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Report of the individual review of the annual submission of New Zealand submitted in 2010*

* In the symbol for this document, 2010 refers to the year in which the inventory was submitted, and not to the year of publication.

Contents

I. Introduction and summary

1. This report covers the in-country review of the 2010 annual submission of New Zealand, coordinated by the UNFCCC secretariat, in accordance with decision 22/CMP.1. The review took place from 30 August to 4 September 2010 in Wellington, New Zealand, and was conducted by the following team of nominated experts from the UNFCCC roster of experts: generalist – Ms. Kristina Saarinen (Finland); energy – Mr. Hongwei Yang (China); industrial processes – Mr. Kiyoto Tanabe (Japan); agriculture – Mr. Tom Wirth (United States of America); land use, land-use change and forestry (LULUCF) – Mr. Xiaoquan Zhang (China) and Mr. Kevin Black (Ireland); and waste – Mr. Eduardo Calvo (Peru). Mr. Yang and Mr. Tanabe were the lead reviewers. The review was coordinated by Ms. Ruta Bubniene (UNFCCC secretariat).

2. In accordance with the "Guidelines for review under Article 8 of the Kyoto Protocol" (decision 22/CMP.1), a draft version of this report was communicated to the Government of New Zealand, which provided comments that were considered and incorporated, as appropriate, into this final version of the report.

3. In 2008, the main greenhouse gas (GHG) in New Zealand was carbon dioxide (CO_2), accounting for 48.0 per cent[1] of total GHG emissions[2] expressed in carbon dioxide equivalent (CO_2 eq), followed by methane (CH_4) (35.0 per cent) and nitrous oxide (N_2O) (15.9 per cent). Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) collectively accounted for 1.2 per cent of the overall GHG emissions in the country. The agriculture sector accounted for 46.3 per cent of total GHG emissions, followed by energy (45.3 per cent), industrial processes (5.7 per cent), waste (2.6 per cent) and solvent and other product use (0.04 per cent). Total GHG emissions amounted to 75,152.68 Gg CO_2 eq and increased by 22.8 per cent between the base year[3] and 2008. The shares of gases and sectors in 2008 (2010 annual submission) were similar to those of 2007 (2009 annual submission).

4. Tables 1 and 2 show GHG emissions from Annex A sources, emissions and removals from the LULUCF sector under the Convention and emissions and removals from activities under Article 3, paragraph 3, by gas and by sector, respectively. In table 1 CO_2, CH_4 and N_2O emissions included in the rows under Annex A sources do not include emissions and removals from the LULUCF sector.

5. Table 3 provides information on the most important emissions and removals and accounting parameters that will be included in the compilation and accounting database.

[1] The calculations in this report, if not specified overwise, are based on the revised 2010 common reporting format (CRF) (v.1.2.) submission provided by New Zealand on 15 October 2010 and further revised estimates of CH_4 emissions from natural gas leakage at industrial plants and power stations (1.B.2.b.v.1).

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

[3] "Base year" refers to the base year under the Kyoto Protocol, which is 1990 for all gases. The base year emissions include emissions from Annex A sources only.

Table 1

Greenhouse gas emissions from Annex A sources and emissions/removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol by gas, base year to 2008[a]

			Gg CO_2 eq								*Change*
		Greenhouse gas	*Base year*[a]	*1990*	*1995*	*2000*	*2005*	*2006*	*2007*	*2008*	*Base year–2008 (%)*
Annex A sources		CO_2	24 893.28	24 893.28	25 873.77	30 939.32	36 105.98	36 346.72	35 233.47	36 063.16	44.9
		CH_4	25 882.79	25 882.79	26 216.86	27 455.08	27 718.30	27 891.04	26 950.70	26 310.16	1.7
		N_2O	9 778.87	9 778.87	10 591.48	11 368.59	12 593.61	12 481.68	12 075.38	11 913.42	21.8
		HFCs	NA, NO	NA, NO	148.10	311.24	741.50	675.63	918.59	812.55	NA
		PFCs	629.87	629.87	131.16	58.06	59.57	90.99	41.47	38.84	–93.8
		SF_6	15.20	15.20	17.88	10.52	19.41	16.95	15.04	14.55	–4.3
KP-LULUCF	Article 3.3[b]	CO_2								–14 417.27	
		CH_4								0.02	
		N_2O								0.0001	
	Article 3.4[c]	CO_2	NA							NA	NA
		CH_4	NA							NA	NA
		N_2O	NA							NA	NA

Abbreviations: KP-LULUCF = land use, land-use change and forestry emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, NA = not applicable, NO = not occurring.

[a] "Base year" for Annex A sources refers to the base year under the Kyoto Protocol, which is 1990 for all gases. The "base year" for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol is 1990.

[b] Activities under Article 3, paragraph 3, of the Kyoto Protocol, namely afforestation and reforestation, and deforestation. Only the latest inventory years of the commitment period must be reported.

[c] Elected activities under Article 3, paragraph 4, of the Kyoto Protocol, including forest management, cropland management, grazing land management and revegetation. For cropland management, grazing land management and revegetation the base year and the latest inventory years of the commitment period must be reported.

Table 2

Greenhouse gas emissions by sector and activity, base year to 2008

			Gg CO_2 eq								*Change*
		Sector	*Base year*[a]	*1990*	*1995*	*2000*	*2005*	*2006*	*2007*	*2008*	*Base year–2008 (%)*
Annex A		Energy	23 198.43	23 198.43	23 870.32	29 090.10	33 940.59	34 322.85	32 889.81	34 050.55	46.8
		Industrial processes	3 385.79	3 385.79	3 314.34	3 562.81	4,314.89	4 280.82	4 636.59	4 291.98	26.8
		Solvent and other	41.54	41.54	44.95	47.12	44.33	40.30	43.40	31.00	–25.4
		Agriculture	31 865.41	31 865.41	33 191.82	35 076.29	36,782.50	36 745.89	35 563.37	34 826.29	9.3
		Waste	2 708.84	2,708.84	2 557.83	2 366.49	2,156.05	2 113.16	2 101.48	1 952.85	–27.9
		Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
		LULUCF	–31 066.30	–31 066.30	–28,768.08	–31 281.18	–23 792.68	–19 714.14	–16 820.75	–26 176.78	–15.7
		Total (with LULUCF)	30 133.71	30 133.71	34 211.17	38 861.63	53 445.68	57 788.88	58 413.90	48 975.90	62.5
		Total (without LULUCF)	61 200.01	61 200.01	62 979.25	70 142.81	77 238.36	77 503.02	75 234.65	75 152.68	22.8
KP-LULUCF	Article 3.3[b]	Afforestation & reforestation								–17 327.39	NA
		Deforestation								2,910.60	NA
		Total (3.3)								–14 416.78	**NA**
	Article 3.4[c]	Forest management								NA	NA
		Cropland management	NA							NA	NA
		Grazing land management	NA							NA	NA
		Revegetation	NA							NA	NA
		Total (3.4)	**NA**							**NA**	**NA**

Note: KP-LULUCF data refer to KP-LULUCF CRF v. 1.1. submission.

Abbreviations: LULUCF = land use, land-use change and forestry; KP-LULUCF = LULUCF emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, NA = not applicable.

[a] "Base year" for Annex A sources refers to the base year under the Kyoto Protocol, which is 1990 for all gases. The "base year" for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol is 1990.

[b] Activities under Article 3, paragraph 3, of the Kyoto Protocol, namely afforestation and reforestation, and deforestation. Only the inventory years of the commitment period must be reported.

[c] Elected activities under Article 3, paragraph 4, of the Kyoto Protocol, including forest management, cropland management, grazing land management and revegetation. For cropland management, grazing land management and revegetation the base year and the latest inventory years of the commitment period must be reported.

Table 3
Information to be included in the compilation and accounting database in t CO_2 eq

	As reported	*Adjustment*[a]	*Final*[b]	*Accounting quantity*[c]
Commitment period reserve	278 608 260	NA	278 608 260	
Annex A emissions for current inventory year	74 658 748	NA	75 152 678	
CO_2	36 063 156	NA	36 063 164	
CH_4	25 816 239	NA	26 310 161	
N_2O	11 913 416	NA	11 913 416	
HFCs	812 547	NA	812 547	
PFCs	38 844	NA	38 844	
SF_6	14 545	NA	14 545	
Total Annex A sources	74 658 748	NA	75 152 678	
Activities under Article 3, paragraph 3, for current inventory year	–14 416.78	NA	–14 416.78	–14 416.78
3.3 Afforestation and reforestation on non-harvested land for current year of commitment period as reported	–17 395.14	NA	–17 395.14	–17 395.14
3.3 Afforestation and reforestation on harvested land for current year of commitment period as reported	67.76	NA	67.76	67.76
3.3 Deforestation for current year of commitment period as reported	2910.60	NA	2 910.60	2 910.60
Activities under Article 3, paragraph 4, for current inventory year[d]	**NA**	**NA**	**NA**	**NA**
3.4 Forest management for current year of commitment period	NA	NA	NA	NA
3.4 Cropland management for current year of commitment period	NA	NA	NA	NA
3.4 Cropland management for base year	NA	NA	NA	NA
3.4 Grazing land management for current year of commitment period	NA	NA	NA	NA
3.4 Grazing land management for base year	NA	NA	NA	NA
3.4 Revegetation for current year of commitment period	NA	NA	NA	NA
3.4 Revegetation in base year	NA	NA	NA	NA

Abbreviation: NA = not applicable.

[a] "Adjustment" is relevant only for Parties for which the ERT has calculated one or several adjustment(s).

[b] "Final" includes New Zealand's 2010 annual submission, CRF version 1.2, submitted 15 October 2010 and further revision of estimates of CH_4 emissions from natural gas leakage at industrial plants and power stations (1.B.2.b.v.1) submitted on 15 December.

[c] "Accounting quantity" is included in this table only for Parties that chose annual accounting for activities under Article 3, paragraph 3 and elected activities under Article 3, paragraph 4, of the Kyoto Protocol, if any.

[d] Activities under Article 3, paragraph 4, are relevant only for Parties that elected one or more such activities.

6. The GHG inventory shows some inconsistencies with the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines) and the Intergovernmental Panel on Climate Change (IPCC) *Good Practice Guidance for Land Use, Land-Use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF) with regard to disaggregation or allocation of emissions/removals, namely in the energy (see paras. 50, 57 and 62), industrial processes (see paras. 78 and 83) and LULUCF sectors (see paras. 109 and 110).

7. The 2010 annual submission is generally of a high quality. The expert review team (ERT) identified a need for: further improvement of completeness by including the estimates for emissions from non-key sources in the energy (see para. 59) and waste (see para. 133) sectors, which were provided during the review; improvement of archiving by documenting confidential information not archived at the inventory agency; and improvement of transparency by enhancing the documentation of the methodology for inventory preparation and by further elaborating a description of the quality assurance/quality control (QA/QC) plan, its implementation and the quality objectives established and an inventory improvement plan in the national inventory report (NIR).

8. During the review New Zealand acknowledged these findings and undertook measures to improve completeness of the inventory for the three non-key categories in the energy and waste sectors. In response to a request from the ERT during the review, New Zealand provided revised emission estimates for: CO_2, CH_4, N_2O emissions from manufacturing industries and construction (see para. 50); fugitive CO_2 and CH_4 emissions from oil and natural gas (see para. 60); CH_4 emissions from solid waste disposal on land (see para. 129); and CH_4 emissions from wastewater treatment (see para. 134). During the review, in response to the ERT request, New Zealand provided a resubmission of entire GHG inventory (CRF v.1.2 of 15 October, 2011) and further revisions of estimates of CH_4 emissions from natural gas leakage at industrial plants and power stations (1.B.2.b.v.1). These revisions resulted in an increase in total national emissions, excluding LULUCF, of 0.7 per cent (from 74,658.75 Gg CO_2 to 75,152.68 Gg CO_2 eq) in 2008.

9. By supplying the additional information requested by the ERT, New Zealand has demonstrated sufficient capacity to comply with the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories" (hereinafter referred to as the UNFCCC reporting guidelines), the Revised 1996 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).

10. The Party has submitted supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol in accordance with chapter I of the annex to decision 15/CMP.1.

