presented in the NIR in a transparent manner. Tier 1 methods are used for all categories. AD is compiled by the Ministry of Economic Development (MED), which is responsible for estimating the emissions of the energy sector, based on its own database and on the data compiled by Statistics New Zealand. The AD used for emission estimates together with other energy statistics are regularly published in the New Zealand Energy Data File (September 2006 edition) which is available on the MED website.[4] Country-specific EFs are used for estimations of CO_2 emissions, while mostly IPCC tier 1 or tier 2 EFs are used for non-CO_2 gases. The NIR includes the complete set of EFs, the energy balance and the worksheets used to estimate the emissions. The ERT commends New Zealand’s efforts in improving the transparency of the energy sector in the NIR.

25. Three external reviews of the energy sector have been undertaken, focusing on emissions estimates (Clarkson, 2002), emission factors (Hale and Twomey, 2003) and the overall sectoral inventory (Goldthorpe, 2006). The ERT commends New Zealand for its initiatives to improve estimates. However, there is a lack of QA/QC procedures for the use of plant-specific data (EFs, AD and emission estimates) as well as for the process of taking decisions that are based on expert judgment. This led to a lack of transparency in some cases in oil and natural gas. The ERT recommends that data produced externally be subject to procedures in accordance with the IPCC good practice guidance, including the QA/QC guidance. The ERT notes that additional documentation and explanatory background material could be incorporated into the electronic and paper archives. In addition, the ERT encourages New Zealand to provide information in the NIR on how experts are selected and the procedures to elicit expert opinion.

26. Emissions estimates have been recalculated for all years from 1990 to 2003, resulting in minor changes. For the period 1990–2002, except for 1997 and 2003, the recalculations of estimates reported in the original 2006 submission resulted in increases in the total figures for the aggregated emissions of CO_2, CH_4 and N_2O of about 0.2 per cent. For 1997 and 2003 the recalculations resulted in decreases of 0.03 and 0.05 per cent respectively. The NIR reports that these differences are associated with minor rounding errors and updates to data in the New Zealand Energy Data File (September 2006 edition).

B. Reference and sectoral approaches

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

27. In 2004, the CO_2 emissions estimated in the sectoral approach as originally submitted in 2006 are 1.4 per cent less than those estimated in the reference approach. By type of fuel, the differences are 0.9 per cent for liquid fuels, –4.4 per cent for solid fuels and 7.4 per cent for gaseous fuels. However, the differences in energy consumption are larger and all positive: 9.9 per cent for liquid fuels, 25.9 per cent for solid fuels and 35.8 per cent for gaseous fuels. Explanations are provided in the CRF tables and the NIR provides explanations on annual fluctuations in the differences between the two approaches for the period 1990–2004. The ERT recommends that further efforts be made to reconcile the methods used in estimating AD.

[4] <http://www.med.govt.nz>.

2. International bunker fuels

28. The allocation of fuel consumption between domestic and international transport is based on the data on fuel consumption by international transport reported in the Energy Data File (September 2006 edition), which reports coastal shipping and national air transport under domestic transport. The NIR reports that the distinction between domestic and international flights is based on refuelling at the domestic and international terminals of New Zealand airports and that there is no basis to split the domestic and international components of fuels used for international flights with a domestic leg. Although the AD associated with the domestic legs of these international flights is considered to be negligible, during the in-country visit New Zealand started consultations with the airlines to clarify this situation and assess the order of magnitude of the AD. As in previous review reports, it is recommended that New Zealand make efforts to clarify the allocation of fuel consumption in accordance with the IPCC good practice guidance.

3. Feedstocks and non-energy use of fuels

29. The non-energy use of bitumen, the use of natural gas as feedstock for methanol production and the amount of carbon contained in the coal used in iron and steel production are taken into account in the reference approach. The IPCC default value is used for the fraction of carbon stored in bitumen, and for confidentiality reasons only the total amount of carbon stored for the production of methanol is reported.

30. A carbon mass balance approach, which takes into account the amount of carbon contained in the fuel that is input to each manufacturing plant and the amount of carbon stored in the final products, is used for the chemicals category under manufacturing industries and construction. Emissions from both the energy and the industrial processes sectors are aggregated in the resulting estimates. CO_2 emissions from methanol are reported under the energy sector while CO_2 emissions associated with other chemical products (ammonia, urea, etc.) are reported under the industrial processes sector. To improve transparency, the ERT recommends that a better specification of reporting choices be provided in the next NIR. It is recommended that the estimation and reporting of the associated non-CO_2 emissions also be discussed.

4. Country-specific issues

31. Fugitive emissions of CO_2 and CH_4 from geothermal plant operations are estimated and reported. The NIR reports that these emissions are estimated on the basis of information obtained directly from geothermal field operators. During the in-country visit the ERT assessed the information reported by New Zealand in the CRF in the context of recent publications (Bertani and Thain, 2002; Sheppard and Mroczeck, 2004) and concluded that these emission estimates can be considered as conservative. However, New Zealand is encouraged to improve transparency by providing information on estimation of emissions and QA/QC procedures used by the operators. As significant fluctuations in the trend of CO_2 and CH_4 emissions from geothermal power generation do not correlate with the AD, the ERT recommends that New Zealand provide information on the nature of this variability in its future submissions.

C. Key categories

1. Stationary combustion: gaseous fuels – CO_2

32. The relatively high values of CO_2 EFs for natural gas (58.7 t/TJ) have been pointed out in previous reviews. For 1990 and 1991, they are the highest of reporting Parties and are higher than the IPCC default value (56.1 t/TJ). During the in-country visit, the *New Zealand Energy Information Handbook* (Baines, 1993) was made available to the ERT. It contains typical chemical compositions for natural gas sales streams of the different local gas fields, indicating relatively high concentrations of ethane (3.8 to 11.2 per cent by volume) and propane (2.9 to 11.7 per cent by volume). This information source also indicates that the majority of the natural gas that is distributed in New Zealand has a CO_2

concentration of about 4 per cent. During the in-country visit, typical compositions of New Zealand's natural gas from the two main gas streams (Maui and treated gas from Kapuni) for different years in the period 1997–2000 were made available to the ERT. These compositions are in line with those reported by Baines (1993) and also with the EFs reported by New Zealand in the cited period. The ERT recommends that New Zealand collect and archive the natural gas composition that is used to estimate CO_2 EF each year. The ERT encourages New Zealand to include a brief discussion of the chemical compositions of the two major gas streams and its influence on the relative high value of the CO_2 EFs.

33. The NIR reports that the relative proportions of the Maui and treated gas from Kapuni that are input to the distribution system are assumed to be 50/50 for the period 1990–2004. The Energy Data File (September 2006 edition) reports the annual production of the local gas fields for the period 1970–2005, and the relative proportions actually produced deviate from the assumed 50/50 share. During the in-country visit, the ERT recommended that New Zealand use this information to estimate average annual CO_2 EFs that are more representative of the actual conditions. After the in-country visit, New Zealand revised the emission estimates in line with the ERT recommendations and submitted revised estimates for the period 1990–2004. For each year, New Zealand revised the average CO_2 EFs using the actual annual production information from both Maui and Kapuni gas fields to create a weighted EF, and revised the emissions using the new CO_2 EFs in 1.A.2a iron and steel, 1.A.2f other, 1.A.4a commercial/institutional and 1.A.4b residential categories. However, in the future this methodology will be revised based on the composition of gas in the main transmission pipeline as new gas fields come on stream.

