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Australian National Greenhouse Accounts

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Table of Contents

Volume 3

11. Kyoto Protocol LULUCF	2
11.1 General Information	2
11.2 Land-related information	3
11.3 Methods for carbon stock changes and greenhouse gas emissions and removal estimates	6
11.4 Deforestation	8
11.5 Afforestation & reforestation	13
11.6 Article 3.4 activities – Forest management	20
11.7 Cropland management	57
11.8 Grazing land management	62
11.9 Revegetation	68
11.10 Other information	70
12. Information on accounting of Kyoto Units	75
12.1 Summary of information reported in the Standard Electronic Format Tables	75
12.2 Discrepancies and notifications	93
12.3 Publically accessible information	93
12.4 Calculation of the Commitment Period Reserve	93
12.5 KP-LULUCF Accounting	93
13. Changes to the National System	96
14. Changes to the National Registry	97
15. Minimisation of adverse impacts in accordance with Article 3.14	99
How Australia addresses domestic impacts of response measures	99
How Australia addresses the international impacts of response measures	99
ANNEX 1: Key category analysis	101
A1.1 Convention accounting	101
A1.2 Kyoto Protocol LULUCF Activities	116
ANNEX 2: Uncertainty analysis	117
A2.1 Energy	129
A2.2 Industrial Processes and Product Use	131
A2.3 Agriculture	133
A2.4 Land Use, Land Use Change and Forestry	133
A2.5 Waste	135
ANNEX 3: Other Detailed Methodological Descriptions	136
ANNEX 4: Carbon dioxide reference approach for the energy sector	137
A4.1 Estimation of CO ₂ using the IPCC reference approach	137
A4.2 Comparison of Australian methodology with IPCC reference approach	137

ANNEX 5: Assessment of Completeness	139
A5.1 Completeness of activity data	139
A5.2 Omitted emission sources	139
ANNEX 6: Additional information: quality controls including Australia's National Carbon Balance	142
A6.1 Additional information on the QA/QC Plan	142
A6.2 Australia's National Carbon Balance	149
A6.3 Summary of Responses to UNFCCC ERT Recommendations and Comments	159
ANNEX 7: Description of Australia's National Registry	176
A7.1 Name and contact information of the registry administrator designated by the Party to maintain the national registry	176
A7.2 Names of any other party with which the party cooperates by maintaining their respective registries in a consolidated system	176
A7.3 A description of the database structure and capacity of the national registry	177
A7.4 A description of how the national registry conforms to the technical standards for the purpose of ensuring the accurate, transparent and efficient exchange of data between national registries, the clean development registry and the independent transaction log, including (i) to (vi) below	178
A7.5 Identification and Authentication	180
A7.6 Access control	180
A7.7 Access protection	181
A7.8 A list of the information publicly accessible through the user interface to the national registry	181
A7.9 An explanation of how to access information through the user interface of the national registry	183
A7.10 Measures to safeguard, maintain and recover data in the event of a disaster	183
A7.11 Results of previous test procedures	183
ANNEX 8: General notes, glossary and abbreviations	184
A8.1 General notes	184
A8.2 Glossary	186
A8.3 Abbreviations	190
ANNEX 9: References	197

List of Figures

Figure 11.3 Comparison of 4 bushfire datasets over a part of Victorian multiple-use public forests	25
Figure 11.4 Validation of MODIS burnt area (orange), AVHRR burnt area (yellow) using the fire history data from Queensland (blue) derived from Landsat satellites. Black dots represent sampling points	26
Figure 11.5 AVHRR based burnt area frequency for the period from 1988 to 2014	27
Figure 11.6 Year since last burn for the period from 1988 to 2014. Inset map shows the distribution of forest management Lands in Australia	27
Figure 11.7 Decision tree to support the development of a natural disturbance background level that is consistent with the IPCC background level quality criteria	29
Figure 11.8 Wildfire burnt CO ₂ emissions on <i>forest management</i> land and trend line, excluding CO ₂ emissions associated with salvage logging	30
Figure 11.9 Comparison of emissions trend across the selected calibration period and of a longer calibration period (1995-2012)	30
Figure 11.10 Background level and background level plus margin based on the 2000-2012 calibration data set	32
Figure 11.11 Monitoring and classification of <i>forest management</i> land following a forest cover loss event	37

Figure 11.12 Comparison of recalculated reference level emissions (FMRLcorr) with previous estimates (FMRL)	47
Figure 11.13 Forest production in Australia (1991-2015)	49
Figure 11.14 Correlation of estimated emissions from <i>forest management</i> and native forest log production (2002-2015)	53
Figure A6.1 Balance flow chart showing carbon inputs and distribution of outputs for 2015	151
Figure A6.2 Fugitive gas balance flow chart for underground mines, 2015	152
Figure A6.3 Fugitive gas balance flow chart for open cut mines, 2015	153
Figure A7.1 ANREU Logical Network Topology (Production Environment)	178

List of Tables

Table 11.1 Selection of parameters for defining 'forest' under the KP	2
Table 11.2 Reconciliation table between UNFCCC and KP classifications	4
Table 11.3 Land area subject to KP LULUCF activities in 2015	5
Table 11.4 Monitoring period for Article 3.3 and 3.4 lands	6
Table 11.5 Area of land monitored for land-use change by jurisdiction in 2015 (ha)	6
Table 11.6 Summary of methodologies and emission factors –KP Land Use Change activities	7
Table 11.7 Area of deforestation 1990-2015	8
Figure 11.1 Location (in red) of land included in the deforestation account	9
Table 11.8 Estimated net emissions from deforestation (kt CO ₂ -e)	10
Table 11.9 Estimated AAUs to be cancelled for deforestation net emissions (t CO ₂ -e)	10
Table 11.10 Reconciliation of emissions from UNFCCC forest conversion and KP deforestation and other classifications	11
Table 11.11 <i>Deforestation</i> : recalculation of total CO ₂ -e emissions (Gg), 1990-2014	12
Table 11.12 Area of <i>afforestation/reforestation</i> 1990-2015	13
Figure 11.2 Location (in green) of plantation land included in the <i>afforestation/reforestation</i> account	14
Table 11.13 Estimated net emissions from <i>afforestation/reforestation</i> (kt CO ₂ -e)	17
Table 11.14 Estimated Accounting Quantity for <i>afforestation/reforestation</i> (t CO ₂ -e)	18
Table 11.15 <i>Afforestation/reforestation</i> : recalculation of total CO ₂ -e emissions (Gg), 1990-2014	19
Table 11.16 Land subject to <i>forest management</i>	20
Table 11.17 Forest management reference level harvest rates	22
Table 11.18 Components of Australia's background level and margin for wildfire	28
Table 11.19 Test of the balance criterion for a background level based on the 2000-2012 calibration group	31
Table 11.20 Reported wildfire emissions and excluded natural disturbance emissions	32
Table 11.21 Estimates of salvage logging activity and emissions	33
Table 11.22 Adaptation of Australia forest genera to fire	38
Table 11.23 Technical correction by sub-category – summary	39
Table 11.24 Elements of technical correction and cross-reference with IPCC <i>good practice</i> guidance	40
Table 11.25 Summary table for reporting of technical correction	47
Table 11.26 Estimated net emissions from <i>forest management</i> (kt CO ₂ -e)	50
Table 11.27 Estimated accounting quantity for Forest management (t CO ₂ -e)	50
Table 11.28 Native forest harvesting reference level and key activity data	52
Table 11.29 Time series comparison of FMRL and reporting of <i>forest management</i>	52
Table 11.30 Reconciliation of UNFCCC forest lands and <i>forest management</i> lands	54
Table 11.31 Reconciliation of <i>forest management with forest land remaining forest land</i> emissions (Mt CO ₂ e)	55
Table 11.32 <i>Forest management</i> : recalculation of total CO ₂ -e emissions (Gg), 1990-2014	57

Table 11.33 Estimated emissions from <i>cropland management</i> (kt CO ₂ -e)	60
Table 11.34 Estimated accounting quantity for <i>cropland management</i> (t CO ₂ -e)	61
Table 11.35 <i>Cropland management</i> : recalculation of total CO ₂ -e emissions (Gg), 1990-2014	61
Table 11.36 Estimated emissions from <i>Grazing land management</i> (ktCO ₂ -e)	65
Table 11.37 Estimated accounting quantity for <i>grazing land management</i> (t CO ₂ -e)	65
Table 11.38 <i>Grazing land management</i> : Recalculation of total CO ₂ -e emissions (Gg), 1990-2014	67
Table 11.39 Estimated emissions from <i>revegetation</i> (ktCO ₂ -e)	69
Table 11.40 Estimated accounting quantity for <i>revegetation</i> (t CO ₂ -e)	69
Table 11.41 <i>Revegetation</i> : Recalculation of total CO ₂ -e emissions (Gg), 1990-2014	70
Table 11.42 Summary overview for key categories for land use, land use change and forestry activities under the Kyoto Protocol	70
Table 11.43 Australia's compliance with the requirements of 2/CMP.8.	71
Table 12.1 SEF Table 1, Total quantities of Kyoto Protocol units by account type at beginning of reported year 2016	76
Table 12.2 SEF Table 2(a), Annual internal transactions for the reported year 2016	76
Table 12.3 SEF Table 2(b), Annual external transactions for the reported year 2016	77
Table 12.4 SEF Table 2(c), Total annual transactions for the reported year 2016	78
Table 12.5 SEF Table 3, Expiry, cancellation and replacement for the reported year 2016	78
Table 12.6 SEF Table 4, Total quantities of Kyoto Protocol units by account type at end of reported year 2016	79
Table 12.7 SEF Table 5(a), Summary information on additions and subtractions for the reported year 2016	80
Table 12.8 SEF Table 5(b), Summary information on replacement for the reported year 2016	81
Table 12.9 SEF Table 5(c), Summary information on retirement for the reported year 2016	82
Table 12.10 SEF Table 6(a), Memo item: Corrective transactions relating to additions and subtractions for the reported year 2016	83
Table 12.11 SEF Table 6 (b), Memo item: corrective transactions relating to replacement for the reported year 2016	83
Table 12.12 SEF Table 6(c), Memo item: Corrective transactions relating to retirement for the reported year 2016	83
Table 12.13 SEF Table 1, Total quantities of Kyoto Protocol units by account type at beginning of reported year 2016	84
Table 12.14 SEF Table 2(a), Annual internal transactions for the reported year 2016	85
Table 12.15 SEF Table 2(b), Annual external transactions for the reported year 2016	86
Table 12.16 SEF Table 2(c), Annual transactions between PPSR accounts for the reported year 2015	86
Table 12.17 SEF Table 2 (d) Share of proceeds transactions under decision 1/CMP.8, paragraph 21 – Adaptation Fund - for the reported year 2016	86
Table 12.18 SEF Table 2(e), Total annual transactions for the reported year 2016	87
Table 12.19 SEF Table 3, Expiry, cancellation and replacement for the reported year 2016	87
Table 12.20 SEF Table 4, Total quantities of Kyoto Protocol units by account type at end of reported year 2016	88
Table 12.21 SEF Table 5(a), Summary information on additions and subtractions for the reported year 2016	89
Table 12.22 SEF Table 5(b), Summary information on annual transactions for the reported year 2016	89
Table 12.23 SEF Table 5(c), Summary information on annual transactions between PPSR accounts for the reported year 2016	90
Table 12.24 SEF Table 5(d), Summary information on expiry, cancellation and replacement for the reported year 2016	90
Table 12.25 SEF Table 5(e), Summary information on retirement for the reported year 2016	91
Table 12.26 SEF Table 6(a), Memo item: Corrective transactions relating to additions and subtractions for the reported year 2016	92
Table 12.27 SEF Table 6 (b), Memo item: corrective transactions relating to replacement for the reported year 2016	92

Table 12.28 SEF Table 6(c), Memo item: Corrective transactions relating to retirement for the reported year 2016	92
Table 12.29 Accounting of Kyoto Protocol Units	93
Table 12.30 Information table on accounting for activities under Articles 3.3 and 3.4 of the Kyoto Protocol	94
Table 13.1 Change to the national system	96
Table 14.1 Change to the national registry – 2016	97
Table A1.1 Key categories for Australia's 2015 inventory-level assessment including LULUCF	102
Table A1.2 Key categories for Australia's 2015 inventory—trend assessment including LULUCF	104
Table A1.3 Key categories for Australia's 2015 inventory—summary including LULUCF	107
Table A1.4 Key categories for Australia's 2015 inventory-level assessment excluding LULUCF	109
Table A1.5 Key categories for Australia's 2015 inventory—trend assessment excluding LULUCF	111
Table A1.6 Key categories for Australia's 2015 inventory—summary excluding LULUCF	114
Table A1.7 Summary overview for key categories for Land use, Land-use Change and Forestry activities under the Kyoto Protocol – 2015	116
Table A2.1 General reporting table for uncertainty including LULUCF	119
Table A2.2 General reporting table for uncertainty excluding LULUCF	125
Table A2.3 Quantified uncertainty values for key stationary energy subcategories	129
Table A2.4 Emissions and quantified uncertainty values for key transport subcategories	130
Table A2.5 Quantified uncertainty values for key fugitive emissions subcategories	131
Table A2.6 Quantified uncertainty values for key industrial processes subsectors using different techniques	132
Table A2.7 Uncertainty in emission estimates for agriculture sectors	133
Table A2.8 Estimation of uncertainties in components of the land use change and forestry subsectors	135
Table A2.9 Relative uncertainty in emission estimates for key waste subsectors	135
Table A4.1 Reference approach and sectoral approach comparison for 1990 to 2015	137
Table A.5.1 <i>LULUCF</i> reporting matrix	141
Table A6.1 Summary of principal mitigation strategies and quality control measures	143
Table A6.2 Australia's National Carbon Balance 2015	149
Table A6.3 Underground mining raw coal production, by coal field	154
Table A6.4 Australian Petroleum refining activity data	155
Table A6.5 Stock of carbon in Australia's living forests, 2001-10 (Source: Table 5.1, <i>Australia's State of the Forests Report 2013</i> (ABARES 2013))	158
Table A6.6(a) Status of Issues raised in the previous report	159
Table A6.6(b) Issues identified in three or more successive reviews and not addressed by the Party	167
Table A6.6(c) General	167
Table A6.6(a) Energy	168
Table A6.6(c) Industrial processes and product use	169
Table A6.6(d) Agriculture	170
Table A6.6(e) Waste	172
Table A6.6(f) Land Use Land Use Change and Forestry	172
	175

PART 2:
SUPPLEMENTARY
INFORMATION REQUIRED
UNDER ARTICLE 7.1 OF THE
KYOTO PROTOCOL

11. Kyoto Protocol LULUCF

In accordance with decision 1/CMP.8, this Part of the Report contains supplementary information to fulfill reporting requirements under Article 7 of the KP (decisions 6/CMP.9, 2/CMP.8, 2 and 4/CMP.7, 15/CMP.1 and 2, 3 and 4/CMP.11 and net emissions estimates compiled using reporting rules and guidance applicable to the KP CP2, including guidance contained in IPCC 2014.

Decision 1/CMP.8 provides that, pending the entry into force of the KP Doha Amendment that establishes the CP2 (2013 – 2020), KP Parties will continue to implement KP commitments and other responsibilities in a manner consistent with their national legislation and domestic processes. The Australian Government submitted its instrument of acceptance to the Doha Amendment on 9 November 2016.

11.1 General Information

11.1.1 Definition of forest and other criteria

Forests include all vegetation with a tree height of at least 2 metres and crown canopy cover of 20 per cent or more and lands with systems with a woody biomass vegetation structure that currently fall below but which, *in situ*, could potentially¹ reach the threshold values of the definition of forest. Young natural stands and all plantations which have yet to reach a crown density of 20 per cent or tree height of 2 metres are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of either human intervention, such as harvesting, or natural causes, but which are expected to revert to forest.

The forest cover definition is consistent with the definition used in Australia's National Forest Inventory that has been used for reporting to the Food and Agriculture Organisation and Montreal Process. Australia has adopted a minimum forest area of 0.2 ha (Table 11.1).

Forest use is typically evident by human disturbance, such as in commercial forest harvest, or clearly delineated by land tenure, such as conservation reserves. In extensive systems, such as grazed woodlands, there is a continuum in the intensity and intent of use.

Table 11.1 Selection of parameters for defining 'forest' under the KP

Parameter	Range	Selected value
Minimum land area	0.05 – 1 ha	0.2
Minimum crown cover	10 – 30%	20
Minimum height	2 – 5 m	2

11.1.2 Elected activities under Article 3.4

For the second KP commitment period, Australia will report on *forest management* and has elected to report emissions and removals from the following Article 3.4 activities:

- *cropland management*
- *grazing land management*
- *revegetation*.

¹ This potential is evidenced from the Landsat series in that the land has previously supported forest.

11.1.3 Precedence conditions and hierarchy among Article 3.4 activities

Australia has implemented a hierarchy of Article 3.4 activities into its land classification system.

Forest management, as a mandatory activity takes precedence over the other Article 3.4 activities, consistent with IPCC requirements. The hierarchy of Article 3.4 activities is applied as follows:

- 1) *forest management*;
- 2) *cropland management*;
- 3) *grazing land management*; and
- 4) *revegetation*.

Australia's system for the classification of land in the UNFCCC and KP LULUCF inventories is described in more detail in section 6.3 in Volume 2 of the NIR and in section 11.2 below.

11.2 Land-related information

11.2.1 Description of how the definitions of each activity under Article 3.3 and 3.4 have been implemented and applied consistently over time

Deforestation under the KP is a subset of *forest conversion* and includes only lands where there has been direct human-induced conversion of forest to alternative land uses since 1 January 1990.

Conversion of *forest lands* to alternative land uses prior to 1990 are accounted for under *cropland management* or *grazing land management* to enable complete accounting under CP2.

Forest management is a subset of *forest land remaining forest land* and includes those forests managed under a system of practices designed to support commercial timber production such as harvest or silvicultural practices or practices that are designed to implement specific sink enhancement activities.

Forests included under this definition include multiple-use public forests, plantations established prior to 1990, privately managed native forest land where *forest management* activities (harvesting and silvicultural practices) have been observed to occur; and forests where regulated sink enhancement activities occur.

Forest lands outside of the multiple-use public forests and pre-1990 plantation lands are also monitored for signs of harvesting and silvicultural practices in order to achieve complete accounting for these management practices. If a harvest event is observed, the net emissions are reported under the *forest management* category and all future net emissions on that land continue to be reported under that category.

Afforestation/reforestation is a subset of *land converted to forest land* and includes only those forests established since 1 January 1990 on land that was continuously clear of forest from 1972 until the end of 1989. Forests under *land converted to forest land* may be established through planting events either for commercial timber or for other reasons, known as 'environmental plantings', or by regeneration from natural seed sources on lands regulated for the protection of forests.

Cropland management includes all land that is used for continuous cropping, lands managed as crop-pasture rotations and *land converted to cropland from grassland*. As noted above, *forest land converted to cropland* prior to 1990 is also included under *cropland management*. *Land converted to forest land* is excluded from *cropland management*.

Perennial crops including orchards and vineyards are included under *cropland management*. Units of land where orchards were established on land clear of forest on 31 December 1989 are included in the *cropland management* and not the *afforestation/reforestation* classification.

Grazing land management lands include permanent *grasslands*; biomass burning in forests in northern Australia; and forests established by regeneration from natural seed sources on lands not regulated for the protection of forests (which means they are not classified as *afforestation/reforestation*). *Forest lands* are not double counted in Australia's land classification systems as Australia has applied a 'narrow' approach to *forest management*, allowing certain specified forests (northern forests subject to fire and unprotected forests as outlined above) not identified as being managed for timber to be included under *grazing land management*.

A forest observed to be deforested, or observed to be subject to a forest management practice, is reported under *deforestation* or *forest management* categories in preference to *grazing land management* in accordance with the hierarchy used for Australia's inventory.

Revegetation includes establishment of vegetation that covers a minimum area of 0.05 hectares and does not meet the definitions of *afforestation/reforestation*. It is restricted to settlements and wetlands.

While there are some essential differences between the KP and UNFCCC classification systems, it is possible to reconcile them. For the most part, the differences have become either less pronounced or less significant as the coverage of land activities adopted by the Australian Government has increased over time. In Table 11.2, a concordance between UNFCCC and KP classifications used in the preparation of net emission estimates in this Report is presented.

Table 11.2 Reconciliation table between UNFCCC and KP classifications

UNFCCC	KP
<i>Forest land</i>	
<i>Forest land – multiple-use public forest</i>	<i>forest management</i>
<i>Forest land – pre-1990 plantations</i>	<i>forest management</i>
<i>Forest land – harvested private native forests</i>	<i>Monitored for forest management activity</i>
<i>Forest land – other native forest</i>	<i>Monitored for forest management activity</i>
<i>Forest land – biomass burning in northern Australia</i>	<i>grazing land management</i>
<i>Forest land – from biomass burning in temperate forests</i>	<i>forest management</i>
<i>Land converted to forest</i>	
<i>New plantations since 1990</i>	<i>afforestation/reforestation</i>
<i>Native regeneration since 1990 – direct human-induced</i>	<i>afforestation/reforestation</i>
<i>Cropland</i>	
<i>Cropland – permanent</i>	<i>cropland management</i>
<i>Forest land converted to cropland since 1990</i>	<i>deforestation</i>
<i>Forest land converted to cropland prior to 1990</i>	<i>cropland management</i>
<i>Grassland converted to cropland</i>	<i>cropland management</i>
<i>Grassland</i>	
<i>Grasslands – permanent</i>	<i>grazing land management</i>
<i>Forest land converted to grassland since 1990</i>	<i>deforestation</i>
<i>Forest land converted to grassland – pre-1990 conversion</i>	<i>grazing land management</i>
<i>Settlements</i>	<i>revegetation may occur</i>
<i>Forest land converted to settlements since 1990</i>	<i>deforestation</i>
<i>Wetlands</i>	<i>revegetation may occur</i>
<i>Forest land converted to wetlands – since-1990</i>	<i>deforestation</i>

11.2.2 Identification of geographical locations

All lands under the reporting categories of *afforestation/reforestation*, *deforestation*, *cropland management* and *grazing land management* are monitored using a Reporting Method 2 land identification system (IPCC, 2014, Chapter 2.2.2) based on the Landsat time series in conjunction with ABARES Land Use Map Version 5. The methods of mapping forest extent and change in extent are outlined in Chapter 6 (Appendix 6.A).

The exact geographic location of each unit of land entering the *afforestation/reforestation* and *deforestation* accounts is mapped at 25 m resolution using continental coverages of Landsat data.

Land is tracked and simulated in FullCAM at a pixel by pixel (25m x 25m) level and the carbon stock change on each pixel is tracked from the start of the simulation to the reporting year. The outputs of the simulations are stored in a datacube which can be queried using the FullCAM Outputs Analysis System (OASys).

The consistent tracking through time of individual units of land down to 0.2 ha results in millions of estimation units. For the purpose of reporting under Article 3.3 and Article 3.4, the areas are summed into larger reporting units. This is achieved by co-locating the areas of change on maps that represent logical identification codes. The initial divisions are the Australian states and territories. For *afforestation/reforestation* the areas are then reported by 3 broad types of forest: softwood, hardwood and native. Allocations to these classifications are obtained from more detailed analysis of the Landsat data (see Appendix 6.A).

Lands subject to *forest management* are monitored using Reporting Method 1 under IPCC (2014) Chapter 2.2.

11.2.3 Methodology used to develop the land transition matrix

The land transition matrix is developed using the forest extent data derived from Australia's Landsat archive consistent with the data for the UNFCCC reporting categories (Table 6.3 in Section 6.3).

Table 11.3 Land area subject to KP LULUCF activities in 2015

Activity	Area in 2015 (k ha)
Afforestation and Reforestation	3,558.90
Deforestation	11,966.93
Forest Management	10,979.36
Cropland Management	34,913.88
Grazing Land Management	533,874.97
Revegetation	20,073.15
Wetland drainage and rewetting	NA
Other	153,632.80
Total	769,000.00

11.2.3.1 Information on how harvesting or forest disturbance that is followed by the re-establishment of forest is distinguished from deforestation

Land where forest cover loss is identified as being human-induced and where it is not expected that the forest will be regenerated or replanted is classified as *deforestation* land.

In cases where there is a temporary change in forest cover due to natural events (e.g. fire, drought) or where changes occur within a land tenure where it is expected that the land will revert to forest (e.g. harvested forest, national park), the land is monitored for a period of time, depending upon the land tenure and use, consistent with the guidance provided in section 2.6.2.1 of IPCC 2014.

Areas that have entered the monitoring system continue to be classified as *forest land* provided that the time since forest cover loss is shorter than the number of years within which tree establishment is expected (Table 11.4). After the specified monitoring period, however, lands that have lost forest cover due to direct human-induced actions, have undergone land use change, and failed to regenerate are classified as *deforestation*.

Table 11.4 Monitoring period for Article 3.3 and 3.4 lands

Land classification	Monitoring period (x years)
afforestation/reforestation	8
settlements	10
forest management	12

11.2.3.2 Information on the size and geographical location of forest areas that have lost forest cover but which are not yet classified as deforested

Areas of land that have entered the monitoring system described above and have been without forest cover for less than the monitoring periods in Table 11.4, (that is, forest or plantation re-establishment has not been confirmed), amounted to 620,039 hectares in 2015 (Table 11.5).

In accordance with good practice, estimates will be made at the end of the commitment period of the proportion of these areas that are not expected to regenerate.

Table 11.5 Area of land monitored for land-use change by jurisdiction in 2015 (ha)

State	Total
Australian Capital Territory	3,442
New South Wales	114,527
Northern Territory	2,172
Queensland	83,203
South Australia	43,385
Tasmania	62,223
Victoria	135,789
Western Australia	175,298
Total	620,039

11.3 Methods for carbon stock changes and greenhouse gas emissions and removal estimates

In general, a Tier 3, Approach 3 (Reporting Method 2 under IPCC (2014)) system is used to estimate emissions and removals under Article 3.3 and 3.4 using the same methods as used to estimate the UNFCCC inventory (Chapter 6). Tier 2 methods are used for biomass burning and for emissions and removals under *forest management*, consistent with the methods used for corresponding categories in the UNFCCC inventory (Chapter 6).