11. New Zealand has chosen to account for activities under Article 3, paragraph 3, of the Kyoto Protocol at the end of the commitment period. The Party has not elected any activities under Article 3, paragraph 4, of the Kyoto Protocol. New Zealand has reported information on activities under Article 3, paragraph 3, of the Kyoto Protocol in accordance with decisions 15/CMP.1, 16/CMP.1 and 6/CMP.3. However, completeness of the information submitted under Article 3, paragraph 3, could be improved by providing estimates of: CO_2 emissions in organic soils associated with reforestation and deforestation; N_2O and CH_4 emissions from biomass burning due to wildfires on reforested and deforested lands; and N_2O and CH_4 emissions from controlled burning on deforested land which are currently not estimated ("NE") (see para. 140).

12. New Zealand has reported information on its accounting of Kyoto Protocol units in accordance with chapter I.E of the annex to decision 15/CMP.1, and has used the standard electronic format (SEF) tables as required by decision 14/CMP.1.

13. The national system continues to perform its required functions as set out in the annex to decision 19/CMP.1.

14. The national registry continues to perform the functions set out in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1, and continues to adhere to the technical standards for data exchange between registry systems in accordance with relevant decisions of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP).

15. New Zealand has reported information on the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol, as requested in chapter I.H of the annex to decision 15/CMP.1, in its NIR. However, completeness of the information submitted under Article 3, paragraph 14, of the Kyoto Protocol could be improved by providing information on how actions to minimize adverse impacts undertaken under this article are prioritized (see para. 156). During the in-country review, New Zealand provided the ERT with the further information on the actions taken to minimize adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol.

16. In the course of the review, the ERT formulated a number of recommendations relating to the completeness of the annual submission in the energy (see para. 60) and waste (see para. 132) sectors and transparency in regard to the energy (see para. 50) industrial processes (see paras. 67 and 71), agriculture (see para. 88) and LULUCF (see para. 105) sectors.

II. Technical assessment of the annual submission

A. Overview

1. Annual submission and other sources of information

17. The 2010 annual inventory submission was submitted on 15 April 2010; it contains a complete set of common reporting format (CRF) tables for the period 1990–2008 and an NIR. New Zealand also submitted information required under Article 7, paragraph 1, of the Kyoto Protocol, including information on: activities under Article 3, paragraph 3, of the Kyoto Protocol, accounting of Kyoto Protocol units, changes in the national system and in the national registry, and minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol. The SEF tables were submitted on 15 April 2010. The annual submission was submitted in accordance with decision 15/CMP.1.

18. New Zealand officially submitted revised emission estimates on 15 October 2010 in response to questions raised by the ERT during the course of the review, and additionally provided minor revised estimates of CH_4 emissions from natural gas leakage at industrial plants and power stations (1.B.2.b.v.1) on 15 December 2010, in response to the ERT's request for further clarifications (see paras. 50, 60, 129, 133 and 134).

19. In addition, the ERT used the standard independent assessment report (SIAR), parts I and II, to review information on the accounting of Kyoto Protocol units (including the SEF tables and their comparison report) and on the national registry.[4]

20. During the review, New Zealand provided the ERT with additional information. The documents concerned are not part of the annual submission but are in many cases referenced in the NIR. The full list of materials used during the review is provided in annex I to this report.

Completeness of inventory

21. The inventory covers all source and sink categories for the period 1990–2008 and is complete in terms of years and geographical coverage. New Zealand has estimated all emissions with the exception of: fugitive CO_2 and CH_4 emissions from oil and natural gas (see para. 60); and CH_4 emissions from wastewater treatment (see para. 133). During the review New Zealand provided the missing minor non-key category emission estimates. The ERT recommends that New Zealand continue to estimate and report these emissions in its next annual submission.

22. Under Article 3, paragraph 3, of the Kyoto Protocol, New Zealand has not estimated CO_2 emissions in organic soils associated with reforestation and deforestation, N_2O and CH_4 emissions from biomass burning due to wildfire on reforested and deforested lands, and N_2O and CH_4 emissions from controlled burning on deforested land. The ERT recommends that New Zealand provide estimates of these emissions in its next annual submission.

2. A description of the institutional arrangements for inventory preparation, including the legal and procedural arrangements for inventory planning, preparation and management

Overview

23. The ERT concluded that the national system continued to perform its required functions. New Zealand described the changes of the national system since the previous annual submission and these changes are discussed in chapter G.3 of this report. The two major changes include the establishment of a cross-governmental reporting governance group and the independent agricultural inventory advisory panel. The ERT commends New Zealand for these improvements of the national system.

Inventory planning

24. Institutional arrangements for inventory preparation and management, including the process of official approval of the inventory, are well described in the NIR. During the review New Zealand provided the ERT with a QA/QC plan and an inventory improvement plan and further elaborated on the national system under Article 5, paragraph 1, of the Kyoto Protocol.

25. The Ministry for the Environment has overall responsibility for the national inventory. Other agencies and organizations are also involved in the preparation of the inventory: the Ministry of Economic Development is responsible for the preparation of the

[4] The SIAR, parts I and II, is prepared by an independent assessor in line with decision 16/CP.10 (paras. 5 (a), 6 (c) and 6 (k)), under the auspices of the international transaction log administrator using procedures agreed in the Registry System Administrators Forum. Part I is a completeness check of the submitted information relating to the accounting of Kyoto Protocol units (including the SEF tables and their comparison report) and to national registries. Part II contains a substantive assessment of the submitted information and identifies any potential problem regarding information on the accounting of Kyoto Protocol units and the national registry. The SIAR is available at <http://unfccc.int/kyoto_protocol/registry_systems/independent_assessment_reports/items/4061.php>.

inventory for the energy and industrial processes sectors and the Ministry of Agriculture and Forestry is responsible for the inventory of the agriculture sector. Contracts made with outside contractors are managed by the appropriate sector compilers. Work undertaken by contractors has included developing emission estimates, research or development of emission factors (EFs) and peer review. The contracts stipulate the requirements to be met to ensure the work will be done in line with the inventory planning by the Ministry for the Environment. Copies of the necessary documentation of this work are held by the inventory agency. The Ministry for the Environment coordinates all of the government agencies involved in the preparation of the inventory.

26. Planned improvements to methodologies and EFs for each sector are discussed annually in a meeting of the lead sectoral experts after the submission of the inventory, as well as in the new cross-governmental working group for reporting and projections of GHG emissions and removals, and in the agriculture advisory panel. Results of the key category and uncertainty analyses are used to prioritize efforts to improve the accuracy of the inventory and to guide methodological choices. The ERT noted a strong link between the GHG inventory improvements and ongoing research. For example, in the agriculture sector the inventory improvements were based on extensive measurements of CH_4 from grazing cattle and sheep. The ERT commends New Zealand for the efficient inter-institutional cooperation which leads to continuous inventory improvements.

Inventory preparation

Key categories

27. New Zealand has reported a key category tier 1 analysis, both level and trend assessment, as part of its 2010 submission. The key category analysis performed by the Party and that performed by the secretariat[5] produced similar results. New Zealand has included the LULUCF sector in its key category analysis, which was performed in accordance with the IPCC good practice guidance and the IPCC good practice guidance for LULUCF. The ERT encourages New Zealand to implement a tier 2 key category analysis for its next annual submission.

Uncertainties

28. New Zealand prepared and reported a tier 1 uncertainty analysis in accordance with the UNFCCC reporting guidelines and IPCC good practice guidance. The uncertainty in total emissions is ±12.9 per cent and ±9.5 per cent including emissions and removals from the LULUCF sector. The uncertainty in the trend of total net emissions is ±4.1 per cent and ±3.8 per cent including emissions and removals from the LULUCF sector. Also, New Zealand reported an uncertainty analysis of the emissions and removals from afforestation, reforestation and emissions from deforestation.

29. Compared with the previous annual submission, uncertainty in net emissions for 2008 has decreased by 7.7 per cent. The decrease in the uncertainty for net emissions is largely due to the improved data from the Land Use and Carbon Analysis System (LUCAS) model and improved uncertainty analysis for CH_4 emissions from enteric fermentation for sheep and cattle. The uncertainty analysis is prioritized by key categories and following the ERT

[5] The secretariat identified, for each Party, the 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 LULUCF. Key categories according to the tier 1 trend assessment were also identified for Parties that provided a full set of CRF tables for the base year or period. 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.

recommendations. The ERT encourages New Zealand to continue reassessing the uncertainty estimates for activity data (AD) in the industrial processes sector, as well as further work to decrease the uncertainty for N_2O from agricultural soils.

Recalculations and time-series consistency

30. Recalculations have been performed and reported in accordance with the IPCC good practice guidance. The ERT noted that recalculations reported by New Zealand of the time series 1990–2007 have been undertaken to take into account changes in some categories included in the energy and industrial processes sectors, improvements in AD in the energy, industrial processes and agriculture sectors, improvements to EFs in the energy and agriculture sectors, and improved mapping, AD and EFs in the LULUCF sector.

31. According to the CRF tables (version 1.2) submitted on 15 October 2010, the total effect of the recalculations with the LULUCF sector is a decrease in the estimated net GHG emissions in the base year by 31.1 per cent, and an increase by 12.9 per cent in 2007. The total effect of the recalculations without the LULUCF sector is a decrease by 1.1 per cent in the base year and by 0.5 per cent in 2007. The major recalculations were made in the LULUCF sector to incorporate country-specific methods and data and in the agriculture sector to include more accurate data as well as emission estimates for minor missing activities and for the improvement made in $Frac_{GASM}$. The rationale for all recalculations is provided in the NIR and in CRF table 8(b).

Verification and quality assurance/quality control approaches

32. New Zealand provided information on QA/QC procedures in the NIR in accordance with the IPCC good practice guidance. During the review New Zealand provided the ERT with the QA/QC plan and inventory improvement plan and demonstrated how QA/QC procedures are implemented in practice in the different sectors of the inventory.

33. The QC activities are carried out by the person performing the calculations and additionally by an independent expert, who performs compilation of sectoral emissions. The ERT encourages New Zealand to document the checks carried out according to Table 8.1 in the IPCC good practice guidance and note that activities are carried out and documented by a person not involved in preparation of the calculations. The ERT noted an example of QA sheet provided in the NIR and that in some cases in the energy and industrial processes sectors the QC checks are conducted at tier 2 level where plant-level data are used. The ERT commends New Zealand for the quality work and encourages New Zealand to indicate the higher tier QA/QC work in the NIR of its next annual submission.

34. The ERT noted that the QA/QC plan does not include specific procedures for documentation and archiving of confidential information. During the review week, New Zealand provided the ERT with confidential information used for inventory preparation, such as plant-specific documentation in the energy and industrial processes sectors. However, it was still not sufficiently clear how such confidential information is treated and kept in archives by the inventory compilers. The ERT recommends that New Zealand elaborate the QA/QC plan by including specific procedures for the documentation and archiving of confidential information with a view to ensuring that all the confidential information used for inventory preparation is appropriately treated and archived.

35. No verification procedure is currently established for the inventory as a whole, except for the energy, agriculture and LULUCF sectors. For instance, in the energy sector, a reference approach is used to check that all carbon in fuels is accounted for, and data from the emissions trading scheme (ETS) are used for QA/QC checks; and in the agriculture and LULUCF sectors, different datasets available from different sources (such as studies and statistics for the same AD) are compared. New Zealand's ETS may, over time, help to provide

a means of verification. The ERT commends New Zealand for these efforts, and encourages New Zealand to perform verifications for the other sectors in the inventory in future.

Transparency

36. The NIR provides much of the information necessary to assess the inventory. Some additional information would further improve the transparency of the NIR, such as documentation of expert judgements in all sectors and of how confidential information is handled. In addition, transparency would be enhanced by further improvement of the descriptions for several methodologies, especially in the energy (see para. 50), industrial processes (see paras. 67, 71, and 85 (a)), agriculture (see para. 88) LULUCF (see para. 105) and waste (see para. 124) sectors, as well as further enhancing the description of the QA/QC plan and further elaboration of the source-specific planned improvements.

37. The ERT noted apparent discrepancies between the definition of organic soils in the agriculture and the LULUCF sectors, and encourages New Zealand to ensure the use of harmonized data sets for all inventory preparation in the different sectors, for example for organic soils (see para. 113). During the review, New Zealand informed the ERT that the work to harmonise the definitions and AD for organic soils has been commissioned and this issues are expected to be resolved for the 2012 submission.

38. The use of some notation keys in the CRF tables are not applied according to reporting guidelines, for example, in the energy (see paras. 51 and 59), industrial processes (para. 68) and agriculture (see para. 87) sectors and the ERT recommends that New Zealand revise the use of these notation keys in its next annual submission.