2. Stationary combustion: solid fuels – CO_2

34. During the in-country visit, New Zealand indicated that increasing amounts of coal have been imported since 2000. The ERT recommends that New Zealand collect data about the carbon content and heating value of imported coals and, if necessary, update the CO_2 EF to reflect this situation.

35. The NIR reports that CO_2 emissions from iron and steel are estimated and reported in the industrial processes sector on the basis that virtually all coal is used as a reductant. However, during the in-country visit, New Zealand informed the ERT that part of this coal is used for energy purposes although the amount cannot be estimated owing to lack of data. It is recommended that New Zealand include this explanation in its future NIRs.

3. Stationary combustion: liquid fuels – CO_2

36. The ERT identified in New Zealand's worksheets used for estimation of stationary combustion emissions fuels that typically are used in mobile combustion such as gasoline, jet kerosene and aviation gasoline. Although, the amounts of these fuels used under stationary combustion categories are relatively small, the ERT recommends that New Zealand revise this allocation, and if necessary reallocate these data into appropriate mobile combustion categories, and perform the corresponding recalculations.

4. Road transportation: liquid fuels – CH_4

37. The CH_4 EF for gasoline (63.16 kg/TJ) in 1990 is the highest among reporting Parties and is higher than the IPCC default value (20 kg/TJ). This value is taken from the study undertaken by Bone et al. (1993). From 2003 onwards, the value adopted is the IPCC default. The EFs from 1994 to 2002 are calculated using linear interpolation. The case of EFs for diesel oil is similar to that described for EFs for gasoline. In both cases, the trend of the CH_4 EFs in the period 1990–2004 is distinct from that of most reporting Parties. During the in-country visit, the ERT recommended that New Zealand consider revising the CH_4 emissions from road transportation for gasoline and diesel oil using IPCC default emission factors (20 kg/TJ for gasoline and 5 kg/TJ for diesel oil). After the in-country visit New Zealand revised the CH_4 emissions in line with the recommendations of the ERT and submitted revised

estimates. The revised EFs used to estimate the annual emissions in the period 1990–2002 are those suggested by Hale and Twomey (2003): 19.5 kg/TJ for gasoline and 4 kg/TJ for diesel oil. These values that have been already used to estimate the emissions in 2003 and 2004 correspond to the mid-point of the tier 2 EFs reported for United States vehicles (uncontrolled) in the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines). For gasoline, the selected CH_4 EF is 2.5 per cent lower than the tier 1 IPCC default value. For diesel oil, the selected CH_4 EF is 20 per cent lower than the tier 1 IPCC default value.

38. CH_4 emissions from road transportation have been identified as a key category by trend. After the in-country visit New Zealand informed the ERT that in the future it will attempt to use country-specific EFs for liquid fuels. The ERT encourages New Zealand to implement a higher tier approach to estimate these emissions, in accordance with the IPCC good practice guidance.

5. Oil and natural gas – CO_2

39. In the CRF tables, natural gas transmission is reported as included under distribution. However, the NIR seems to imply that only the emissions from distribution are estimated, assuming that these emissions amount to up to 1.75 per cent of unaccounted gas entering the distribution system. During the in-country visit, New Zealand explained that a separate estimate that is based on information provided by natural gas transmission companies is done to estimate the fugitive emissions from transmission. The ERT encourages New Zealand to report these estimates independently from those arising from distribution, to assess the QA/QC procedures used by the data providers and include a brief explanation about the estimate of the emissions from transmission in its future submissions.

40. All venting and flaring operations are reported under gas flaring. Emissions from natural gas production and processing are reported as “NE” in the CRF tables. During the in-country visit, New Zealand informed the ERT that these emissions are also accounted for, under natural gas venting. The ERT recommends that “NE” be replaced by included elsewhere (“IE”) in the CRF.

D. Non-key categories

Railways and navigation: liquid fuels – CO_2

41. The inter-annual changes of CO_2 emissions for different years of the 1990–2004 period exhibit large variations for these two categories. The trend for railways is unusual and the trend for navigation is unstable and fluctuates. During the in-country visit, New Zealand informed the ERT that these estimates will be reviewed, and, if appropriate, recalculated. The ERT welcomes this intention and encourages New Zealand to revise these estimates.

III. Industrial processes and solvent and other product use

A. Sector overview

42. In 2004, the industrial processes sector and the solvent and other product use sector accounted for 5.6 per cent and 0.1 per cent, respectively, of the total national GHG emissions. From 1990 to 2004, emissions from these sectors increased by 27.5 per cent and 16.4 per cent, respectively. In the industrial processes sector the major categories in 2004 were CO_2 from iron and steel production (41.3 per cent), HFCs from consumption of halocarbons (14.2 per cent), CO_2 from aluminium production (13.2 per cent) and CO_2 from cement production (11.4 per cent). Both actual and potential emissions of HFCs, PFCs and SF_6 are reported. The estimates for these sectors are almost complete except for a small number of minor categories in the solvent and other product use sector which are noted as “NE” (e.g. N_2O from aerosol cans).

43. Reported recalculations have been performed for several source categories (e.g. CO_2 from category 2.A.4 soda ash production and use, HFCs from category 2.F consumption of halocarbons and

SF_6). CO_2 from soda ash production has been estimated and included in the inventory for all years for the first time. The ERT welcomes this improvement made by New Zealand. As a consequence of recalculations, the industrial processes sector total emissions in 2003 have increased by 8.5 per cent. The number of companies in New Zealand with activities producing CO_2 from industrial processes is small and the CO_2 emissions data supplied directly by the companies are considered to be accurate in a range of ±5 per cent. The uncertainties surrounding estimates of non-CO_2 emissions were assessed by the contractor using the questionnaires and correspondence with industry sources. They are greater than for CO_2 emissions and vary with each particular gas and category.

B. Key categories

1. Cement production – CO_2

44. New Zealand reported in the NIR that for 1997–2004 estimates of CO_2 emissions from cement production have been calculated by multiplying the amount of clinker produced by a plant-specific EF for clinker in accordance with tier 2 methodology, while for 1990–1996 estimates of CO_2 have been calculated using tier 1 methodology. However, during the in-country visit New Zealand explained to the ERT that the methodology used was incorrectly classified in the NIR and that emissions had actually been estimated using plant-specific EFs for clinker in accordance with tier 2 methodology for the whole time series. During the in-country visit, New Zealand provided the ERT with additional background data and supporting information, but the ERT found that those data were not consistent with the reported values. After the in-country visit, New Zealand revised emission estimates for the whole time series based on detailed data and information additionally obtained from the cement production company. According to the revised estimates, in 2004 CO_2 emissions from this category are 479.81 Gg (lower than the original estimate by 4.95 Gg). The ERT found that these estimates were calculated appropriately in accordance with IPCC tier 2 method for the whole time series. New Zealand expressed its intention to improve the description of the methodology in its future NIR. The ERT welcomes this, and recommends that New Zealand provide more detailed explanation about the clinker export/import, as well as the cement kiln dust (CKD) correction, among other information.

2. Ammonia production – CO_2

45. New Zealand identified CO_2 from ammonia and urea production as a qualitative key category because of the large increase in nitrogenous fertilizer use observed in the agriculture sector of the country. New Zealand reported this under the 2.B.1 ammonia production category, following the recommendations from the previous years' reviews. The ERT commends and welcomes it.