Table 11.6 Summary of methodologies and emission factors –KP Land Use Change activities

Greenhouse Gas Source And Sink	CO ₂		CH ₄		N ₂ O	
	Method applied	EF	Method applied	EF	Method applied	EF
Article 3.3 activities						
Afforestation/Reforestation						
C stock changes	T3	M				
Biomass burning	T3	M	CS	CS	CS	CS
Deforestation						
C stock changes	T3	M				
Biomass burning	T3	M	CS	CS	CS	CS
Article 3.4 activities						
Forest management						
C stock changes	T2	M				
Biomass burning	T2	CS	CS	CS	CS	CS
Cropland management						
C stock changes	T3	M				
Biomass burning	T3	M	CS	CS	CS	CS
Grazing land management						
C stock changes	T3	M				
Biomass burning	T2	CS	CS	CS	CS	CS
Revegetation						
C stock changes	T2	CS				
Biomass burning	IE	IE	IE	IE	IE	IE

EF = emission factor, CS = country specific, M = Model, NO = not occurring, IE=included elsewhere, T1 = Tier 1 and T3 = Tier 3.

11.3.1 Years for which carbon stock changes and non-CO₂ emissions are reported

Carbon stock changes and non-CO₂ emissions from land subject to Article 3.3 and Article 3.4 activities are reported from the start of the commitment period in 2013.

11.3.2 Information that demonstrates that Article 3.3 activities began on or after 1 January 1990 and are direct human-induced

The land is monitored using a time series of Landsat imagery since 1972 in order to be able to demonstrate the date at which the Article 3.3 activities began.

11.3.3 Factoring out of indirect and natural emissions and removals

Indirect effects on greenhouse gas emissions and removals are not explicitly factored out although, as Australia's estimation methods utilise a process-based Tier 3 modelling approach, it is clear that the relationships between biomass, climate and atmospheric concentrations are fixed for the time series of emission estimates.

Natural emissions and removals are managed through the application of the natural disturbance provision for a range of identified natural disturbances under *forest management*.

11.3.4 Uncertainty estimates

Uncertainty estimates are provided in Annex 2.

The same methods and data are used to estimate emissions and removals in all Article 3.3 and 3.4 activities as are used for the associated UNFCCC categories.

11.4 Deforestation

11.4.1 Identification of land subject to *deforestation*

Deforestation activity (Table 11.7) is identified using methods applied to the identification of *forest conversion* under the UNFCCC and described in Appendix 6.A. *Deforestation* only includes lands where there has been direct human-induced conversion of forest to alternative land uses since 1 January 1990.

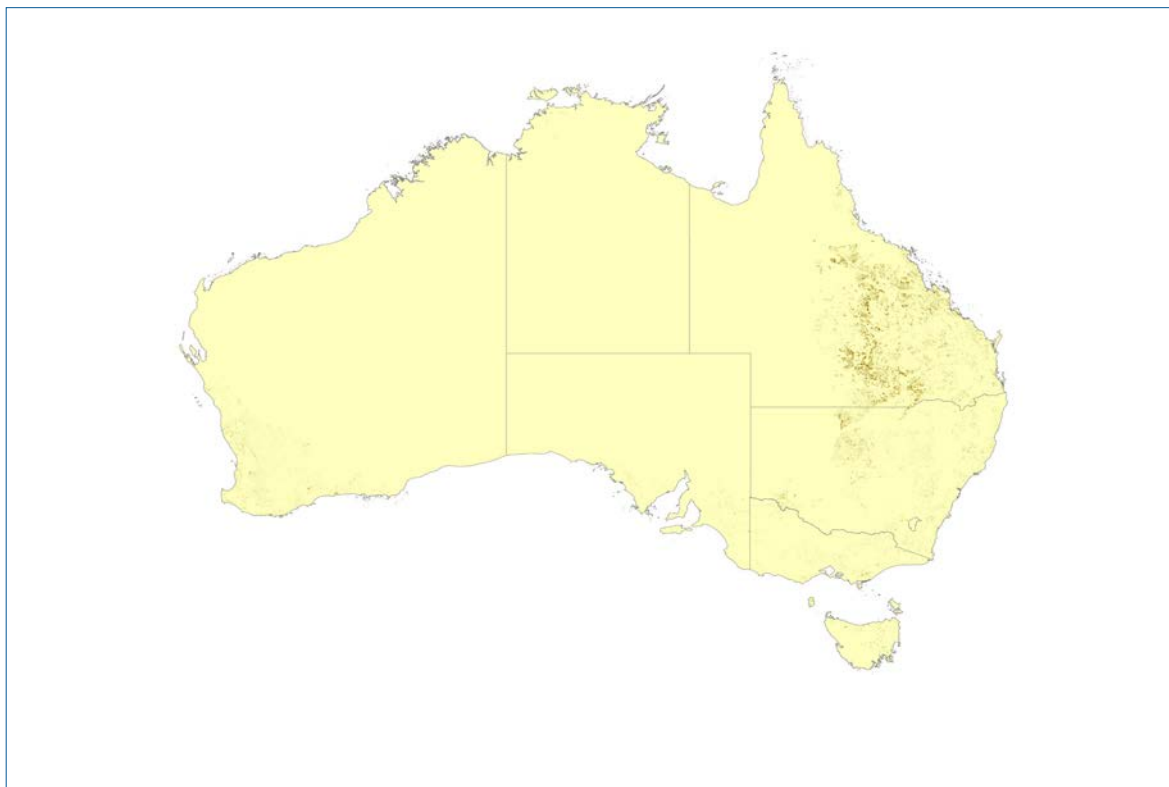
Table 11.7 Area of deforestation 1990-2015

Year	Area of deforestation (Mha)
1990	0.51
1991	1.34
1992	2.07
1993	2.64
1994	3.22
1995	3.68
1996	4.15
1997	4.61
1998	5.11
1999	5.67
2000	6.21
2001	6.82
2002	7.36
2003	7.86
2004	8.41
2005	9.07
2006	9.65
2007	10.11
2008	10.44
2009	10.72
2010	10.95
2011	11.14
2012	11.34
2013	11.58
2014	11.78
2015	11.97

11.4.1.1 Spatial identification of *deforestation* lands

The location of land included in the *deforestation* account is shown in Figure 11.1.

Figure 11.1 Location (in red) of land included in the deforestation account



11.4.2 Methods for estimation of carbon stock changes and greenhouse gas emissions and removal estimates

11.4.2.1 Data

The same data sources are used for *deforestation* as for *forest conversion*, as detailed in Volume 2.

11.4.2.2 Methods

The same Tier 3, Approach 3 (Reporting Method 2 under IPCC (2014)) system is used for *deforestation* as that used to estimate *forest conversion* (see Appendices 6.B and 6.F).

11.4.2.3 Start year

Estimation of net emissions is undertaken from 1972 consistent with the available Landsat series.

11.4.2.4 Carbon pools

FullCAM estimates emissions from soil through a process involving all on-site carbon pools (living biomass, dead organic matter and soil).

11.4.3 Harvested wood products from deforestation events

Harvested wood products from deforestation events are separately identified and emissions reported according to instantaneous oxidation in accordance with paragraph 31 of the annex to Decision 2/CMP.7.

The Tier 3, Reporting Method 2 spatial monitoring system for *deforestation* is used to detect and differentiate deforestation events from harvesting on *Afforestation / Reforestation* and *Forest management* lands, as described in Section 11.2.3.

These deforestation events are modelled as part of *deforestation*, where all biomass from the deforestation event is burned on site, with no products produced.

National aggregate harvesting statistics have been allocated between harvest from *Afforestation / Reforestation*, *Forest Management* and *Deforestation* (from the deforestation event) to ensure that there is no double-counting of products produced from deforestation events. The deforestation component is excluded from the reporting of emissions estimates of the *harvested wood products* pool, as these products have already been accounted for on the basis of instantaneous oxidation.

11.4.4 Reporting of *deforestation* in 2015

11.4.4.1 Reporting of *deforestation* net emissions in 2015

Estimates of net emissions from *deforestation* are reported in Table 11.8.

Table 11.8 Estimated net emissions from deforestation (kt CO₂-e)

Year	Total
2000	68,754
2005	82,140
2008	61,425
2009	54,676
2010	49,192
2011	45,281
2012	39,827
2013	41,527
2014	37,724
2015	31,138

11.4.4.2 Estimation of AAUs to be cancelled for deforestation in 2013 to 2015

In the reporting period, 2013-2020, one AAU is to be cancelled for every tonne of emissions reported from the deforestation activity (the same approach as for emissions from sources in the energy, industrial processes and product use, agriculture, waste sectors). Estimates of AAUs to be cancelled in 2013 to 2015 are presented in Table 11.9.

Table 11.9 Estimated AAUs to be cancelled for deforestation net emissions (t CO₂-e)

Year	AAUs to be cancelled
2013	41,526,576
2014	37,723,971
2015	31,137,941

11.4.5 Quality Assurance – Quality Control

Deforestation activity is identified using methods applied to the identification of forest lands converted to grass and other lands under the UNFCCC and is described in detail in Section 6.6 of Volume 2 of the NIR.

Table 11.10 provides a reconciliation between emissions reported under the KP *deforestation* account (Table 11.10, Components A and B) and the UNFCCC *forest land converted to cropland* and *forest land converted to grassland* classifications. Differences between these two classifications arise because the *deforestation* account does not include the ongoing emissions and removals from:

- land in a *forest conversion* classification that was clear of forest on 31 December 1989 that has naturally regrown and had not been re-cleared (this land is classified as *grazing land management* land) (Component B); and
- land cleared prior to 1990 that has remained cleared (this land is classified as *grazing land management* land) (Table 11.10, Component C).

Table 11.10 Reconciliation of emissions from UNFCCC forest conversion and KP deforestation and other classifications

Year	Deforestation	Clear in 1990, Regrown and remains vegetated	Clear in 1990, and remains clear	Total UNFCCC Forest land converted to other land uses
	(kt CO ₂ -e)	(kt CO ₂ -e)	(kt CO ₂ -e)	(kt CO ₂ -e)
Component A	B	C	A+B+C	
2008	61,425	-1,220	3,400	63,605
2009	54,676	-1,044	4,332	57,963
2010	49,192	-770	3,845	52,268
2011	45,281	-742	4,000	48,538
2012	39,827	-1,094	5,240	43,973
2013	41,527	-1,064	6,398	46,861
2014	37,724	-937	3,694	40,481
2015	31,138	-668	2,453	32,923

Note: Nitrous oxide emissions due to soil disturbance are not included in these comparisons

11.4.6 Recalculations

Further descriptions of the recalculations is provided in the corresponding LULUCF category in Chapter 6, namely *forest land converted to grasslands*

Table 11.11 Deforestation: recalculation of total CO₂-e emissions (Gg), 1990-2014

Year	Deforestation			Reasons for Recalculations				
	2016 submission (Gg CO ₂ -e)	2017 submission (Gg CO ₂ -e)	Change (Gg CO ₂ -e) %	A. Enhanced geospatial monitoring	B. FullCAM 'M' parameter update	C. FullCAM tree parameter updates	D. Alignment with sectoral estimation periods	E. Rounding policy
1990	81,441	63,035	-18,406 -23%	42,351	4,688	-15,171	-50,274	0
1995	67,348	65,816	-1,532 -2%	4,618	2,847	-21,745	12,748	0
2000	73,066	68,754	-4,312 -6%	10,587	869	-15,524	-244	0
2005	90,211	82,140	-8,071 -9%	14,575	-2,047	-13,839	-6,759	1
2006	87,288	83,592	-3,696 -4%	6,654	459	-7,260	-3,549	0
2007	69,785	75,478	5,693 8%	11,488	1,220	-26,959	19,944	0
2008	58,399	61,425	3,026 5%	8,039	1,871	-12,262	5,378	0
2009	55,188	54,676	-512 -1%	1,527	2,666	1,804	-6,508	1
2010	46,752	49,192	2,440 5%	7,087	3,355	-22,209	14,207	0
2011	39,209	45,281	6,071 15%	6,213	2,284	-803	-1,622	1
2012	39,653	39,827	174 0%	-143	1,701	4,229	-5,612	1
2013	40,902	41,527	624 2%	3,804	1,513	-5,081	389	1
2014	33,361	37,724	4,363 13%	6,621	918	-10,700	7,525	1

11.5 Afforestation & reforestation

11.5.1 Identification of land subject to *afforestation/reforestation*

Afforestation/reforestation activity is identified using methods applied to the identification of *land converted to forest* under the UNFCCC and described in Appendix 6.A. Plantations for timber, environmental plantings and the promotion of natural seed sources are included within the *afforestation/reforestation* classification. Emissions from *harvested wood products* associated with hardwood plantation timber harvested since 2000 are also included.

The natural regeneration of forests from natural seed sources are identified in areas consistent with the intentions of land use regulatory systems and reflect the deliberate decisions of land managers to not maintain pasture for grazing. To qualify as a *forest land* converted from natural seed sources, the land must have been clear of forest in the period 1972-1989 and must have converted to forest land after 1 January 1990.

Conversions to forest land can be supported through a range of government programs and regulatory processes including from offsets created under State vegetation management acts or under major project approval processes. The *Emission Reduction Fund* is used to encourage these outcomes.

The identification of regeneration of forest from natural seed sources as *afforestation/reforestation* is explained further in section 11.5.1.2 below. The area of *afforestation/reforestation* is presented in Table 11.12.

Table 11.12 Area of *afforestation/reforestation* 1990-2015

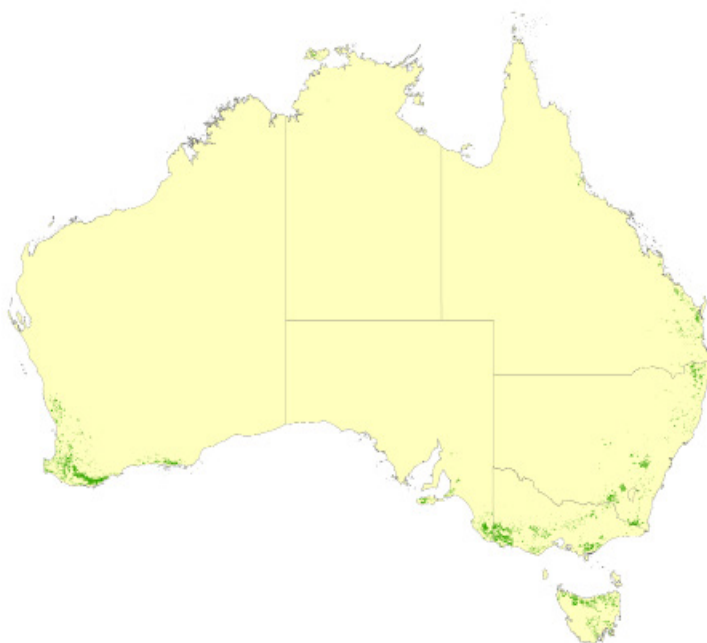
Year	Area of <i>afforestation/reforestation</i> estate (M ha)
1990	0.14
1991	0.30
1992	0.43
1993	0.56
1994	0.68
1995	0.79
1996	0.90
1997	1.00
1998	1.09
1999	1.20
2000	1.31
2001	1.45
2002	1.57
2003	1.70
2004	1.85
2005	1.98
2006	2.09
2007	2.22
2008	2.38
2009	2.55
2010	2.77
2011	3.06
2012	3.25
2013	3.40
2014	3.44
2015	3.56

Australia's *afforestation/reforestation* estate has increased in area over the period 1990-2015 (Table 11.12).

11.5.1.1 Spatial identification of *afforestation/reforestation* lands

Afforestation/reforestation activities are identified in relation to a 1990 base map of forest land derived from the land monitoring program (Appendix 6.A). The location of land from plantings included in the *afforestation/reforestation* account is shown in Figure 11.2.

Figure 11.2 Location (in green) of plantation land included in the *afforestation/reforestation* account



11.5.1.2 Identification of regeneration of native forests as *afforestation/reforestation*

It is estimated that there were approximately 2.13 million hectares of land which was not forest on 31 December 1989 (and was not forested at any time between 1972 and 1989), which was subsequently converted to *forest land* through natural regeneration and remained forest.

All lands in South Australia, Tasmania, Victoria and Western Australia have been identified as subject to land clearing restrictions. In Queensland, lands mapped as high value regrowth under the *Vegetation Management Act 1999* and land that is included in the Collaborative Australian Protected Area Database (CAPAD) is considered protected. In the remaining jurisdictions (Australian Capital Territory, New South Wales and the Northern Territory) further analysis of land clearing regulations is required to include all protected lands. In NSW, in particular, the area identified as protected is likely to be a significant under estimate. The focus of current analysis is to improve the estimated area of protected land in New South Wales.

Every two years, the Australian Government collects information on protected areas from state and territory Governments and other protected area managers, which is published in the Collaborative Australian Protected Area Database (CAPAD).

CAPAD is used to provide a national perspective of the conservation of biodiversity in protected areas. It also allows Australia to regularly report on the status of protected areas to meet international obligations such as those in the Convention on Biological Diversity (CBD). Australian protected area information is also included in the World Database on Protected Areas (WDPA).

Australia has in force a framework of federal, state and territory legislation and guidelines regulating clearing of native vegetation and forests (see below). These laws establish a framework whereby land that has naturally regenerated to meet the forest definition has been allowed to do so as a result of a deliberate management decision not to clear those lands.

While dedicated vegetation management legislation emerged in some states in the 1990s, land management activities have been, and continue to also be, regulated by more general land planning legislation introduced prior to, or around, 1990. A more complete listing of relevant state and territory legislation governing land clearing is provided below.

State and territory native vegetation clearance statutes

New South Wales

- *Native Vegetation Act 2003*
- *Threatened Species Conservation Act 1995*
- *Environmental Planning and Assessment Act 1979 (Local Environmental Plan)*

Victoria

- *Victorian Planning Provision (Clause 52.17)*
- *Planning and Environment Act 1987*
- *Flora & Fauna Guarantee Act 1988*
- *Catchment and Land Protection Act 1994*

Queensland

- *Vegetation Management Act 1999 (prior to this, the Land Act 1994 and the Environmental Protection Act 1994)*
- *Sustainable Planning Act 2009*
- *Integrated Planning Act 1997*
- *Nature Conservation Act 1992*

Western Australia

- *WA Environmental Protection Act 1986*

South Australia

- *SA Native Vegetation Act 1991*

Tasmania

- *Tasmania Forest Practices Act 1985*

Australian Capital Territory

- *ACT Planning and Development Act 2007*
- *Nature Conservation Act 1980*

Northern Territory

- *NT Planning Act 2002*
- *NT Planning Scheme*
- *Pastoral Land Act 1994*

A primary aim of the emergence of specific – purpose legislation, such as Queensland’s *Vegetation Management Act 1999*, was to unify and make more consistent existing regulatory measures and, in particular, ensure consistency between regulations that applied to leasehold and freehold land (government and private lands).

While the legislative instruments in place have clearly evolved, the list shows that relevant regulations to govern the management of native vegetation have been in place over a long period of time in all States and Territories.

Examples of administrative processes include compliance with regional ecosystem plans established under legislation, individually negotiated property management plans or additional approval processes/permit processes for clearing.

Permits for conversion of all forests to grasslands for agriculture are required in the Northern Territory, Western Australia, Victoria, South Australia and Tasmania, with minor exceptions. The relevant acts and regulations specify exemptions from the current approval process for the routine maintenance of agricultural land but only for lands with regrowth of an age that is less than a specified number of years (usually between five and ten years) and only where a permit to clear has been previously issued. Effectively a legal consequence through an approval process is associated with all revegetation actions.

In Queensland the administrative processes are more complex. Legal consequences derive from a combination of regional ecosystem plans issued under regulation, individual property agreements and land clearing permits.

A similar mix of instruments is applied in New South Wales. Protected regrowth is native vegetation that has grown since 1 January 1990 (or 1983 in the Western District), but is protected because it has grown on vulnerable land or has been identified as protected regrowth in a Property Vegetation Plan (PVP), an environmental planning instrument, a natural resources management plan or an interim protection order under the NV Act. It also includes native vegetation that is regrowth that has been grown or preserved with the assistance of public funds granted for biodiversity conservation purposes.

The national regulatory framework, together with the raft of legislative instruments and other policies and measures in place at national and State and Territory level, demonstrate that land managers have a legal need for activities to prevent an undesired regrowth of an area to forest and that the regrowth of an area as forest should take place only where desired by land managers based on land managers’ decisions. *Deforestation* of these lands is possible only under certain circumstances and several administrative steps must be taken before it is legally allowed.

At the national level, there are many relevant federal government programs which also aim to promote vegetation cover either directly or indirectly, such as through carbon or biodiversity objectives.

These measures continue past actions by the Federal government to promote vegetation outcomes across the country over a long period of time. For example, in the ‘Our Country Our Future’ package announced 20 July 1989, the measures included the National Soil Conservation Program, Save the Bush, the National Weeds Strategy, the One Billion Trees Program and the Decade of Landcare Plans. There have been many measures in the period since this package was put in place.

Currently the Emissions Reduction Fund promotes regeneration from natural seed sources through a direct subsidy program.

These federal government programs operate in addition to land management legislation operated by State and Territory governments identified above.

11.5.2 Methods for carbon stock changes and emissions and removal estimates

11.5.2.1 Data

The same data sources are used for *afforestation/reforestation* as for *land converted to forest land* in the UNFCCC inventory (see Appendix 6.A and 6.G).

11.5.2.2 Methods

For *afforestation/reforestation*, the same tier 3, Approach 3 system is used as for *land converted to forest land* under the UNFCCC inventory (see Appendix 6.A and 6.G). The use of the tier 3, Approach 3 (reporting method 2 under IPCC (2014)) system means that the combined reporting of *afforestation* and *reforestation* does not affect the area of land reported or estimates of the emissions and removals.

HWP associated with harvesting in short rotation hardwood plantation areas from 2000 onwards are assumed to have occurred in plantations established after 31 December 1990 and are included in *afforestation/reforestation*, and are calculated consistent with the methods for *forest management* set out in 11.6.3.2.

11.5.2.3 Start year

Estimation of net emissions is undertaken from 1972 consistent with the available Landsat series.

11.5.2.4 Carbon pools

FullCAM estimates emissions from soil through a process involving all on-site carbon pools (living biomass, dead organic matter and soil).

11.5.3 Reporting of *afforestation/reforestation* in 2015

11.5.3.1 Reporting of *afforestation/reforestation* net emissions in 2015

Estimates of net emissions from *afforestation/reforestation* are reported in Table 11.13.

Table 11.13 Estimated net emissions from *afforestation/reforestation* (kt CO₂-e)

Year	Total
2008	-17,265
2009	-16,838
2010	-17,601
2011	-21,279
2012	-19,479
2013	-18,183
2014	-16,745
2015	-12,614

11.5.3.2 Estimation of *afforestation/reforestation* Accounting Quantity in 2013-15

For land activity categories other than *deforestation*, credits (called RMU credits) are issued against the reduction in net emissions relative to a specified benchmark base year or reference level.

For *afforestation/reforestation* estimates of net emissions in the reporting year are used to estimate the amount of RMU credits (the accounting quantity) to be issued. The estimated quantities of RMUs to be issued for 2013-15 are contained in Table 11.14.

Table 11.14 Estimated Accounting Quantity for *afforestation/reforestation* (t CO₂-e)

Year	Accounting Quantity (RMU credits)
2013	-18,183,333
2014	-16,745,316
2015	-12,613,695

* Note: Negative values indicate that RMUs are to be issued.

11.5.4 Quality Assurance – Quality Control

Refer to Chapter 6.6.

11.5.5 Recalculations

The quantification of the recalculation components is shown in Table 11.15. Descriptions of the reasons for the recalculations are provided in the corresponding LULUCF sub-category in Chapter 6, namely *land converted to forest land* (section 6.5.5).

Table 11.15 *Afforestation/reforestation*: recalculation of total CO₂-e emissions (Gg), 1990-2014

Year	2016 submission	2017 submission	Change	Reasons for Recalculation					
	(Gg CO ₂ -e)	(Gg CO ₂ -e)	(Gg CO ₂ -e) (% change)	A. FullCAM and simulation improvements*	B. First inclusion of Wetlands converted to Forest lands	C. Updated and expanded spatial inputs	D. Impacts consequent of revisions to Forest Conversions	E. Rounding policy	F. Alignment with sectoral estimation periods
1990	737	664	-73 -10%	3	-8	74	0	1	-143
1995	-1,346	-65	1,281 95%	451	-37	35	0	2	829
2000	-7,873	-7,130	743 9%	144	-60	-133	0	2	789
2005	-12,949	-13,748	-799 -6%	-787	-125	-1,224	0	3	1,334
2006	-12,128	-14,645	-2,517 -21%	-646	-144	-1,104	0	2	-626
2007	-14,648	-15,345	-697 -5%	-1,358	-163	-1,297	0	3	2,117
2008	-14,479	-17,265	-2,786 -19%	-2,037	-186	-1,158	0	3	592
2009	-12,797	-16,838	-4,040 -32%	-2,452	-213	-728	1	3	-651
2010	-14,258	-17,601	-3,343 -23%	-5,014	-243	-567	-1	4	2,479
2011	-16,746	-21,279	-4,533 -27%	-5,216	-283	-266	0	4	1,228
2012	-9,448	-19,479	-10,032 -106%	-8,392	-325	237	0	3	-1,554
2013	-9,909	-18,183	-8,275 -84%	-9,157	-374	904	0	3	349
2014	-7,360	-16,745	-9,386 -128%	-6,828	-419	87	-17	2	-2,210

*includes enhanced geospatial monitoring, introduction of spatially monitored harvesting areas and updates to FullCAM tree parameters

11.6 Article 3.4 activities – Forest management

Forest management comprises emissions and removals from *forest lands* that are managed under a defined system of practices, and includes emissions from harvested wood products and natural disturbances relating to *forest management* lands. Forest harvesting is the key driver of anthropogenic emissions and removals from *forest management* over the medium term.

In accordance with Decision 2/CMP.7, *forest management* is accounted against an emissions reference level that represents policies and practices in place as at December 2009. Australia's forest management reference level (FMRL) was reported in its 2011 *Forest Management Reference Level Submission* (DCCEE, 2011).

A summary of responses to the reporting requirements contained in Decision 2/CMP.7 is contained section 11.10.2.

11.6.1 Identification of land subject to *forest management*

Forest lands are identified using methods applied to the identification of forest under the UNFCCC and described in Appendix 6.A. *Forest Management* lands are a subset of *Forest lands* identified using the narrow approach in accordance with practices specified in section 11.6.2.