Inventory management

39. New Zealand has an archiving system established at the Ministry for the Environment where all annual inventory submissions are stored. The archiving of disaggregated EFs and AD, and documentation on how these factors and data have been generated and aggregated for the preparation of the inventory, is organized by the Ministry of Economic Development in the energy and industrial processes (CO_2) sectors and by the Ministry of Agriculture and Forestry in the agriculture sector, while the remaining sectors data are archived by the Ministry for the Environment. In its response to a request from the ERT, New Zealand indicated its intention to improve archiving by establishing a register at the lead inventory agency (Ministry for the Environment) for all information held by Ministry of Economic Development.

40. The archived information also includes internal documentation on QA procedures, external and internal reviews, and documentation on annual key categories and planned inventory improvements. Not all confidential data and expert judgements were archived at the Ministry for Environment. However, during the review, the ERT was provided with the requested archive of the confidential data from the other agencies and data providers for the inventory preparation. New Zealand explained that not all confidential information was provided to, and thus archived by, the inventory compiler. The ERT encourages New Zealand to maintain a list of confidential information stored at agencies other than Ministry of Environment to ensure that the inventory can be more easily reproduced in the future.

3. Follow-up to previous reviews

41. New Zealand has addressed a number of recommendations from the previous review (for example, the inclusion of potatoes as one of the crops contributing nitrogen residues to soils to calculate N_2O emissions from agricultural soils; the inclusion of information in the NIR on how and where CO_2 emissions associated with feedstocks and other non-energy use of fuels are accounted for by providing energy flow diagrams as well as through the improved

data from the LUCAS system in the LULUCF sector). The ERT commends New Zealand for the improvement of its inventory, particularly the inclusion of LUCAS data in the LULUCF reporting.

42. However, the ERT noted that New Zealand has not implemented some of the recommendations from the previous review, particularly:

(a) Revising its approach to estimating non-CO_2 emissions (mainly N_2O) from liquid fuel use in road transportation in the energy sector, taking into consideration advanced developments in vehicle technology since 1990;

(b) Reassessing the uncertainty estimates for AD, reporting uncertainty estimates for each EF and providing a more detailed description of the uncertainty estimates at least for every key category in the industrial processes sector;

(c) Providing more information on which flux elements are included in the mass balance calculation and how related CO_2 emissions from iron and steel production are reported in the CRF tables;

(d) Validating the model to estimate emissions from recovered gas in solid waste disposal on land by using metered values from selected sites.

4. Areas for further improvement

Identified by the Party

43. The 2010 NIR identifies several areas for improvement, namely that New Zealand is working to improve its estimates in the energy, industrial processes, waste and LULUCF sectors by: further improving documentation for fugitive emissions from oil and gas; resolving differences between the energy sector reference and sectoral approaches, and between AD, CO_2 and CH_4 estimates for the 1990s; checking the conversion period for land; and undertaking further work to improve and validate the soil carbon monitoring system and reviewing data for land-use change in the LULUCF sector.

Identified by the expert review team

44. The ERT identifies the following cross-cutting issues for improvement:

(a) Improve completeness of the annual submission by:

(i) Further estimating not estimated categories/activities, especially in the energy and waste sectors and more transparently reporting lagged emissions from land deforested before 2008;

(ii) Providing information on how actions to minimize adverse impacts under Article 3, paragraph 14, of the Kyoto Protocol are prioritized;

(b) Improve transparency and accuracy of the annual submission by:

(i) Further improving the description of methodologies to estimate emissions and removals in all sectors, as recommended in detail in the relevant chapters of this report;

(ii) Improving the documentation of expert judgements;

(iii) Providing information on how New Zealand's emissions trading units are associated with the other units in the national registry and further information on changes in the national registry, including information on the integration of the New Zealand ETS;

(iv) Revising the use of some notation keys in the energy (see paras. 52 and 59), industrial processes (para. 68) and agriculture (see para. 87) sectors and revising the use of these notation keys in its next annual submission;

(v) Further elaborating on how New Zealand strives to minimize adverse impacts under Article 3, paragraph 14, of the Kyoto Protocol;

(vi) Refining the methodology to distinguish between deforested and harvested land for 2008–2012;

(vii) Elaborating a QA/QC plan by including specific procedures for documentation and archiving of confidential information;

(c) Improve consistency with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance for LULUCF by following more thoroughly the definitions of the categories set there, namely disaggregating the "other" subcategory in the energy sector, reassessing the allocation of emissions in the industrial processes sector and improving the disaggregation of subcategories in the LULUCF sector. During the review, New Zealand noted its intention to disaggregate subcategories in the LULUCF sector for the 2011 annual submission.

45. Recommended improvements relating to specific categories are presented in the relevant sector chapters of this report.

B. Energy

1. Sector overview

46. According to the CRF tables submitted on 15 April 2010, the energy sector is the second largest sector (after agriculture) in the GHG inventory of New Zealand. In 2008, emissions from the energy sector amounted to 33,838.8 CO_2 eq, or 45.3 per cent of total GHG emissions. Since 1990, emissions have increased by 46.9 per cent and led the changes in total GHG emissions trend of New Zealand in 1990–2008. The key drivers for the rise in emissions are road transportation and public electricity and heat production. Within the sector, 42.2 per cent of the emissions were from transport, followed by 26.3 per cent from energy industries, 16.9 per cent from manufacturing industries and construction, and 8.6 per cent from other sectors (commercial/institutional, residential and agriculture/forestry/ fisheries). The remaining 6.1 per cent was from fugitive emissions from fuels (including geothermal).

47. During the review, in response to questions raised by the ERT, New Zealand provided a resubmission of the entire GHG inventory (CRF v. 1.2 on 15 October, 2011) and further revisions to the estimates of the CH_4 emissions from natural gas leakage at industrial plants and power stations (1.B.2.b.v.1) (see paras. 50) and 60). According to these revised estimates, total emissions from the energy sector in 2008 amounted to 34,050.55 Gg CO_2 eq, and increased by 46.8 per cent between 1990 and 2008. According to the revised estimates, within the energy sector, 41.9 per cent of the emissions were from transport, followed by 26.1 per cent from energy industries, 16.8 per cent from manufacturing industries and construction, 8.5 per cent from other sectors (commercial/institutional, residential and agriculture/forestry/fisheries) and 6.6 per cent from fugitive emissions from fuels (including geothermal).The ERT agrees with the estimates and recommends that New Zealand continue to report these emissions in its next annual submission.

48. In general, New Zealand's energy inventory is transparent where methodologies, AD and EFs were provided in annex 2 of the NIR. However, the ERT noted several areas for further improvement to transparency, such as the description of methodologies for manufacturing industries and construction, where most of the GHG emissions were aggregated into one subcategory (see para. 50 below), and of fugitive emissions from oil, natural gas and

other sources (1.B.2.d) where the methodology for estimating CO_2 and CH_4 emissions from geothermal is unclear.

49. The tier 1 quality checks were applied for all categories. During the review, the ERT was informed that more plant-specific data may become available next year along with the implementation of the New Zealand ETS. The ERT encourages New Zealand to strengthen QA/QC procedures for data collection and management, giving priority to the maintenance of time-series consistency and archiving of confidential data.

50. In the CRF tables submitted on 15 April 2010, estimates of CO_2, CH_4 and N_2O emissions from solid, liquid and gaseous fuel combustion under manufacturing industries and construction lacks transparency due to a very high level of aggregation. Most of the emissions were reported under the subcategory other, which constitutes 99.2 per cent of liquid fuels, 100 per cent of solid fuels, 36.9 per cent of gaseous fuels and 100 per cent of biomass; 70.5 per cent of CO_2, 93.7 per cent of CH_4 and 98.4 per cent of N_2O emissions were reported under this category. During the review, in response to a request from the ERT, New Zealand made efforts to disaggregate these emissions reported under the subcategory other into specific industries for liquid fuels, solid fuels and biomass for the entire time series 1990–2008. The ERT welcomes this improvement made by New Zealand and recommends that New Zealand continue making efforts to further improve the disaggregation of AD and emission estimates into specific industries in the energy sector, ensuring consistency with the Revised 1996 IPCC Guidelines and IPCC good practice guidance as well as with the data obtained from plants that are used in the industrial processes sector.

51. The notation key not occurring ("NO") was used by mistake for some manufacturing industries, which is contradictory to the information contained in the energy balance table provided by New Zealand during the review, such as: solid fuel use for food processing, beverages and tobacco, and biomass use for pulp, paper and print. The ERT recommends that New Zealand correct the use of these notation keys while revising the emissions estimate by disaggregation, as mentioned in paragraph 50 above.

2. Reference and sectoral approaches

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

52. The CO_2 emissions from fuel combustion were calculated using the reference approach and the sectoral approach. For the year 2008, the CO_2 emissions estimated by the reference approach are 1.0 per cent higher than those estimated by the sectoral approach. Explanations are provided in the documentation box of CRF table 1.A(c). In addition, the NIR provides explanations for the fluctuations in the differences between the two approaches over the years.

53. The energy data provided in the CRF table1.A(b) are on a gross calorific value (GCV) basis. After adjustment, by lowering the values by 5 per cent for oil and coal and by 10 per cent for natural gas in order to obtain those data on a net calorific value (NCV) basis, the apparent consumption reported to the UNFCCC corresponds to that reported to the International Energy Agency (IEA) within a 5 per cent margin for all years except 1990 and 1991, when the CRF data are about 7 per cent higher than the IEA data. The relatively large discrepancy in 1990 and 1991 is mainly due to a large quantity of refinery feedstocks stock changes (equivalent to about 7 per cent of the CRF total apparent consumption), reported in the CRF and not to the IEA. The total apparent consumption in 2008 in the CRF is higher than that of the IEA by 3.5 per cent, mainly due to differences in crude oil and natural gas production as well as crude oil imports.

International bunker fuels

54. The consumption in international aviation and international marine bunkers, as reported in CRF table 1.C, is comparable with but systematically higher than the data from the IEA. For international aviation, the data reported in the CRF tables for jet kerosene are systematically higher than the data from IEA – up to 4 per cent for the entire time series. For international marine bunkers, the data reported in the CRF tables are systematically higher than the data from IEA by 3–6 per cent, except for 2005 (where the CRF data are higher by 16 per cent). During the review, the ERT was informed of New Zealand's intention to include in the inventory the plant-specific AD from the major five oil companies and 19 distributors, following their inclusion in the New Zealand ETS. This will improve consistency between domestic and international statistics in the next annual submission.

Feedstocks and non-energy use of fuels

55. Following the recommendations from the previous ERT, New Zealand provided energy flow diagrams for liquid fuels, solid fuels and natural gas, including the consideration of feedstocks and non-energy use of fuels, to avoid a potential double counting or omission of emissions from fuel combustion. The ERT encourages New Zealand to continue to include this information in the NIR for subsequent annual submissions and to consider the inclusion of more plant-specific information provided by New Zealand ETS.

3. Key categories

Stationary combustion: gaseous fuels – CO_2

56. The ERT noted that the CO_2 implied emission factors (IEFs) for natural gas under public electricity and heat production are higher than the IPCC default value (56.1 t/TJ) ranging from 56.2 t/TJ to 58.9 t/TJ. Inter-annual change for 1990–2001 and for 2003–2008 range from –2.8 per cent to 1.7 per cent. During the review, New Zealand provided additional information indicating how natural gas mix changed over time, from mainly two gas fields (Maui and Kapuni) until the middle of the 1990s, to more than 10 gas fields in recent years. This resulted in fluctuations in IEFs due to differences in EFs from different gas fields. The ERT recommends that New Zealand provide this explanation in the NIR for the next annual submission to explain the fluctuations.

4. Non-key categories

Stationary combustion: liquid – CH_4

57. The CH_4 emissions from methanol production was reported under chemicals to protect confidentiality. However, according to the Revised 1996 IPCC Guidelines it should be reported under the industrial processes sector, other (chemical industry). The ERT learned that the AD is maintained at the agency responsible for reporting energy emissions and CO_2 industrial process emissions (MED) rather than the lead inventory agency (MfE). During the review New Zealand stated its intention to store a register of all information held by MED at the lead inventory agency (MfE) in order to improve QA/QC procedures. The ERT encourages New Zealand to improve its QA/QC procedures and ensure that emissions from methanol production are estimated accurately and reported transparently, following the UNFCCC reporting guidelines while maintaining confidentiality.