46. The trend of CO_2 emissions is unstable and fluctuates for 2000–2004. The implied emission factors (IEFs) for 2000–2004 (1.43–1.47 Gg CO_2/kt ammonia produced) are lower than the IPCC default value (1.5–1.6 Gg CO_2/kt ammonia produced). The ERT consideres that New Zealand did not provide sufficient explanation on these issues in the NIR, and therefore recommends that New Zealand provide more explanation in its next NIR, for example, by giving more information about characteristics of natural gas used to produce ammonia.

47. After the in-country visit, New Zealand revised the CO_2 emission factors for the specific type of natural gas (i.e. a mixture of gas from Maui and treated gas from Kapuni) following the ERT's recommendation made in the energy sector chapter (see para. 33 in this report). New Zealand revised CO_2 emissions from ammonia production using these revised EFs. The ERT considers this recalculation appropriate. The estimate of CO_2 emissions from ammonia production in 2004 remained unchanged in spite of this revision, because the specific type of natural gas mentioned above was not used and hence the revision of EFs did not affect the estimation of CO_2 emissions in 2004.

3. Iron and steel production – CO_2

48. New Zealand reported in the NIR that it used a modification of the tier 2 approach for calculating CO_2 emissions from iron and steel production. The ERT recommends that New Zealand explain more clearly, the methodology used and provide more information in its next NIR, such as a reference to the paper which justifies neglecting the amount of carbon in iron sand when estimating CO_2 emissions.

49. The ERT found that CO_2 emissions from limestone used in steel production were included in the estimates for iron and steel production. The ERT recommends that New Zealand, in its next inventory submission, report CO_2 emissions from limestone used as flux under the category 2.A.3 limestone and dolomite use, following the IPCC good practice guidance, instead of including them in the estimates for iron and steel production.

4. Aluminium production – CO_2

50. The ERT found an inconsistency between the NIR and CRF tables with regard to the key category analysis. CO_2 from aluminium production was identified as a key category for 2004 in the CRF tables, while it was not in the NIR. During the in-country visit, it was confirmed that CO_2 from aluminium production is a key category.

51. New Zealand stated in the NIR that the carbon consumption was multiplied by 3.812 to convert carbon (C) to CO_2 (as compared with 3.666 if the standard atomic weights ratio of 44/12 is used). This number was explained in the NIR as being specific to Comalco smelters to take into account some other process losses, but it does not seem sufficiently transparent to the ERT. The ERT recommends New Zealand to provide more explanations in its next NIR, for example, by quoting the equation from the relevant paper shown to the ERT during the in-country visit.

5. Aluminium production – PFCs

52. The IEFs for PFCs have decreased drastically (by 87.8 per cent for tetrafluoromethane (CF_4) and by 90.6 per cent for hexafluoroethane (C_2F_6) between 1990 and 2004). These IEFs are very low (0.031 kg/t aluminium for CF4 in 2004 and 0.0029 kg/t aluminium for C_2F_6 in 2004) and lower than the IPCC default value for Centre Work Pre Bake (CWPB) which is used in New Zealand (0.31 kg/t aluminium for CF_4 and 0.04 kg/t aluminium for C_2F_6). New Zealand explained in the NIR that these emissions were calculated using the tier 2 method with the IPCC default slope coefficients for CWPB technology and smelter-specific operating parameters. However, the ERT found that the ratio of IEF for CF_4 to that for C_2F_6 fluctuates over time (0.091–0.143). These fluctuations would be impossible if tier 2 method was used with IPCC default slope coefficients (in this case the ratio must have been constant and equal to 0.129 (0.018/0.14) for the whole time series). New Zealand explained that this variation in IEFs was probably the result of CF_4 and C_2F_6 estimates being rounded off to one or two significant digits before being transferred into the CRF Reporter. This issue should be addressed by New Zealand in its future submissions because of the low IEFs and lack of transparency of the information provided in the NIR. New Zealand expressed its intention to ensure the full estimate is entered into the CRF Reporter for future inventory submissions. The ERT welcomes this intention and recommends that New Zealand make further efforts to improve estimates in its next inventory submission.

6. Consumption of halocarbons and SF_6 – HFCs

53. The ratios of potential to actual emission of HFCs are reported to be less than 1 for 1993–2004 (ranging from 0.52 to 0.86). They are the lowest of the reporting Parties. This issue could not be clearly explained either in the NIR or during the in-country visit. The New Zealand inventory team indicated a higher level of confidence in the estimate of actual emissions, and that the estimate of potential emissions could be an underestimate. The ERT recommends that New Zealand investigate this issue, and provide further explanation in its next NIR. The ERT also recommends that New Zealand continue making its

efforts to further improve the quality of estimates where possible, for example by reinforcing QC activities on data collection.

54. New Zealand reported in the CRF tables for 2004 the emissions of HFC-245FA used for foam blowing (0.228 Gg CO_2 equivalent). For 1990–2003, these emissions were reported as “NO”. New Zealand included the amount of HFC-245FA emissions in national total emissions for 2004. The ERT recommends that New Zealand exclude HFC-245FA from national totals, following the UNFCCC reporting guidelines, as the 100-year global warming potential (GWP) value for HFC-245FA has not yet been adopted by the Conference of the Parties to the UNFCCC. After the in-country visit, New Zealand submitted revised emission estimates following the ERT’s recommendation. According to the revised estimates, in 2004 HFCs emissions from this category are 597.13 Gg CO_2 equivalent (lower than the original estimate by 0.228 Gg CO_2 equivalent). The ERT considers this revision appropriate and welcomes it.

C. Non-key categories

1. Lime production – CO_2

55. The types of lime produced in the country are not reported in the NIR or CRF tables. NIR states that a single country-specific EF based on the typical levels of impurities in the lime produced in New Zealand was applied to all lime prior to 2002, and plant-specific EFs have been used since 2002. However, no quantitative information on these values is provided in the NIR. For enhancing transparency, the ERT recommends that New Zealand include in its next NIR the information on the types of lime produced in the country and impurities for each type of lime.

2. Limestone and dolomite use – CO_2

56. The NIR explains that all limestone in New Zealand is used for making lime or cement, and therefore New Zealand reported “IE” for this category in the CRF tables. However, the ERT found that limestone is also used in iron and steel production in New Zealand. The ERT recommends that New Zealand report CO_2 emissions from limestone used in iron and steel production under this category, following the IPCC good practice guidance. The ERT also recommends that New Zealand improve the description of this category in the NIR in its future inventory submissions.

3. Solvent and other product use – CO_2

57. CO_2 from steel production is reported as “IE” under this sector in the CRF. However, during the in-country review New Zealand explained to the ERT that this was a mistake and that it should have been not applicable (“NA”). The ERT recommends that New Zealand correct this mistake in its next inventory submission.

IV. Agriculture

A. Sector overview

58. In 2004, emissions from the agriculture sector in New Zealand amounted to 37,349.63 Gg CO_2 equivalent, or 49.7 per cent of the total national GHG emissions. The agriculture sector is the largest source of emissions in the country. During the period 1990–2004 the emissions from the sector increased by 14.9 per cent, mainly owing to increases in CH_4 emissions from enteric fermentation and N_2O emissions from agricultural soils. Because rice cultivation does not occur in New Zealand, the notation key “NO” has been used. For the enteric fermentation and manure management categories, buffalo, camels, llamas, mules and asses populations are reported in the CRF tables as “NE” and the CRF documentation box explains that, on the basis of the last agriculture census, they make up less than 0.05 per cent of the total livestock in New Zealand.