Forest management lands include:

- all commercial plantations not included under Article 3.3 (i.e. plantations established on or before 31 December 1989);
- all public land available for timber harvesting as at December 2009, specifically multiple-use public forests as identified by the Montreal Process Implementation Group 2008;
- other forest lands (comprising forest lands that were in formal conservation reserves as at December 2009, privately managed native forests and extensively grazed woodlands) where the following activities are observed:
- harvesting since 1990, and
- direct human-induced activities which aim to recover the forest from a degraded state, such as enrichment planting, conducted after December 2009.

All forest lands are monitored for harvesting since 1990 because the management intent of forest land outside of plantations, multiple-use public forests and conservation areas is not known. Once an activity is identified, the land on which it occurs is transferred to the *forest management* lands account. This enables the balanced and complete accounting of emissions and removals over time from this activity.

Table 11.16 shows the area of land included under each of these components of *forest management*.

Table 11.16 Land subject to *forest management*

Forest management sub-classifications	Modelled area (M ha)
Multiple use forests	9.2
Private native forests (where harvest has been observed and which have been included in forest management)	0.9
Pre-1990 plantations (commercial plantations not included under Article 3.3)	0.8
Total forest area	11.0

11.6.2 Identification of management practices

Forest management includes lands where management practices for the purpose of sustainable production of wood and wood fibre occur, such as:

- harvesting of forests, including thinning, selective harvesting and clearfell;
- silvicultural practices used for forest management;
- slash management, pest control, or fertilisation;
- protection of natural resources within the areas of land available for harvesting; and
- the application of codes of forest practice.

11.6.2.1 Policies included in the reference level projection

Australia has a comprehensive domestic framework designed to achieve the conservation and sustainable management of all of its forests. This framework includes:

- A national policy framework – Australia's 1992 National Forest Policy Statement (NFPS) promotes the conservation and sustainable management of forests.
- Regional Forest Agreements (RFAs) – RFAs have legal status via the national Regional Forests Agreement Act 2002. RFAs are 20-year plans underpinning regional approaches to balance conservation and production from native forests and cover the majority of production forest regions in Australia. In addition to forest conservation provisions, RFAs provide certainty for sustainable timber supply.
- Australia's Sustainable Forest Management Framework of Criteria and Indicators 2008 – this is an internationally recognised framework for sustainable forest management applied to Australia's forests.
- State and territory frameworks – jurisdictional legislation and codes of practice are applied to ensure environmentally responsible forestry practices.
- Forest certification – independent third party forest certification applies to most of Australia's production forests.

At the national level, Australia uses the international Montreal Process Criteria and Indicators as the framework for monitoring and measuring the management of forests.

Harvesting in native forests in Australia is regulated both at the national and State level. In 1992, Commonwealth and State governments agreed to a National Forest Policy statement establishing a regime for balancing ecologically sustainable forest management and harvesting with establishment of a Comprehensive, Adequate and Representative (CAR) reserve system to protect areas of environmental and heritage value such as old growth forests. This regime involved scientific research and consultation (called Comprehensive Regional Assessments) to support 20-year Regional Forest Agreements that provide certainty for forest-based industries, forest-dependent communities and conservation.

These agreements represent an important part of the policy context for regulating harvest rates in native multiple-use public forests in Australia. Regional Forest Agreements cover more than 39 million hectares, and in the four states New South Wales, Tasmania, Victoria and Western Australia nearly 17 million hectares are protected from logging under the CAR reserve system (MPIG, 2013). Additionally, the amount of wood that can be harvested from multiple-use public forests under Regional Forest Agreements is regulated using sustainable yield calculations designed to ensure the environmental attributes and the productive capacity of the forest are maintained. There are additional constraints on harvesting from native forests in areas that are reserved for conservation, water or heritage protection or other purposes. The application of codes of forest practice can also restrict harvesting in some areas (MPIG, 2013).

For native forests subject to harvesting (multiple-use public forests and harvested private native forests) inclusion of the relevant pre-2009 policies has been achieved by extrapolating the average harvest rates during the period 2002-2009 to the projection period. This projected harvest rate (Table 11.15) was used to model projected emissions during the FMRL period.

Table 11.17 Forest management reference level harvest rates

	Harvesting area (ha)
Reference Level harvesting (2002-2009 average)	108,166

For pre-1990 plantations, it is assumed in the reference level that harvesting occurs when plots reach maturity based on standard growth rates and rotation lengths, an assumption which is not affected by policy changes.

11.6.3 Methods used to establish the Forest Management Reference Level and for *forest management* reporting

11.6.3.1 Methods for estimating emissions in FMRL and reporting of *forest management*

The methods used in reporting of emissions from *forest management* and for calculation of the technical correction are described below in accordance with IPCC (2014), Chapter 2.7.2. Equivalent methods have been used for *forest management* as for the corresponding UNFCCC forest category (as described in Vol 2 Chapter 6).

Consistent with *forest lands remaining forest lands*, emissions from *forest management* have been estimated using a Tier 2, Reporting Method 1 approach (IPCC, 2006; IPCC, 2014).

The emissions and removals from multiple-use public forests and harvested private native forests are estimated using the non-spatially explicit Estate modelling capability of *FullCAM*. This model enables the use of age-based growth data and incorporates the effects of differing silvicultural treatments on the generation and management of harvest slash. The forest classification and related characteristics including biomass and growth rates used to estimate carbon stock changes and emissions are the same as those described for the *harvested native forests* model in Chapter 6.4.1.1. Management and harvesting practices used in the model are also described in Chapter 6.4.1.1, and in Chapter 6.4.2 regarding emissions from post-harvest regeneration burning (slash burning).

The annual change in living biomass in native forests subject to harvesting is the net result of uptake due to forest growth (above and belowground as determined from the growth models) and losses due to forest harvesting. The forest type and harvest type influence the proportions of biomass transferred to the harvested wood products pool or residue material (including belowground biomass) moved to dead organic matter.

Emissions from consumption of fuelwood are estimated using the same methodology described in Chapter 6.4.4. It has been estimated that 19 per cent of emissions from consumption of wood and wood-waste is attributable to *forest management* lands.

The methods used to estimate carbon stock change and emissions for pre-1990 plantations are the same as those described in Chapter 6.4.2.

11.6.3.2 Harvested wood products

A tier 3, country specific method is used to estimate harvested wood products from forest management. In accordance with IPCC (2014) section 2.8.4 and paragraph 30 of the annex to Decision 2/CMP.7, Tier 3 or country specific methods can be used provided transparent and verifiable activity data is available and methods applied are at least as detailed and accurate as the default factors described in paragraph 29 of the annex to Decision 2/CMP.7

The general approach to estimating carbon stock changes in HWPs is set out in Section 4G – *harvested wood products* in Volume 2. The HWP model relies on the log harvest, HWP production and trade data contained in the Australian Forest Product Statistics (ABARES 2016a). In this submission, *forest management* includes HWP derived from softwood; all native hardwood; and all plantation hardwood harvests prior to the year 2000. HWP derived from harvests from all hardwood plantations from the year 2000 onwards are included in *afforestation/reforestation*. HWP stored in solid waste disposal sites is not included.

Consistent with decision 2/CMP.7, only HWP sourced from domestic forests are considered and exported material is included. Estimates are reported according to 3 broad HWP pools: Paper; Sawn wood; and Wood based panels. Accordingly, the 5 pool structure of HWP model used for the UNFCCC inventory is aggregated in the following way for the purposes of reporting:

- Paper and paper-board – pool 1 (Very short term paper and paper products);
- Sawn wood – pool 4 and pool 5 (long and very long term products); and,
- Wood based panels – pool 2 and pool 3 (short and medium term products).

11.6.3.3 Data

The same data sources are used for *forest management* as for *forest land remaining forest land*, as detailed in Chapter 6.4.1.1, Appendix 6.A and 6.G.

11.6.3.4 Start year

Estimation of net emissions is undertaken from 1970.

11.6.3.5 Carbon pools

FullCAM estimates emissions from soil through a process involving all on-site carbon pools (living biomass, dead organic matter and soil).

11.6.4 Natural Disturbances

In Australia, wildfire is the most widespread and frequent natural disturbance event which causes significant losses of carbon stock to the atmosphere.² Other natural disturbances include drought, storm damage, tropical cyclones, and pests and pathogens.

Decision 2.CMP/7 outlines rules for the reporting of natural disturbances in national inventories (the natural disturbances provision).³

Country specific approaches to the natural disturbance provision may be implemented as long as the approach is consistent with an expectation that net credits or net debits generated under the treatment of disturbances is zero (decision 2/CMP.7, annex, paragraph 33 (a)).

The natural disturbance provision has been applied to the estimates of emissions from *forest management*.

² Natural disturbances are defined in Decision 2/CMP.7 as: Non-anthropogenic events or non-anthropogenic circumstances. For the purposes of this decision, these events or circumstances are those that cause significant emissions in forests and are beyond the control of, and not materially influenced by, a Party. These may include wildfires, insect and disease infestations, extreme weather events and/or geological disturbances, beyond the control of, and not materially influenced by, a Party. These exclude harvesting and prescribed burning.

³ Annex to decision 2/CMP.7, paragraph 33.

For the Kyoto Protocol, emissions include all gases from all wildfires on lands identified as *forest management* lands. The approach differs to that used in Chapter 6 since the natural disturbance provision is applied to the estimates of emissions rather than to the activity data as in Chapter 6.

11.6.4.1 Monitoring system for wildfires

A monitoring system based on the Advanced Very High Resolution Radiometer (AVHRR) has been implemented to identify and map natural disturbance impacts due to wildfire on *forest management* lands. The new system has been designed to comply with the following safeguard mechanisms prescribed under decision 2/CMP.7, which relate to:

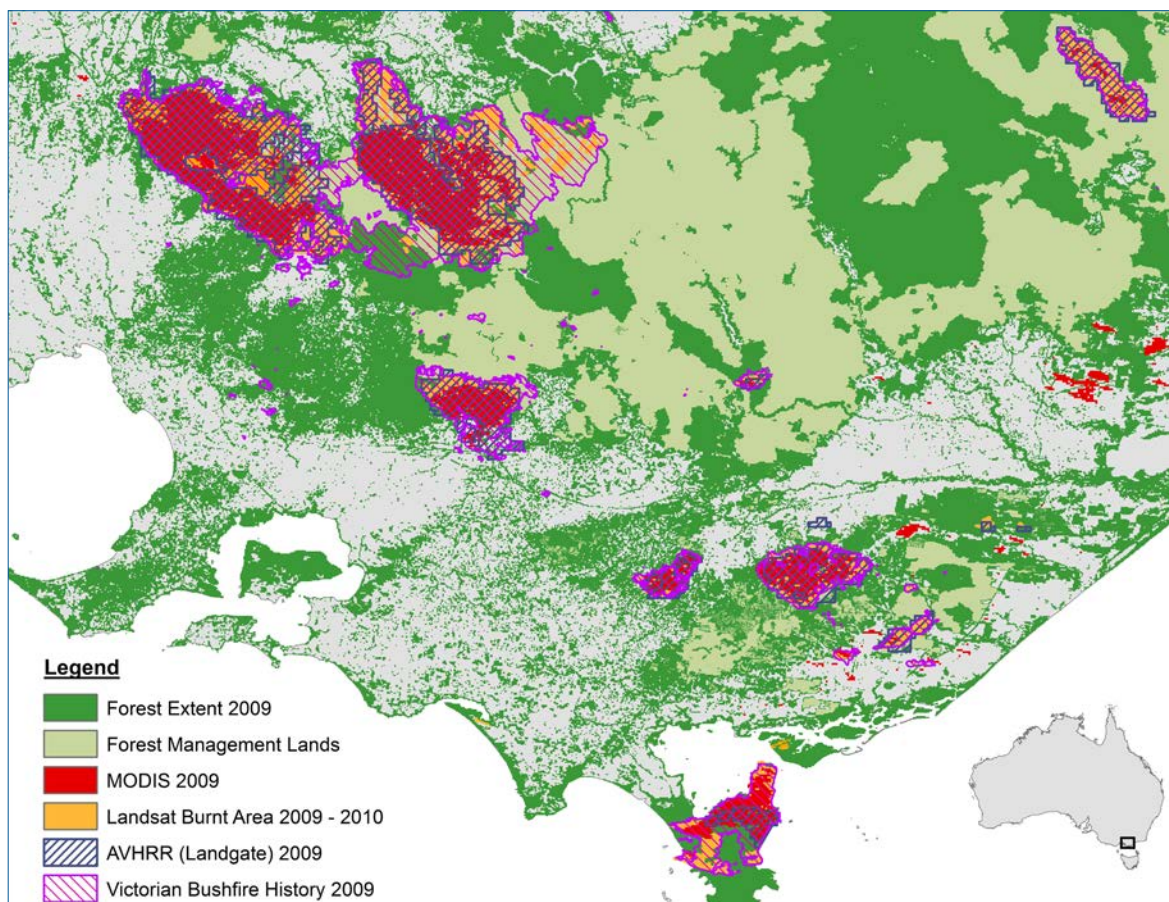
- the use of geolocated time series wildfire activity data,
- coverage of all forest management lands,
- the ability to monitor if there is a permanent land use change on those lands following a wildfire event during the commitment period,
- the inclusion of emissions associated with salvage logging in the accounting,
- identification of lands where the natural disturbance is followed by another disturbance event, in order to avoid double counting, and
- when using remote sensing data, a Party needs to identify the temporal, and spatial resolutions, calibration and validation of wildfire datasets using complementary ancillary and/or ground truth data.

The AVHRR burnt area product produced by the Western Australian Land Authority (Landgate), is tailored to Australian conditions and based on the visual interpretation of fire areas by experienced operators. The data was assessed by the Royal Melbourne Institute of Technology (RMIT) (Lowell, 2014), and compared with a range of alternative datasets, and was found to be the most suitable and highest quality time series data available (Figure 11.3). The datasets considered by the RMIT included:

1. Monthly AVHRR burnt area products (1990 to 2014), obtained from the Western Australian Land Information Authority (Landgate);
2. Monthly MODIS burnt area 500m products (2000 to 2013), obtained from the global database maintained by the University of Maryland, USA;
3. Limited coverage of wildfire data from the Landsat series of satellites; and
4. Reference bushfire history data supplied by state agencies.

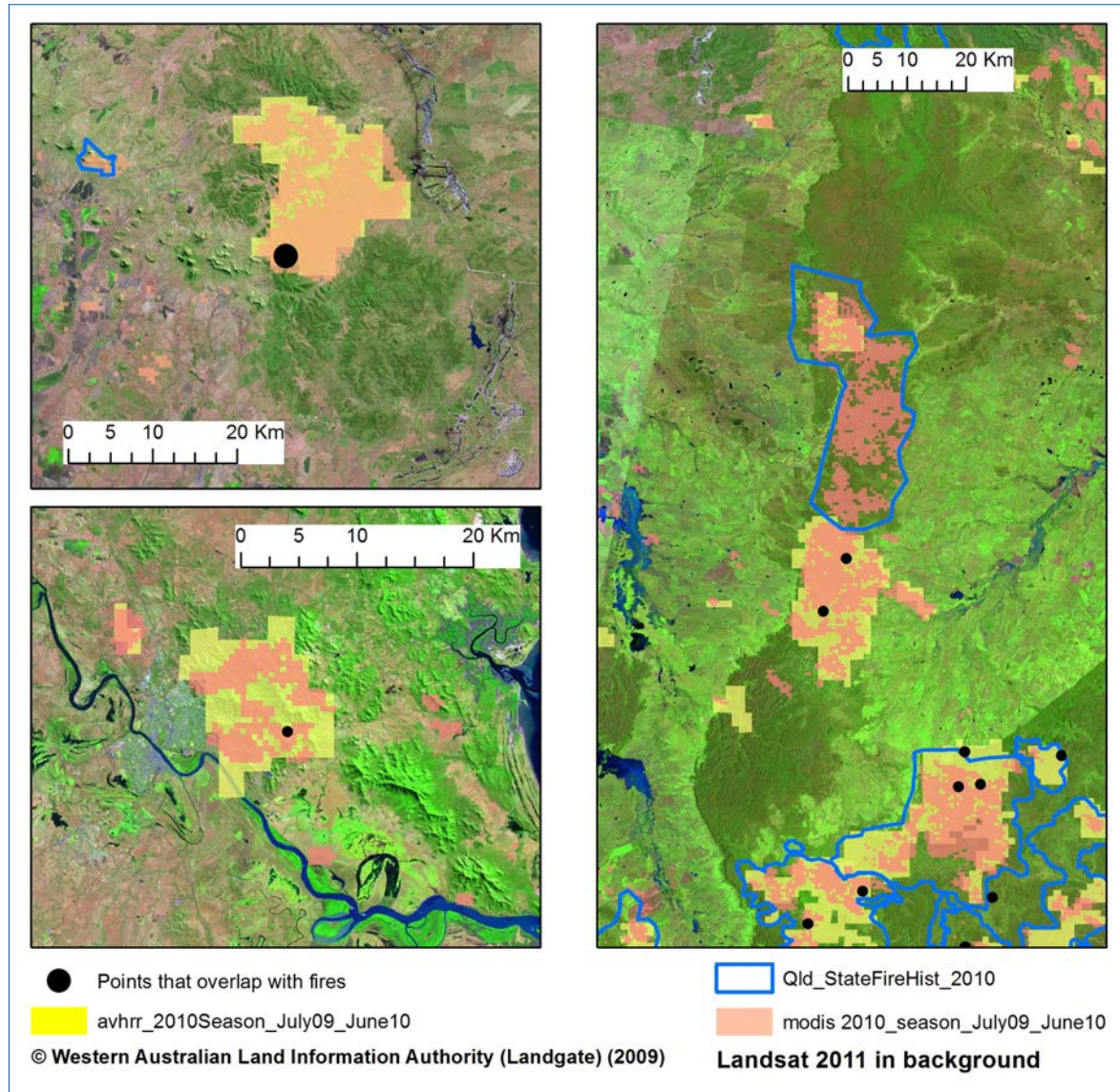
The overall quality of the post-2000 AVHRR burnt area products had a low commission error (5.4%) which indicates that 94.6 % of the wildfire detected in the Landgate AVHRR burnt area product were correctly classified (Figure 11.4). The omission error was around 11% after accounting for the undetected low-intensity prescribed burns (22%) and smaller fires below the minimum mapping unit (9%) which the 1km resolution AVHRR optical sensors were not expected to detect.

Figure 11.3 Comparison of 4 bushfire datasets over a part of Victorian multiple-use public forests



The overall quality of the post-2000 AVHRR burnt area products had a low commission error (5.4%) which indicates that 94.6 % of the wildfire detected in the Landgate AVHRR burnt area product were correctly classified (Figure 11.4). The omission error was around 11% after accounting for the undetected low-intensity prescribed burns (22%) and smaller fires below the minimum mapping unit (9%) which the 1km resolution AVHRR optical sensors were not expected to detect.

Figure 11.4 Validation of MODIS burnt area (orange), AVHRR burnt area (yellow) using the fire history data from Queensland (blue) derived from Landsat satellites. Black dots represent sampling points



Prescribed burns are estimated on the basis of State agency reports, as these fire types are hard to detect from coarser resolution satellite missions, such as the AVHRR sensor.

In addition to the calculation of annual wildfire extent, the system has been designed to monitor post-fire regrowth to ensure that there is no permanent land use change following a fire event (see Section 11.2.3.1). The system also monitors for incidences of multiple fires affecting the same lands within the commitment period (Figure 11.5, Figure 11.6) to avoid double-counting.

Figure 11.5 AVHRR based burnt area frequency for the period from 1988 to 2014

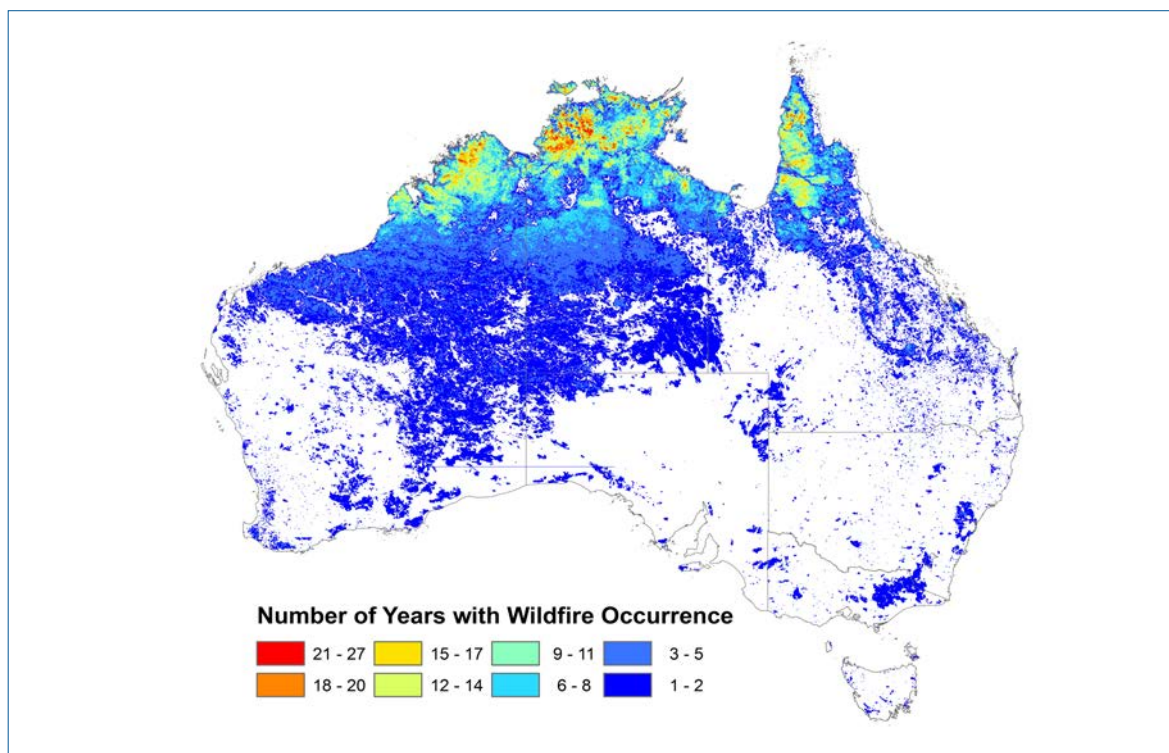
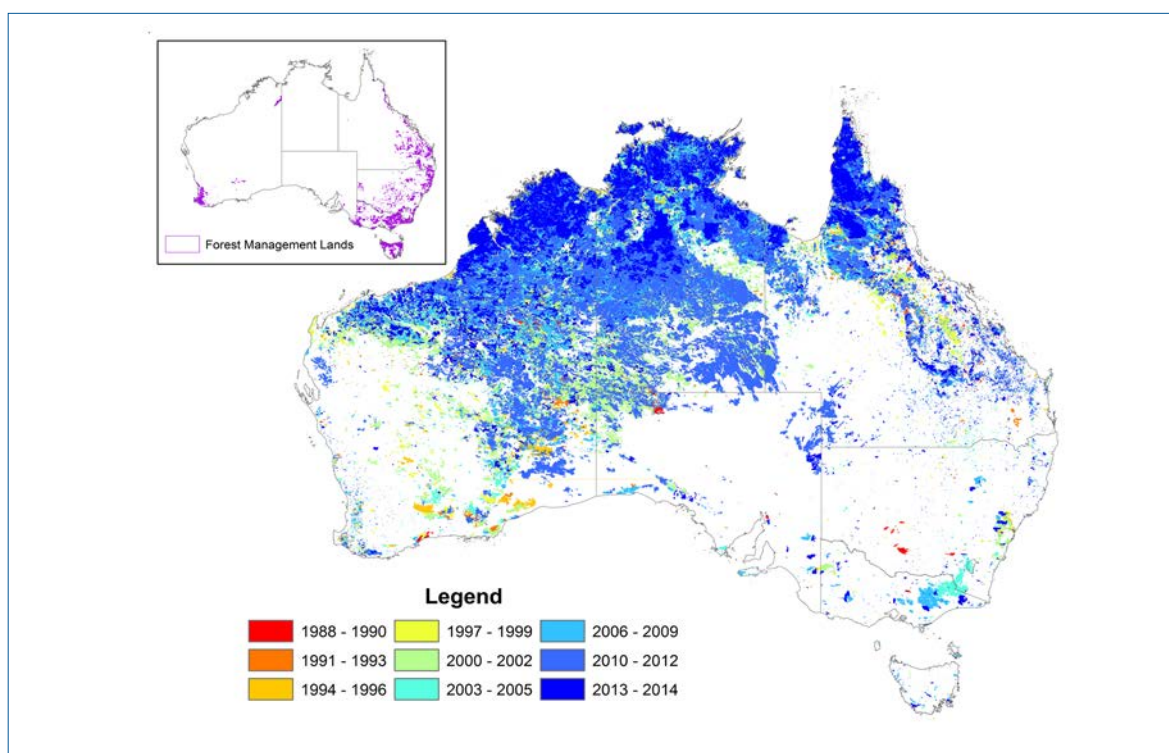


Figure 11.6 Year since last burn for the period from 1988 to 2014. Inset map shows the distribution of forest management Lands in Australia



The system will be subject to regular enhancements over time as remote sensing and data processing technologies evolve and as new information becomes available.

11.6.4.2 Method to estimate natural disturbance emissions and subsequent removals on forest management lands

The methodology used by Australia to estimate wildfire emissions and subsequent removals on *forest management* lands is consistent with the methodology applied to the *Forest land remaining Forest land* classification which is documented in section 6.4.3.

11.6.4.3 The Background Level and the Margin

Australia has calculated a background level and margin using the IPCC default method (see IPCC 2014, page 2.48-2.50) for the natural disturbance of wildfire. The background level and margin are presented in Table 11.18.