Road transportation: liquid – CH_4 and N_2O

58. New Zealand applied the tier 1 approach to estimate the CH_4 and N_2O emissions from road transportation using IPCC default EFs. As indicated in previous reviews, the ERT noted that the tier 1 approach does not accurately represent the characteristics of New

Zealand's transportation fleet, where about half of the fleet is used cars which are more than 10 years old (dominated by Euro 1.3 standard with catalytic converters, although some converters were removed by users). During the review, the ERT noted that New Zealand is working on estimating emissions using a tier 2 approach. The ERT encourages New Zealand to take into consideration the specific characteristics of the car fleet and report the tier 2 results in its future annual submissions..

Oil and natural gas –CO_2 and CH_4

59. The notation key "NE" was used for the CO_2 and CH_4 emission estimates of several subcategories. However, New Zealand explained in the CRF tables that these emissions were insignificant based on expert judgment. During the review, New Zealand acknowledged that some emissions reported as "NE" are not actually occurring or are included elsewhere, and thus should be reported as "NO" or included elsewhere ("IE"). The ERT recommends that New Zealand report correctly the notation keys in its next annual submission.

60. New Zealand clarified that fugitive CO_2 emissions from oil transport (1.B.2.a.iii.), and fugitive CH_4 emissions from natural gas at industrial plants and power stations (1. B.2.b.v.1), and natural gas in residential and commercial sectors (1.B.2.b. v.2) could be estimated and reported. During the review, in response to a request from the ERT, New Zealand provided these estimates for the entire time series. For 1990, the revised emission estimate from oil and natural gas was 1,058.13 Gg CO_2 eq, or an increase by 17.3 per cent compared to the original estimate; for 2008, the estimate was 1,928.28 Gg CO_2 eq, or an increase of 12.3 per cent. The ERT agrees with the estimates and recommends that New Zealand continue to report these emissions in its next annual submission.

5. Areas for further improvement

Identified by the Party

61. New Zealand is implementing the New Zealand ETS which will improve the availability of AD from many major industrial facilities, including 50 facilities that fall under the Stationary Energy and Industrial Processes Regulations, 5 participants (covering all the major oil companies in New Zealand) under the Liquid Fossil Fuel Regulations and many participants under the Unique Emission Factors Regulations. These regulations form the major framework of the New Zealand ETS by defining the participants of the ETS and methodologies and EFs for emission estimates.

Identified by the expert review team

62. The ERT recommends that New Zealand make efforts to further disaggregate the "other" (manufacturing industries and construction) by following the Revised 1996 IPCC Guidelines and the IPCC good practice guidance and provide more detailed information on methodologies and data utilized for the estimation of CO_2 and CH_4 emissions from geothermal energy production (for example, EFs calculated by one of the major geothermal operators based on data obtained from spot measurements). The ERT encourages New Zealand to apply the tier 2 approach for CH_4 and N_2O emissions from road transportation to reflect the national circumstances of New Zealand's transportation fleet.

C. Industrial processes and solvent and other product use

1. Sector overview

63. In 2008, emissions from the industrial processes sector amounted to 4,291.98 Gg CO_2 eq, or 5.7 per cent of total GHG emissions, and emissions from the solvent

and other product use sector amounted to 31.00 Gg CO_2 eq, or 0.04 per cent of total GHG emissions. Since the base year, emissions have increased by 26.8 per cent in the industrial processes sector, and decreased by 25.4 per cent in the solvent and other product use sector. The key driver for the rise in emissions in the industrial processes sector is an increase in the emissions of HFCs and PFCs from refrigeration and air-conditioning equipment since the mid-1990s when chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) began to be phased out under the Montreal Protocol.

64. Within the industrial processes sector, 35.9 per cent of the emissions were from iron and steel production, followed by 17.0 per cent from refrigeration and air-conditioning equipment (consumption of halocarbons and SF_6), 14.8 per cent from cement production and 12.6 per cent from aluminium production. Ammonia production accounted for 7.7 per cent and hydrogen production accounted for 5.7 per cent. The remaining 6.2 per cent was from lime production, limestone and dolomite use, and subcategories other than refrigeration and air-conditioning equipment under consumption of halocarbons and SF_6.

65. New Zealand applied a tier 1 QC check in accordance with the IPCC good practice guidance to all the key categories and one non-key category (lime production) under the industrial processes sector in its 2010 submission. The results of the tier 1 QC check are well-organized, but little information about the check is provided in the NIR. The ERT recommends that New Zealand provide more explanation about QC procedures and its results in the NIR in order to improve transparency. Furthermore, the ERT encourages New Zealand to obtain and record information on QC carried out by companies from which emission estimates were directly collected. The ERT also encourages New Zealand to apply a tier 2 QC check in accordance with the IPCC good practice guidance to key categories and categories where significant methodological and data revisions have taken place.

66. The previous ERT noted 0 per cent uncertainties for AD for several categories of the industrial processes and recommended that New Zealand should: reassess the uncertainty estimates for AD; report uncertainty estimates for each EF; and provide a more detailed description of the uncertainty estimates at least for every key category. However, this recommendation was not implemented in the 2010 submission. The ERT noted that 0 per cent uncertainties were still reported for AD of six categories (cement production, glass production, ammonia production, methanol production, iron and steel production and aluminium production). The ERT reiterates the previous recommendation.

67. The ERT noted that the explanation of emission estimate methodologies provided in the NIR is not sufficiently transparent for several categories under the industrial processes sector. This is partly because many data are confidential as New Zealand has only a small number of plants for each industry, but partly because explanation is provided incorrectly or the explanation is insufficient. Specific problems with regard to incorrect explanation (for ammonia production and iron and steel production) and insufficient explanation (for cement production, iron and steel production, aluminium production and consumption of halocarbons and SF_6) are described below under the specific categories. For the categories with these problems, explanation should be improved to the extent possible with confidentiality issues in mind.

68. Under consumption of halocarbons and SF_6, New Zealand reported both actual and potential emissions of HFCs, PFCs and SF_6 for the entire time series except for several years for which the notation keys not applicable ("NA"), "NO" or "IE" were used for HFCs (1990–1991) and for PFCs (1990–1994, 1999–2001 and 2005). The ERT noted that notation keys were not correctly used in some cases (for example, "IE" for potential emissions of PFCs at the level of category consumption of halocarbons and SF_6, "NE" for actual emissions of HFCs from manufacturing for subcategory refrigeration and air-conditioning equipment). The ERT recommends that New Zealand reconsider the use of notation keys and correct it where necessary.

2. Key categories

Cement production – CO_2

69. There were two cement production companies in operation in New Zealand in 2008. Estimates of CO_2 emissions from cement production were calculated by these companies using the Cement CO_2 Protocol. The data for clinker production and plant-specific EFs were not presented in the NIR because of the confidentiality issue.

70. During the review week, however, New Zealand disclosed those data to the ERT, and the ERT confirmed that the calculation was made following the IPCC good practice tier 2 method. The amount of clinker produced by each cement plant was multiplied by a plant-specific clinker EF. The IPCC default value of cement kiln dust (CKD) correction factor (1.02) was multiplied to the data reported by one company, but the CKD correction factor was not applied to the data reported by the other company because the CKD was completely recycled there.

71. The ERT reiterates the recommendation from the previous review that New Zealand should further improve transparency of the NIR by discussing which tier method has been used and how the method is consistent with the IPCC good practice guidance. The ERT also encourages New Zealand to continue making efforts to obtain relevant data to use plant-specific CKD values where the IPCC default value has been used.

Ammonia production – CO_2

72. This category was specified as a qualitative key category due to the large increase in nitrogenous fertilizer use observed in the agriculture sector since 1990. The explanation of AD in the NIR is not transparent, and seems to imply that only 20 per cent of the carbon used for ammonia production was reported as CO_2 emissions from this category, while the remaining 80 per cent was reported in the energy sector.

73. During the review, New Zealand informed the ERT that this explanation was not correct, and demonstrated the spreadsheet used for the calculation of CO_2 emission estimates. The ERT confirmed that all the carbon contained in the natural gas used for ammonia production (including both that which is assumed to be sequestered in urea products and that which is not) was actually reported as CO_2 emissions from this category. The ERT recommends that, in its next annual submission, New Zealand provide a more thorough and correct explanation of the method and assumption used to estimate emissions from this category, including an explanation of the consumption of natural gas as a raw material and how double counting with the energy sector was prevented.

Iron and steel production – CO_2

74. There were two steel producers in operation in New Zealand in 2008. New Zealand explained in the NIR that the IPCC tier 2 method was applied to estimate CO_2 emissions from one company for the entire time series from 1990–2008. However, there is no explanation in the NIR about carbon content of steel produced, which needs to be taken into account according to the IPCC tier 2. Also, the plant-specific EF and the carbon content of raw material (ironsand) used by this company were not explained in a transparent manner in the NIR. During the review, New Zealand provided the ERT with detailed explanations about these factors, and confirmed that New Zealand actually used the IPCC tier 2 method.

75. New Zealand also explained in the NIR that the IPCC tier 2 method was applied for 2000–2008 but not for 1990–1999 to estimate CO_2 emissions from the other company. The explanation about the method and data used by this company is not sufficiently transparent. For example, the NIR explains that minor carbon component of the additives used during steel-making process was excluded from reported CO_2 emissions, but no quantitative

information about it is provided in the NIR. During the review, New Zealand provided the ERT with some quantitative information about this, and explained that carbon from the additives was considered to be contained in the final steel product.

76. Noting the assessment made in paragraphs 74 and 75, the ERT strongly recommends that New Zealand explain more transparently the method and data used by companies (e.g. plant-specific EFs for reducing agents, carbon content of raw materials and steel products, carbon content of additives) in its next annual submission.

77. Recalculation was implemented to improve time-series consistency in emissions estimates from one company for the years 2000–2008, and this is explained in the NIR. The ERT welcomes this effort made by New Zealand. During the review, the ERT found that the NIR does not provide a correct explanation about the EF based on steel production which was used for emissions estimates from one company for the years 1990–1999. New Zealand acknowledged this, and further informed the ERT that the EF value should have been updated to be equal to the average of IEFs for 2000–2008. The ERT recommends that New Zealand correct the emission estimates for 1990–1999 using the updated EFs in its next annual submission.

78. In the section on limestone and dolomite use in the NIR New Zealand explained that CO_2 emissions arising from limestone, coke and electrodes used in the iron and steel-making process are reported under limestone and dolomite use, because the data on limestone could not be separated from those on coke and electrodes. This was not explained in the section on iron and steel production in the NIR. The ERT reiterates the recommendations from the previous review that New Zealand provide more information in the section on iron and steel production so as to make it clear which flux elements are included and how their emissions are reported in the CRF tables. The ERT encourages New Zealand to make efforts to obtain data from steel-producing companies to estimate CO_2 emissions from coke and electrodes separately from those for limestone use, so that the former can be reported under the iron and steel production category in accordance with the Revised 1996 IPCC Guidelines.

Aluminium production – PFCs

79. New Zealand estimated emissions of PFCs from aluminium production using the International Aluminium Institute (2006)[6] tier 3 method, which is equivalent to the tier 2 method in the IPCC good practice guidance. The IEF for CF_4 emissions in 2008 (0.0152 kg/t aluminium produced) is the lowest among all the Annex I Parties that reported these emissions, and so is the IEF for C_2F_6 emissions in 2008 (0.00184 kg/t aluminium produced). (The range of implied EFs reported by Annex I Parties is 0.0152–1.00 kg/t aluminium produced for CF_4 and 0.00184–0.100 kg/t aluminium produced for C_2F_6). These IEFs reported by New Zealand are remarkably lower than the IPCC tier 1 default values provided in the IPCC good practice guidance (0.31 kg/t aluminium produced for CF_4 and 0.04 kg/t aluminium produced for C_2F_6), though they are within the uncertainty range for the IPCC tier 1 default values (0.0003–1.3 kg/t aluminium produced for CF_4 and 0.00004–0.2 kg/t aluminium produced for C_2F_6). New Zealand implied in the NIR that these low IEFs are due to the technology (operating software) introduced in 1998 which prevents the anode effect from occurring.

80. The ERT recommends that New Zealand make further analysis of why the IEFs are so remarkably lower than other countries as well as IPCC default values, and that New Zealand provide more explanation about it in the NIR in its next annual submission. In this context, the ERT recommends that New Zealand report 'Anode effect minutes per pot day' in the NIR following table 3.11 in the IPCC good practice guidance, with a view to demonstrating the low occurrence of anode effects. The ERT encourages New Zealand to

[6] International Aluminium Institute, 2006. The Aluminium Sector Greenhouse Gas Protocol. London: International Aluminium Institute.

apply a tier 2 QC check to this category in accordance with the IPCC good practice guidance in its next annual submission.