59. All basic agricultural AD for emissions estimations are obtained from Statistics New Zealand. These AD have a very high quality, as shown in the uncertainty analysis. The ERT had the opportunity to verify this during the in-country review.

60. The information presented in the CRF tables is transparent and consistent, but not all the additional information tables and relevant documentation boxes in the CRF are filled in. In some cases there is an inappropriate use of notation keys, for example the amount of Volatile substance in animal manure is reported as “NA” for important categories, although it is the main driver for CH_4 emissions from manure; and in others there is some missing information, for example the fraction of crop residue burned ($Frac_{BURN}$) is reported as “0” although emissions from burning of agricultural residues are occurring in the country. This minor problems do no affect the emissions estimates which for the major sources have a high scientific standard.

61. The supporting information in the NIR contains some inconsistencies or gaps, for example it is explained that the OVERSEER model is used to calculate the nitrogen excretion from animals. However, during the in-country review New Zealand explained that the model is not used and these references should therefore be removed. No data on nitrogen (N) content in feed is reported in the NIR, making it difficult to review the total excreted nitrogen by animals (Nex) without additional information from the Party. These data were provided to the ERT during the in-country review. The AD for dairy cattle provided in the NIR and the CRF tables is consistent with data reported by Statistics New Zealand as dairy cattle. According to the IPCC good practice guidance dairy cattle refers to “cows that have calved at least once and are being kept to produce milk”. According to Statistics New Zealand dairy cattle is “the number of dairy cows and heifers in milk or calf estimated at 4.1 million”. This means that the calculated CH_4 IEF from enteric fermentation and Nex cannot easily be compared with other Parties.

62. New Zealand uses enhanced livestock characterization in its calculations, which is in accordance with the IPCC good practice guidance for key categories, although the NIR explains that only a detailed level of livestock characterisation is used. The AD reported in the NIR are reported at detailed level. The ERT recommends that New Zealand in its next NIR include a description of the enhanced livestock characterization used in calculations, basic AD and other data relevant for understanding the methods used, and improve the transparency of the NIR.

63. Recalculations have been reported for the whole time series because of the change in use from tier 1 to tier 2 for CH_4 emissions from manure management and a changed leaching factor ($Frac_{LEACH}$). The overall effect of these recalculations is an increase for 1990 of 0.9 per cent and for 2003 a decrease 0.6 per cent. For all years the AD used are an average of three years, which is accordance with the IPCC good practice guidance.

64. The ERT considers that total N_2O emissions seem to have been estimated appropriately and using up to date methodologies, although there are some issues to be solved in the next submissions regarding N_2O emissions due to NH_3 volatilization. As conditions for a proper estimation of N_2O emissions are very complex, the ERT encourages New Zealand to describe the total N pool circulating in the agriculture sector of New Zealand, which may clarify some of the underlying driving forces for the country-specific EFs.

B. Key categories

1. Enteric fermentation – CH_4

65. New Zealand has estimated CH_4 emissions from enteric fermentation using a country-specific model based on sound scientific principles (Clark et al. 2003). The model estimates the total dry matter (DM) intake for several different subgroups of dairy cattle, beef cattle, sheep and deer and multiplies the DM intake with a country-specific CH_4 EF, taking into account changes in productivity. For estimation of CH_4 emissions from horses, goats, pigs and poultry New Zealand used tier 1 methods. Of these

animals only goats are ruminants. For goats New Zealand uses a value of 9 kg CH_4/head/yr, although it is stated in the NIR that it has used the IPCC default value (5 kg CH_4/head/yr). New Zealand is recommended to verify its choice of EF in its next submission.

2. Manure management – CH_4

66. For the estimation of CH_4 emissions from manure management New Zealand uses a tier 2 method based on data from Sagger et al. (2004). The whole time series has been recalculated, as previously New Zealand used the tier 1 method. The effect of the change is an increase in the emissions of CH_4 of 32.1 per cent for year 2003. The change in EF for manure deposited on grassland is well documented in the NIR. Only 5 per cent of the manure from dairy cattle is managed and because of the relatively small population of pigs in New Zealand only small amounts of pig manure are handled. As a consequence, CH_4 emissions from this source are very low compared with other countries. The ERT believes that estimated emissions from this category are of a good quality.

3. Direct soil emissions – N_2O

67. The total amount of mineral fertilizer used in 2004 is 310.7 Gg N. This figure is based on data from the New Zealand Fertiliser Manufacturers Research Association and in accordance with the data reported by the International Fertilizer Industry Association. The total fertilizer consumed in New Zealand has increased sixfold since 1990, while the area of annual crops has remained about the same. The major part of the fertilizer is applied to grassland.

68. The Nex is calculated on feed consumption derived from the model by Clark et al. (2003) multiplied by a fixed factor of N in the feed of 3.7 per cent in DM for dairy cattle and 3.0 per cent for non-dairy cattle, sheep and deer in combination with an animal nutrient turnover model which takes into account animals' increased productivity and weight gain as well. For other minor animal categories default IPCC values are used. During the in-country review New Zealand explained to the ERT that it has data on 6,000 feeding samples, which yielded the above-mentioned percentages. As a consequence there are changes in excreted N per animal/year, for example, since 1990 the amount of N excreted by dairy cattle has increased from 104.9 kg N/year to 116.9 kg N/year in 2004. As mentioned in paragraph 61 above the population of dairy cattle in the CRF tables is different from the number of dairy cows. During the in-country review in answering to questions from the ERT, New Zealand presented calculations to the ERT showing that the amount of Nex from dairy cows having calved is estimated to be 126.07 kg N/animal/year for 2004. This figure seems to be a reasonable value for all year grazing dairy cows with high productivity level in New Zealand. The total Nex in 2004 is estimated to be 1 595 Gg N/year.

69. N-fixing crops such as clovers are used intensively in New Zealand pastures, and New Zealand is a major producer of clover seed. The use of N fixing crops increases the N turnover in soil from dead roots and root exudates and increases the N_2O emissions compared with native soils. Sagger et al. (2004) has estimated the total N fixation in New Zealand to approximately 1,100 Gg N/year or 69 to 77 per cent of the annually estimated Nex from animals in the period 1990 to 2004. The total N fixation reported in New Zealand's inventory for 2004 is 3.7 Gg, or only 0.3 per cent of the total N fixation. New Zealand accounts only for N-fixation based on seed yield from pulses and peas. New research (Rochette and Janzen, 2005) has shown that there are no N_2O emissions from the nitrogen fixation process itself, but emissions may occur from the breakdown of N fixing crops. New Zealand provided the ERT with information on measured N_2O emissions data from 18 field trials that gave an average emission of 0.9 kg N_2O-N/ha/year from plots not receiving nitrogen (i.e. control plots) (0.1 to 2.4 kg N_2O-N/ha/year) or 1.4 kg N_2O/ha/year. New Zealand has provided the ERT with N_2O emission data from a native forest showing that no or little N_2O emission and some data from partly water logged and organic soils. No measurements on N_2O emissions from native unsaturated soils have been given. The measured values from pastoral areas are comparable with other background measurements from intensive cropping systems in the world, for example as described in Bowman et al. (1996), and therefore there is little

evidence that the intensive use of clover in New Zealand pastures has increased the N_2O emissions above other intensive cropping systems. However, conversion of more native soils to improved grassland or further improvement of existing grassland is likely to increase N_2O emissions from pastures. The ERT therefore recommends that New Zealand in its future inventories include the effect of changes in its management of grassland and other leguminous crops.