Table 11.18 Components of Australia's background level and margin for wildfire

Parameter	Value
Calibration period	2000-2012
Method used	IPCC default
Background level	3.90 Mt CO ₂ -e
Margin	5.92 Mt CO ₂ -e
Background level plus margin	9.81 Mt CO ₂ -e
Number of excluded years	Three
Excluded years	2003, 2007, 2010

IPCC quality criteria for the construction of the background level plus margin

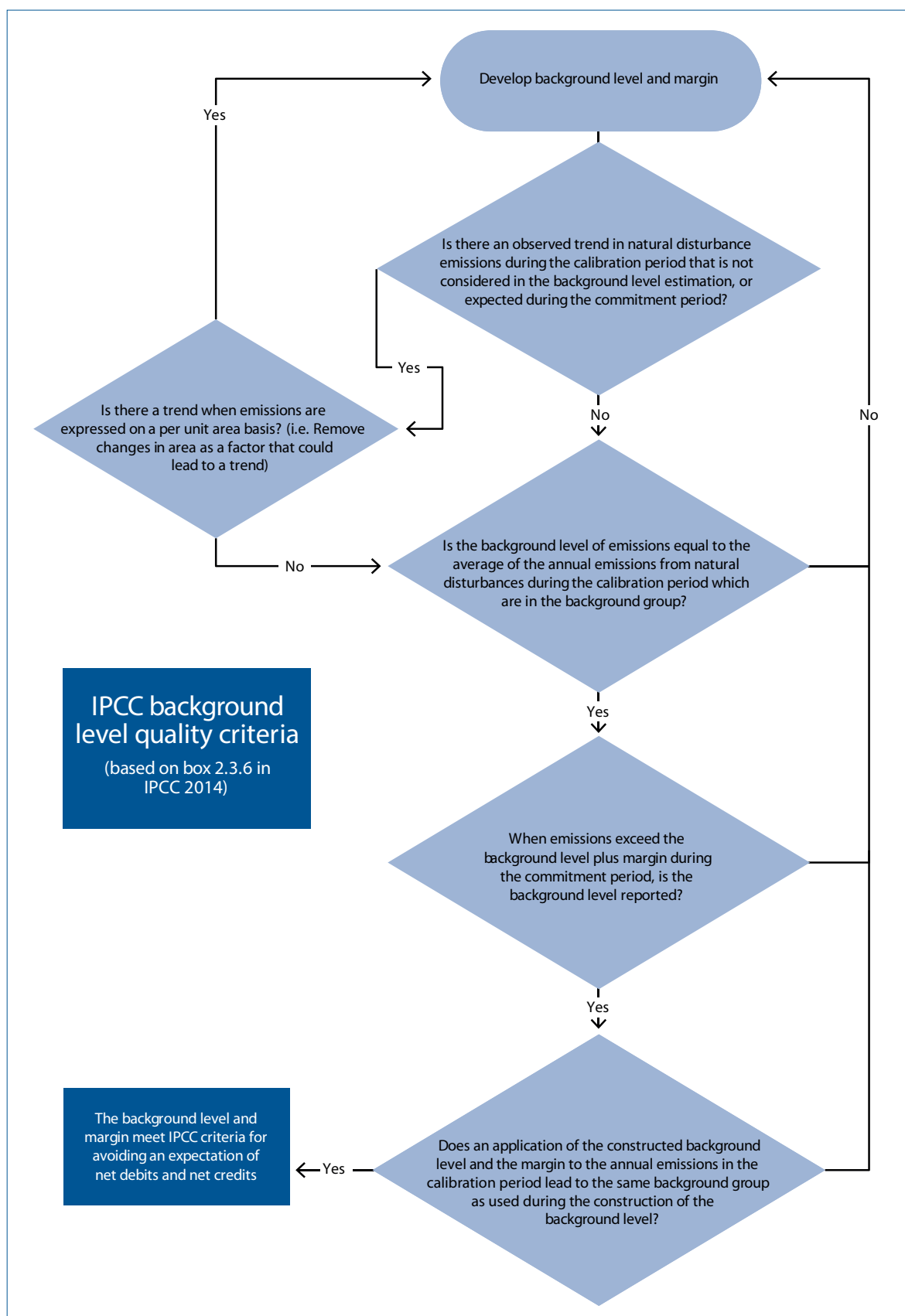
Four criteria for determining whether the data used to construct the background level and margin could result in an expectation of net credits or net debits are set out in Box 2.3.6 of IPCC (2014) page 2.50:

1. **Trend** – If there is a trend in natural disturbance emissions during the calibration period that is not considered in the background level estimation, or expected during the commitment period, then this could create an expectation of net debits or net credits.
2. **Balance** – The background level of emissions is equal to the average of the annual emissions from natural disturbances during the calibration period which are in the background group.
3. **Reporting the background level** – Any emission from natural disturbances during the commitment period that falls into the background group is not separately excluded from accounting. During the commitment period, emissions are only excluded from accounting when the annual emissions are greater than the background level plus the margin. When this occurs, only those emissions that are greater than the background level are excluded.
4. **Validation** – A test application of the constructed background level and the margin to the annual emissions in the calibration period leads to the same background group as used during the construction of the background level.

The procedure shown in the decision tree below (Figure 11.7) was implemented to ensure that the specified background level and margin meet these four criteria.

Reporting of natural disturbances and calculation of the background level and margin are both based on gross emissions only, instead of net emissions and removals (CO₂ removals due to post-fire regrowth are not reported). When CO₂ removals are also calculated, removals from previous year's natural disturbances can effect whether subsequent years exceed the background level and margin. Exclusion of removals therefore improves transparency in the application of the iterative process to remove outliers to establish the background group, and simplifies the application of the four IPCC criteria above.

Figure 11.7 Decision tree to support the development of a natural disturbance background level that is consistent with the IPCC background level quality criteria



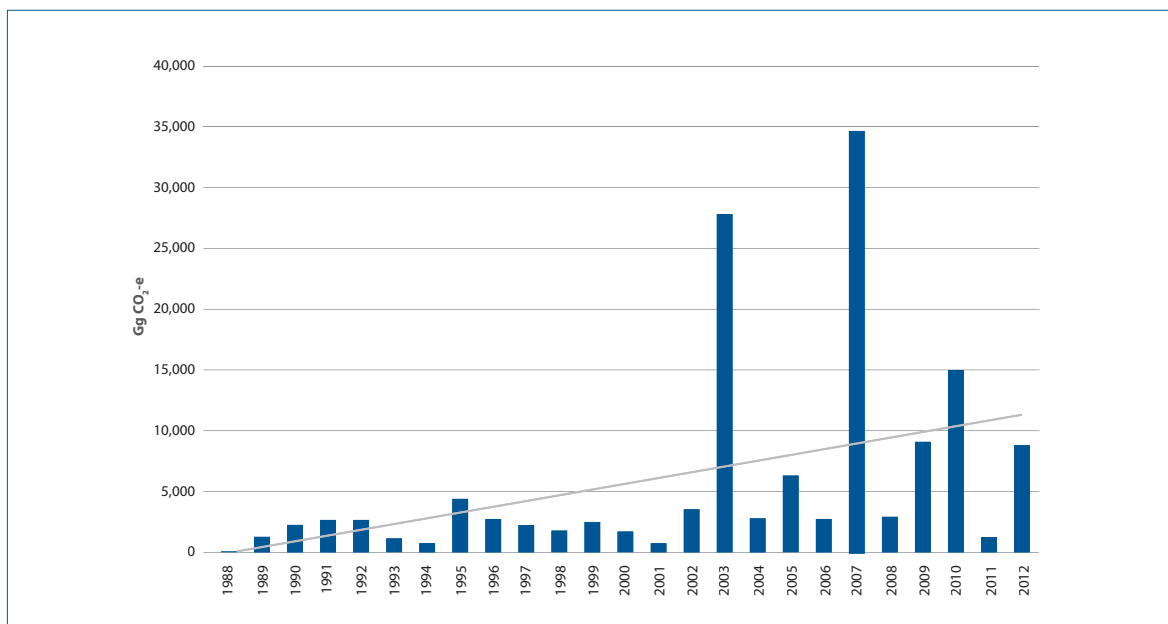
Trend criterion

Decision 2/CMP.7 indicates parties should use data from 1990-2009 – known as the calibration period – for the purpose of developing the background level and margin.

An important condition that must be satisfied is that there is no observable trend in natural disturbance emissions over the available time series. As shown in Figure 11.8, this condition is not satisfied by the full time series data on wildfire in Australia. Based on this trend assessment, the period 1988-1999 was excluded from the calibration group.

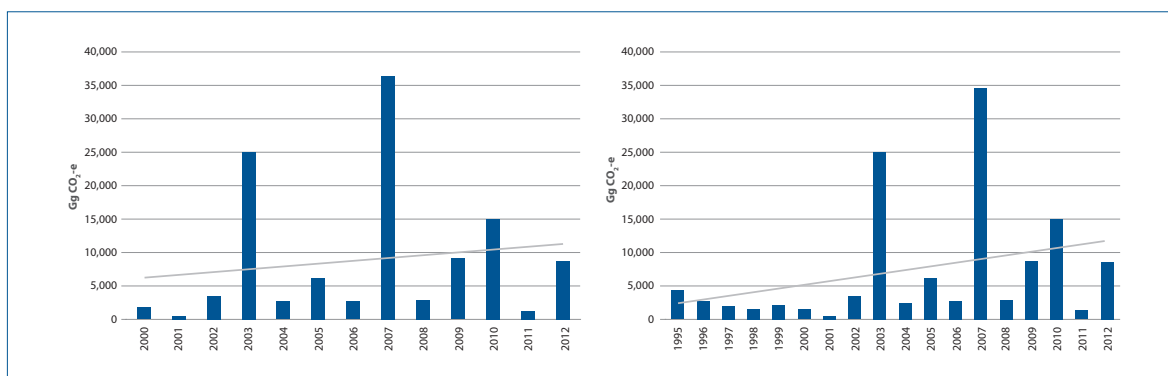
The period chosen to establish the dataset that underpins the estimation of the Background level is 2000-2012. This selected calibration group was then tested against the three IPCC quality criteria.

Figure 11.8 Wildfire burnt CO₂ emissions on *forest management* land and trend line, excluding CO₂ emissions associated with salvage logging



As shown in Figure 11.9 the slope of the trend line for the selected calibration period (2000-2012) is shallower than the slope of a longer calibration period (e.g. 1995-2012) (Figure 11.9).

Figure 11.9 Comparison of emissions trend across the selected calibration period and of a longer calibration period (1995-2012)



If the trend lines in Figure 11.9 are extended over the period 2013-2020 the increase in emissions for the selected calibration period is 1,566 kt CO₂-e while with a longer calibration period, for example 1995-2012, the increase in emissions is 3,397 kt CO₂-e.

While there remains a trend in the selected calibration period, the period 2000-2012 was selected to balance the need to limit the trend in emissions against having a calibration period that was too short.

A planned improvement is underway to consider the use of a longer time series including the period 1990-2009.

Balance criterion

To meet the balance criterion, the calculated background level must equal the average of the annual emissions from natural disturbances during the calibration period which are in the background group.

The performance of the calculated background level against the balance criterion is shown in Table 11.19, which shows the calculated background level meets the balance criterion.

Table 11.19 Test of the balance criterion for a background level based on the 2000-2012 calibration group

Years included in background group	Wildfire emissions Mt CO ₂ -e
2000	1.58
2001	0.68
2002	3.42
2004	2.53
2005	6.24
2006	2.66
2008	3.02
2009	8.81
2011	1.37
2012	8.66
Average of background group	3.90
Background level	3.90
Difference	0.00
Balance criterion met?	Yes

Reporting of the background level

Emissions should only be excluded from accounting when annual emissions are greater than the background level plus margin, and when this occurs only those emissions and removals exceeding the background level should be excluded (that is, the background level should be reported). Table 11.20 shows that only emissions exceeding the background level are excluded in years where the natural disturbances provision is applied.

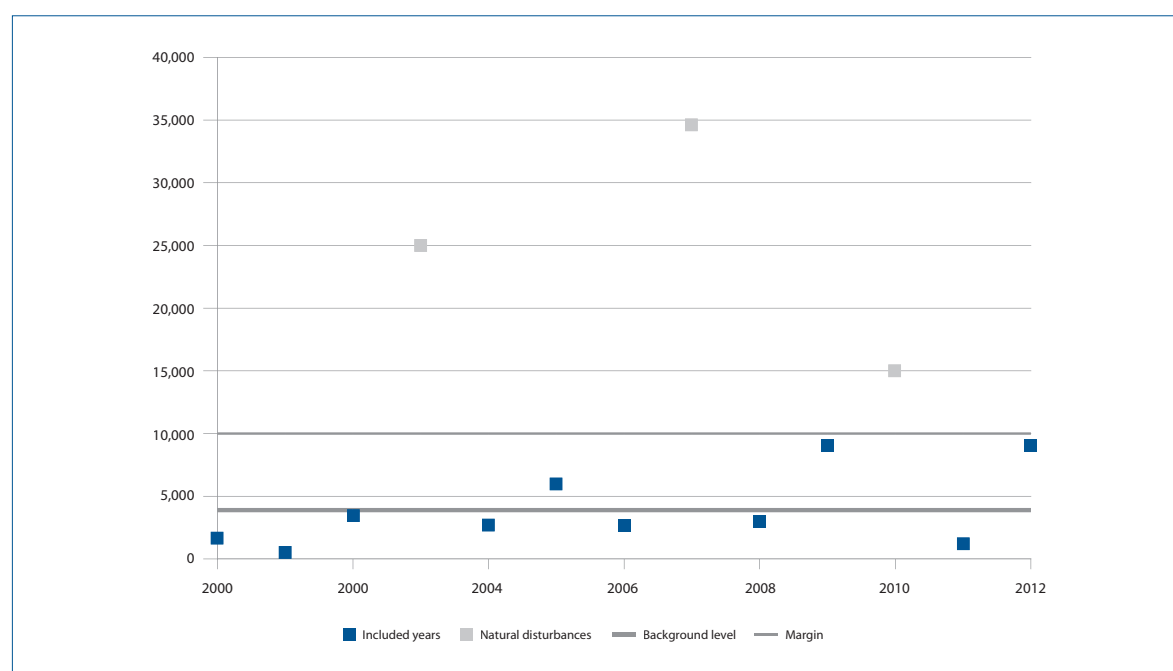
Table 11.20 Reported wildfire emissions and excluded natural disturbance emissions

Year	Reported emissions (after excluding natural disturbances)	Natural disturbance emissions that are excluded from reporting
	(kt CO ₂ -e)	
2000	1,575	0
2001	678	0
2002	3,416	0
2003	3,895	21,115
2004	2,525	0
2005	6,237	0
2006	2,665	0
2007	3,895	30,688
2008	3,022	0
2009	8,809	0
2010	3,895	11,035
2011	1,367	0
2012	8,658	0
2013	3,895	10,990
2014	3,895	7,912
2015	8,774	0

Validation criterion

To satisfy the validation criterion, the emissions in any of the background group years should not exceed the background level plus margin. As shown in Figure 11.10, emissions in the background group years do not exceed the background level plus margin. The validation criterion has been met.

Figure 11.10 Background level and background level plus margin based on the 2000-2012 calibration data set



11.6.4.4 Demonstration that the expectation of net credits/net debits is zero.

According to IPCC (2014) (section 2.3.9.6, step 5) it is *good practice* for parties to ensure that the method applied to the development of the background level and margin does not lead to the expectation of net credits or net debits.

The Department of the Environment and Energy monitors the implementation of the background level and margin to ensure that there is no expectation of net debits or net credits associated with the implementation of the natural disturbance provision. If such a situation arises a technical correction will be applied to the FMRL.

11.6.4.5 Ensuring that emissions caused by salvage logging on land subject to natural disturbance are transparently reported

Emissions from salvage logging are included in estimates for multiple-use public forests, harvested private native forests and pre-1990 plantations. Estimates of forest harvesting are based on log production information that includes the products of salvage logging. These production statistics do not differentiate between material sourced from conventional clear felling and salvaging activities following wildfire or other natural disturbances.

A review of salvage harvesting by ABARES (Finn et al, 2015) identified that this is a very minor activity compared to either total harvesting activity or total areas burned. Salvage harvesting is generally opportunistic, determined as much by commercial factors as biophysical factors. However it does occur more often in forest and plantation types which are located in areas with sufficient harvesting capacity. A time series of emissions associated with salvage logging has been developed utilising industry data on the national sales of salvaged pine, and state government reporting in states where salvage harvesting of multiple use forests is known to occur (Table 11.21). In recent years, multiple use forest salvage harvesting has predominantly occurred in ash forests where the combination of economic factors are conducive to salvage harvesting practices. Estimates of biomass volumes per hectare or per unit of harvested wood are based on harvesting parameters from FullCAM. Estimates of wood density and carbon content are drawn from parameters used in the modelling of *harvested wood products*.

Table 11.21 Estimates of salvage logging activity and emissions

Year ending 30 th June	Pine plantation salvage harvests (m ³) ⁵	Multiple Use Forest salvage harvests (m ³) ⁶	Modeled emissions (kt CO ₂ -e C) ⁷
2007	496,416	18,923	120
2008	425,350	98,383	129
2009	389,591	71,551	112
2010	438,792	114,511	137
2011	516,658	86,836	146
2012	179,179	10,564	45
2013	111,708	0	26
2014	101,138	0	23
2015	76,187	602	18

11.6.4.6 Information that natural disturbance events were beyond the control of the party (IPCC 2014, page 2.36)

In Australia, wildfires threaten life and property, and are addressed in disaster response plans and management arrangements in each state and territory. Common frameworks for national, state and territory fire management policies include: reducing the likelihood of fires occurring, for example through fuel reduction burning and fire bans; managing or controlling the fire during its occurrence; monitoring programs and early warning systems;

and firefighting operations. In addition to such disaster management policies, there is also a significant research effort into understanding and better managing wildfires, and following many significant fire events, inquests or enquiries are held to assess the disaster response and potential for improvement.

There are fire management policies and plans in place at the national and the state and territory level to control for the risks, events and consequence of wildfire to the extent that this is possible. These documents set out frameworks for:

- Reducing the likelihood of a wildfire occurring, for example, through the use of prescribed burning;
- Managing or controlling the disturbance during its occurrence;
- Monitoring programs and early warning systems; and
- Firefighting operations.

The implementation of plans and strategies to avoid and minimise risks to life and property from wildfires is documented in the following section.

National level

The National Bushfire Management Policy Statement for Forests and Rangelands (FFMG 2014)⁴ outlines Australian, state and territory government objectives and policies for the management of landscape-level fire in Australia's forests and rangelands. The statement was developed by the Forest Fire Management Group, a national body within the Council of Australian Governments, with the role of providing information to governments on major forest fire-related issues, policies and practices affecting land management. The Australasian Fire and Emergencies Authorities Council is the national peak organisation that provides advice on a range of policies and standards. Research on bushfires is performed by a number of organisations, including:

- the Bushfire Cooperative Research Centre, which brings together experts from universities;
- the Commonwealth Scientific and Industrial Research Organisation (CSIRO);
- other Australian, state and territory government organisations, and;
- the private sector for long-term programs of collaborative research.

The national Bureau of Meteorology publishes fire weather warnings and has a role in the declaration of fire bans when weather conditions are conducive to the spread of dangerous bushfires. Warnings are generally issued within 24 hours of the potential onset of hazardous conditions. Warnings are also broadcast on radio and television.

Fire agencies determine Fire Danger Ratings. In most States and Territories, fire agencies declare fire bans based on a range of criteria including forecast weather provided by the Bureau.

The Bureau also incorporates Total Fire Ban Advises into warnings, if one is being enforced at the time of issue, and an action statement from local fire authorities detailing areas where the ban is in effect.

Fire Weather Warnings are distributed through the media, fire agencies and other key emergency service organisations. Warnings are normally issued in the afternoon for the following day so to be available for evening television and radio news broadcasts. Warnings are renewed at regular intervals and generally at the same time major forecasts are issued. However, warnings may be issued or amended and reissued at any time if a need is identified. If there is a Fire Weather Warning current, the Bureau will mention this in State, Territory and District weather forecasts for that area.

In each State the issue of a Fire Weather Warning has different impacts on restrictions for lighting fires.

The Bureau of Meteorology does not have the power to declare a Total Fire Ban. This responsibility resides with designated fire agencies in each State and Territory. However, in South Australia, Northern Territory,

4 https://www.semc.wa.gov.au/riskmanagement/Documents/NationalBushfireManagementPolicy_2014.pdf

Victoria, New South Wales and Tasmania, the Bureau does issue Total Fire Ban Advices to assist publicising and distributing the message. The Bureau also includes information about the existence of current fire bans in weather forecasts and warnings.

The areas covered by fire bans do not align with Bureau forecast districts in New South Wales, Tasmania and Northern Territory.

State and territory level

Each state and territory has published a document which sets the framework for the management of bushfires. These plans include information on the use of public information campaigns and requirements around the declaration and publication of fire bans and fire danger ratings during fire seasons. In Queensland the documents are published for a number of regions within the state, rather than at the state level.

New South Wales

The aim of the State Bush Fire plan is to set out the arrangements for preparedness, prevention, mitigation, response to and recovery from bush fire events by combat, participating and support agencies in NSW.

This plan describes the arrangements for the control and coordination of the response to Class 2 and 3 bush and grass fires, including those managed under the provisions of section 44 of the Rural Fires Act 1997 (RF Act), and the provisions for emergency warnings at all classes of fires.

These arrangements ensure that the two combat agencies, New South Wales Rural Fire Service (NSW RFS) and Fire & Rescue NSW (FRNSW), are able to manage bush and grass fires, utilising assistance from the other firefighting authorities being the National Park & Wildlife Service (NPWS) and Forestry Corporation NSW (FCNSW).

The NSW State Bush Fire plan is available here:

<https://www.emergency.nsw.gov.au/publications/plans/sub-plans/bush-fire.html>

Victoria

Victoria's State Bushfire Plan provides an overarching view of responsibilities of agencies, government and communities in bushfire management.

The first version of the State Bushfire Plan was developed in 2012 in conjunction with the Country Fire Authority, the Metropolitan Fire Brigade, the Department of Environment and Primary Industries and the Fire Services Commissioner.

The second version of the State Bushfire Plan was produced in 2014, with updates to reflect the changes in Victorian emergency management legislation and the emergency management sector.

The plan reflects an integrated approach and shared responsibility for bushfire management between government, agencies, business, communities and individuals.

Although intended as a reference document for fire and emergency management agencies, the State Bushfire Plan will be of equal interest to anyone who works or volunteers in bushfire management.

The State Bushfire Plan is a sub-plan of the State Emergency Response Plan (SERP), found in the Emergency Management Manual of Victoria (EMMV), the principal document for guiding the State's emergency management arrangements.

Victoria's State Bushfire Plan is available here:

<http://www.emv.vic.gov.au/plans/state-bushfire-plan/>

Queensland

In Queensland, fire management policies and plans are developed at regional rather than at the state level. The Queensland government provides an overview of the approach to disaster management in Queensland here:

<http://www.disaster.qld.gov.au/>

Western Australia

Western Australia has developed a series of State Emergency Management Plans (Westplans) including an integrated urban and bushfire management plan. The plan is available here:

<https://www.semc.wa.gov.au/Publications%20and%20Resources/Westplan%20-%20Fire.pdf>

South Australia

The South Australian State Emergency Management Plan is available here:

http://www.safecom.sa.gov.au/site/emergency_management/emergency_management_arrangements/state_emergency_management_arrangements.jsp

Tasmania

Tasmania's state fire protection plan is available here:

http://www.fire.tas.gov.au/userfiles/stuartp/file/Publications/StateFireProtectionPlanVersion2_2.pdf

Northern Territory

Bushfire management and control in the Northern Territory is managed through the framework provided by the Regulations under the Bushfires Act (1980). The regulations are available here:

<http://notes.nt.gov.au/dcm/legislat/legislat.nsf/2afcb7bfe1e1348e6925705a001697fb/f809e4153030055269257d9000221450/%24FILE/ATTTAP7M.pdf/Repb004R2.pdf>

Australian Capital Territory

The Standard Operating Procedures of the ACT Rural Fire Services provide the framework for the management of bushfires in the ACT. The Standard Operating Procedures are available here:

<http://esa.act.gov.au/actrfs/publication-and-links/standard-operating-procedures/>

11.6.4.7 Information to identify lands where the natural disturbance is followed by another disturbance event, in order to avoid double counting (IPCC 2014, page 2.45)

Wildfire natural disturbance events are monitored using data derived from the AVHRR sensor as described in section 11.6.4.1. The system established to monitor, track and archive the AVHRR burnt area data detects incidences of burnt areas on the same unit of land within the commitment period.