Consumption of halocarbons and SF_6 – HFCs

81. Emissions of HFCs from refrigeration and air-conditioning equipment accounts for 87.7 per cent of total emissions from consumption of halocarbons and SF_6 in 2008. Emissions from stationary refrigeration and air-conditioning equipment were estimated based on a top-down tier 2b approach in the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the 2006 IPCC Guidelines) which is equivalent to the IPCC good practice guidance tier 2 top-down approach. Emissions from mobile air-conditioning equipment were estimated based on IPCC good practice guidance tier 2b method. However, the explanation provided in the NIR about these methods is not sufficiently transparent because it does not present any data actually used in the calculation. During the review, New Zealand provided the ERT with a background report[7] which contained detailed background data. The ERT recommends that New Zealand improve the transparency of its explanation in the NIR by including the data used for the calculation (e.g. annual sales of new refrigerant) which are given in the background report.

82. New Zealand informed the ERT about its intentions to further improve the models used to estimate emissions from consumption of halocarbons and SF_6. The ERT welcomes this plan of improvement, and recommends that New Zealand provide a transparent explanation of the improved models used for emissions estimation in its next annual submission.

3. Non-key categories

Aluminium production – CO_2

83. During the review, the ERT noted that CO_2 emissions from soda ash use in the flue gas scrubbing process are included under this category. The ERT recommends that, in the next inventory submission, New Zealand report these CO_2 emissions under soda ash production and use, in accordance with the Revised 1996 IPCC Guidelines. If it is difficult to do so because of the confidentiality issue, this should be clearly explained in the NIR.

4. Areas for further improvement

Identified by the Party

84. New Zealand identified in the NIR its intention to separately report estimates for refrigeration and air-conditioning equipment for domestic, commercial, transport and industrial refrigeration, currently aggregated under domestic refrigeration, in future inventory submissions.

Identified by the expert review team

85. The ERT noted the following areas for further improvement and recommends that New Zealand improves transparency and accuracy of reporting by:

(a) Providing more explanation about QC procedures and its results, as well as on the methods and data used for each category (as mentioned in paras. 71, 73, 76, 78, 80, and 82 above);

[7] "Inventory of HFC, SF_6 and Other Industrial Process Emissions for New Zealand 2008" (CRL Energy Ltd).

(b) Reassessing the uncertainty estimates for AD, reporting uncertainty estimates for each EF and providing a more detailed description of the uncertainty estimates at least for every key category;

(c) Reallocating the reporting of CO_2 emissions from soda ash use in the flue gas scrubbing process under aluminium production to the soda ash production and use category, in accordance with the Revised 1996 IPCC Guidelines;

(d) Reconsidering and correcting the use of notation keys.

D. Agriculture

1. Sector overview

86. In 2008, emissions from the agriculture sector amounted to 34,826.29 Gg CO_2 eq, or 46.3 per cent of total GHG emissions. Since the base year, agriculture emissions have increased by 9.3 per cent. The key drivers for the rise in emissions are a 21.3 per cent (1,993.3 Gg CO_2 eq) increase in N_2O emissions from agricultural soils and a 3.8 per cent (820.3 Gg CO_2 eq) increase from enteric fermentation. The increase in emissions from agricultural soils since 1990 is largely due to a 453.7 per cent increase in the amount of synthetic fertilizer nitrogen applied to soils between 1990 and 2008. The increase in emissions from enteric fermentation is largely due to a 62.1 per cent increase in the dairy cattle population over the time series. Within the sector, 65.1 per cent of the emissions were from enteric fermentation and 32.7 per cent from agricultural soils, followed by 2.2 per cent from manure management. Less than 1 per cent of emissions came from field burning of agricultural residues and prescribed burning of savannas. Rice cultivation does not occur in New Zealand.

87. The ERT noted minor cases of inaccuracy. In table 4.B(a) of the 2008 CRF tables, the allocation for manure from goats to pasture, range and paddock (PRP) should be 100 per cent, rather than 0. The ERT recommends that New Zealand make this change. Additionally, in table 4.F the notation key "NE" is used for rye. However, since a small amount of rye is grown in the country, but without burning of the residues, the ERT recommends that this be changed to "NA".

88. The ERT also noted a lack of transparency in the agriculture chapter of the NIR and recommends that New Zealand improve transparency in its next annual submission by continuing with the efforts already underway to provide a more complete and detailed description of the methodologies, which includes equations, EFs and the parameters used for the various emission estimates. When the approach applied is country-specific, such as for enteric fermentation and manure management, special emphasis should be made to improve transparency by providing the equations (including the parameters and factors used in the equations) and a more thorough explanation of the methodology and AD utilized in the approach.

89. Tier 1 QC checks were performed on all AD used by key categories. However, this was not done for field burning of agricultural residues or prescribed burning of savannas. The ERT encourages New Zealand to perform QC checks for all source categories and to include tier 2 QA/QC checks for key categories on a regular basis.

90. The ERT noted several institutional and inventory improvements made for the 2010 annual submission in the agriculture sector. In 2009, New Zealand formed an independent Agricultural Inventory Advisory Panel, which advises on whether proposed changes to the New Zealand agriculture inventory are scientifically robust prior to implementing the changes in the inventory. The ERT commends New Zealand on the formation and functioning of this panel, which strengthens the link between the latest research achievements and improvements of the inventory.

91. The other improvement worth mentioning is the inclusion of the effect of the nitrification inhibitor dicyandiamide (DCD), which is applied to dairy pastures. This is a significant improvement to the Party's agricultural soils inventory given that, in 2008, 20 per cent of agricultural emissions were from PRP manure. Recalculations were performed for most categories, mainly due to updated AD, though not for prescribed burning of savannas. In summary, the recalculations and improvements made within the agriculture sector resulted in a decrease of 654.7 Gg CO_2 eq (1.0 per cent) in 1990 emissions and a decrease of 866.6 Gg CO_2 eq (1.1 per cent) in 2007 emissions when compared with the previous submission in 2009.

2. Key categories

Enteric fermentation – CH_4

92. A country-specific approach based on the relationship between the amount of CH_4 emitted per unit of feed intake for dairy cattle, beef cattle, sheep and deer was utilized to calculate the CH_4 emissions from enteric fermentation. The method is in line with the IPCC good practice guidance, and the EFs developed from New Zealand research and for New Zealand farming conditions for the above mentioned animal species are comparable to the IPCC tier 1 default EFs presented in the guidance.

93. New Zealand has made improvements to the estimates of CH_4 from enteric fermentation by assembling the necessary data on a regional basis (17 regions) rather than on a national basis for dairy cattle. As a result of this improvement, regional differences in animal performance/management are captured, thus allowing for the development of more accurate and appropriate EFs. The regional estimates are aggregated to obtain the national number. In addition, New Zealand has included alpacas, which represent a small but increasing livestock population in the country. The ERT commends New Zealand for these improvements to its enteric fermentation estimates.

Manure management – CH_4

94. New Zealand uses an approach similar to the IPCC tier 2 approach for estimating CH_4 emissions from manure management, but utilizes country-specific EFs. While the approach is in line with the IPCC good practice guidance, transparency could be improved by showing the equations and parameters used to generate the emission estimates. Additionally, the ERT encourages New Zealand to include a description of the uncertainty estimate for this source category in the NIR of the next annual submission.

Agricultural soils – N_2O

95. Emissions of N_2O from agricultural soils have increased by 21 per cent since 1990, largely due to a 453.7 per cent increase in the amount of synthetic nitrogen fertilizer applied to soils over the time period 1990–2008. While total nitrogen excretion from dairy cows onto PRP also increased significantly over the same time period, this was largely offset by a decrease in the sheep population and a subsequent total decrease in nitrogen excretion from that animal species.

96. Country-specific EFs and parameters were used for calculations of N_2O emissions from agricultural soils and were considered appropriate by the ERT. As recommended in the IPCC good practice guidance, the ERT recommends New Zealand to include several other nitrogen inputs to the soil. These inputs would include other organics (e.g. tankage/slaughterhouse waste, blood and bone meal, compost, and brewery waste). Additionally, as indicated in the 2006 IPCC Guidelines, New Zealand may wish to consider the inclusion of nitrogen mineralization in soils and pasture renewal.

97. Several improvements have been made to this category in the 2010 annual submission. As recommended by the previous ERT, New Zealand has included potatoes as one of the crops contributing nitrogen residues to soils. Although potatoes only represent about 2 per cent of the cropland, the ERT considers this an important step towards completeness. Additionally, New Zealand has incorporated the effect of DCD into its country-specific EFs for nitrogen excretion on PRP (EF_{3PRP}) and fraction of nitrogen input to soils that is lost through leaching and run-off ($Frac_{LEACH}$). This product is used on pastoral grasslands and its effects have been well researched and documented in peer-reviewed publications prior to inclusion in the inventory. In 2008, DCD reduced total agricultural N_2O emissions by 40.8 Gg CO_2 eq or 0.1 per cent. The ERT commends New Zealand on the inclusion of the effect of this measure in its inventory estimates, as it represents a potentially significant mitigation option that may gain increased use over time.

98. As recommended by the previous ERT, New Zealand should continue its efforts to account for all types of crops grown, as an improvement to its estimates from agricultural soils. While crop production in New Zealand occurs on a very small percentage of its agricultural lands, inclusion of such crops can further improve the completeness of emission estimates for this category. Other crops to consider, and which are currently being investigated by New Zealand, include carrots, cabbage, cauliflower and lettuce, as well as several other minor crops.

3. Areas for further improvement

Identified by the Party

99. A number of improvements are currently being planned by New Zealand, these include:

(a) Research into better characterising the livestock population and the weights of animals. This can potentially improve the estimates of the key categories CH_4 from enteric fermentation, direct N_2O emissions from soils, and CH_4 emissions from manure management;

(b) Improvements to the data on distribution of manure into the various animal waste management systems for both poultry and swine manure are underway by the respective industry associations;

(c) Research to improve the country-specific N_2O EF for pastoral soils is underway. This includes further refinement of the impact of DCD on N_2O emissions EFs from dung and urine separately, and from hill country pastures. Inclusion of other crops (cabbage, carrots, cauliflower, lettuce and forage brassicas) is also underway;

(d) Improvements to the value for the percentage of barley, wheat and oats that are burned are underway. Currently, New Zealand lacks good data on these factors, but new evidence indicates that an increasing demand for these residues may be decreasing the amount being burned.

Identified by the expert review team

100. The ERT recommends that New Zealand investigate the following improvements:

(a) Improve the transparency of the NIR by further expanding the discussion on methodologies, AD and EFs, and including the equations, where possible, and presenting this information in an orderly and consistent manner across the chapter;

(b) In table 4.B(a) of the 2008 CRF the allocation for manure from goats to PRP should be 100 per cent, rather than 0. Additionally, in table 4.F the notation key "NE" is used for rye. However, since a small amount of rye is grown in the country, but without burning of the residues, the ERT recommends that this be changed to "NA";

(c) Include the additional nitrogen inputs to the soils such as other organics (tankage/slaughterhouse waste, blood meal, bone meal, compost, brewery waste, etc.);

(d) Continue its efforts to improve its estimates from agricultural soils by accounting for all types of crops grown.

E. Land use, land-use change and forestry

1. Sector overview

101. In 2008, net emissions from the LULUCF sector amounted to –26,176.78 Gg CO_2 eq. Since the base year, net removals have decreased by 15.7 per cent. The key drivers for the decrease in removals are: an increase in harvesting and replanting in the four years prior to 2008 resulting in lower average age class and hence a decrease in sink capacity in forest lands; and an increase in deforestation. Within the sector, removals from land converted to forest land constitute 17,327.74 Gg CO_2 eq and removals from forest land remaining forest land amounted to 12,430.50 Gg CO_2 eq, which is offset by 2,849.61 Gg CO_2 eq emissions from land converted to grassland. The remaining 742.49 Gg CO_2 eq come from grassland remaining grassland, cropland, wetlands, settlements and other lands.

102. The 2010 annual submission includes a number of improvements in the LULUCF sector. It was the first submission where LUCAS was used for reporting on the LULUCF sector. The ERT acknowledges the contribution of LUCAS in improving the LULUCF reporting under the Convention and the reporting of afforestation, reforestation and deforestation under the Kyoto Protocol. LUCAS comprises a geospatial system, database gateway and reporting systems designed to transparently and consistently provide the outputs required for LULUCF sector reporting.