70. N_2O emissions from crop residues returned to soils are estimated using the default IPCC method. The overall emissions from this category have very little impact on the total emissions from agriculture (0.1 per cent). However, the default methodology is very uncertain and improvements could be made where actual N content in crop residues (which are lower than the default values) are used as well as more precise national data on the amount of crop residues returned to soil.

4. Pasture, range and paddock manure – N_2O

71. The N_2O emissions from animal excreta deposited on pastures is estimated using a country specific EF (EF_{PRP}) of 0.01 kg N_2O-N/kg N based on measurements, while the IPCC default value is 0.02 kg N_2O-N/kg N. The NIR clarifies that an EF of 0.01 kg N_2O-N/kg N is a proper value and that measurements continued until the measurements dropped down to background emission levels. The chosen value is adequately addressed in the NIR and therefore the approach for emissions estimation is justified.

5. Indirect emissions – N_2O

72. Indirect N_2O emissions are a key category for New Zealand. For ammonia emissions from mineral fertilizer New Zealand uses the default IPCC methodology. In New Zealand 75 per cent of the fertilizer consumption is urea, which is known to have a high ammonia (NH_3) EF (Black et al. 1985, 1987 – studies performed in New Zealand referred by Bolan et al. 2004). In answering questions raised by the ERT during the in-country review, New Zealand made calculations with the OVERSEER model showing that the average NH_3 volatilization from mineral fertilizer consumed in the country is approximately at the same level as the IPCC default value (10 per cent). The OVERSEER uses a non-linear model in these estimations; New Zealand explained that this is appropriate for the country conditions and application rates. No validation of the performance of the OVERSEER model is available and hence the ERT had no opportunity of assessing the overall NH_3 emissions from mineral fertilizer. As this issue was also raised during the previous 2005 review, New Zealand is recommended to use a higher tier for this category in its next submission.

73. For the estimation of NH_3 emissions from animal excreta, New Zealand uses the default value of 20 per cent for $Frac_{GASM}$ although it is a key category. This default value includes emissions from stables, storages, manure application and grazing animals. Sagger et al. (2004) published a review of gaseous emissions from animal excreta for New Zealand conditions. In this review no recommendation on appropriate NH_3 EFs is made; however, the review showed that NH_3 emission from grazing animals could be substantially lower than the default value. New Zealand is recommended to implement a higher tier approach for NH_3 emissions from animal excreta, especially on pastures, in order to improve the transparency and the accuracy of the estimated N_2O emissions from indirect sources. This issue also was raised during the previous 2005 review but has not been addressed in the 2006 submission. The ERT encourages New Zealand to investigate a country specific $Frac_{GASM}$ or document why the IPCC default value is considered appropriate for New Zealand conditions.

74. In the 2006 submission the fraction of N leached ($Frac_{LEACH}$) has been changed from 0.15 to 0.07 based on calculations using the OVERSEER model. A recalculation has been performed for the whole time series. The rationale for this change is documented in a peer-reviewed article by Thomas et al. (2005). A $Frac_{LEACH}$ of 0.07 in all-year pastoral systems as in New Zealand may be a proper value of the N leaching although there are very few references to similar systems in the international literature;

therefore its use could be seen as the best available value and the indirect N_2O emissions from leaching in combination with the default EF_5 of 0.025 is justified.

C. Non-key categories

Field burning of agricultural residues – N_2O and CH_4

75. N and C are closely linked in agriculture, which means that both N_2O emissions from crop residues returned to soil and CH_4 and N_2O emissions from burned crop residues have the same origin. New Zealand in its calculations used different N contents for agricultural residue regardless that it is returned to soil or burned. Furthermore, the fraction burned has been reduced from 2003 to 2004 without a similar increase in the fraction returned to soil. Such changes also affect the carbon stock in soil. New Zealand is recommended to develop a simple methodology for all crop residues accounting for both N and C which takes into account gathered crop residues, burned residues and residues returned to soil using national data on N content in crop residues.

V. Land use, land-use change and forestry

A. Sector overview

76. In its 2006 inventory submission, New Zealand has applied the methods recommended by the IPCC good practice guidance for LULUCF and reported emissions and removals in all the relevant CRF tables. New Zealand's LULUCF sector in 2004 represented a net sink of 24 482.63 Gg CO_2 equivalent, offsetting 32.6 per cent of total national GHG emissions. Net removals in 2004 were 29.0 per cent above those in 1990. The net removals over the time series 1990–2004 show inter-annual variations between 1.5 per cent and 13.2 per cent, which can be mostly attributed to annual variations in the forest land remaining forest land category due to variability in the extent of new plantations, increased growth rates due to breeding improvement and wood harvest rates fluctuations.

77. All the land-use categories and GHG emissions and most removals from living biomass and soil organic carbon pools are reported in the CRF tables. All the relevant CRF tables are provided, either with estimations or notation keys. Forest land and cropland represent net sinks. Forest land is the most important category by far; the forest land remaining forest land subcategory drives the trend for all the time series. Emissions/removals from soil organic carbon pool (SOC) from forest land and cropland remaining cropland are assumed to be stable (zero) as a conservative approach due to the lack of reliable information to provide estimates. The use of the notation key "IE" is not appropriate when the emissions/and removals are assumed to be zero and not estimated. All the other land-use categories are emission sources.

78. The NIR provides detailed information on the selection of adequate IPCC default or country-specific EFs and methodologies used in the inventory. Additional information is contained in the annex to the NIR on annual afforestation, forest fires and grassland burning. Calculated emissions and removals from harvesting are included in the NIR to improve transparency. Although the NIR states that living biomass pool includes above-ground and below-ground biomass (section 7.1.2.2), it is recommended that the titles of tables 7.1.3.2 and 7.1.3.3 (on country-specific factors) specify this as well as provide short explanations on the provided worksheets.

79. According to the NIR, the LULUCF sector is included in the analysis in determining key categories. Forest land remaining forest land, land converted to forest land, land converted to grassland and cropland remaining cropland are key categories. In addition, the secretariat's key categories analysis identified carbon emissions from agricultural lime application (5.G) as a key category as well, with an overall increasing trend from 1990 to 2002 (111.7 per cent) and a decrease from 2002 to 2004 (6.1 per cent).

80. Since New Zealand adopted all the land-use categories according to the IPCC good practice guidance for LULUCF in its 2005 submission, recalculations in its 2006 submission have been estimated for the complete time series. Furthermore, the complete time series is expected to be recalculated again in future submissions once a more consistent set of data for the entire time series has been prepared based on the Land Use Change and Analysis System (LUCAS) presented to the ERT during the visit, which is partially described in the annex A3.2 of the NIR.

81. New Zealand has used an analysis of two existing country-wide cover maps obtained from satellite imagery for the years 1997 and 2002 to report the land transition matrix, according to approach 3 in the IPCC good practice guidance for LULUCF. In the NIR a land-use interpolation matrix between 1997 and 2002 is provided and the land-use areas for 1990–1996 and 2003–2004 are extrapolated linearly. More detailed transition matrix is provided in the annex A8.5 of the NIR, including examples for interpolation (1997 to 1998) and extrapolation (2003 to 2004). Review of the land transition matrix is foreseen after LUCAS become fully operational by the end of 2009.