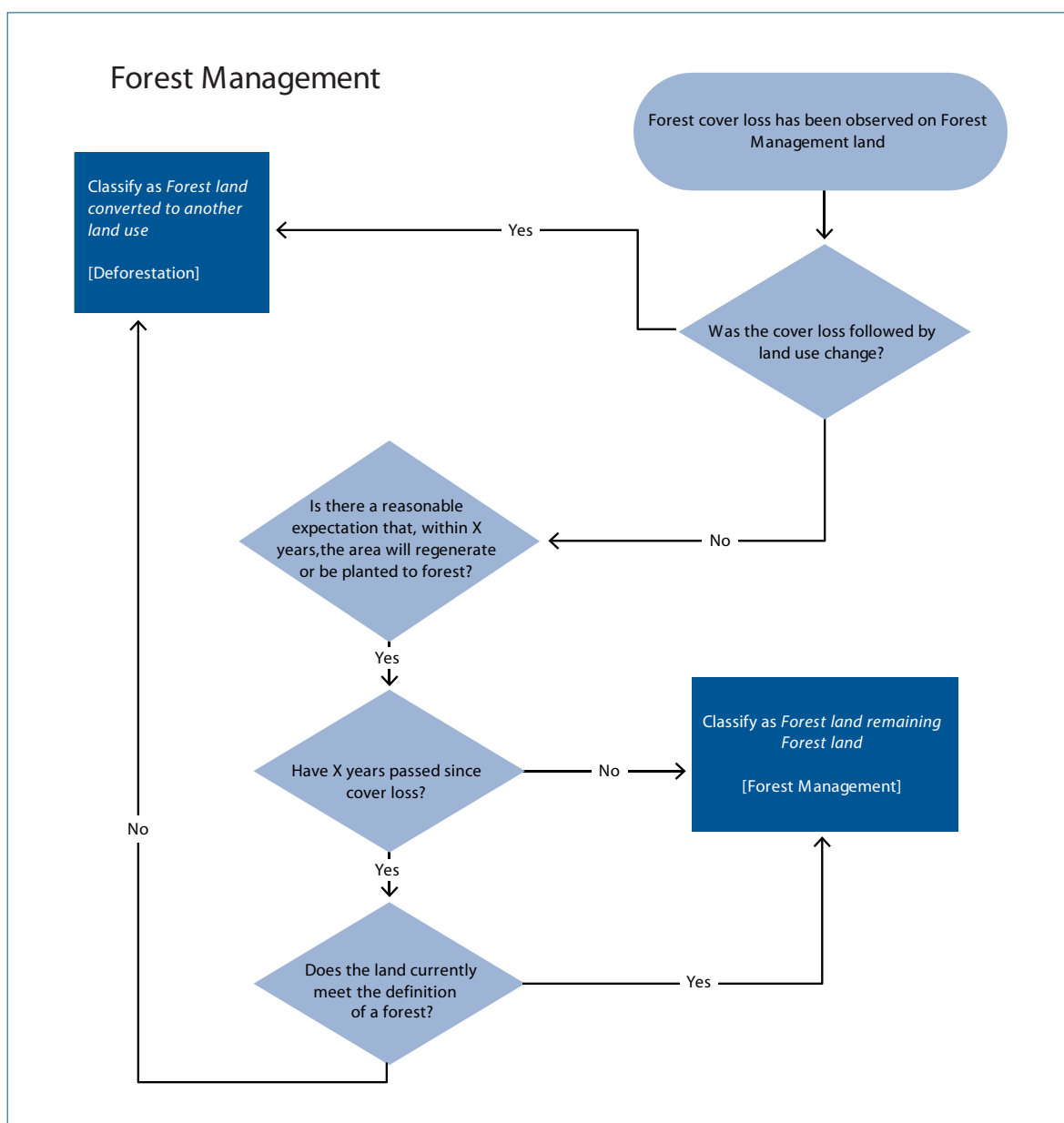
The method for estimating removals during the recovery from a natural disturbance event is documented in Volume 2, section 6.4.1.1. According to this method, the biomass consumed during a wildfire in temperate

forests recovers over a number of years following the fire, modeled using Olson curves calibrated with data for each State and Territory. On average across Australia, fuel loads reach 95% of equilibrium levels within 11 years (Roxburgh et al 2015). If a single unit of land was already affected by a wildfire within the recovery period, some portion of the emissions on this land could be considered as double counted if the fuel load was assumed to be at an equilibrium level when the second wildfire occurred. Where repeat burning is observed before fuel loads have recovered an estimate of the fuel load present can be made by calculating the fuel load at time t using Equation 4A.1_5 and 4A.1_6 in Chapter 6.

11.6.4.8 Information to identify lands where land use change has occurred after a natural disturbance (IPCC 2014, page 2.45)

All forest land is monitored for harvesting and deforestation events. *Forest management* land is monitored for 12 years following forest cover loss events (due to harvesting, fire and other disturbances) to determine if land use change has occurred (section 11.2.3.1) consistent with the requirements for determining if land is subject to *deforestation* specified in Figure 2.6.1 of IPCC (2014) (Figure 11.11).

Figure 11.11 Monitoring and classification of *forest management* land following a forest cover loss event



11.6.4.9 Information on efforts to rehabilitate the land subject to natural disturbances (IPCC 2014, page 2.53)

The need for rehabilitation of Australia's native forests following natural disturbance is dependent upon the nature of the disturbance. Australia's native forest are generally dominated by fire tolerant species. The principal fire tolerant responses in forest tree species are summarised Table 11.22⁵. Some species however, for example Mountain Ash (*Eucalyptus regnans*) and Alpine Ash (*Eucalyptus delegatensis*) are vulnerable to frequent fires as the plants are unable to reach maturity and produce sufficient seed before the next fire.

In the case of Alpine Ash there are examples of the need for re-seeding following fire to ensure the rehabilitation of the forest.⁶

Table 11.22 Adaptation of Australia forest genera to fire

Adaptation to enable natural regeneration after fire	Forest genera
Stimulation of seed release from woody capsules by heat and desiccation	Casuarina, Hakea, Banksia, Leptospermum and Eucalyptus.
Stimulation of germination of soil-stored seed by fire	Acacia
Stimulation of bud development after fire from lignotubers	Eucalyptus

11.6.5 Forest management reference level technical correction

Australia's 2011 FMRL submission (DCCEE, 2011) outlines the methods used for estimating the reference level.

There have been a number of methodological refinements since this reference level was submitted, which include changes to address the subsequently agreed rules for implementing the natural disturbances provision and calculating emissions from harvested wood products (UNFCCC, 2011). There have also been refinements to other methodological elements used in the estimation of emissions from *forest management*.

Methodological consistency between the reference level and the reporting of *forest management* in the national inventory must be demonstrated, including by making technical corrections to the FMRL if necessary. If there are any recalculations of the historical data used to establish the reference level, a technical correction must be applied.

In order to maintain such methodological consistency, a technical correction has been estimated as -4.34 Mt CO₂-e. This correction incorporates corrections to the sub-categories of *forest management* reporting (Table 11.23).

⁵ Atwell, Kriedemann, and Turnbull (1999) *Plants in Action*, Macmillan Education Australia, Melbourne.

⁶ <http://archive.premier.vic.gov.au/2014/media-centre/media-releases/7162-helicopters-sowing-alpine-ash-forest-following-harrietteville-fire.html>

Table 11.23 Technical correction by sub-category – summary

(Mt CO ₂ -e)	Multiple-use public forests	Harvested private native forests	Pre-1990 Plantations	Prescribed burning	Included natural disturbance emissions	Fuelwood combusted	Harvested wood products	N-Mineralisation	Total
FMRL 2011 Submission	-9.93	8.94	0.27	0.19	8.68	1.29	-4.74	na	4.70
FMRL Estimate for 2015 submission	-7.81	5.70	2.63	0.10	2.63	1.60	-3.73	na	1.12
FMRL Estimate for 2016 submission	-9.68	7.29	2.72	0.65	3.90	-0.12	-5.31	0.03	-0.52
FMRLcorr for 2017 submission	-10.04	7.59	3.23	0.65	3.90	-0.13	-4.87	0.03	-0.52
Technical Correction (FMRLcorr minus FMRL 2011)	-0.11	-1.35	2.96	0.46	-4.78	-1.41	-0.13	0.03	-4.34

Relevant criteria under IPCC (2014) (page 2.101) that trigger the requirement to report a technical correction include:

The method used to report emissions and removals from *forest management* changed after the adoption of FMRL.

Any of the following methodological elements used to establish the FMRL (as reported in the FMRL submission) changed after the adoption of the FMRL.

- Pools and gases
- Area under forest management
- Historical inventory data Forest characteristics and related management
- Historical harvesting rates
- Climate data assumed by models for projecting FMRL
- *Harvested wood products* (including data or methods)
- Natural Disturbances.

These criteria have been matched against the different aspects of technical correction in Table 11.24.

Table 11.24 Elements of technical correction and cross-reference with IPCC good practice guidance

Component of forest management Correction	Technical Correction	Factors leading to correction	IPCC (2013) Guidance Criteria	Reason for methodological change or methodological refinement
	(Mt CO ₂ -e)			(With reference to good practice in 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Vol 1)
Total correction	-4.34	(sum of corrections reported in NIR 2013 - 2015)		
Total corrections reported in NIR 2015	0.89			
Harvested private native forest	0.30	<div>- Availability of annual climate data climate data</div> <div>- Alignment with sectoral estimation periods</div>	Criteria 2.f Different observed climate data as compared to what was assumed in the FMRL	Methodological refinement as part of continuous improvement of the FullCAM modelling framework when new data becomes available (available data has changed; Vol 1, Ch 5.2.1)
Multiple-use public forests	-0.36	<div>- Recalculation of harvesting attributable to deforestation</div> <div>- Availability of annual climate data climate data</div> <div>- Alignment with sectoral estimation periods</div>	Criteria 2.e recalculation of historical harvest rates	Methodological refinement as part of continuous improvement of the FullCAM modelling framework when new data becomes available (available data has changed; Vol 1, Ch 5.2.1)
Pre-1990 plantations	0.51	Availability of annual climate data climate data	Criteria 2.f Different observed climate data as compared to what was assumed in the FMRL	Methodological refinement as part of continuous improvement of the FullCAM modelling framework when new data becomes available (available data has changed; Vol 1, Ch 5.2.1)
HWP	0.44	Corrections to AD to avoid double counting of HWP from deforestation events (already accounted for on the basis of instantaneous oxidation)	Criteria 2.g HWP - New / recalculated data and / or methods; inclusion of provisions	Implementation of KP accounting rules (IPCC, 2014; Decision 2/CMP.7) (consistency with IPCC guidelines; Vol 1 Ch 5.2.1)
N-Mineralisation	0.00	Implementation of new rounding policy for emission factor precision (all sectors.	Criteria 2.c Recalculated historical data for FL-FL or FM	Methodological refinement as part of continuous improvement in modelling framework following QA process (correction of errors; Vol 1, Ch 5.2.1)
Total corrections reported in NIR 2014	-1.64			

Component of forest management Correction	Technical Correction (Mt CO ₂ -e)	Factors leading to correction	IPCC (2013) Guidance Criteria	Reason for methodological change or methodological refinement
				(With reference to good practice in 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Vol 1
Harvested private native forest	1.59	Estimation and reporting of Soil Carbon pool with required model updates	Criteria 2.a inclusion of new pools or gasses	Methodological refinement to allow complete reporting of all pools and gasses required in Annex to Decision 2/CMP.7, paragraph 26 (consistency with IPCC guidelines; Vol 1 Ch 5.2.1)
Multiple-use public forests	-1.87	Estimation and reporting of Soil Carbon pool with required model updates	Criteria 2.a inclusion of new pools or gasses	Methodological refinement to allow complete reporting of all pools and gasses required in Annex to Decision 2/CMP.7, paragraph 26 (consistency with IPCC guidelines; Vol 1 Ch 5.2.1)
Pre-1990 plantations	0.09	Revised climate, soil and clay activity data	Criteria 2.f Different observed climate data as compared to what was assumed in the FMRL	Methodological refinement as part of continuous improvement of the FullCAM modelling framework when new data becomes available (available data has changed; Vol 1, Ch 5.2.1)
Natural Disturbances	1.26	Implementation of revised model parameters from new empirical research	Criteria 2.c Recalculated historical data for FL-FL or FM	Implementation of recommendation by ERT from review of FL-FL (ARR 2015, recommendation L.27). Methodological refinement to implement new research and new empirical data, consistent with <i>good practice</i> (available data has changed; Vol 1, Ch 5.2.1)
Fuelwood	-1.71	Addressing double-counting of emissions with HWP, debris and fire	Criteria 2.c Recalculated historical data for FL-FL or FM	Avoiding double-counting of emissions (correction of error consistent with <i>good practice</i> ; Vol 1, Ch 5.2.1)
HWP	-1.58	Corrections to implementation of KP accounting rules; including modelling of domestically produced wood products, disaggregation of HWP from Afforestation / Reforestation and Deforestation activities	Criteria 2.g HWP - New / recalculated data and / or methods; inclusion of provisions	Complete implementation of KP accounting rules (IPCC, 2014; Decision 2/CMP.7) (consistency with IPCC guidelines; Vol 1 Ch 5.2.1)

Component of forest management Correction	Technical Correction		Factors leading to correction	IPCC (2013) Guidance Criteria	Reason for methodological change or methodological refinement
	(Mt CO ₂ -e)				
Prescribed burning	0.55		Implementation of revised model parameters from new empirical research	Criteria 2.c Recalculated historical data for FL-FL or FM	Implementation of recommendation by ERT from review of FL-FL (ARR 2015, recommendation L.27). Methodological refinement to implement new research and new empirical data, consistent with <i>good practice</i> (available data has changed; Vol 1, Ch 5.2.1)
N-Mineralisation	0.03		Reporting of Soil Carbon pool allows estimation of N Mineralisation	Criteria 2.a inclusion of new pools or gasses	Methodological refinement to allow complete reporting of all pools and gasses required in Annex to Decision 2/CMP.7, paragraph 26 (consistency with IPCC guidelines; Vol 1 Ch 5.2.1)
Technical correction reported in NIR 2013 -3.58 Cumulative correction (as reported in NIR 2013)					
Private Native Harvest					
Calendar year Reporting	-3.24		Cumulative correction Activity data converted from financial years to calendar years, consistent with broader LULUCF inventory reporting	Criteria 2.b recalculation of area under FM, and 2.e recalculation of historical harvest rates	Recalculation of activity data in order to ensure consistency with reporting of other Article 3.3 and 3.4 activities and <i>Forest land remaining forest land</i> (in accordance with <i>good practice</i> : IPCC (2014) Ch 2.7.5.1 (construction of FMRL) and Ch 2.7.5.2 (Methodological consistency between FMRL and reporting for FM))
Combined	-2.77		(Tasmania & other states)		
Tasmanian harvested private native forest	-0.80		Changed time series from 1990-2020 to 1970-2020 New activity data (ABARES)	Criteria 2.b recalculation of area under FM, and 2.e recalculation of historical harvest rates	Methodological refinement to utilise new activity data (in accordance with <i>good practice</i> : Ch 5.2.1 Recalculations due to methodological changes and refinements) New data ensures time series consistency by using same method and data source for all years and consistency of estimation method on a national basis including for multiple-use public forests and UNFCCC Harvested Native Forests Extrapolation of pre-1990 harvesting allows comparison with post-1990 emissions trend to ensure that only real changes in activity data are reflected in estimates

Component of forest management Correction	Technical Correction		Factors leading to correction	IPCC (2013) Guidance Criteria	Reason for methodological change or methodological refinement
	(Mt CO ₂ -e)				
Other States (NSW, Qld, WA)	-1.33	New modelling method (now FullCAM) Time series and activity data now consistent with TAS (1970-2020)	Criteria 1. change of GHG reporting method and Criteria 2.b recalculation of area under FM, and 2.e recalculation of historical harvest rates	Methodological refinement to utilise new activity data (in accordance with <i>good practice</i> : Ch 5.2.1 Recalculations due to methodological changes and refinements) New data ensures consistency of estimation method on a national basis including for multiple-use public forests and UNFCCC Harvested Native Forests and time series consistency by using same method and data source for all years	
Multiple-use public forests					
Calendar year Reporting	2.11	Cumulative correction Activity data converted from financial years to calendar years, consistent with broader LULUCF inventory reporting	Criteria 2.e recalculation of historical harvest rates	Recalculation of activity data in order to ensure consistency with reporting of other Article 3.3 and 3.4 activities and <i>Forest land remaining forest land</i> (in accordance with <i>good practice</i> : IPCC (2014) Ch 2.7.5.1 (construction of FMRL) and Ch 2.7.5.2 (Methodological consistency between FMRL and reporting for FM)	
Correction for observed deforestation	2.92	Cumulative correction Annual harvesting area and total forest management estate area corrected for observed deforestation Includes projected rates of deforestation during reference level period (2013-2020) (based on historical average)	Criteria 2.b recalculation of area under FM, and 2.e recalculation of historical harvest rates	Implementation of land classification system consistent with Article 3.3 and 3.4 and consistent with <i>good practice</i> : IPCC (2014) Ch 1.3 and 2.7.2 Correction a result of improvements in forest monitoring capabilities enabling identification of deforestation (harvesting that was not observed to re-grow within the defined period) on FM lands Annual harvesting and lands excluded from FM are reported under deforestation	

Component of forest management Correction		Technical Correction		Reason for methodological change or methodological refinement	
		Factors leading to correction		(With reference to good practice in 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Vol 1	
		(Mt CO ₂ -e)		IPCC (2013) Guidance Criteria	
Pre-1990s average harvest rates		4.16	Cumulative correction Early '90s average used to project backwards; reflecting an assumption of harvesting occurring on lands listed as conservation reserves as at December 2009 Using new activity data from ABARES AFWPS	Criteria 2.e recalculation of historical harvest rates	Used extrapolation to estimate pre-1990 harvest and improve consistency with post-1990 harvest data (in accordance with Ch 5.3.3.4 using trend extrapolation to resolve data gaps) Ensures that modelled emissions trends reflect only real changes in activity data (post 1990), not model artefact due to technique to resolve data gap in historical activity data
Activity Data		0.09	Cumulative correction Using new activity data – Australian Forest and Wood Products Statistics by ABARES	Criteria 2.b recalculation of area under FM, and 2.e recalculation of historical harvest rates	Methodological refinement to utilise new activity data (in accordance with <i>good practice</i> : Ch 5.2.1 Recalculations due to methodological changes and refinements) New data ensures consistency of estimation method on a national basis including for harvested private native forest and UNFCCC Harvested Native Forests and time series consistency by using same method and data source for all years
Time series change		0.24	Cumulative correction multiple-use public forests harvest now modelled for 1970 to 2020. (Prev 1960) Using FMRL raw harvest data	Criteria 2.e recalculation of historical harvest rates	Reduces length of time for which extrapolated activity data is used (in accordance with Ch 5.3.3.4 using trend extrapolation to resolve data gaps) Consistent time series with harvested private native forest and other parts of the national inventory including UNFCCC Harvested Native Forests, to more accurately reflect emissions trends across forest management reporting
WA lookup		-0.04	Cumulative correction Modelling of correct subset of raw harvest data for WA Using FMRL raw harvest data	Criteria 2.e recalculation of historical harvest rates	Corrected error in activity data requiring recalculation of historical emissions trends (in accordance with good practice: Ch 5.2.1 Recalculations due to methodological changes and refinements)

Component of forest management Correction	Technical Correction		Factors leading to correction	IPCC (2013) Guidance Criteria	Reason for methodological change or methodological refinement
	(Mt CO ₂ -e)				
NSW Allocation correction	2.00		Using additional data points to allocate harvest Using FMRL raw harvest data	Criteria 2.e recalculation of historical harvest rates	Methodological refinement to utilise new activity data (in accordance with <i>good practice</i> : Ch 5.2.1 Recalculations due to methodological changes and refinements) Allocation better supported by including harvest information available after submission of FMRL
Prescribed Burning	-0.10		Updated GWPs from IPCC AR4 Updated activity data to maintain methodological consistency with timeseries used for reporting	Criteria 2.d recalculation of historical data on forest characteristics and related management	GWP for NO ₂ and CH ₄ updated in accordance with IPCC (2007) Recalculation of historical activity data (prescribed burning area) to enable reporting of time series and trends in accordance with good practice (IPCC 2006: Ch 5.2.3) Correction to maintain methodological consistency between reported timeseries and FMRL (IPCC 2014 Ch 2.7.5.2)
Fuelwood	0.31		New activity data based on NGERS reporting and emissions factors from the Energy sector	Criteria 2.e recalculation of historical harvest rates	Methodological refinement to utilise new activity data (in accordance with <i>good practice</i> : Ch 5.2.1 Recalculations due to methodological changes and refinements) New data ensures consistency of estimation method across the inventory (including energy)
Pre-1990 plantations	2.36		Implementation of tree yield formula to model biomass, permitting utilisation of climate data Estimation of soil carbon pool	Criteria 2.d recalculation of historical data on forest characteristics and related management	Methodological refinement to utilise new model capability (in accordance with good practice: Ch 5.2.1 Recalculations due to methodological changes and refinements) New soil carbon and tree yield formula improves consistency with other reporting categories, including afforestation/reforestation.
Natural Disturbances	-6.04		Implementing IPCC (2014) methods and guidance, including calculation of background level and margin	Criteria 2.h new data and methods for accounting for natural disturbances	Updated supplementary methods and good practice guidance finalised after submission of the FMRL (IPCC, 2014)

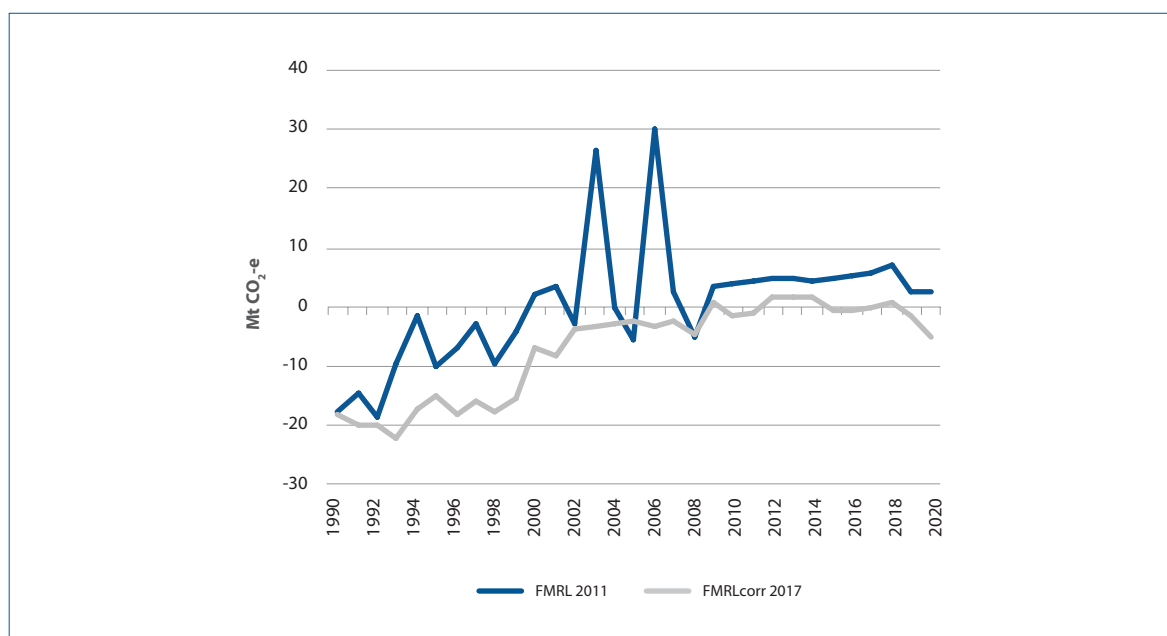
Component of forest management Correction	Technical Correction		Factors leading to correction	IPCC (2013) Guidance Criteria	Reason for methodological change or methodological refinement
	(Mt CO ₂ -e)				
Harvested Wood Products	1.01	Addressing Decision 2/CMP.7 and IPCC (2014), including by calculating emissions from the exports pool and excluding the imports pool			(With reference to good practice in 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Vol 1 Internationally agreed rules (Decision 2/CMP.7) on accounting for harvested wood products and Updated supplementary methods and good practice guidance (IPCC, 2014) finalised after submission of the FMRL
		Criteria 2.g New/recalculated data and methods and inclusions of provisions for Harvested Wood Products			

Table 11.25 reports the technical correction for 2014 (the accounting quantity is reported below at section 11.6.6.2), and Figure 11.12 shows a plot of the temporal dynamics of the estimates underlying the FMRL_{corr} and FMRL (refer to IPCC (2014) Ch 2.7.6.2).

Table 11.25 Summary table for reporting of technical correction

Summary table for technical correction (Table 2.7.2, IPCC, 2014)		
Forest Management Reference Level recalculated for the purpose of calculating the Technical Correction (FMRL _{corr})	364	kt CO ₂ -e
Forest Management Reference Level (FMRL)	4,700	kt CO ₂ -e
Difference in Percent	-92	%
Technical Correction	-4,336	kt CO ₂ -e

Figure 11.12 Comparison of recalculated reference level emissions (FMRL_{corr}) with previous estimates (FMRL)



* Note: the FMRL includes emissions from wildfires, consistent with the reference level inscribed in the Annex to Decision 2/CMP.7. The FMRL_{corr} time series applies the natural disturbances provision as set out in the Annex to Decision 2/CMP.7 and described in IPCC 2014.

11.6.5.1 Rationale for calculating FMRL_{corr}

The details of the technical corrections are outlined in Table 11.24. The rationale for the changes reflected in the FMRL are outlined below only for the main changes since the 2016 submission.

Native forest harvesting from multiple use public forests and private native forest harvesting

Methodological refinements due to new activity data and aligning of estimation periods in order to maintain consistency with data and modelling of *forest land remaining forest land* – see chapter 6.4.5 for further information.

Pre-1990 plantations

Update to include observed annual climate data for 2015 instead of projected climate data used to model the FMRL (see IPCC 2014, Table 2.7.1–2.f).

Correcting the background level and margin for expected changes in the area of land under forest management

Guidance is provided in IPCC (2014) page 2.50 that indicates that technical corrections need to be made when the area under *forest management* changes during the commitment period. An approach to correcting for these situations is provided in Box 2.3.8 on page 2.53.

Some lands will enter the *forest management* area as a result of new harvesting activities on privately managed forests.

The following approach has been used to avoid an expectation of net credits and net debits when the area of *forest management* increases during the commitment period:

1. Include all observed wildfire on the new *forest management* land in a recalculation of the background level and the background level plus margin
 - Without this step there is an expectation of net debits as the area which is monitored for wildfire during the commitment period is larger than that included in the background level plus margin.
2. Test that the recalculated background level plus margin meets the four IPCC quality criteria (see Section 11.6.4.3).

Apply the revised background level and background level plus margin to reporting for all years of the commitment period, making any necessary re-calculations of reported emissions.

Harvested Wood Products

Estimates of *harvested wood products* have been revised to remove double-counting of wood products from deforestation events (identified through monitoring of forest management lands) in accordance with paragraph 31 of annex to Decision 2/CMP.7. In order to maintain methodological consistency with the reporting of *forest management*, the projections of *harvested wood products* included in the FMRL have also been revised to account for projected *deforestation* of *forest management* lands. As observed data becomes available on harvested wood products from deforestation events on formerly forest management lands, the technical correction to this data will be reviewed to determine the need for a revised technical correction.