103. In addition, in its 2010 submission, New Zealand for the first time used a tier 2 system (Carbon Monitoring System (CMS)) for reporting mineral soil stock changes following land use transition. The ERT commends the Party for this improvement, but questions the statistical validity of estimating soil carbon change from these estimates, particularly for some poorly represented (i.e. sampled) land use transitions.

104. The introduction of the new system prompted a recalculation of the time series for the LULUCF sector. The main differences between this and previous submissions were well documented and explained in the NIR. The recalculations have resulted in an increase of net removals (by 12,927.8 Gg CO_2 eq) for 1990 and a decrease in net removals (by 7,037.66 Gg CO_2 eq) for 2007. The major changes appeared in removals from forest land (76.2 per cent increase in net removals in 1990 and 25.0 per cent decrease in net removals in 2007) and grassland (101.7 per cent and 1,180.3 per cent increase in net emissions in 1990 and 2007, respectively).

105. The LUCAS system uses models – the Forest Carbon Predictor (FCP) and the CMS – for estimating biomass and soil carbon stock changes. Although the methodologies are clearly referenced, the functionality, parameterization and QA/QC of these models are not documented in the NIR. To improve transparency, the ERT recommends that more detailed information on models be documented in the NIR or attached appendices in the next annual submission.

106. The ERT noted that a tier 1 uncertainty analysis assesses uncertainty of soil carbon stock but it does not assess the uncertainty associated with soil carbon stock changes**.** During the review New Zealand acknowledged this and indicated its intention to complete a tier 2 uncertainty analysis in the 2011 annual submission. The ERT recommends that New Zealand include uncertainty analysis of soil stock changes.

107. The use of some notation keys in the CRF tables might need to be reconsidered. For example, in CRF table 5(III) N_2O emissions from cropland disturbance are documented as being very small (NIR p.172), and reported as "NE". During the review, the ERT learned that cropland disturbance might not occur in the country. The ERT recommends that New Zealand reassess the occurrence of cropland disturbance and if the activity does not occur, report N_2O emission estimates as "NO" in its next annual submission.

108. For representation of land areas, New Zealand applied a mix of approaches 2 and 3 to map land-use changes between 1990 and 2007, based on wall-to-wall analysis of satellite images in 1990 and 2008. This was complemented by a Land Cover Database in 1996 and 2001, an annual National Exotic Forest Description (NEFD) and a 2008 deforestation survey, etc. The historic data from 1990 to 2007 on areas are derived by an interpolation. The 2008 data, including land-use changes areas, are derived from statistics, surveys and LUCAS mapping.

109. New Zealand chose a transition period of 28 years for disaggregating land-use categories into 'land remaining' subcategories and 'land conversion' subcategories. However, only land converted after 1989 was allocated to land conversion subcategories, which was inconsistent with the IPCC good practice guidance for LULUCF (which requires Parties to report conversions since 1963 in case of a transition period of 28 years). This potentially overestimated emissions/removals for land remaining categories and underestimated emissions/removals for land conversion categories.

110. In addition, New Zealand also used 28 years as the transition period for conversion among different cropland types and among different grassland types. However, conversions that occurred before 1990 were not captured and the associated lagged removals/emissions were not estimated. During the review, the ERT was informed that 'back-casting' studies are underway to define land use back to the year 1963. The ERT commends the undertaking of these studies and recommends that New Zealand follow the IPCC good practice guidance for LULUCF for land use disaggregation to estimate lagged emissions/removals for pre-1990 land cover conversions.

111. New Zealand used a plot sampling approach to measure and model changes in soil carbon stocks associated with land-use change. The ERT commends this improvement, but questions the statistical validity of this approach, particularly in some poorly represented land-use transitions. It is unclear whether or not the currently adopted methodology can with any certainty detect significant changes in soil carbon stock changes for different land uses (statistical significance of the mean reference soil values used for different land uses). The ERT encourages New Zealand to re-examine the methodological approach used for reporting mineral soil carbon changes following land-use change for those land uses without significant difference of the mean reference value. To reduce the level of uncertainty in soil-climate and land-use classes New Zealand is encouraged to include increased sampling in land-use classes (particularly other land, wetland, croplands and post-1989 forest), which are currently under represented in the national sample.

112. Also, organic soils are reported as "NE" but included as mineral soil estimates, which potentially leads to an underestimation of emissions in organic soils. Although the area of organic soil in New Zealand is minor (less than 0.9 per cent of national territory), it is a main emission source in cropland. During the review, in response to a question raised by the ERT, New Zealand outlined the methodological problems for deriving AD to apply a tier 1 approach to organic soils.

113. The ERT was informed during the review that the definitions of organic soil applied for the reporting of the LULUCF and agriculture sectors are different in terms of criteria for defining organic soil. Given that AD of cultivated organic soils from the agriculture sector are available and reported (10,109 ha) and that relevant N_2O emissions were reported as well, the

ERT recommends that New Zealand apply the IPCC tier 1 method for reporting organic soil emissions in the LULUCF sector in its next annual submission. The ERT also recommends that New Zealand harmonize the definition of organic soil between the LULUCF and agriculture sectors.

2. Key categories

Forest land remaining forest land – CO_2

114. New Zealand reports 'natural forests' using a tier 1 approach by assuming emissions/removals are in steady state. During the review the ERT was informed that areas of natural forest are subject to harvest and transition to plantation forestry. These harvest losses are, however, not reported and therefore emissions are underestimated in this category. The ERT recommends that New Zealand estimate the emissions associated with the land cover transition from natural to plantation forest and report them in its next annual submission.

Land converted to forest land – CO_2

115. The FCP model estimates the biomass increment and carbon allocation for all plantation species using site index growth curves derived mainly from radiata pine plantations. Although radiata pine is the most common species, 8 per cent of these plantations include Douglas fir and eucalyptus species. Additional information supplied to the ERT during the review suggests that the total carbon stock for eucalyptus survey plots was underestimated using current biomass increment models. In the NIR, New Zealand specifies that category-specific planned improvements include the development of Douglas fir and eucalyptus growth and biomass allocation models. The ERT welcomes New Zealand's future improvements to the minor species model and encourages New Zealand to investigate developing yield tables by species cohors in order to reduce uncertainty and enhance transparency in the inventory

Land converted to grassland – CO_2

116. In 2008, land converted to grassland in New Zealand amounted to a net source of 2,849.61 Gg CO_2 eq. Both tier 1 and tier 2 methods were used to estimate CO_2 emissions and removals from different subcategories under this category. Land converted to grassland that occurred before 1990 is not reported in this category, but rather under grassland remaining grassland, which resulted in an underestimation of emissions/removals of land converted to grassland. The ERT recommends that, in the next annual submission, New Zealand follow the IPCC good practice guidance and further improve the disaggregation of its subcategories, and investigate using the higher tier method to estimate emissions from this category.

3. Non-key categories

Cropland remaining cropland – CO_2

117. New Zealand used the IPCC tier 1 method to estimate CO_2 removals due to conversion from annual crop to perennial crop. Although New Zealand chose the appropriate IPCC default carbon stock of perennial cropland (63 t C), a time period of 28 years was selected to achieve steady state. This is shorter than the IPCC default value (30 years), potentially leading to an overestimation of CO_2 biomass removals. During the review, the ERT was informed that New Zealand intends to use a country-specific value of carbon stock in its next submission. The ERT welcomes this improvement and recommends that New Zealand report the results in its next annual submission.

118. Lagged CO_2 removals/emissions for conversions that occurred before 1990 and CO_2 emissions in cultivated organic soils were not estimated and reported as "NE". The ERT

recommends that New Zealand estimate these neglected CO_2 removals/emissions and report them in its next annual submission.

Biomass burning – CH_4 and N_2O

119. The CH_4 and N_2O emissions from biomass burning due to land use conversion, except land converted to forest land, were reported as "NE". The ERT encourages New Zealand to investigate future sources of AD on biomass burning due to land-use conversion and estimate the relevant CH_4 and N_2O emissions, following the IPCC good practice guidance for LULUCF, in its next annual submission.

4. Areas for further improvement

Identified by the Party

120. New Zealand's planned improvements include:

(a) Further improving land-use mapping for both 1990 and 2008;

(b) Creating a 2012 land-use map using high-resolution satellite data;

(c) Improving soil carbon estimates by enhancing sampling, model validation and disaggregating based on landform;

(d) Quantifying emissions from controlled burning of planted forest harvesting residues;

(e) Improving the estimate of natural forests and pre-1990 planted forests;

(f) Using country-specific values for perennial cropland and grassland with woody biomass.

Identified by the expert review team

121. Areas of further improvement identified by the ERT include:

(a) Improving the disaggregation of land use into land remaining subcategories and land conversion subcategories, following the IPCC good practice guidance for LULUCF;

(b) Improving the estimate of land remaining subcategories in cropland and grassland by including lagged emissions due to conversion between annual cropland/grassland and perennial crop/grassland that occurred before 1990;

(c) Improving country-specific soil carbon stock changes.

F. Waste

1. Sector overview

122. According to the CRF tables submitted on 15 April 2010, in 2008, emissions from the waste sector amounted to 1,670.69 Gg CO_2 eq, or 2.2 per cent of total GHG emissions. Since the base year (1990), emissions have decreased by 31.5 per cent. The key driver for the fall in emissions is the reduction in per capita waste generation. New Zealand attributes the decrease of waste generation to an increased emphasis on waste minimization in its policy development and legislation in recent years. Within the sector, 76.5 per cent of emissions were from solid waste disposal on land and 23.3 per cent from wastewater handling. The remaining 0.1 per cent was from waste incineration. During the review, in response to the ERT response, New Zealand provided revised estimates of CH_4 emissions from solid waste disposal on land

and CH_4 emissions from wastewater treatment (CRF version 1.2 provided on 15 October 2010). According to these revisions, in 2008, emissions from the waste sector amounted to 1,952.85 Gg CO_2 eq, or 2.6 per cent of total GHG emissions and since the base year, emissions have decreased by 27.9 per cent.

123. The Waste Minimization Act (2008) requires landfill operators to report on waste targets and measures, among other things. The previous ERT encouraged New Zealand to use the enforcement of the regulations under the Act to improve the quality of AD for waste streams. The ERT noted that New Zealand partially followed this recommendation and encourages New Zealand to further improve accuracy and transparency of the reporting by obtaining data on waste types that are co-deposited with municipal solid waste at solid waste disposal sites (SWDS) (particularly on industrial solid waste and non-stabilized wastewater sludge) as well as by providing CH_4 recovery and utilization measured data.

124. The ERT noted that all GHG emission estimations and allocations are modelled; however, some of the principles and assumptions used in the SWDS model are not transparently reported. Reporting on the fraction of gas used for energy recovery under the energy sector and the fraction of gas which is flared under memo items as biomass combustion is not clearly reported to ensure that no double counting occurs. The ERT reiterates the recommendation from the previous review that New Zealand make efforts to disaggregate and accurately account for the fraction of gas used for energy recovery under the energy sector and the fraction of gas which is flared under memo items as biomass combustion.

125. In the 2010 submission, New Zealand recalculated CH_4 emissions from solid waste disposal on land and CH_4 and N_2O emissions from wastewater handling due to the changes in population statistics which were updated in 2007. These recalculations resulted in an increase in emissions from waste in 2007 of 0.001 per cent or 0.02 Gg CO_2 eq. The ERT commends New Zealand for these recalculations, which were made following the recommendations of the previous ERT.

126. During the review, in response to a request from the ERT, New Zealand provided the ERT with the revised emission estimates of CH_4 emissions from solid waste disposal on land (see para. 129) as well as CH_4 emissions from wastewater handling (see para.133) for the entire time series. For 1990 the revised emission estimate for the waste sector was 2,708.84 Gg CO_2 eq or an increase by 11.1 per cent compared to the original estimate, and for 2008 the revised estimate was 1,952.85 Gg CO_2 eq or an increase of 16.9 per cent. The ERT agrees with the estimates and recommends that New Zealand continue to report these emissions in its next annual submission.

2. Key categories

Solid waste disposal on land – CH_4

127. New Zealand estimates emissions using the IPCC tier 2 first order decay method. In recent years New Zealand has improved the transparency of the application of the methodology by using and providing to the ERT the spreadsheet for the model described in the 2006 IPCC Guidelines. The model incorporates a default six-month delay in the anaerobic decomposition process, default values of degradable organic carbon for decomposable waste, and individual half-life (*k*) values to the estimation instead of an aggregated value for the various waste streams. The ERT commends New Zealand for these methodological improvements in recent years' submissions.