82. Attempts made to quantify the uncertainties in CO_2 removals for planted forests, cropland, wetland, settlement and other lands, using country-specific factors and default factors taken from the IPCC good practice guidance for LULUCF are being extended to 2004. The uncertainty calculations are provided in the NIR, table A7.1, following the IPCC tier 1 method, for CO_2 in forest land and other land-use categories and for CH_4 and N_2O across the LULUCF sector. The NIR states that the forest land category introduces an uncertainty of about 2.2 per cent into the trend in the national total from 1990 to 2004, having the second largest impact on the trend after CO_2 emissions from the energy sector.

83. The ERT recommends that New Zealand implement the following improvements in its future submission: (a) Consider updating table 7.1.1 of the NIR, which contains a land-use matrix for the years 1997–2002, so as to complete the time series since 1990; (b) consider double–checking the use of notation keys “NE” and “IE”, for most of the CRF tables; (c) Update the description in the appendix A3.2 with a more comprehensive description on how the different components of the Carbon Monitoring System and LUCAS, will be arranged, and how data management and archiving and QA/QC procedures, including a timetable for implementation, will be implemented; (d) Since liming is reported in an aggregated way in the CRF tables, provide explanations in an specific section of the NIR, including explanations of why the trend of increasing use of lime changed twice during 1990–2002 and has been decreasing since 2002.

84. The ERT commends New Zealand for the effort made to address completeness for the LULUCF sector, and recommends improving in its next inventory submission the descriptions of specific methodologies related to subcategories under the main land categories, with special emphasis on forest land.

B. Key categories

1. Forest land – CO_2

85. Emissions and removals from the forest land category (subcategory forest land remaining forest land and lands converted to forest land) are key categories in New Zealand’s 2004 inventory. New Zealand has adopted a national definition of forest consistent with the New Zealand forest definition reported to the Food and Agriculture Organization of the United Nations (FAO), that corresponds to areas over 1 hectare with 30 per cent canopy cover and stands of 5 metres in height or more.

86. Forest land remaining forest land and lands converted to forest land subcategories have been identified as key categories in the 2004 inventory. A combination of the IPCC good practice guidance for LULUCF tier 1 approach, country-specific EFs and tier 2 modelling approach (in the case of plantations) for the subcategory forest land remaining forest land have been used for calculating

emissions and removals in the forest land category. Among the different pools, living biomass (including understorey) and dead organic matter (DOM) are estimated for plantations, whereas the SOC is not. The SOC estimates are foreseen under the LUCAS.

87. Trends for the forest land category are dominated by the net removals (harvest versus growth) of the highly productive pine plantations, since the natural forests are, considered to be C neutral and the harvest rates are very small there. The ERT recommends that New Zealand include in chapter 7 (LULUCF) of its next NIR the information contained in the appendix A3.2.

2. Cropland – CO_2

88. Only tier 1 estimates for living biomass and soil C stocks for woody crops are provided, since the IPCC good practice guidance for LULUCF does not provide a default method for reporting DOM pool. No information on the land use management changes for the 20-year period prior the inventory time series is available in the country. Therefore, carbon stocks are assumed to be constant for cropland remaining cropland. Tier 1 estimates are provided for C stock changes for living biomass and soil C for lands converted to cropland, whereas no estimates are provided for N_2O emissions from disturbance associated with land-use conversion to cropland (CRF table 5(III)). The ERT recommends New Zealand to include in its next inventory submission the missing estimates for N_2O emissions associated with land-use conversion, and to provide in its next NIR information supporting the assumption that soil carbon stocks in croplands remaining croplands are not a source.

3. Grassland – CO_2

89. No estimates are provided for grassland remaining grassland. A tier 1 method has been applied for estimates for lands converted to grasslands, and only changes in living biomass and soil C stocks are provided in the CRF tables, since the IPCC good practice guidance for LULUCF allows Parties not to report DOM pool. Table 7.1.3.2 in the NIR assumes that grassland with woody vegetation has a living biomass of 63 t C per hectare (value provided for perennial crops above-ground biomass, table 3.3.2. of the IPCC good practice guidance for LULUCF), which seems to be a high value compared with the peak above-ground living biomass given in table 3.4.2 of the IPCC good practice guidance for LULUCF.

C. Non-key categories

Biomass burning – CO_2, CH_4 and N_2O

90. New Zealand provides a detailed estimation of the biomass that is burned associated with land conversions and wildfires in Annex A8.5 of the NIR. Estimations reported in the CRF tables (5(V)) for non-CO_2 GHGs are calculated using tier 1 methods. However, it is unclear where the CO_2 emissions from biomass burning are reported. The ERT recommends that New Zealand clarify in its next NIR whether the CO_2 emissions from biomass burning are included under the forest land category.

VI. Waste

A. Sector overview

91. In 2004, the waste sector contributed 2.5 per cent of total national GHG emissions. In 2004 emissions from the waste sector were 23.4 per cent below the 1990 level. In 2004, CH_4 emissions from solid waste disposal on land are identified as a key category, in both the level and the trend assessments. The amount of emissions from waste incineration is considered to be negligible, and the notation key "NE" is used for this category.

92. The methodologies used in the waste sector are: IPCC tier 1 for wastewater handling and tier 2 with country-specific AD and EFs for solid waste disposal on land. Emissions from managed waste

disposal on land over the period 1992–2003 have been recalculated based on new data on recovery of CH_4 emissions. The tier 1 approach is used for verification and QA/QC.

93. The ERT identified some inconsistencies in the use of population and waste generation data in different parts of the NIR and the CRF tables and encourages New Zealand to use consistency checks in its future submissions.

B. Key categories

Solid waste disposal on land – CH_4

94. In 2004, 90 per cent of waste is reported as going to managed waste disposal sites. During the in-country review, the ERT was informed that by 2010 all solid waste will go to managed waste disposal sites, eradicating the unmanaged sites. Emissions of CH_4 from this category represented 79.8 per cent of total emissions from the waste sector in 2004.

95. New Zealand averages the additional day of the year every four years using 365.25 days per year. This adds 0.25 to 1990 and subtracts 0.75 days for the present inventory year (2004). The ERT recommends New Zealand to use the calendar year consistently for the complete time series.

96. The ERT was able to review the reports on which original CH_4 recovery estimates were based and found inconsistencies between data reported in these reports and calculations included in the CRF tables, particularly for 1990. After the in-country review, New Zealand confirmed that there had been no landfill gas recovery in 1990 and 1991. Solid waste was being disposed of at some landfills that would, at some point in later years, have installed gas recovery systems, but in 1990 and 1991 there were no gas recovery systems operational in the country. The ERT recommends that New Zealand include such information in its next NIR.

97. The NIR reports that a new landfill review and audit and solid waste analysis protocol have been used to recalculate emissions from 1992 to 2003. For 2004, the gross annual CH_4 generation has been verified using results from tier 1 and tier 2 methods, and the tier 1 QC process has been employed. The ERT was informed that although no plans for further improvement are reported in the NIR, minor improvements are planned for this key category.

C. Non-key categories

1. Wastewater handling – CH_4 and N_2O

98. There are no recalculations reported for the waste-water handling category. The ERT was informed by New Zealand that a new wastewater database was developed in 2006 and data will be available for the next inventory submission. The use of the up-scaling factor from chemical oxygen demand (COD) to biological oxygen demand (BOD) was not consistent with the IPCC good practice guidance. This factor was corrected in the revised emissions estimates provided to the ERT during the six week period following the in-country review.