11.6.6 Reporting of forest management in 2015

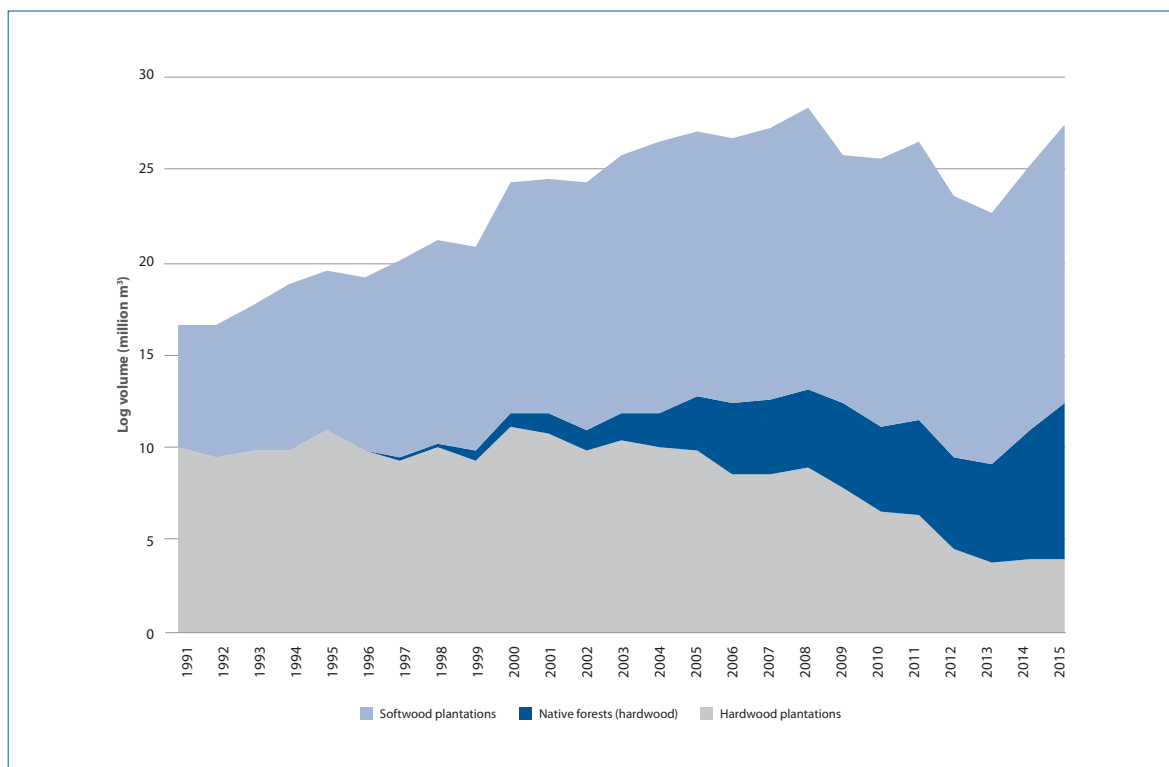
11.6.6.1 Reporting of forest management net emissions in 2015

In accordance with *good practice* the emissions and removals for *forest management* are estimated using the same methodologies, models and activity data as were used in the calculation of $FMRL_{corr}$, described above in Section 11.6.3.

The main factor affecting the trends in *forest management* net emissions in 2015 remains the decline in emissions from native forest harvesting from multiple-use public forests and harvested private native forests. This corresponds to a change in activity levels that also impacts on the harvested wood products pool and related emissions. The importance of this trend in activity data to overall emissions from *forest management* is shown in the correlation in Figure 11.13.

Australian forest production statistics indicate a rapid decline in production from native forest harvesting (from multiple-use public forests and harvested private native forest) has occurred since 2008-2009 (ABARES, 2016a) (Figure 11.13). This has been part of a broader structural transition in the forest production industry in Australia.

Figure 11.13 Forest production in Australia (1991-2015)



Source: ABARES (2016a)

Constraints on timber supply from native forests and favourable policy and economic conditions for plantation establishment resulted in a peak in reported new plantation establishment for hardwood plantations in the decade from 2000 (ABARES 2016b). Emissions and removals from these plantations are reported under *afforestation/reforestation*. Due to the standard rotation lengths for commonly used hardwood plantation species the new plantations established during these periods are now ready for harvest, causing rapid increases in hardwood plantation production rates (Figure 11.13).

This increase the supply of plantation hardwood in Australia, in combination with broader economic factors affecting the forest industry, has led to the observed decline in harvesting from native forests in particular through the substitution of log production from native forests with production from plantations.

Currently harvesting activity levels in multiple-use public forests and harvested private native forests are below reference levels. This decline in activity levels is reflected in reported emissions from *forest management* (Table 11.26).

Table 11.26 Estimated net emissions from *forest management* (kt CO₂-e)

Year	Multiple-use public forest (a)	Private harvested native forests	Pre-1990 plantations	Harvested wood products	Natural disturbances	Prescribed burning	Total
2000	-10,952	9,427	-2,327	-5,404	1,575	164	-7,517
2005	-11,079	7,688	1,629	-5,143	6,237	476	-191
2010	-18,717	2,932	4,918	-4,417	3,895	802	-10,587
2011	-20,017	2,695	4,850	-4,763	1,367	871	-14,997
2012	-23,986	-669	7,124	-4,063	8,658	460	-12,477
2013	-26,613	-1,585	5,983	-3,780	3,895	455	-21,644
2014	-27,423	-1,221	5,850	-4,658	3,895	477	-23,081
2015	-28,009	-1,477	6,847	-5,148	8,774	620	-18,394

(a) Includes carbon stock changes due to fuelwood collection and combustion

11.6.6.2 Reporting of *forest management* Accounting Quantity in 2013-15

Estimates of the accounting quantity for *forest management* – to be used to estimate the amount of RMU credits to be issued – are reported in Table 11.27. Estimates are derived by deducting the reported net emissions in 2015 from the FMRL after technical correction. Note that Australia has elected to account for Article 3.4 activities at the end of the commitment period.

Table 11.27 Estimated accounting quantity for Forest management (t CO₂-e)

Year	FMRL _{corr}	Forest management	Accounting Quantity (RMU credits)
2013	364,277	-21,643,958,	-22,008,235
2014	364,277	-23,080,705	-23,444,982
2015	364,277	-18,393,558	-18,757,835

* Note: negative accounting quantities indicate that RMUs are to be issued.

11.6.6.3 Reporting of conversion of natural forests to planted forests (Annex to Decision 2/CMP.7, paragraph 5)

Available evidence indicates that conversion of multiple-use public forests to plantations no longer occurs in Australia as a result of state and territory regulations.

Reporting of emissions from the conversion of natural (native) forests to planted forests (plantations) is included in reported emissions under *forest management*.

11.6.7 Quality Assurance – Quality Control

11.6.7.1 Quality Control

In addition to the tests reported under section 11.6.4 (relating to the natural disturbances provision), four Quality Control tests are reported aimed at demonstrating methodological consistency and the avoidance of credits or debits between the FMRL and estimates of net emissions from *forest management* from methodological inconsistency.

- (i) Comparison of the initial FMRL (DCCEE, 2011) and FMRL_{corr};
- (ii) Reproduction of the historical time series in the reporting of *forest management* and the forest management reference level (IPCC 2014, pages 2.100, 2.103);
- (iii) A quantitative comparison of trends in native forest wood production and emissions from *forest management* from 2002 to 2013 (IPCC 2014, p2.97); and
- (iv) Reconciliation of estimates used for the FMRL with estimates from *forest land remaining forest land*.

(i) Comparison of the initial FMRL (DCCEE, 2011) and FMRL_{corr}

Comparison of the FMRL (DCCEE, 2011) and FMRL_{corr} improves transparency by highlighting the main factors generating the technical correction. There are changes in activity data and parameters for reporting on biomass burning that have been updated for the reporting of *forest management*.

However there are also methodological refinements to the subcategories of harvesting from multiple use public forests and private native forests which are the most important in terms of the trend in reported *forest management* emissions in 2014. These refinements include changes in the pools reported to include the soil carbon pool, changes in activity data that affects activity levels for the reference period of 2002-2009, and changes to the area under *forest management*. Table 11.28 shows how these changes have affected the FMRL_{corr} relative to the 2011 FMRL submission.

In multiple-use public forests, the inclusion of a sink from soil carbon pool (-1.6 Mt CO₂-e) offsets the increased harvesting rate which results from utilization of new nationally consistent harvest data, so there is minimal change in estimated emissions. Soil carbon represents a net sink for multiple-use public forests, because reference harvest rate (91,250 ha/yr) relative to the total area of multiple-use public forests (9.23 Mha) means that the area which is losing soil carbon following a harvesting event is much smaller than the area in which soil carbon stocks are increasing (recovering from historical harvesting).

The main contributor to the technical correction to harvested private native forests, is the change in area of *forest management* lands, which has been revised upwards from 0.39 Mha (as estimated in the DCCEE, 2011) to 0.93 Mha (reported in this submission). This results in a larger forest area acting as a carbon sink where CO₂ removals from biomass growth is occurring, and an overall negative technical correction (-1.4 Mt CO₂-e, Table 11.28). This increase in area of forest acting as a sink is partially offset by emissions from the inclusion of the soil carbon pool. The soil carbon pool in harvested private native forests represents a source of emissions due to a relatively higher harvesting rate in proportion to forest area.

Table 11.28 Native forest harvesting reference level and key activity data

Component of FMRL Technical Correction	Technical Correction by component	Original FMRL submission				2017 FMRL (FMRL _{corr})		
		RL 2011	Reference Harvest Rate	Area under FM	FMRL _{corr}	Included soil carbon emissions/removals	Reference Harvest Rate	Area under FM
		(Mt CO ₂ -e)	(ha/yr)	(M ha)	(Mt CO ₂ -e)	(Mt CO ₂ -e)	(ha/yr)	(M ha)
Private Native Harvest	-1.4	8.9	16,764	0.39	7.6	1.1	16,915	0.93
Multiple-use public forests	-0.1	-9.9	88,537	9.4	-10.0	-1.6	91,250	9.23

(ii) **Reproduction of the time series used for the FMRL using methods used to estimate net emissions for forest management**

It is *good practice* to provide information that there is no expectation of net credits or net debits linked to any methodological inconsistency between FMRL_{corr} and reporting for *forest management* (IPCC, 2014, pages 2.102-2.103).

Methodological consistency and the avoidance of credits or debits can be shown by reproducing the same historical time series in the reporting of *forest management* and the forest management reference level (IPCC 2014, pages 2.100, 2.103). This historical reproduction (Table 11.29) demonstrates that the difference in estimated emissions between the FMRL and the reporting of *forest management* is linked to variations in the activity data during the period since 2009. Remaining model variables have been addressed in the construction of FMRL_{corr}, as described in Section 11.6.3.

Table 11.29 Time series comparison of FMRL and reporting of forest management

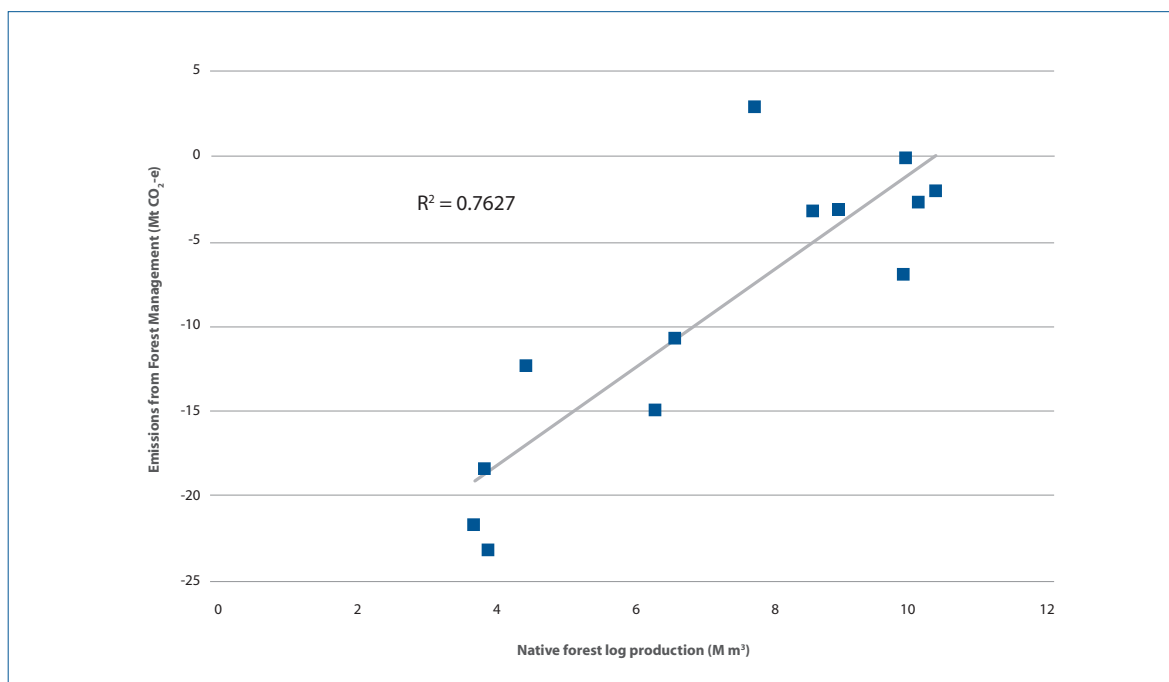
Year	Historical time series used for constructing FMRL _{corr}	Reporting of FM
	Emissions / Removals (kt CO ₂ -e)	
1990	-16,417.47	-16,417.47
1991	-18,836.36	-18,836.36
1992	-20,125.26	-20,125.26
1993	-21,546.03	-21,546.03
1994	-18,111.14	-18,111.14
1995	-12,832.06	-12,832.06
1996	-15,646.41	-15,646.41
1997	-16,025.06	-16,025.06
1998	-15,157.65	-15,157.65
1999	-17,147.58	-17,147.58
2000	-7,517.13	-7,517.13
2001	-5,583.20	-5,583.20
2002	-7,109.57	-7,109.57
2003	-2,177.51	-2,177.51
2004	-2,668.86	-2,668.86
2005	-190.59	-190.59
2006	-3,613.13	-3,613.13

Year	Historical time series used for constructing FMRL _{corr}	Reporting of FM
	Emissions / Removals (kt CO ₂ -e)	
2007	-3,200.92	-3,200.92
2008	-3,099.45	-3,099.45
2009		2,777.44
2010		-10,587.03
2011		-14,997.34
2012		-12,476.83
2013		-21,643.96
2014		-23,080.71
2015		-18,393.56
FMRL	364.28	

(iii) **Quantitative comparison of trends in native forest wood production and emissions from forest management**

A quantitative comparison of trends in native forest wood production and emissions from *forest management* from 2002 to 2013 is shown in Figure 11.14 (IPCC 2014, p.2.97). This provides evidence that the main factor generating the accounting quantity is the decline in harvesting activity from native forests, specifically multiple-use public forests and private native harvesting relative to the activity levels assumed in the FMRL. There are other components of *forest management* estimates, in particular associated with biomass burning, which introduce volatility into this relationship.

Figure 11.14 Correlation of estimated emissions from *forest management* and native forest log production (2002-2015)



(iv) Reconciliation of forest management with forest land remaining forest land reporting

In accordance with *good practice*, the area of lands subject to *forest management* have been reconciled against the relevant categories within *forest land remaining forest land* in Table 11.30 below.

Table 11.30 Reconciliation of UNFCCC forest lands and *forest management* lands

Forest land remaining forest land category	forest management sub-classifications	Estimated area in 2014 (M ha)
Plantations	Pre-1990 plantations (commercial plantations not included under Article 3.3)	0.8
Harvested native forests	Multiple use forests	9.2
	Private native forests (where harvest has been observed and which have been included in <i>forest management</i>)	0.9
Other native forests		117.4

Pre-1990 plantations included in *forest management* are equivalent to *plantations* reported under *forest land remaining forest land*.

The combined emissions from multiple-use public forests and private native harvesting forests are a subset of the *harvested native forest* category (Table 11.30).

Wildfire, fuelwood and prescribed burning emissions for *forest management* lands are a subset of the emissions reported for *forest land remaining forest land*. Carbon stock changes in the pool of *harvested wood products* from *forest management* lands are not reported in the corresponding categories of *forest land remaining forest land* and instead are reported in aggregate under Chapter 4G – *harvested wood products*.

Table 11.31 provides a reconciliation of emissions estimates between the reporting categories of *forest management* and *forest land remaining forest land*.

Table 11.31 Reconciliation of forest management with forest land remaining forest land emissions (Mt CO₂e)

Forest land remaining forest land	Plantations	Harvested Native Forests				Harvested Native Forest Total	Reported differently for KP and UNFCCC (FM is a subset due to narrow approach to defining FM Lands; or different accounting rules)					Other Native Forest total	Forest land remaining forest land total	
		Pre 1990 plantations	Multiple- use public forests	Private Native forest harvesting	N mineralisation		N-leaching and runoff	Prescribed Burning	Fuelwood	Harvested wood products	Natural disturbances			FM total
FM														
1990	-12,265	-11,263	6,426	58	43	-17,001	72	85	-1,534	2,005	-16,417	4,414	-12,588	
1991	-13,076	-12,114	6,107	42	38	-19,004	-98	93	-2,282	2,492	-18,836	3,781	-15,222	
1992	-13,602	-12,532	5,699	74	58	-20,304	287	101	-2,830	2,679	-20,125	5,018	-15,286	
1993	-14,504	-11,295	5,976	47	43	-19,732	301	115	-3,280	1,094	-21,546	5,677	-14,055	
1994	-10,236	-11,027	6,026	31	31	-15,176	106	110	-3,904	784	-18,111	699	-14,476	
1995	-12,069	-8,397	7,051	38	36	-13,341	284	95	-4,049	4,215	-12,832	1,716	-11,625	
1996	-11,280	-10,306	6,340	40	35	-15,170	130	88	-3,286	2,627	-15,646	3,389	-11,782	
1997	-7,148	-13,133	5,926	28	28	-14,300	-39	88	-3,745	1,999	-16,025	3,497	-10,803	
1998	-7,092	-12,903	7,571	38	29	-12,356	-81	70	-4,383	1,621	-15,158	1,651	-10,705	
1999	-7,580	-14,440	6,746	42	32	-15,199	-196	56	-4,018	2,242	-17,148	4,336	-10,863	
2000	-2,346	-10,714	9,618	41	34	-3,367	-334	46	-5,404	1,575	-7,517	3,558	191	
2001	-2,457	-6,049	7,510	32	29	-935	-176	24	-5,145	678	-5,583	2,022	1,087	
2002	795	-12,500	6,577	24	25	-5,078	-125	-186	-5,111	3,416	-7,110	2,239	-2,839	
2003	274	-8,761	7,994	23	24	-446	-17	-15	-5,570	3,895	-2,178	5,077	4,631	
2004	2,550	-10,137	7,953	26	25	417	-28	-51	-5,507	2,525	-2,669	1,447	1,864	
2005	1,626	-10,728	7,842	27	27	-1,208	29	-80	-5,143	6,237	-191	3,790	2,582	
2006	6,170	-13,047	5,418	29	28	-1,402	200	-93	-4,953	2,665	-3,613	5,987	4,585	
2007	5,439	-13,105	5,656	32	31	-1,946	271	-105	-5,284	3,895	-3,201	8,689	6,743	
2008	5,114	-12,386	6,247	38	29	-958	271	-116	-5,289	3,022	-3,099	6,704	5,746	
2009	8,039	-15,389	5,131	37	29	-2,153	457	-126	-4,181	8,809	2,777	5,690	3,537	
2010	4,880	-18,409	3,007	64	50	-10,408	527	-135	-4,417	3,895	-10,587	6,119	-4,288	
2011	4,825	-19,701	2,770	50	41	-12,015	598	-144	-4,763	1,367	-14,997	5,363	-6,652	

Forest land remaining forest land	Plantations	Harvested Native Forests				Harvested Native Forest Total	Reported differently for KP and UNFCCC (FM is a subset due to narrow approach to defining FM Lands; or different accounting rules)				Other Native Forest total	Forest land remaining forest land total	
		Pre 1990 plantations	Multiple- use public forests	Private Native forest harvesting	N mineralisation		N-leaching and runoff	Prescribed Burning	Fuelwood	Harvested wood products			Natural disturbances
FM													
2012	7,104	-23,771	-649	48	41	-17,229	307	-109	-4,063	8,658	-12,477	-35	-17,264
2013	5,974	-26,449	-1,573	36	31	-21,981	337	-83	-3,780	3,895	-21,644	2,187	-19,794
2014	5,845	-27,261	-1,197	29	30	-22,555	345	-79	-4,658	3,895	-23,081	3,396	-19,159
2015	6,836	-27,838	-1,454	33	28	-22,395	492	-88	-5,148	8,774	-18,394	-514	-22,909

11.6.7.2 Quality Assurance

The methodology for the implementation of the natural disturbances provision was reviewed in S. Federici (2016) prior to submission of the 2016_14 National Inventory Report.

11.6.8 Recalculations

Further descriptions of the recalculations is provided in the corresponding LULUCF category in the *forest land remaining forest land* section of Volume 2 (section 6.4.5).

Table 11.32 *Forest management: recalculation of total CO₂-e emissions (Gg), 1990-2014*

Year	2016 submission	2017 submission	Change		Reasons for Recalculations				
	(Gg CO ₂)	(Gg CO ₂)	(Gg CO ₂)	%	A. Recalculation of harvest attributable to deforestation events	B. Rounding policy	C. Alignment with sectoral estimation periods	D. Data improvements (climate long term average)	Other
1990	-17,323	-16,417	906	5%	177	3	681	47	-3
1995	-14,858	-12,832	2,026	14%	664	2	1,295	43	23
2000	-6,658	-7,517	-859	-13%	-41	2	-841	40	-19
2005	-1,865	-191	1,675	90%	-825	1	2,436	39	24
2006	-2,795	-3,613	-818	-29%	-862	1	24	38	-19
2007	-1,797	-3,201	-1,404	-78%	-889	1	-523	38	-31
2008	-4,374	-3,099	1,274	29%	-912	2	2,136	38	10
2009	1,019	2,777	1,758	172%	-930	2	2,624	38	24
2010	-10,502	-10,587	-85	-1%	-943	3	846	38	-29
2011	-17,733	-14,997	2,736	15%	-959	2	3,614	38	41
2012	-13,080	-12,477	603	5%	-974	2	1,539	38	-2
2013	-20,621	-21,644	-1,022	-5%	-1,000	2	-28	38	-33
2014	-22,031	-23,081	-1,050	-5%	-1,029	1	104	37	-164

11.7 Cropland management

Anthropogenic emissions and removals on croplands occur as a result of changes in management practices on cropping lands, from changes in crop type – particularly between herbaceous and woody crops – and from changes in land use. *Permanent* changes in management practices generate changes in the levels of soil carbon or woody biomass stocks over the longer term – and it is this process of change or transition to a higher or lower carbon stock level that generates net sequestration or net emissions of carbon dioxide that are reported in the inventory.

11.7.1 Identification of land subject to *cropland management*

Cropland management includes all land that is used for continuous cropping and those lands managed as crop-pasture (grassland) rotations as well as the land converted to cropland from grassland.

Forest land converted to cropland from 1990-2014 is identified based on attribution of the Landsat time series and is included under *deforestation*. Forest land converted to cropland prior to 1990 is identified based on attribution of the Landsat time series and is included under *cropland management*.

Land converted to forest land, or land that is identified as forest land from the Landsat series, is excluded from croplands.

Perennial crops including orchards and vineyards are included under the *cropland* classification in the UNFCCC inventory and hence are included under *cropland management*. Units of land where orchards were established on land clear of forest on 31 December 1989 are included in the *cropland management* and not the *afforestation/reforestation* classification.

Land subject to *cropland management* is identified using a reporting method 2 land identification system (IPCC, 2014, Chapter 2.2.2). The area of *cropland management* includes all land classified as cropping land in the ABARES Land Use Map Version 5 subject to a number of amendments.

FullCAM simulates on a pixel by pixel (25m x 25m) level and the carbon stock change on each pixel are tracked from the start of the simulation to the reporting year. The outputs of the simulations are stored in a datacube which can be queried using the Outputs Analysis System (OASys). OASys supports the reporting of the geographical location of the boundaries of the area that encompass land subject to *cropland management* annually, along with the total land areas subject to this activity.

11.7.2 Identification of management practices

According to the IPCC (2014), the aim of this reporting exercise is to identify and report trends and systematic changes in the carbon stocks resulting from changes in *cropland management* practices over time. The premise is that changes in soil carbon stocks result from changes in *cropland management* practices that influence the rates of either additions to, or losses of, soil organic carbon.

Specified management practices affecting anthropogenic emissions and removals from *cropland management* include:

- total cropping area;
- crop type and rotation (including pasture leys);
- stubble management, including burning practices;
- tillage techniques;
- fertiliser application and irrigation;
- application of green manures (particularly legume crops);
- soil ameliorants (application of manure, compost or biochar) as well as from
- changes in land use from grassland.

Carbon dioxide emissions from the application of lime are reported under *agriculture*. Nitrous oxide emissions from the application of fertiliser are also reported under *agriculture*.

11.7.3 Methods for estimating carbon stock change and emissions due to management changes over time

Emissions and removals from *cropland management* activities are estimated using methods consistent with IPCC 2006 in conjunction with techniques described in IPCC 2014.

Carbon dioxide emissions and removals from the *cropland remaining cropland* soils component are estimated using the Tier 3 model FullCAM (Appendix 6.B).

The carbon dioxide emissions and removals associated with changes in the area of perennial woody crops are estimated using the Tier 2 approach outlined in section 6.6, Volume 2.

11.7.3.1 Data

Data sources for the estimation of *cropland management* are reported in Section 6.6, Volume 2. Soil carbon and clay content values are taken from the finely disaggregated soil maps (Viscarra-Rossel et al, 2014, Viscarra-Rossel, 2014) – see Volume 2, Appendix 6.E – which permit organic soils to be distinguished from mineral soils. Organic soils occur only rarely in Australia.

Data on management practices are derived from ABS statistics. The climate, site and management datasets are those used in the forest land converted to cropland estimates as described in Volume 2, Appendix 6.B and 6.E.

11.7.3.2 Methods

The IPCC (2014) includes provision to reduce inter-annual variability and isolate the impacts of changes in human activities by calculating two time series of emissions and removals in which only the rate of human activities differ.

To implement this technique, FullCAM is simulated once with the time series of actual management practices and once with management practices held constant at 1990 levels. The difference between these two time series is an estimate of the impacts of changes in human activities over time since 1990. The impacts of inter-annual variability in climate and natural disturbances are the same in both scenarios and cancel each other out (IPCC 2014, 2.31).

In this way, estimates of net emissions mimic the outcomes of a Tier 1/2 approach in which the effects of management practice changes are isolated from all other impacts on soil carbon (IPCC 2014, p2.135) (for example, as is done for estimates of the emissions from liming in this report). Similarly, under *Agriculture*, in this report, nitrous oxide emissions from the effects of management practice changes are isolated in Tier 1 or Tier 2 methods (for example, from the effects of the current year's application of fertiliser).