128. The most significant improvement of the method used to estimate emissions in recent years is the inclusion of the most recent AD (including waste composition data based on

the 2006–2007 *National Landfill Census*[8] and the 2006 *Report on Waste Composition and Construction Waste Data*[9]) The results of the studies led to a revision of the quantity of solid waste going to SWDS in 2006 (from 2.078 to 2.053 kg/person/day).

129. The ERT notes that k-parameters used in the model do not split the waste streams "garden" and "food" and the model applies a k-value for garden for both food and garden waste, which leads to an underestimation of emissions from this waste stream. During the review, in response to a request from the ERT, New Zealand provided the ERT with the revised emission estimates. The use of the conservative approach by applying the k-value for "food" for the whole waste stream (currently named "garden") resulted in changes to CH_4 emissions from total waste disposal on land (a decrease of 2.82 Gg CO_2 eq in 2008 and an increase of 37.59 Gg CO_2 eq in 1990). The ERT agrees with the revised estimates and recommends that New Zealand estimate and report these emissions using the same method, or a further improved method if possible, in its next annual submission.

130. New Zealand estimates emissions from recovered gas using a country-specific model, which differs from the common practice of using facility-specific data on recovery and utilization. The ERT reiterates the recommendation of the previous review that New Zealand validate the model using metered values. During the review, New Zealand indicated its intention to provide metered values that will ensure that emissions after CH_4 recovery are not underestimated.

3. Non-key categories

Wastewater handling – CH_4 and N_2O

131. Emissions of CH_4 and N_2O from wastewater handling increased by 8.2 per cent (29.6 Gg CO_2 eq) from 1990 to 2008, mainly due to population growth and an increase of activities in industries processing agricultural products. Only general information on wastewater system was provided in the NIR. During the review, New Zealand provided further information on wastewater system.[10] The ERT reiterates the recommendation from the previous review that New Zealand investigate and verify the wastewater treatment systems and report on it in its next annual submission.

132. The ERT noted that, in the 2007 submission, CH_4 emissions from industrial wastewater and sludge handling included emissions from wool scouring and wine processing. In the 2008, 2009 and 2010 submissions, emissions from those industries were removed and only three key industries (meat processing (killing and rendering), pulp and paper, and dairy processing) are reported, resulting in incomplete coverage and potential underestimation of emissions. The ERT notes that it is a good practice to assess all sources of emissions occurring. During the review, New Zealand provided information for emissions from domestic wastewater[10]. The ERT recommends that New Zealand continue to estimate these emissions and include them in its next annual submission.

133. The NIR states that sludge from wastewater treatment plants is sent to landfill. The ERT noted that sludge from wastewater treatment plants is estimated as 0 in the waste model under "Sludge". During the review, New Zealand explained that in fact, sludge sent to landfill is already stabilized and thus emissions do not occur on the landfill site and shall be reported under wastewater treatment. Furthermore, New Zealand explained that stabilized sludge is sent to landfill or to incineration. Also, the ERT learned that small amounts of sludge might have

[8] Ministry for the Environment. 2006–2007 National Landfill Census
[9] Ministry for the Environment. 2006 Report on Waste Composition and Construction Waste Data
[10] Ministry for the Environment, October 2010. National Greenhouse Gas Emissions from Wastewater Sludge.

been put on forest land. CH_4 and N_2O emissions from industrial wastewater occur but this was not estimated and the processing of it at the wastewater treatment plant and distribution of it afterwards was not clear. During the review, in response to a request from the ERT, New Zealand presented estimates of CH_4 emissions from sludge. New Zealand did not provide estimates of N_2O emissions because there is no methodology available in the Revised 1996 IPCC Guidelines or the IPCC good practice guidance. The ERT recommends that New Zealand continue to estimate these emissions and include them in its next annual submission.

134. During the review, in response to a request from the ERT, New Zealand provided a report "National Greenhouse Gas Emissions from Wastewater Sludge" [11]. The report transparently elaborates on data collection, disposal practices, sludge treatment and estimation methods for GHG emissions from domestic wastewater treatment sludge and from industrial wastewater sludge. The report provides disaggregated AD for 1990–2009 and notes that, overall, the uncertainty in the final emission calculation for domestic wastewater sludge is assessed as being in the order of ±50 per cent. For emissions from industrial discharges the uncertainty is assessed to be in the order of +100 per cent to –50 per cent. The inclusion of GHG emission estimates from sludge resulted in an increase in CH_4 emissions from wastewater handling of 284.98 Gg CO_2 eq (in 2008) and 233.08 Gg CO_2 eq (in 1990). The ERT agrees with the revised estimates and recommends that New Zealand estimate and report these emissions in its next annual submission.

4. Areas for further improvement

Identified by the Party

135. The NIR states New Zealand's intention to improve the AD to estimate CH_4 recovery from SWDS. The ERT encourages New Zealand to proceed with this improvement and report the revised data and methodology in its next annual submission.

Identified by the expert review team

136. During the review New Zealand provided revised estimates for emissions from "garden" and "food" waste, estimates for CH_4 emissions from sludge and revised estimates for CH_4 emissions from industrial wastewater treatment. The ERT recommends that New Zealand further improve completeness and transparency of reporting of emissions from wastewater treatment.

G. Supplementary information required under Article 7, paragraph 1, of the Kyoto Protocol

1. Information on activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol

Overview

137. New Zealand has estimated and reported GHG removals by sinks and emissions by sources from reforestation and deforestation activities in the CRF tables for the year 2008.[12] Also, New Zealand provided in the NIR complete information with respect to the requirements outlined in paragraphs 5 to 9 of the annex to decision 15/CMP.1. New Zealand has not elected any activities under Article 3, paragraph 4.

[11] Ministry for the Environment. October 2010. National Greenhouse Gas Emissions from Wastewater Sludge.

[12] In this report, the analysis of the information on activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol is based on the KP-LULUCF CRF submission version 1.1.

138. New Zealand also reported tier 2 uncertainty analysis in emissions and removals from afforestation and reforestation and the uncertainty in emissions from deforestation, which is 15.1 per cent, based on the uncertainty in emissions and removals from post-1989 forest. Combined uncertainty in emissions and removals from afforestation and reforestation of post-1989 forest is 12.0 per cent. Combined uncertainty in emissions from deforestation is 19.5 per cent in pre-1990 forest,12.0 in post-1989 forest , and 6.8 per cent in natural forest.

139. New Zealand has not provided information on the size and geographical location of forest areas that have lost forest cover but which are not yet classified as deforested, as requested in the annotated NIR as complementary information to that requested in paragraph 8(a) of decision 15/CMP.1. On this issue, the Party has procedures in place (as described in the NIR) to distinguish deforestation from harvesting during and at the end of the commitment period. This is planned to be done using a number of data sources available: satellite images complemented with aerial photography, LiDAR (Light Detection and Ranging) images, ETS, land tenure surveys, permanent sample plot inventories and future deforestation information from the national emissions trading process. However, the ERT noted that deforestation is supposed to be fully confirmed after four years of land clearance, which is likely to cause some uncertainty for distinguishing deforestation from harvesting in the last reporting years of the commitment period. The ERT recommends that New Zealand further refine the procedure, allowing full confirmation of deforestation in the last reporting years.

140. The CO_2 emissions in organic soils associated with reforestation and deforestation were not estimated separately from mineral soils. This is likely to result in an underestimate of CO_2 emissions associated with reforestation and deforestation. In addition, N_2O and CH_4 emissions from biomass burning due to wildfires on reforested and deforested lands and controlled burning on deforested land were not estimated. The ERT recommends that New Zealand apply the IPCC tier 1 method to estimate and report such missing emission sources in its next submission.

Activities under Article 3, paragraph 3, of the Kyoto Protocol

Afforestation and reforestation – CO_2

141. New Zealand used the same tier 2 method applied under the Convention for land converted to forest land, which is generally in line with the IPCC good practice guidance for LULUCF. The FCP estimates the biomass reductions/emissions for all plantation species using yield tables derived from radiata pine models (which covers 92 per cent of species). The application of this model to faster growing species (e.g. eucalyptus) which are harvested could lead to an underestimation of the harvest emissions from the biomass pools. In the NIR, New Zealand indicates planned improvements such as the development of growth and biomass allocation models for Douglas fir and eucalyptus, and the ERT recommends that New Zealand implement those improvements.

142. The Party reported loss of below-ground biomass on harvested reforestation land with a decay of the below-ground biomass pool over 20 years. However, this loss shall be reported under the dead organic matter pool. The ERT recommends that New Zealand investigate developing yield tables by species cohort in order to reduce uncertainty and enhance transparency, and report CO_2 removals and emissions under the correct carbon pools in its next annual submission.

Deforestation – CO_2

143. New Zealand used the same tier 2 method applied under the Convention for forest land converted to any other land, which is in line with the IPCC good practice guidance for LULUCF. The lagged emissions from soil carbon on lands that were deforested before the reporting year were estimated, but were not transparently described in the NIR. The ERT

recommends that New Zealand enhance transparency in reporting these emissions in its next annual submission.

144. The ERT recommends that New Zealand improve transparency in reporting lagged emissions from deforested land before 2008 in its next annual submission and refine the methodology to distinguish between deforested and harvested land during 2008–2012.

2. Information on Kyoto Protocol units

Standard electronic format and reports from the national registry

145. New Zealand has reported information on its accounting of Kyoto Protocol units in the required SEF tables, as required by decisions 15/CMP.1 and 14/CMP.1. The ERT took note of the findings included in the SIAR on the SEF tables and the SEF comparison report.[13] The SIAR was forwarded to the ERT prior to the review, pursuant to decision 16/CP.10. The ERT reiterated the main findings contained in the SIAR.

146. Information on the accounting of Kyoto units has been prepared and reported in accordance with chapter I.E of the annex to decision 15/CMP.1, and reported in accordance with decision 14/CMP.1 using the SEF tables. This information is consistent with that contained in the national registry and with the records of the international transaction log (ITL) and the clean development mechanism registry and meets the requirements set out in paragraph 88 (a–j) of the annex to decision 22/CMP.1. The transactions of Kyoto Protocol units initiated by the national registry are in accordance with the requirements of the annex to decision 5/CMP.1 and the annex to decision 13/CMP.1. No discrepancy has been identified by the ITL and no non-replacement has occurred.

National registry

147. The ERT took note of the SIAR and its finding that the reported information on the national registry is complete and has been submitted in accordance with the annex to decision 15/CMP.1. The ERT further noted from the SIAR and its finding that the national registry continues to perform the functions set out in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1, and continues to adhere to the technical standards for data exchange between registry systems in accordance with decisions 16/CP.10 and 12/CMP.1. The national registry also has adequate security, data safeguard and disaster recovery measures in place.

148. New Zealand has reported on corrective action undertaken to improve its reporting on changes made to the test procedures or test results, in accordance with paragraph 32(j) of the annex to decision 15/CMP.1 that were identified as necessary by the previous SIAR and previous the ERT. The ERT commends New Zealand for the implementation of this action in a timely manner.

Calculation of the commitment period reserve

149. New Zealand has reported its commitment period reserve in its 2010 annual submission. The reported commitment period reserve has not changed since the initial report review (278,608,260 t CO_2 eq) as it is based on the assigned amount and not the most recently reviewed inventory. The ERT agrees with the figure.

[13] The SEF comparison report is prepared by the international transaction log (ITL) administrator and provides information on the outcome of the comparison of data contained in the Party's SEF tables with corresponding records contained in the ITL.

3. Changes to the national system

150. New Zealand reported that there are changes in its national system since the previous annual submission, including establishment of a cross-government reporting governance group and an independent agricultural inventory advisory panel. The ERT commends New Zealand for improvements of its national system and concludes that the Party's national system continues to be in accordance with the requirements of national systems outlined in decision 19/CMP.1.

4. Changes to the national registry

151. New Zealand reported that there are changes in its national registry since the previous annual submission. The changes include the change in the name of the contact person for the national registry, the change in the conformance to technical standards and the change of the test results. Changes in the conformance to technical standards and the change of the test results were necessary due to the introduction of the New Zealand Unit (NZU) in 2009, as a result of the implementation of the national registry under the New Zealand ETS.

152. The ERT noted that NZUs are not regulated by any CMP decisions and encourages New Zealand to provide, for the sake of transparency, information on how NZUs are associated with the other units in the national registry in its next annual submission.

153. During the review New Zealand informed the ERT that there would be a change in hosting providers. The ERT recommends that New Zealand clearly report the changes to its national registry in accordance with provisions of decision 15/CMP.1 in its next annual submission.