99. The ERT was provided during the in-country review with the basic studies for domestic and commercial wastewater handling used by New Zealand in its estimates. Those studies contain BOD measurements for the years 1997 and 2001. The effect of population increases and use of existing surveys and estimates was incorporated into the revised estimates provided to the ERT within the six week period following the in-country review. The ERT encourages New Zealand to keep reflecting the changing conditions, particularly the growing population conditions, in its next NIR.

100. New Zealand did not provide numerical information on AD in table 6.B of the CRF for industrial wastewater. The methodology applied does not use data as required by table 6.B. The ERT encourages New Zealand to flag this in its next NIR. The ERT also encourages New Zealand to provide information on data and data sources in its next NIR, and in particular for agriculture-related industries.

101. New Zealand applies a constant per capita wastewater coefficient (13 g N/day) throughout the whole period 1990–2004, not reflecting probable changes in protein consumption. The ERT encourages New Zealand to check the consistency of this approach with data on protein consumption provided by New Zealand to FAO.

2. Waste incineration – CO_2, CH_4 and N_2O

102. Emissions from this category are reported as “NE” in the CRF tables. There is no incineration of municipal waste in New Zealand, however incineration of very small amounts of waste from specialized facilities, such as hospitals and research institutions, still occurs. Incineration occurs in 16 small incinerators, which deal with medical waste (5 incinerators), veterinary and laboratory waste (6 incinerators), quarantine waste (3 incinerators) and hazardous waste (2 incinerators). The quantity of material being disposed of through these incinerators is not required to be measured, creating difficulties in estimating the quantity of GHG emissions being released. The ERT encourages New Zealand to make efforts to estimate and report these emissions.

VII. Conclusions and recommendations

103. In its 2006 submission, New Zealand has submitted a complete set of CRF tables for the years 1990–2004 and an NIR. New Zealand’s GHG inventory is consistent with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance. New Zealand’s inventory is particularly strong in the areas of institutional arrangements, archiving and methodological approaches to emissions from enteric fermentation and manure management.

104. In the course of the review, the ERT formulated a number of recommendations relating to the completeness and transparency of New Zealand’s information presented in the 2006 GHG inventory submission. Most of the recommendations have been implemented during the review process and the potential problems have been resolved. The ERT notes that New Zealand provided timely and thorough replies to the ERT questions concerning potential problems, providing additional information and revising estimates. The remaining key recommendations[5] are that New Zealand should:

(a) Improve the implementation of its QA/QC plan, in particular with the aim of reducing minor errors and inconsistencies;

(b) Use CRF notation keys more consistently to improve transparency and facilitate future reviews;

(c) Provide more transparency in the NIR on the choice of methods and data, paying particular attention to the task of centralized review teams that will need to make conclusions on the basis of the NIR text;

(d) Report CO_2 emissions from limestone use in steel production under category 2.A.3 limestone and dolomite use instead of category 2.C.1 iron and steel production in accordance with to the IPCC good practice guidance.

105. The ERT believes that in future reviews the following topics should be examined in depth:

(a) Progress in implementing the proposed New Zealand Carbon Accounting System for Land-Use, Land-Use Change and Forestry;

(b) Possible new information on the actual and potential emissions of fluorinated gases, particularly those used as substitutes for ozone depleting substances.

[5] 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/>.

IPCC. Good practice guidance for land use, land-use change and forestry. 2003. Available at <http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.htm>.

IPCC/OECD/IEA. Revised 1996 IPCC Guidelines for national greenhouse gas inventories, volumes 1–3. 1997. Available at <http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm>.

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>.

UNFCCC. Guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention. FCCC/CP/2002/8. Available at <http://unfccc.int/resource/docs/cop8/08.pdf>.

UNFCCC secretariat. Status report for New Zealand. 2006. Available at <http://unfccc.int/resource/docs/2006/asr/nzl.pdf>.

UNFCCC secretariat. Synthesis and assessment report on the greenhouse gas inventories submitted in 2006. FCCC/WEB/SAI/2005. Available at <http://unfccc.int/resource/docs/webdocs/sai/sa_2006.pdf>.

UNFCCC secretariat. New Zealand: Report of the individual review of the greenhouse gas inventory submitted in the year 2005. FCCC/WEB/ARR/2005/NZL. Available at <http://unfccc.int/resource/docs/2006/arr/nzl.pdf>.

B. Additional information provided by the Party

"National System Checklist". Informal checklist provided by the Ministry for the Environment of New Zealand's implementation of Article 5.1 of the Kyoto Protocol.

New Zealand Climate Change Office–Quality Management Review QA/QC – QA Report on QA/QC Plan (Contract #04/05-0175-S). Claws Consulting Ltd.

New Zealand National Greenhouse Gas Inventory Quality Control and Quality Assurance Plan (Updated 25 January 2006).

New Zealand National Inventory Improvement Plan 2006/2007

New Zealand's Greenhouse Gas Inventory 1990–2004: The National Inventory Report and the Common Reporting Format. Updated for Kyoto protocol Initial Report Requirements. August 2006.

New Zealand's Greenhouse Gas Inventory 1990–2004: The National Inventory Report and the Common Reporting Format. April 2006.

New Zealand's Initial Report under the Kyoto Protocol. Ministry for the Environment. 1 September 2006.

Optimisation of the Statistical Confidence and Cost Effectiveness of New Zealand's Greenhouse Gas Inventory. PriceWaterhouseCoopers. October 2005. Document ID: 127792.

Responses to questions during the review were received from Ms. Sonia Petrie (Ministry for the Environment) including additional material on the methodology and assumptions used.

References used in the energy sector

Baines JT (ed.). 1993. New Zealand Energy Information Handbook. Taylor Baines and Associates. Christchurch.

Bertani R and Thain I. 2002. Geothermal power generating plant CO_2 emission survey, IGA News-Newsletter of the International Geothermal Association, 55, 11–13.

Bone IH, Hunt M and Spring CE. 1993. Greenhouse Gas Emissions from New Zealand Transport. Report by Beca Carter Hollings and Ferner Ltd, for the Ministry of Transport.

Clarkson T, Lloyd B, SriRamaratnam R and Brown L. Changes in Energy Sector Emission Factors resulting from Peer Review of the Hale and Twomey Review of Energy Sector Emission Factors. Report of the Peer Review Panel. New Zealand. 27 January 2004.

Clarkson T. Review of Energy Sector Greenhouse Gas Emission Reporting. NIWA, New Zealand. April 2002.

Goldthorpe S. Review of Energy Sector Greenhouse Gas Inventory, New Zealand. November 2006.

Hale and Twomey Ltd. 2003. Review of Energy Sector Greenhouse Gas Emission Factors. Report to Energy Modelling and Statistics Unit, Ministry of Economic Development, New Zealand. 2003.

Ministry of Economic Development. 2006. New Zealand Energy Data File, Wellington. Available at <http://www.med.govt.nz/energy/info>.

Ministry of Economic Development. 2006. Revised New Zealand Energy Greenhouse Gas Emissions 1990–2005. Wellington. Available at <http://www.med.govt.nz/energy/info>.

Sheppard D and Mroczeck E. 2004. New Zealand greenhouse gas emissions from the exploitation of geothermal systems, Geothermal power generating plant CO_2 emission survey. IGA News-Newsletter of the International Geothermal Association, 49, 1–3.