It is good practice to document whether the methods selected for the estimation of emissions and removals are sensitive to inter-annual variability of environmental conditions during the CP, and to report how inter-annual variation was addressed in the inventory calculations (IPCC 2014, page 2.33). The effects of inter-annual variability, and how they have been addressed, have been reported in Volume 2, Section 6.6.1.

Perennial woody crops are estimated using Tier 2 methods described in Volume 2.

11.7.3.3 Start year

Estimation of net emissions is undertaken from 1970 consistent with IPCC good practice (IPCC 2014, p 2.137).

11.7.3.4 Carbon pools

FullCAM estimates emissions from soil as a result of an estimation process involving all on-site carbon pools (living biomass, dead organic matter and soil).

For non-woody crops, only the changes in the soil carbon pool are reported. Decision 2/CMP.7 specifies that a Party may choose not to account for a given pool, except for HWP, in a CP, if transparent and verifiable information is provided that the pool is not a source using reasoning based on sound knowledge of likely system responses (IPCC 2014, page 2.26). Carbon stock changes from living biomass and DOM of non-woody annual crops have been excluded as they do not constitute a source based on reasoning provided by the guidance in IPCC 2006. In particular, for annual crops, increases in biomass stocks in a single year may be assumed equal to biomass losses from harvest and mortality in that same year (IPCC 2006, p5.7) and, in general, croplands will have little or no dead wood, crop residues or litter (IPCC 2006, p5.12).

The purpose of excluding these pools is aimed at ensuring that reported inventory estimates reflect trends and systematic changes in the carbon stocks resulting from changes in *cropland management* practices over time (IPCC 2014, page 2.135) and do not reflect inter-annual variability driven by climate fluctuations or natural disturbances (IPCC 2014, page 2.135).

For perennial woody crops, estimates are reported for changes in carbon stocks or net emissions from above and below ground biomass. Net emissions from DOM or soil carbon have not been estimated.

11.7.4 Reporting of *cropland management* in 2015

11.7.4.1 Reporting of *cropland management* net emissions in 2015

Estimates of net emissions from *cropland management* are reported in Table 11.33.

Table 11.33 Estimated emissions from *cropland management* (kt CO₂-e)

Year	Annual crops	Woody crops	Forest converted to cropland prior to 1990	Nitrogen mineralisation	Wetlands converted to cropland	Total
1990	0	-69	10,995	14	232	11,173
2000	538	-50	336	7	232	1,063
2005	-3,720	-162	317	10	232	-3,322
2006	-4,725	-175	440	5	232	-4,223
2007	-5,135	36	222	10	232	-4,636
2008	-5,615	-122	422	8	232	-5,074
2009	-5,910	-152	488	7	232	-5,335
2010	-6,449	-282	474	14	232	-6,011
2011	-4,169	-363	515	15	232	-3,770
2012	-4,530	-109	191	8	232	-4,208
2013	-5,408	94	795	9	232	-4,278
2014	-5,577	36	577	8	232	-4,724
2015	-4,555	-83	219	7	232	-4,180

11.7.4.2 Estimation of *cropland management* Accounting Quantity in 2015

For the Article 3.4 land activity categories credits (called RMU credits) are to be issued against the reduction in net emissions relative to a specified benchmark base year or reference level. If net emissions are higher in the reporting year than in the 1990, AAUs or RMUs are to be cancelled.

For *cropland management* estimates of the accounting quantity – to be used to estimate the amount of RMU credits to be issued – are reported in Table 11.34. Estimates are derived by deducting the reported net emissions in 2015 from the reported net emissions in 1990. Note that Australia has elected to account for Article 3.4 activities at the end of the commitment period.

Table 11.34 Estimated accounting quantity for *cropland management* (t CO₂-e)

Year	CM 1990 ^a	CM Reporting year	Estimated Accounting Quantity (RMU credits)
2013	163,247	-4,277,866	-4,441,114
2014	163,247	-4,724,287	-4,887,535
2015	163,247	-4,180,099	-4,343,346

a In this report, crop land management estimates for 1990 were adjusted for the emissions reported under Forest Conversion in the UNFCCC inventory in 1990 from conversions up to 31 December 1989 and recorded in the report used to calculate the assigned amount, in order to avoid double counting.

Note: Negative values for accounting quantity indicate that RMUs are to be issued.

In order to avoid double counting of emissions from *Forest converted to cropland* in 1990 which are included in the Assigned Amount, emissions and removals associated with such conversions in 1990 are not included in the base for *cropland management* for the purposes of estimating the accounting quantity.

11.7.5 Quality Assurance – Quality Control

Refer to Chapter 6 of Volume 2 (section 6.6.4)

11.7.6 Recalculations

Further descriptions of the recalculations is provided in the corresponding LULUCF category in Chapter 6, namely *cropland remaining cropland* and *land converted to cropland*. The quantification of the recalculation components is shown in Table 11.35.

Table 11.35 *Cropland management: recalculation of total CO₂-e emissions (Gg), 1990-2014*

Year	2016 submission	2017 submission	Change		Reasons for recalculation			
	(Gg CO ₂)	(Gg CO ₂)	(Gg CO ₂)	%	A. Cropland soils	B. Perennial crops	C. Forest land converted to cropland before 1990	D. Wetlands converted to cropland
1990	7,067	11,173	4,106	58%	0.0	0.0	4,108.4	-0.1
1995	-8,746	1,463	10,209	117%	9,791.7	0.0	414.3	-0.1
2000	-7,099	1,063	8,162	115%	8,950.5	0.0	-786.7	-0.1
2005	868	-3,322	-4,190	-483%	-4,496.9	0.0	304.5	-0.1
2006	1,856	-4,223	-6,079	-328%	-4,876.9	0.0	-1,200.7	-0.1
2007	-5,636	-4,636	999	18%	439.5	0.0	557.3	-0.1
2008	3,032	-5,074	-8,107	-267%	-8,277.8	0.0	169.5	-0.1
2009	1,666	-5,335	-7,001	-420%	-6,772.6	0.0	-226.6	-0.1
2010	-4,212	-6,011	-1,800	-43%	-1,704.2	0.0	-89.9	-0.1
2011	2,011	-3,770	-5,781	-288%	-6,329.1	0.0	538.9	-0.1
2012	-2,098	-4,208	-2,110	-101%	-1,360.2	0.0	-750.3	-0.1
2013	-1,661	-4,278	-2,617	-158%	-3,097.4	0.0	481.9	-0.1
2014	-698	-4,724	-4,027	-577%	-4,125.4	8.4	90.7	-0.1

11.8 Grazing land management

Grazing Land Management is the system of practices on land used for livestock production aimed at manipulating the amount and type of vegetation and livestock produced.

11.8.1 Identification of land subject to grazing land management

Grazing land management lands includes grasslands, grasslands with sparse woody cover, and certain specified lands with forest cover – limited to situations in which the presence of grassland has been observed from the Landsat time series and where there has been no change in land use since 1990; or where burning takes place.

Grasslands are identified using a reporting method 2 land identification system (IPCC, 2014, Chapter 2.2.2). The lands included in the *grassland* category are defined in Section 6.3.1, Volume 2.

Grassland excludes all land that is used for continuous cropping, lands managed as crop-pasture rotations and land converted to cropland from grassland at any time.

The *Grassland remaining grassland* classification includes shrub land vegetation. Emissions and removals due to shrubland transitions are established by the methods described in Section 6.8, Volume 2 and Section 6.2, Volume 2. Activity data for shrubland transitions are based on the national mapping programme to assess both the extent, and changes in extent, of sub-forest forms of woody biomass using the Landsat TM, ETM+ and OLI data for the years from 1988 to 2014.

Forest land converted to grassland after 1 January 1990 is identified based on attribution of the Landsat time series and is included under *deforestation*. If the conversion occurred prior to 1990, this land is included under *grazing land management*.

Land that has been observed to be converted to *forest land* in the Landsat time series after 1 January 1990 is included under *afforestation/reforestation*.

Land that is identified as *forest land* from the Landsat series is also excluded from *grasslands* but may in certain circumstances be reported under *grazing land management*. Lands which were *grassland* in 1990, and therefore included in *grazing land management*, remain in *grazing land management* even where increases in woody cover result in the land meeting the threshold parameters for *forest* provided there is no subsequent change in land use. A change in land use occurs if the increase in woody cover occurs on lands protected as forest by national, State or Territory regulations, in which case the land would be transferred to *afforestation/reforestation*. Alternatively, if the growth occurs outside a protected forest area, no change in land use occurs and the land remains in *grazing land management*.

Land that is identified as *forest land* from the Landsat series may also be incorporated under *grazing land management* in northern and central Australia where fire management including indigenous burning takes place. The identification of fire areas in non-temperate zone forest lands and grass lands is described in Volume 2, chapter 6.8.

Forest lands are not double counted in Australia's land classification systems for KP as a 'narrow' approach to *forest management* has been applied allowing specified forests not identified as being managed for timber to be included under *grazing land management*.

FullCAM simulates on a pixel by pixel (25m x 25m) level. The outputs of the simulations are stored in a datacube which can be queried using the Outputs Analysis System (OASys). OASys supports the reporting of the geographical location of the boundaries of the area that encompass land subject to *grazing land management* annually, along with the total land areas subject to this activity.

11.8.2 Identification of management practices

The concepts underlying carbon stock changes in biomass of *grassland remaining grassland* are tied to management practices (IPCC 2006, p6.6).

Specified management practices affecting anthropogenic emissions and removals from *grazing land management* include:

- the area under grasslands;
- pasture management from fertilisers, irrigation and other inputs and seed selection;
- grazing management practices;
- woody biomass management; and
- fire management.

11.8.3 Methods to estimate changes in carbon stocks and emissions due to management changes over time

11.8.3.1 Data

Data sources for the estimation of changes in carbon stocks from changes in pasture management are reported in Section 6.8, Volume 2. Soil carbon and clay content values are taken from the finely disaggregated soil maps (Viscarra-Rossel et al 2014, Viscarra-Rossel, 2014) – see Volume 2, Appendix 6.E which permit organic soils to be distinguished from mineral soils. Organic soils occur only rarely in Australia.

Data on management practices are derived from ABS statistics. The climate, site and management datasets are those used in the *forest land converted to cropland* estimates as described in Volume 2, Appendix 6.B and 6.E.

11.8.3.2 Methods

Pasture Management

Areas of grassland are stratified, consistent with IPCC 2014, 2.135, step 5, by climate and pasture type to distinguish between productive pastures and rangelands.

The IPCC encourages countries to use higher tier methods to develop emissions coefficients or models to represent the effects of management practices rather than those of inter-annual variability and short term temporal dynamics (IPCC 2014, p2.149).

Changes in soil carbon stocks are estimated for productive pasture regions using FullCAM in accordance with techniques described in IPCC (2014).

For productive pastures, FullCAM is simulated once with management practices changing over time and once with management practices held constant at 1990 levels. The difference between these two time series estimates the impacts of changes in human activities. The impacts of inter-annual variability in climate and natural disturbances are the same in both scenarios and cancel each other out (IPCC 2014, 2.31).

It is good practice to document whether the methods selected for the estimation of GHG emissions and removals are sensitive to inter-annual variability of environmental conditions during the CP, and to report how inter-annual variation was addressed in the inventory calculations (IPCC 2014, page 2.33). The effects of inter-annual variability, and how they have been addressed, have been reported in Section 6.8, Volume 2.

Changes in carbon stocks for rangeland areas are assumed to be unchanged given limited pasture management activity, arid climate and low carbon soils.

Grazing management practices

For grazing management practices, the international literature which underpins IPCC (2014) and IPCC (2006) suggests that the impact of grazing on emissions and removals from grazing land activities can have important impacts on carbon stocks. In this report, however, the net effects of changes in grazing pressures on carbon stocks have not been estimated.

Shrub/sparse woody biomass

The methods and data used for the estimation of net emissions from woody biomass management are described in Volume 2.

Fire management

The methods and data for estimating emissions from prescribed burning and wildfires on northern and central Australian tropical, subtropical and semi-arid forest lands and grass lands is described in Volume 2, Chapter 6.4.1.1 and 6.8.1.3.

11.8.3.3 Start year

As for the *cropland management* category, FullCAM simulations commence in 1970.

11.8.3.4 Carbon pools

FullCAM estimates emissions from soil as a result of an estimation process involving all on-site carbon pools (living biomass, dead organic matter and soil).

For non-woody grasses, only the changes in the soil carbon pool are reported. Decision 2/CMP.7 specifies that a Party may choose not to account for a given pool, except for HWP, in a CP, if transparent and verifiable information is provided that the pool is not a source using reasoning based on sound knowledge of likely system responses (IPCC 2014, page 2.26). Carbon stock changes from living biomass and DOM of non-woody annual grasses have been excluded as they do not constitute a source based on reasoning provided by the guidance in IPCC 2014. Herbaceous grassland vegetation is assumed to cycle annually such that biomass gains equal biomass losses in a single year (IPCC 2014, p2.153).

For woody vegetation, changes in soil carbon stocks have not been estimated.

11.8.4 Reporting of *grazing land management* in 2015

11.8.4.1 Reporting of *grazing land management* net emissions in 2015

Estimates of net emissions for *grazing land management* are reported in Table 11.36.

Table 11.36 Estimated emissions from *Grazing land management* (ktCO₂-e)

Year	Grasslands	Biomass burning	Woody transitions	Forest converted to grassland prior to 1990	Wetlands converted to Grassland	Total
1990	2,315	6,642	-2,975	97,475	896	104,353
2000	-5,683	12,246	2,297	4,461	896	14,218
2005	2,974	7,723	3,522	3,571	896	18,686
2006	5,648	11,196	3,363	3,888	896	24,991
2007	2,291	11,873	3,045	2,491	896	20,595
2008	4,078	9,938	898	2,965	896	18,775
2009	3,600	10,312	-1,987	3,833	896	16,654
2010	1,605	9,135	-3,581	3,419	896	11,474
2011	4,928	8,174	-5,016	3,522	896	12,504
2012	-4,895	6,680	-4,841	5,041	896	2,880
2013	-8,014	7,374	-4,964	5,534	896	826
2014	2,341	10,333	-4,858	3,105	896	11,815
2015	3,256	7,417	-5,105	2,266	896	8,730

11.8.4.2 Estimation of *Grazing land management* Accounting Quantity in 2013-15

For land activity categories other than *deforestation*, credits (called RMU credits) are to be issued against the reduction in net emissions relative to a specified benchmark base year or reference level. If net emissions are higher in the reporting year than in the 1990, AAUs are to be cancelled.

For *grazing land management* estimates of the accounting quantity – to be used to estimate the amount of RMU credits to be issued – are reported in Table 11.37. Estimates are derived by deducting the reported net emissions in 2015 from the reported net emissions in 1990. Note that Australia has elected to account for Article 3.4 activities at the end of the commitment period.

Table 11.37 Estimated accounting quantity for *grazing land management* (t CO₂-e)

Year	GM 1990 ^a	GM Reporting years	Estimated Accounting Quantity (RMU credits)
2013	6,878,186	825,903	-6,052,283
2014	6,878,186	11,815,345	4,937,158
2015	6,878,186	8,729,558	1,851,371

a In this report, *grazing land management* estimates in 1990 were adjusted to exclude emissions associated with *Forest Conversion* in the UNFCCC inventory in 1990 from conversions up to 31 December 1989 and that are included in assigned amount, in order to avoid double counting. See Table 11.34

Note: Negative Accounting Quantities indicate that RMUs are to be issued. Positive Accounting Quantities indicate cancellation of AAUs.

In order to avoid double counting of emissions from *Forest converted to grassland* in 1990 which is included in the Assigned Amount, emissions and removals associated with such conversions in 1990 are not included in the base for *grazing land management* for the purposes of estimating the accounting quantity.

11.8.5 Quality Assurance – Quality Control

Refer to section 6.8 in Volume 2.

11.8.6 Recalculations

Further descriptions of the recalculations is provided in the corresponding LULUCF category in Chapter 6, namely *grassland remaining grassland* (section 6.8.5) and *land converted to grassland* (section 6.9.5). The quantification of the recalculation components is shown in Table 11.38.

Table 11.38 *Grazing land management: Recalculation of total CO₂-e emissions (Gg), 1990-2014*

Year	Change			Reasons for Recalculations					
	2016 submission (Gg CO ₂)	2017 submission (Gg CO ₂)	(Gg CO ₂)	%	A. Grassland soils	B. Grassland live biomass (sparse transitions)	C. Grassland DOM (biomass burning)	D. Forest land converted to grassland before 1990	E. Wetland converted to Grassland
1990	60,685	104,353	43,668	72%	231	5,175	0	38,262	-1
1995	11,895	9,075	-2,820	-24%	-8,193	4,141	0	1,233	-1
2000	17,542	14,218	-3,324	-19%	-1,703	2,022	0	-3,642	-1
2005	7,320	18,686	11,366	155%	9,803	373	0	1,190	-1
2006	16,822	24,991	8,169	49%	11,504	611	0	-3,946	-1
2007	5,896	20,595	14,699	249%	9,917	134	0	4,650	-1
2008	9,755	18,775	9,020	93%	10,411	-1,731	0	340	-1
2009	11,286	16,654	5,368	48%	9,116	-1,302	0	-2,445	-1
2010	5,689	11,474	5,785	108%	7,374	-678	0	-911	-1
2011	-726	12,504	13,230	1,821%	11,821	-260	0	1,670	-1
2012	-497	2,880	3,377	679%	2,071	1,684	0	-377	-1
2013	-848	826	1,674	197%	-1,431	1,122	1,312	672	-1
2014	-1,051	11,815	12,866	1,224%	8,266	1,446	2,648	508	-1

11.9 Revegetation

Revegetation is a direct human-induced activity to increase carbon stocks through establishing vegetation that does not meet the definition of forest (IPCC 2014, section 2.11.1). In Australia, this includes net emissions from changes in vegetation cover that do not constitute a forest and which occur on non-grazing or cropping lands.

11.9.1 Identification of land subject to revegetation

All forms of woody vegetation are monitored as described in section 11.2. Gains and losses in shrub or sparse woody vegetation are distinguished from *deforestation* or *afforestation/reforestation* because they fall below the definition of forest land, as identified using the comprehensive 3-class vegetation monitoring system.

Gains and losses in sparse woody vegetation on grazing and cropping lands are already included as part of *grazing land management* and *cropland management*. Where these changes occur on managed wetlands and settlements they are reported as part of *revegetation*.

11.9.2 Identification of management practices

The primary management practices associated with revegetation relate to woody vegetation management.

In addition to reporting carbon stock changes due to establishment of woody vegetation on settlements and managed wetlands, to ensure accuracy and balanced accounting, losses of such vegetation are also included in revegetation activities.

11.9.3 Methods to estimate changes in carbon stocks and emissions due to management changes over time

11.9.3.1 Data

The remote sensing data used for the estimation of net emissions from woody biomass management are the same as those described for grass and shrub transitions in *settlements remaining settlements*, and *wetlands remaining wetlands* in NIR Sections 6.10.1 and 6.12.1, respectively.

11.9.3.2 Methods

The methods used for the estimation of net emissions from woody biomass management are the same as those described for grass and shrub transitions in *settlements remaining settlements*, and *wetlands remaining wetlands* in NIR Sections 6.10.1 and 6.12.1, respectively.

11.9.3.3 Start year

Estimation of net emissions is undertaken from 1970 consistent with IPCC good practice (IPCC 2014, p 2.137)

11.9.3.4 Carbon pools

Currently available data only supports modelling of aggregated carbon stock changes due revegetation. These represent changes across all 5 carbon pools, however they are reported under above-ground biomass, as this reflects the most significant pool for this subcategory.

11.9.4 Quality Assurance – Quality Control

The QA/QC for *revegetation* estimates are the same as those described in *settlements remaining settlements*, and *wetlands remaining wetlands* in NIR Sections 6.10.1 and 6.12.1, respectively.

11.9.5 Reporting of *revegetation* in 2015

Estimates of net emissions from *revegetation* are reported in Table 11.39.

and the estimated accounting quantity is reported in Table 11.40.

Table 11.39 Estimated emissions from *revegetation* (ktCO₂-e)

Year	Net Emissions (kt CO ₂ -e)
1990	103
1995	197
2000	178
2005	161
2006	200
2007	238
2008	179
2009	150
2010	167
2011	-21
2012	-94
2013	-101
2014	-86
2015	-112

Table 11.40 Estimated accounting quantity for *revegetation* (t CO₂-e)

Year	RV 1990 ^a	RV Reporting year	Estimated Accounting Quantity (RMU credits)
2013	103,230	-100,830	-204,062
2014	103,230	-86,250	-189,489
2015	103,230	-111,940	-215,175

11.9.6 Recalculations

Further descriptions of the recalculations is provided in the corresponding LULUCF sub-categories in Chapter 6 of Volume 2, namely *wetlands remaining wetlands* (section 6.10.5) and *settlements remaining settlements* (section 6.12.5).

Table 11.41 *Revegetation: Recalculation of total CO₂-e emissions (Gg), 1990-2014*

Year	2016 submission	2017 submission	Change	
	(Gg CO ₂)	(Gg CO ₂)	(Gg CO ₂)	%
1990	105	103	-2	-2%
1995	259	197	-62	-24%
2000	237	178	-59	-25%
2005	119	161	42	35%
2006	178	200	22	12%
2007	226	238	11	5%
2008	264	179	-85	-32%
2009	147	150	3	2%
2010	129	167	38	30%
2011	110	-21	-131	-119%
2012	-89	-94	-5	-5%
2013	-116	-101	15	13%
2014	-122	-86	36	29%

11.10 Other information

11.10.1 Key category analysis

The key category analysis for Article 3.3 and relevant Article 3.4 activities are reported in Annex 1 and in Table 11.42.

Table 11.42 *Summary overview for key categories for land use, land use change and forestry activities under the Kyoto Protocol*

Criteria used for Key Category Identification					
Key Categories of Emissions and Removals	Gas	Associated category in UNFCCC inventory is key	Category contribution is greater than the smallest category considered key in the UNFCCC inventory (including LULUCF)	Other	Comments
Deforestation	CO ₂	forest land converted to grassland	TRUE	NA	
Deforestation	CH ₄	forest land converted to grassland	FALSE	NA	
Deforestation	N ₂ O	forest land converted to grassland	FALSE	NA	
Forest management	CO ₂	forest land remaining forest land	TRUE	NA	Australia has applied the narrow approach to forest management. As a result the forest land remaining forest land classification does not directly correspond to the forest management activity.

Criteria used for Key Category Identification					
Key Categories of Emissions and Removals	Gas	Associated category in UNFCCC inventory is key	Category contribution is greater than the smallest category considered key in the UNFCCC inventory (including LULUCF)	Other	Comments
Afforestation/Reforestation	CO ₂	grassland converted to forest land	TRUE	NA	
Grazing land management	CO ₂	grassland remaining grassland, land converted to grassland (conversion prior to 1990)	TRUE	NA	
Grazing land management	CH ₄	grassland remaining grassland, land converted to grassland (conversion prior to 1990)	TRUE	NA	
Grazing land management	N ₂ O	grassland remaining grassland, land converted to grassland (conversion prior to 1990)	TRUE	NA	
Cropland management	CO ₂	cropland remaining cropland, land converted to cropland (conversion prior to 1990)	TRUE	NA	

11.10.2 Provision of information relating to KP-LULUCF activities under Article 3, paragraphs 3 and 4

Annex II to decision 2/CMP.8 sets out the requirements for the reporting of Information on land use, land-use change and forestry activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol in annual greenhouse gas inventories. The following table is provided to assist the assessment of compliance with the reporting requirements set out in this decision.

Table 11.43 Australia's compliance with the requirements of 2/CMP.8.

Provision of information relating to KP-LULUCF activities under Article 3, paragraphs 3 and 4	
Information item	Reference/additional information
Emissions by sources and removals by sinks are clearly distinguished from emissions from categories included in Annex A to the Kyoto Protocol	Refer to CRF tables and Volume 1 Executive Summary and Ch.11
Information on how inventory methodologies have been applied taking into account the 2006 Intergovernmental Panel on Climate Change Guidelines for National Greenhouse Gas Inventories and any relevant supplementary guidance recognising the principles laid out in decision 16/CMP.1.	Refer to NIR Vol.2 and Vol.3, Ch.11

Provision of information relating to KP-LULUCF activities under Article 3, paragraphs 3 and 4	
Information item	Reference/additional information
Information on geographical location of the boundaries of areas that encompass:	
Units of land subject to activities under Article 3, paragraph 3	Refer to Table 11.5, Figures 11.1 and 11.2 and Vol.2 Appendix 6.A
Units of land subject to activities under Article 3, paragraph 3, which would otherwise be included in land subject to forest management or elected activities under Article 3, paragraph 4	Refer to Table 11.5, Figures 11.1 and 11.2 and Vol.2 Appendix 6.A
Land subject to forest management or elected activities under Article 3, paragraph 4	Refer to Table 11.5 and Section 11.6
Information on the spatial assessment unit for determining the area of accounting for afforestation, reforestation and deforestation	Refer to section 11.2.2
Information on GHG emissions/removals resulting from activities under Article 3, paragraph 3, and Article 3, paragraph 4, for all geographical locations reported in the current and previous years since the beginning of the commitment period or the onset of the activity, whichever comes later.	Refer to sections 11.4, 11.5, 11.6, 11.7, and 11.8
Information on carbon pools (above-ground/below-ground biomass, litter, dead wood and soil organic carbon) that are not accounted for.	All carbon pools are accounted for. Refer to CRF table NIR-1.
When a Party applies the provisions for natural disturbances, information demonstrating that these emissions in any single year exceed the background level(s), including a margin, when needed. For this purpose the Party shall include information showing:	
That all lands subject to exclusion due to natural disturbances are identified	Refer to section 11.6.4.1
How annual emissions resulting from natural disturbances and the subsequent removals are estimated and excluded from accounting	Refer to sections 11.6.4.2 and 11.6.4.3
That no land-use change has occurred on lands for which the provisions in decision 2/CMP.7, annex, paragraph 33, are applied	Refer to section 11.6.4.8
That events and circumstances were beyond the control of the Party	Refer to section 11.6.4.6
The efforts taken to rehabilitate the land for which the provisions contained in decision 2/CMP.7, annex, paragraph 33, are applied	Refer to section 11.6.4.9
That emissions associated with salvage logging were not excluded from accounting	Refer to section 11.6.4.5
If not accounted for by instantaneous oxidation, information on GHG emissions/removals resulting from changes in the HWP pool accounted for in accordance with decision 2/CMP.7, including:	
Activity data for the HWP categories used for estimating the pool removed from domestic forests, for domestic consumption and for export	Refer to CRF table 4.G and NIR section 11.6.3.1.
Half-lives used in estimating emissions/removals for the HWP categories used	Refer to CRF table 4.G and NIR section 6.15.1.
Whether emissions from HWP originating from forests prior to the start of the second commitment period have been included in the accounting, if the forest management reference level is based on a projection	Emissions from HWP originating from forests prior to the start of the second commitment period have been included in the accounting. Refer to Sections 11.6.3 and 6.15.1.