154. The ERT concluded that the Party's national registry continues to perform the functions set out in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1, and continues to adhere to the technical standards for data exchange between registry systems in accordance with relevant CMP decisions.

5. Minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol

155. New Zealand has reported information on the minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol, as requested in chapter I.H of the annex to decision 15/CMP.1, in its 2010 annual submission. During the in-country review, New Zealand provided further information on the minimization of adverse impacts in accordance with Article 3, paragraph 14.

156. The reported information is considered to be transparent and almost complete. New Zealand lists actions taken to minimize impacts but does not include information of how these actions are prioritized.

157. Information reported includes opportunities provided by New Zealand's legislative system to raise concerns in bilateral relationships, close technical, economic and political work with non-Annex I Parties in the Pacific, free trade and investment principles, participation in international work towards abatement of emissions and improving energy efficiency, as well as projects to improve fuel efficiencies, for example with Tuvalu Electricity. In addition, New Zealand considers that it has no significant market imperfections, fiscal incentives, tax and duty exemptions and subsidies for environmentally unsound and unsafe technologies. New Zealand has no active cooperation related to technological development of non-energy use of fossil fuels and support to non-Annex I Parties.

158. During the review New Zealand elaborated that energy efficiency improvements in the Pacific islands is the priority area. The ERT recommends that New Zealand provide information on how the actions are prioritized and encourages New Zealand to further

elaborate on how it strives to minimize adverse impacts under Article 3, paragraph 14, in the next annual submission.

III. Conclusions and recommendations

159. New Zealand made its annual submission on 15 April 2010. The annual submission contains the GHG inventory (comprising CRF tables and an NIR) and supplementary information under Article 7, paragraph 1, of the Kyoto Protocol (information on: activities under Article 3, paragraph 3, of the Kyoto Protocol, Kyoto Protocol units, changes to the national system and the national registry, and minimization of adverse impacts in accordance with Article 3, paragraph 14, of the Kyoto Protocol). This is in line with decision 15/CMP.1.

160. The ERT concludes that the inventory submission of New Zealand has been prepared and reported almost in accordance with the UNFCCC reporting guidelines, with the exception of several cases where notation keys were used inaccurately and the methodological descriptions lacked transparency. The inventory submission is complete and the Party has submitted a complete set of CRF tables for the years 1990–2008 and an NIR; these are complete in terms of geographical coverage, years and sectors, but almost complete in terms of categories and gases. Some categories in the energy and waste sectors were reported as not estimated. During the review, New Zealand provided estimates of these missing categories for the entire time series, and the ERT concluded that the revised estimates are accurate and explanations on methodology used for estimations are transparent.

161. The submission of information required under Article 7, paragraph 1, of the Kyoto Protocol has been prepared and reported and is almost complete as required by decision 15/CMP.1. However, the submission did not include some information relevant to activities under Article 3, paragraph 3, of the Kyoto Protocol, namely: CO_2 emissions in organic soils associated with reforestation and deforestation; N_2O and CH_4 emissions from biomass burning due to wildfires on reforested and deforested lands; and N_2O and CH_4 emissions from controlled burning on deforested land. Also, New Zealand did not include information on how the actions to minimize adverse impacts under Article 3, paragraph 14, of the Kyoto Protocol are prioritized.

162. New Zealand has reported information on its accounting of Kyoto Protocol units in accordance with chapter I.E of the annex to decision 15/CMP.1, and used the required reporting format tables as required by decision 14/CMP.1.

163. The Party's inventory is almost in line with the UNFCCC reporting guidelines, the Revised 1996 IPCC Guidelines, the IPCC good practice guidance and the IPCC good practice guidance for LULUCF. The ERT commends New Zealand for extensive improvements in the LULUCF and agriculture sectors. However, the ERT noted that there are some inconsistencies with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance for LULUCF with regard to the disaggregation or allocation of emissions/removals in the energy, industrial processes and LULUCF sectors.

164. New Zealand selected commitment period accounting for removals and emissions from activities under Article 3, paragraph 3, of the Kyoto Protocol and did not elect to account for any of the activities under Article 3, paragraph 4, of the Kyoto Protocol. In the NIR, New Zealand provided complete information as required by paragraphs 5–9 of the annex to decision 15/CMP.1. The ERT recommends that New Zealand enhance transparency of the description of the methodology for estimating emissions and removals from afforestation, reforestation and deforestation in the NIR and improve the completeness of the reporting of these activities in the CRF tables by reporting lagged emission from land deforested before 2008 as well as by refining the methodology to distinguish between deforested and harvested land for 2008–2012.

165. The national system continues to perform its required functions as set out in the annex to decision 19/CMP.1.

166. The national registry continues to perform the functions set out in the annex to decision 13/CMP.1 and the annex to decision 5/CMP.1, and continues to adhere to the technical standards for data exchange between registry systems in accordance with relevant CMP decisions.

167. New Zealand has reported the information requested in chapter I.H of the annex to decision 15/CMP.1, "Minimization of adverse impacts in accordance with Article 3, paragraph 14" as part of its 2010 annual submission. This information can be further improved by including a description on how actions to minimize impacts are prioritized.

168. In the course of the review, the ERT formulated a number of recommendations relating to the completeness of the annual submission (including Article 7.1 information) and to transparency of the annual submission. The key recommendations are that New Zealand:

(a) Improve completeness of the annual submission by:

(i) Continuing to report emission estimates provided during the review for the following categories: fugitive CO_2 emission from oil transport (1.B.2.a.iii.) and fugitive CH_4 emission from natural gas at industrial plants and power stations (1. B.2.b.v.1) and natural gas in residential and commercial sectors (1.B.2.b.v.2); CH_4 from wastewater sludge;

(ii) Estimating lagged emissions from land deforested before 2008;

(iii) Providing information on how actions to minimize adverse impacts under Article 3, paragraph 14, of the Kyoto Protocol are prioritized;

(b) Improve the transparency and accuracy of the annual submission by:

(i) Further improving the description of the methodologies used to estimate emissions and removals in all sectors, as recommended in detail in the relevant sector chapters of this report;

(ii) Documenting all expert judgements;

(iii) Providing information on how New Zealand ETS units are associated with the other units in the national registry and further information on changes in the national registry including information on the integration of the New Zealand ETS;

(iv) Revising the use of some notation keys in the energy, industrial processes, agriculture and LULUCF sectors;

(v) Further elaborating on how New Zealand strives to minimize adverse impacts under Article 3, paragraph 14, of the Kyoto Protocol;

(vi) Refining the methodology to distinguish between deforested and harvested land for 2008–2012;

(vii) Elaborating the QA/QC plan by including specific procedures for the documentation and archiving of confidential information;

(c) Improve consistency with the Revised 1996 IPCC Guidelines, the IPCC good practice guidance and the IPCC good practice guidance for LULUCF by following more thoroughly the definitions of the categories set there, namely disaggregating the 'other' in the energy sector, reassessing the allocation of emissions in the industrial processes sector, and improving the disaggregation of subcategories in the LULUCF sector.

IV. Questions of implementation

169. No questions of implementation were identified by the ERT during the review.

Annex I

Documents and information used during the review

A. Reference documents

Intergovernmental Panel on Climate Change. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Available at <http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html>.

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UNFCCC. *Standard Independent Assessment Report*, Parts I and II. Available at <http://unfccc.int/kyoto_protocol/registry_systems/independent_assessment_reports/items/4061.php>.

B. Additional information provided by the Party

Responses to questions during the review were received from Ms. Jude Addenbrooke, Ms. Maria Alano, Ms. Andrea Brandon, Mr. Len Brown, Ms. Deborah Burgess, Ms. Joanna Carr, Mr. Craig Elvidge, Ms. Bridget Fraser, Mr. Josh Fyfe, Mr. Nelson Gapare, Mr. Scott Gulliver, Ms. Maya Hunt, Mr. Todd Krieble, Mr. Roger Lincoln, Ms. Sonia Petrie, Ms. Helen Plume, Ms. Deb Potter, Ms. Sue Powell, Dr. Paul Reynolds, Mr. Nigel Searles, Mr. Matthew Smith, Ms. Cherie Sweeney, Ms. Jo Taylor, Mr. Chappie Te Kani, Mr. Duncan Watts, Mr. Simon Wear, Ms. Nichole Wilkie, (Ministry for the Environment (MfE)), Ms. Anita Dahya, Mr. Darin Godber , Mr. Simon Lawrence, Ms. Kennie Tsui, (Ministry of Economic Development (MED)), Mr. Darran Austin, Ms. Rosa Rivas Palma, Ms. Andrea Pickering, Mr. Gerald Rys, (Ministry of Agriculture and Forestry (MAF)), Mr. Steven Thomas (Crop and Food Research), Ms. Charlotte Frater (MFAT), Mr. Murray McCurdy (CRL Energy), Mr. Peter Beets, Mr. Chris Goulding, Mr. Mark Kimberley, Mr. Steve Wakelin (Scion), Mr. John Dymond, Mr. Stephen McNeill, Mr. James Sheppard (Landcare Research), Mr. Pete Watt (Poyry Management Consulting), Ms. Jean Watt (STATSNZ), Mr. Harry Clarke, Mr. Frank Kelliher, Ms.Cecile de Klein, (AgResearch), Mr. Tony Hall, Mr. Kailin Lee, Mr. Oliver Valins (TSY), Audit New Zealand, including additional material on the methodology and assumptions used. The following documents[1] were also provided by New Zealand:

Review of carbon emission factors in draft stationary engine and industrial process regulations: using geothermal fluid. Ian thain, Geothermal & Energy Technical Services Ltd., Taupo, 12 May 2009.

Delivering the Diesel: Liquid Fuel Deliveries in New Zealand 1990-2008. Bryan J. Field, Energy Information and Modelling Group, Ministry of Economic Development, February 2010.

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Garrett L. G., Oliver G.R., Pearce S.H., Kimberley M.O. 2009. *Decomposition of woody roots and branches in managed Pinus radiate forests – time series approach*. New Zealand Ministry for the Environment, Client Report No. 45653.

Kimberley M. O., Beets P.N., Wakelin S. 2009. *Revised regression models for estimating forest carbon stocks in New Zealand post-1989 forests using LiDAR*. Ministry for the Environment, Client Report No. 45478.

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McRoberts (eds) *National Forest Inventories: Pathways for Common Reporting*. Managing Forest Ecosystems Series. Springer.

Beets PN, Kimberley MO, Paul TSH. In press (a). Planted Forest Carbon Monitoring System – Forest Carbon Model Validation Study for *Pinus radiata. New Zealand Journal of Forest Research*.

Beets PN, Reutebuch S, McGaughey RJ, Kimberley MO, Oliver GR, Pearce SH. In press (b). Use of LiDAR to estimate biomass carbon, leaf area index, and carbon sequestration in radiata pine. Submitted to *Remote Sensing of Environment*. October 2009. Index for radiata pine. *New Zealand Journal of Forestry* 50, pp 13–18.

Kimberley MO, Dean MG. 2005. A validation of the 300 index growth model. *Plantation Management Cooperative Report No. 98*.

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Annex II

Acronyms and abbreviations

AD	activity data
CFC	chlorofluorocarbon
CH_4	methane
CKD	cement kiln dust
CMP	Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
CRF	common reporting format
DCD	dicyandiamide
EF	emission factor
ERT	expert review team
ETS	emissions trading scheme
GCV	gross calorific value
GHG	greenhouse gas; unless indicated otherwise, GHG emissions are the sum of CO_2, CH_4, N_2O, HFCs, PFCs and SF_6 without GHG emissions and removals from LULUCF
HFC	hydrofluorocarbon
HCFC	hydrochlorofluorocarbon
IE	included elsewhere
IEA	International Energy Agency
IEF	implied emission factor
IPCC	Intergovernmental Panel on Climate Change
ITL	international transaction log
KP-LULUCF	land use, land-use change and forestry emissions and removals from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol
LULUCF	land use, land-use change and forestry
NA	not applicable
NCV	net calorific value
NE	not estimated
NO	not occurring
N_2O	nitrous oxide
NIR	national inventory report
PFC	perfluorocarbon
PRP	pasture, range and paddock
QA/QC	quality assurance/quality control
SEF	standard electronic format
SF_6	sulphur hexafluoride
SIAR	standard independent assessment report
SWDS	solid waste disposal sites
TJ	terajoule (1 TJ = 10^{12} joule)
UNFCCC	United Nations Framework Convention on Climate Change