References used in the industrial processes sector

UNFCCC secretariat. New Zealand: Report of the individual review of the greenhouse gas inventory submitted in the year 2004. FCCC/WEB/IRI/2004/NZL. Available at <http://unfccc.int/files/national_reports/annex_i_ghg_inventories/inventory_review_reports/application/pdf/2004_irr_centralized_review_new_zealand.pdf>.

Government of New Zealand. 1995. Voluntary Agreement between the Government of New Zealand and the New Zealand Cement Industry Incorporating the Golden Bay Cement Company Limited, Lee Cements Limited, Milburn New Zealand Limited, to Reduce Carbon Dioxide Emissions.

Ministry of Economic Development. 2006. Revised New Zealand Energy Greenhouse Gas Emissions 1990–2005. Wellington. Available at <http://www.med.govt.nz/energy/info>.

New Zealand Steel Limited. The Science of Steel. Printed from the homepage of New Zealand Steel Limited on 13 November 2006. <http://www.nzsteel.co.nz/go/about-new-zealand-steel/student-information/the-science-of-steel>

New Zealand Steel Limited. The Art of Pickling. Printed from the homepage of New Zealand Steel Limited on 13 November 2006. <http://www.nzsteel.co.nz/go/about-new-zealand-steel/student-information/the-art-of-pickling>.

New Zealand Steel Limited. The Acid Regeneration Plant Reactor. Printed from the homepage of New Zealand Steel Limited on 13 November 2006. <http://www.nzsteel.co.nz/go/about-new-zealand-steel/student-information/acid-regeneration>.

References used in the agriculture sector

Bolan NS, Sagger S, Luo J, Bhandral R and Singh J. 2004. Gaseous Emissions of Nitrogen from Grazed Pastures: Processes, Measurements and Modelling, Environmental Implications, and Mitigation. Advances in Agronomy, 84, 38–120.

Bouwman A.F. 1996. Direct emissions of nitrous oxide from agricultural soils. Nutrient Cycling in Agrosystems, 52, 165–170.

Clark H, Brookes I and Walcroft A. 2003. Enteric methane emissions from New Zealand ruminants 1990–2001 calculated using a IPCC Tier 2 approach. Report prepared for the Ministry of Agriculture and Forestry. March 2003.

Clark H. 2007. Additional data on the calculation methods for CH_4 emission from New Zealand ruminants (personal communication).

de Klein CAM. 2007. Unpublished data on background N_2O emissions from New Zealand agriculture (personal communication).

Kelliher FM, Ledgard SF, Clark H, Walcroft AS, Buchan M and Sherlock RR. 2003. Revised Nitrous Oxide Emissions from New Zealand Agricultural Soils: 1990–2001. Final Client Report prepared for the Ministry of Agriculture and Forestry. 26 March 2003.

O’Hara P, Freney J and Ulyatt M. 2003. Abatement of Agricultural Non-Carbon Dioxide Greenhouse Gas Emissions, A study of Research Requirements. Report prepared for the Ministry of Agriculture and Forestry. ISBN No. 0-478-7754-8.

Sagger S, Bolan NS, Bhandral R, Hedley CB and Luo J. 2004. A review of emissions of methane, ammonia, and nitrous oxide from animal excreta deposited and farm effluent application in grazed pastures. New Zealand Journal of Agricultural Research. 47, 513–544.

Thomas SM, Ledgard SF and Francis GS. 2005. Improving estimates of nitrate leaching for quantifying New Zealand’s indirect nitrous oxide emissions. Nutrient Cycling in Agroecosystems. 73, 213–226.

References used in the land use, land-use change and forestry sector

Lawton M and Barton J. 2002. Framework Report on the Development of the National Carbon Monitoring System. Report prepared for the Ministry for the Environment: Wellington, New Zealand.

Manley. 2004. Review of NEFD Yield Table Structure. Contract report prepared for the Ministry of Agriculture and Forestry. Canterprise: New Zealand.

Ministry of Agriculture and Forestry. 2005. National Exotic Forest Description as at 1 April 2004 (June 2005).

Payton IJ, Newell CL and Beets PN. 2004. New Zealand Carbon Monitoring System Indigenous Forest and Shrubland Data Collection Manual. Landcare Research and Forest Research report for the Ministry for the Environment: Lincoln and Rotorua.

Scott NA, Tate KR, Giltrap DJ, Newsome PF, Davis MR, Baisden WT, Saggar S, Trotter CM, Walcroft AS, White JD, Trustrum NA and Stephens PR. 2001. Critical issues in quantifying land-use change effects on New Zealand's terrestrial carbon budget: Deforestation, afforestation and reforestation. Extended Abstracts Volume 1. Sixth International Carbon Dioxide Conference. Sendai, Japan. October 2001. Organizing Committee of the Sixth International Carbon Dioxide Conference, Tohoku University: Japan. 559–562.

Tate KR, Scott NA, Parshotam A, Brown L, Wilde R.H, Giltrap DJ, Trustrum NA, Gomez B and Ross DJ. 2000. A multi-scale analysis of a terrestrial carbon budget: Is New Zealand a source or sink of carbon? Agriculture, Ecosystems & Environment, Volume 82, Issues 1–3 (December 2000). 229–246.

Tate KR, Barton JP, Trustrum NA, Baisden WT, Saggar S, Wilde RH, Giltrap DJ and Scott NA. 2003a. Scott-Smith CA (Ed). Monitoring and modelling soil organic carbon stocks and flows in New Zealand. In: Soil organic Carbon and Agriculture: Developing Indicators for Policy Analysis. Proceedings of an OECD expert Meeting, Ottawa, Canada, October 2002. Agriculture and Agri-Food Canada and Organisation for Economic Co-operation and Development: Paris. 329.

Tate KR, Wilde RH, Giltrap DJ, Baisden WT, Saggar S, Trustrum NA and Scott NA. 2003b. Current approaches to soil carbon monitoring in New Zealand. Proceedings of carbon measurement and monitoring forum (CASGMS). Manhattan, Kansas, 15–17 October, 2003.

Te Morenga L and Wakelin SJ 2003. Carbon inventory of New Zealand's planted forests. Report for the Ministry of Agriculture and Forestry and the Ministry for the Environment. Forest Research: Rotorua, New Zealand.

Theron M (Chair), Brown S, O'Loughlin C, Paustian K and Whitmore A. 1999. International review of New Zealand's carbon monitoring project. Contract report for the Ministry for the Environment: Wellington New Zealand.

Thompson S, Gruner I and Gapare N. 2004. New Zealand Land Cover Database Version 2. Illustrated Guide to Target Classes. Report for the Ministry for the Environment: New Zealand.

Wakelin SK and Paul T. 2006. Carbon Inventory of New Zealand's Planted Forests – Calculations revised as at February 2006. Report for the Ministry of Agriculture and Forestry: New Zealand.

References used in the waste sector

SCS Wetherill Environmental. 1998. National Greenhouse Gas Inventory from the Waste Sector 1990–2020. A report for the Ministry for the Environment: New Zealand.

SCS Wetherill Environmental. 2002. National Greenhouse Gas Inventory from the Waste Sector 1990–2020. A report for the Ministry for the Environment: New Zealand.

Waste Management New Zealand 2005. Landfill Methane Recovery Estimate and National Greenhouse Gas Inventory from the Waste Sector. Report commissioned by the Ministry for the Environment: New Zealand.

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