Provision of information relating to KP-LULUCF activities under Article 3, paragraphs 3 and 4	
Information item	Reference/additional information
How emissions from the HWP pool accounted for in the first commitment period on the basis of instantaneous oxidation have been excluded from the accounting for the second commitment period	Australia estimates a time-series consistent with the second commitment period requirements, as per methods described in sections 11.6.3.1 and 6.15.1.
How the HWP resulting from deforestation have been accounted on the basis of instantaneous oxidation	Australia has opted not to estimate emissions from HWP from deforestation on the basis of instantaneous oxidation. These emissions are included in the estimates of emissions from HWP from Forest Management.
How CO ₂ emissions from HWP in SWDS and from wood harvested for energy purposes have been accounted on the basis of instantaneous oxidation	Transfers from the HWP pool to the landfill pool result in a reduction in HWP carbon stock and therefore an instantaneous oxidation. For information on the CO ₂ emissions associated with the combustion of fuelwood, refer to section 6.4.2.
How emissions/removals from changes in the HWP pool accounted for do not include imported harvested wood products	Refer to section 11.6.3.1
Information on anthropogenic GHGs from LULUCF activities under Article 3, paragraph 3, and Article 3, paragraph 4, factoring out removals from:	
Elevated CO ₂ concentrations above pre-industrial levels	Refer to Section 11.3.3
Indirect nitrogen deposition	Refer to NIR Vol 1, Ch.4, CRF tables and section 11.3.3
The dynamic effects of age structure resulting from activities prior to 1 January 1990	Refer to Section 11.3.3
Specific information to be reported for activities under Article 3, paragraph. 3:	
Activities under Article 3, paragraph 3, that began on or after 1 January 1990 and before 31 December of the last year of the commitment period, and are directly human-induced	Refer to Sections 11.2, 11.3, 11.4 and 11.5
How harvesting or forest disturbance that is followed by the re-establishment of forest is distinguished from deforestation	Refer to section 11.2.3.1
Specific information to be reported for activities under Article 3, paragraph 4:	
Activities under Article 3.4 that occurred since 1 January 1990 and are human induced	Refer to sections 11.6, 11.7 and 11.8
Cropland management, grazing land management, revegetation, wetland drainage and rewetting: emissions/removals reported for each year of the commitment period and for the base year for each of the elected activities on the geographical locations reported	Refer to sections 11.7, 11.8, 11.9 and CRF tables
Emissions/removals from activities under Article 3, paragraph 4, are not accounted for under activities under Article 3, paragraph 3	Refer to Vol.2 Appendix 6.A
Information on how emissions arising from the conversion of natural forests to planted forests are accounted for	Refer to section 11.6.6.3 and CRF table NIR 2.1
Methodological consistency between the reference level and reporting for forest management	Refer to section 11.6.5
Technical corrections made pursuant to decision 2/ CMP.7, annex, paragraph 14	Refer to section 11.6.5

Provision of information relating to KP-LULUCF activities under Article 3, paragraphs 3 and 4	
Information item	Reference/additional information
Forest management: if emissions/removals from the harvest and conversion of forest plantations to non-forest land were included, information how requirements set out in decision 2/CMP.7, annex, paragraphs 37–39 were met, including:	
The identification of all lands and associated carbon pools subject to decision 2/CMP.7, annex, paragraph 37, including the geo-referenced location and year of conversion	Australia has not applied this provision.
A demonstration that the forest plantation was first established through direct human-induced planting and/or seeding of non-forest land before 1 January 1990, and, if the forest plantation was re-established, that this last occurred on forest land through direct human-induced planting and/or seeding after 1 January 1960	Australia has not applied this provision.
A demonstration that a new forest of at least equivalent area to the harvested forest plantation is established through direct human-induced planting and/or seeding of non-forested land that did not contain forest on 31 December 1989	Australia has not applied this provision.
A demonstration that this newly established forest will reach at least the equivalent carbon stock that was contained in the harvested forest plantation at the time of harvest, within the normal harvesting cycle of the harvested forest plantation, and, if not, a debit would be generated under Article 3, paragraph 4	Australia has not applied this provision.

12. Information on accounting of Kyoto Units

12.1 Summary of information reported in the Standard Electronic Format Tables

In accordance with decisions 1/CMP.8, 2/CMP.8 and 3/CMP.11, Annex I Parties are required to report information on KP units for the first commitment period and for the CP2 for the reported year 2016. This information has been submitted in the standard electronic format (SEF) tables (Tables 12.1 to 12.28).

12.1.1 SEF reporting for commitment period 1 (CP1)

Table 12.1 SEF Table 1, Total quantities of Kyoto Protocol units by account type at beginning of reported year 2016

Account type	Unit type					
	AAUs	ERUs	RMUs	CERs	tCERs	ICERs
Party holding accounts	127,650,775	NO	NO	21,768,290	NO	NO
Entity holding accounts	NO	NO	NO	NO	NO	NO
Article 3.3/3.4 net source cancellation accounts	115,625,564	NO	108,941,877	NO		
Non-compliance cancellation account	NO	NO	NO	NO		
Other cancellation accounts	3,149,326	367,766	NO	3,375,615	NO	NO
Retirement account	2,711,153,478	NO	NO	NO	NO	NO
tCER replacement account for expiry	NO	NO	NO	NO	NO	
ICER replacement account for expiry	NO	NO	NO	NO		
ICER replacement account for reversal of storage	NO	NO	NO	NO		NO
ICER replacement account for non-submission of certification report	NO	NO	NO	NO		NO
Total	2,957,579,143	367,766	108,941,877	25,143,905	NO	NO

Table 12.2 SEF Table 2(a), Annual internal transactions for the reported year 2016

Transaction type	NO					
	AAUs	ERUs	RMUs	CERs	tCERs	ICERs
Art6 issuance and conversion						
Party verified projects	NO	NO	NO	NO		
Independently verified projects	NO	NO	NO	NO		
Art3.3 and 3.4 issuance or cancellation						
3.3 Afforestation reforestation	NO	NO	NO	NO	NO	
3.3 Deforestation	NO	NO	NO	NO	NO	
3.4 Forest management	NO	NO	NO	NO	NO	
3.4 Cropland management	NO	NO	NO	NO	NO	

Retirement	NO						NO					
	AAUs	ERUs	RMUs	CERs	tCERs	ICERs	AAUs	ERUs	RMUs	CERs	tCERs	ICERs
Transaction type												
3.4 Grazing land management			NO				NO	NO	NO	NO	NO	
3.4 Revegetation			NO				NO	NO	NO	NO	NO	
Art 12 afforestation and reforestation												
Replacement of expired tCERs							NO	NO	NO	NO	NO	
Replacement of expired ICERs							NO	NO	NO	NO		
Replacement for reversal of storage							NO	NO	NO	NO	NO	NO
Replacement for non-submission of certification report							NO	NO	NO	NO		NO
Other cancellation							NO	NO	NO	NO	NO	NO
Subtotal	NO	NO	NO				NO	NO	NO	NO	NO	NO
Transaction type	AAUs	ERUs	RMUs	CERs	tCERs	ICERs						
Retirement	NO	NO	NO	NO	NO	NO						NO

Table 12.3 SEF Table 2(b), Annual external transactions for the reported year 2016

Transfers and acquisitions	Additions						Subtractions					
	AAUs	ERUs	RMUs	CERs	tCERs	ICERs	AAUs	ERUs	RMUs	CERs	tCERs	ICERs
Subtotal	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Independently verified ERU												
Additional Information												
NO												

Table 12.4 SEF Table 2(c), Total annual transactions for the reported year 2016

	AAUs	ERUs	RMUs	CERs	tCERs	ICERs	AAUs	ERUs	RMUs	CERs	tCERs	ICERs
Total (Sum of table 2(a) and 2(b))	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table 12.5 SEF Table 3, Expiry, cancellation and replacement for the reported year 2016

Transaction or event type	Expiry, cancellation and requirement to replace						Replacement					
	tCERs	ICERs	AAUs	ERUs	RMUs	CERs	tCERs	ICERs	AAUs	ERUs	RMUs	CERs
Temporary CERs (tCERs)												
Expired in retirement and replacement accounts	NO											
Replacement of expired tCERs			NO	NO	NO	NO						
Expired in holding accounts	NO											
Cancellation of tCERs expired in holding accounts	NO											
Long-term CERs (ICERs)												
Expired in retirement and replacement accounts		NO										
Replacement of expired ICERs			NO	NO	NO	NO						
Expired in holding accounts		NO										
Cancellation of ICERs expired in holding accounts		NO										
Subject to replacement for reversal of storage		NO										
Replacement for reversal of storage			NO	NO	NO	NO						NO
Subject to replacement for non-submission of certification report		NO										
Replacement for non-submission of certification report			NO	NO	NO	NO						NO
Total			NO	NO	NO	NO			NO	NO	NO	NO

Table 12.6 SEE Table 4, Total quantities of Kyoto Protocol units by account type at end of reported year 2016

Account type	Unit type					
	AAUs	ERUs	RMUs	CERs	tCERs	ICERs
Party holding accounts	127,650,775	NO	NO	21,768,290	NO	NO
Entity holding accounts	NO	NO	NO	NO	NO	NO
Article 3.3/3.4 net source cancellation accounts	115,625,564	NO	108,941,877	NO		
Non-compliance cancellation account	NO	NO	NO	NO		
Other cancellation accounts	3,149,326	367,766	NO	3,375,615	NO	NO
Retirement account	2,711,153,478	NO	NO	NO	NO	NO
tCER replacement account for expiry	NO	NO	NO	NO	NO	
ICER replacement account for expiry	NO	NO	NO	NO		
ICER replacement account for reversal of storage	NO	NO	NO	NO		NO
ICER replacement account for non-submission of certification report	NO	NO	NO	NO		NO
Total	2,957,579,143	367,766	108,941,877	25,143,905	NO	NO

Table 12.7 SEE Table 5(a), Summary information on additions and subtractions for the reported year 2016

	Additions						Subtractions					
	AAUs	ERUs	RMUs	CERs	tCERs	ICERs	AAUs	ERUs	RMUs	CERs	tCERs	ICERs
Starting Values												
Issuance pursuant to Article 3.7 and 3.8	2,957,579,143											
Non-compliance cancellation							NO	NO	NO	NO		
Carry-over	NO	NO		NO								
Subtotal	2,957,579,143	NO		NO			NO	NO	NO	NO		
Annual Transactions												
Year 0 (2007)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 1 (2008)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

	Additions						Subtractions					
	AAUs	ERUs	RMUs	CERs	tCERs	ICERs	AAUs	ERUs	RMUs	CERs	tCERs	ICERs
Year 2 (2009)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 3 (2010)	NO	NO	NO	1	NO	NO	NO	NO	NO	1	NO	NO
Year 4 (2011)	NO	NO	23,032,901	126,851	NO	NO	49,650,531	NO	NO	75,851	NO	NO
Year 5 (2012)	NO	NO	23,262,032	102,714	NO	NO	44,164,557	NO	NO	123,712	NO	NO
Year 6 (2013)	NO	150,000	23,834,852	530,972	NO	NO	11,894,403	150,000	46,294,933	515,872	NO	NO
Year 7 (2014)	NO	100,000	25,907,257	713,954	NO	NO	NO	100,000	38,543,673	530,098	NO	NO
Year 8 (2015)	NO	118,935	12,904,835	28,124,304	NO	NO	13,065,399	118,935	24,103,271	6,584,972	NO	NO
Year 9 (2016)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 10 (2017)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 11 (2018)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 12 (2019)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 13 (2020)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 14 (2021)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 15 (2022)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 16 (2023)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Subtotal	NO	368,935	108,941,877	29,598,796	NO	NO	118,774,890	368,935	108,941,877	7,830,506	NO	NO
Total	2,957,579,143	368,935	108,941,877	29,598,796	NO	NO	118,774,890	368,935	108,941,877	7,830,506	NO	NO

Table 12.8 SEE Table 5(b), Summary information on replacement for the reported year 2016

	Expiry, cancellation and requirement to replace			Replacement				
	tCERs	ICERs	AAUs	ERUs	RMUs	CERs	tCERs	ICERs
Previous CPs			NO	NO	NO	NO	NO	NO
Year 1 (2008)		NO	NO	NO	NO	NO	NO	NO
Year 2 (2009)		NO	NO	NO	NO	NO	NO	NO
Year 3 (2010)		NO	NO	NO	NO	NO	NO	NO
Year 4 (2011)		NO	NO	NO	NO	NO	NO	NO
Year 5 (2012)	NO	NO	NO	NO	NO	NO	NO	NO
Year 6 (2013)	NO	NO	NO	NO	NO	NO	NO	NO
Year 7 (2014)	NO	NO	NO	NO	NO	NO	NO	NO
Year 8 (2015)	NO	NO	NO	NO	NO	NO	NO	NO
Year 9 (2016)	NO	NO	NO	NO	NO	NO	NO	NO
Year 10 (2017)	NO	NO	NO	NO	NO	NO	NO	NO
Year 11 (2018)	NO	NO	NO	NO	NO	NO	NO	NO
Year 12 (2019)	NO	NO	NO	NO	NO	NO	NO	NO
Year 13 (2020)	NO	NO	NO	NO	NO	NO	NO	NO
Year 14 (2021)	NO	NO	NO	NO	NO	NO	NO	NO
Year 15 (2022)	NO	NO	NO	NO	NO	NO	NO	NO
Year 16 (2023)	NO	NO	NO	NO	NO	NO	NO	NO
Total	NO	NO	NO	NO	NO	NO	NO	NO

Table 12.9 SEF Table 5(c), Summary information on retirement for the reported year 2016

Year	Retirement				
	AAUs	ERUs	RMUs	CERs	tCERs
Year 1 (2008)	NO	NO	NO	NO	NO
Year 2 (2009)	NO	NO	NO	NO	NO
Year 3 (2010)	NO	NO	NO	NO	NO
Year 4 (2011)	NO	NO	NO	NO	NO
Year 5 (2012)	NO	NO	NO	NO	NO
Year 6 (2013)	NO	NO	NO	NO	NO
Year 7 (2014)	NO	NO	NO	NO	NO
Year 8 (2015)	2,711,153,478	NO	NO	NO	NO
Year 9 (2016)	NO	NO	NO	NO	NO
Year 10 (2017)	NO	NO	NO	NO	NO
Year 11 (2018)	NO	NO	NO	NO	NO
Year 12 (2019)	NO	NO	NO	NO	NO
Year 13 (2020)	NO	NO	NO	NO	NO
Year 14 (2021)	NO	NO	NO	NO	NO
Year 15 (2022)	NO	NO	NO	NO	NO
Year 16 (2023)	NO	NO	NO	NO	NO
Total	2,711,153,478	NO	NO	NO	NO

Table 12.10 SEF Table 6(a), Memo item: Corrective transactions relating to additions and subtractions for the reported year 2016

Additions					Subtractions				
Unit type					Unit type				
AAUs	ERUs	RMUs	CERs	tCERs	ICERs	AAUs	ERUs	RMUs	ICERs

Table 12.11 SEF Table 6 (b), Memo item: corrective transactions relating to replacement for the reported year 2016

Expiry, cancellation and requirement to replace					Replacement				
tCERs	ICERs	AAUs	ERUs	RMUs	CERs	tCERs	ICERs		

Table 12.12 SEF Table 6(c), Memo item: Corrective transactions relating to retirement for the reported year 2016

Retirement									
AAUs	ERUs	RMUs	CERs	tCERs	ICERs				

12.1.2 SEF reporting for commitment period 2 for the reported year 2016

Table 12.13 SEF Table 1, Total quantities of Kyoto Protocol units by account type at beginning of reported year 2016

Account type	Unit type				
	AAUs	ERUs	RMUs	CERs	tCERs
Party holding accounts	NO	NO	NO	1,442,096	NO
Entity holding accounts	NO	NO	NO	NO	NO
Retirement account	NO	NO	NO	NO	NO
Previous period surplus reserve account	NO				
Article 3.3/3.4 net source cancellation accounts	NO	NO	NO	NO	
Non-compliance cancellation account	NO	NO	NO	NO	
Voluntary cancellation account	NO	NO	NO	45253	NO
Cancellation account for remaining units after carry-over	NO	NO	NO	NO	NO
Article 3.1 ter and quarter ambition increase cancellation account	NO				
Article 3.7 ter cancellation account	NO				
tCER cancellation account for expiry					NO
ICER cancellation account for expiry					NO
ICER cancellation account for reversal of storage					NO
ICER cancellation account for non-submission of certification report					NO
tCER replacement account for expiry	NO	NO	NO	NO	NO
ICER replacement account for expiry	NO	NO	NO	NO	
ICER replacement account for reversal of storage	NO	NO	NO	NO	NO
ICER replacement account for non-submission of certification report	NO	NO	NO	NO	NO
Total	NO	NO	NO	1,487,349	NO

Table 12.14 SEE Table 2(a), Annual internal transactions for the reported year 2016

Transaction type	Additions						Subtractions					
	AAUs	ERUs	RMUs	CERs	tCERs	ICERs	AAUs	ERUs	RMUs	CERs	tCERs	ICERs
Art6 issuance and conversion												
Party verified projects		NO					NO		NO			
Independently verified projects		NO					NO		NO			
Art3.3 and 3.4 issuance or cancellation												
3.3 Afforestation reforestation			NO				NO	NO	NO	NO		
3.3 Deforestation			NO				NO	NO	NO	NO		
3.4 Forest management			NO				NO	NO	NO	NO		
3.4 Cropland management			NO				NO	NO	NO	NO		
3.4 Grazing land management			NO				NO	NO	NO	NO		
3.4 Revegetation			NO				NO	NO	NO	NO		
3.4 Wetland drainage and rewetting			NO				NO	NO	NO	NO		
Art 12 afforestation and reforestation												
Replacement of expired tCERs							NO	NO	NO	NO	NO	
Replacement of expired ICERs							NO	NO	NO	NO		
Replacement for reversal of storage							NO	NO	NO	NO		NO
Cancellation for reversal of storage												NO
Replacement for non-submission of certification report							NO	NO	NO	NO		NO
Cancellation for non submission of certification report												NO
Other cancellation												
Voluntary cancellation							NO	NO	NO	259,439	NO	NO
Article 3.1 ter and quater ambition increase cancellation							NO					
Subtotal		NO	NO				NO	NO	NO	259,439	NO	NO

Transaction type	Retirement					
	AAUs	ERUs	RMUs	CERs	tCERs	ICERs
Retirement	NO	NO	NO	NO	NO	NO
Retirement from PPSR	NO					
Total	NO	NO	NO	NO	NO	NO

Table 12.15 SEF Table 2(b), Annual external transactions for the reported year 2016

Total transfers and acquisitions	Additions						Subtractions					
	AAUs	ERUs	RMUs	CERs	tCERs	ICERs	AAUs	ERUs	RMUs	CERs	tCERs	ICERs
CH	NO	NO	NO	250,001	NO	NO	NO	NO	NO	1	NO	NO
CDM	NO	NO	NO	1,551,959	NO	NO	NO	NO	NO	NO	NO	NO
EU	NO	NO	NO	3,573,312	NO	NO	NO	NO	NO	386,987	NO	NO
GB	NO	NO	NO	1,831,291	NO	NO	NO	NO	NO	1	NO	NO
FR	NO	NO	NO	32,771	NO	NO	NO	NO	NO	NO	NO	NO
Subtotal	NO	NO	NO	7,239,334	NO	NO	NO	NO	NO	386,989	NO	NO

Table 12.16 SEF Table 2(c), Annual transactions between PPSR accounts for the reported year 2015

AAUs	ERUs	RMUs	CERs	tCERs	ICERs	AAUs	ERUs	RMUs	CERs	tCERs	ICERs
Subtotal	NO					NO					

Table 12.17 SEF Table 2 (d) Share of proceeds transactions under decision 1/CMP.8, paragraph 21 – Adaptation Fund - for the reported year 2016

AAUs	ERUs	RMUs	CERs	tCERs	ICERs	AAUs	ERUs	RMUs	CERs	tCERs	ICERs
First international transfers of AAUs	NO					NO					
Issuance of ERU from Party-verified projects		NO					NO				
Issuance of independently verified ERUs		NO					NO				

Table 12.18 SEF Table 2(e), Total annual transactions for the reported year 2016

	AAUs	ERUs	RMUs	CERs	tCERs	ICERs	AAUs	ERUs	RMUs	CERs	tCERs	ICERs
Total (Sum of sub-totals in table 2a and table 2b)	NO	NO	NO	7,239,334	NO	NO	NO	NO	NO	646,428	NO	NO

Table 12.19 SEF Table 3, Expiry, cancellation and replacement for the reported year 2016

Transaction or event type	Requirement to replace or cancel				Replacement				Cancellation						
	tCERs	ICERs	CERs	AAUs	ERUs	RMUs	CERs	tCERs	ICERs	AAUs	ERUs	RMUs	CERs	tCERs	ICERs
Temporary CERs															
Expired in retirement and replacement accounts	NO			NO	NO	NO	NO	NO							
Expired in holding accounts	NO													NO	
Long-term CERs															
Expired in retirement and replacement accounts		NO		NO	NO	NO	NO								
Expired in holding accounts		NO													NO
Subject to reversal of Storage		NO		NO	NO	NO	NO		NO						NO
Subject to non submission of certification Report		NO		NO	NO	NO	NO		NO						NO
Carbon Capture and Storage CERs															
Subject to net reversal of storage			NO							NO	NO	NO	NO		
Subject to non submission of certification report			NO							NO	NO	NO	NO		
Total	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table 12.20 SEF Table 4, Total quantities of Kyoto Protocol units by account type at end of reported year 2016

Account type	Unit type				
	AAUs	ERUs	RMUs	CERs	tCERs
Party holding accounts	NO	NO	NO	8,035,002	NO
Entity holding accounts	NO	NO	NO	NO	NO
Retirement account	NO	NO	NO	NO	NO
Previous period surplus reserve account	NO				
Article 3.3/3.4 net source cancellation accounts	NO	NO	NO	NO	
Non-compliance cancellation account	NO	NO	NO	NO	
Voluntary cancellation account	NO	NO	NO	304,692	NO
Cancellation account for remaining units after carry-over	NO	NO	NO	NO	NO
Article 3.1 ter and quarter ambition increase cancellation account	NO				
Article 3.7 ter cancellation account	NO				
tCER cancellation account for expiry					NO
ICER cancellation account for expiry					NO
ICER cancellation account for reversal of storage					NO
ICER cancellation account for non-submission of certification report					NO
tCER replacement account for expiry	NO	NO	NO	NO	NO
ICER replacement account for expiry	NO	NO	NO	NO	
ICER replacement account for reversal of storage	NO	NO	NO	NO	NO
ICER replacement account for non-submission of certification report	NO	NO	NO	NO	NO
Total	NO	NO	NO	8,339,694	NO

Table 12.21 SEF Table 5(a), Summary information on additions and subtractions for the reported year 2016

	Additions						Subtractions					
	AAUs	ERUs	RMUs	CERs	tCERs	ICERs	AAUs	ERUs	RMUs	CERs	tCERs	ICERs
Assigned amount units issued	NO											
Article 3 Paragraph 7 ter cancellations						NO						
Cancellation following increase in ambition						NO						
Cancellation of remaining units after carry over						NO	NO	NO	NO	NO	NO	NO
Non-compliance cancellation						NO	NO	NO	NO	NO		
Carry-over		NO		NO				NO				
Carry-over to PPSR	NO						NO					
Total	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table 12.22 SEF Table 5(b), Summary information on annual transactions for the reported year 2016

	Additions						Subtractions					
	AAUs	ERUs	RMUs	CERs	tCERs	ICERs	AAUs	ERUs	RMUs	CERs	tCERs	ICERs
Year 1 (2013)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 2 (2014)	NO	NO	NO	130,870	NO	NO	NO	NO	NO	130,870	NO	NO
Year 3 (2015)	NO	NO	NO	3,605,224	NO	NO	NO	NO	NO	2,163,128	NO	NO
Year 4 (2016)	NO	NO	NO	7,239,334	NO	NO	NO	NO	NO	646,428	NO	NO
Year 5 (2017)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 6 (2018)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 7 (2019)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 8 (2020)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2021	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2022	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2023	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total	NO	NO	NO	10,975,428	NO	NO	NO	NO	NO	2,940,426	NO	NO

Table 12.23 SEF Table 5(c), Summary information on annual transactions between PPSR accounts for the reported year 2016

	Additions					Subtractions				
	AAUs	ERUs	RMUs	CERs	tCERs	ICERs	AAUs	ERUs	RMUs	ICERs
Year 1 (2013)	NO						NO			
Year 2 (2014)	NO						NO			
Year 3 (2015)	NO						NO			
Year 4 (2016)	NO						NO			
Year 5 (2017)	NO						NO			
Year 6 (2018)	NO						NO			
Year 7 (2019)	NO						NO			
Year 8 (2020)	NO						NO			
2021	NO						NO			
2022	NO						NO			
2023	NO						NO			
Total	NO						NO			

Table 12.24 SEF Table 5(d), Summary information on expiry, cancellation and replacement for the reported year 2016

	Requirement to replace or cancel					Replacement					Cancellation				
	tCERs	ICERs	CERs	AAUs	ERUs	RMUs	CERs	tCERs	ICERs	AAUs	ERUs	RMUs	CERs	tCERs	ICERs
Year 1 (2013)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 2 (2014)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 3 (2015)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 4 (2016)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 5 (2017)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 6 (2018)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 7 (2019)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

	Requirement to replace or cancel				Replacement				Cancellation						
	tCERs	ICERs	CERs	AAUs	ERUs	RMUs	CERs	tCERs	ICERs	AAUs	ERUs	RMUs	CERs	tCERs	ICERs
Year 8 (2020)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 2021	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 2022	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 2023	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table 12.25 SEF Table 5(e), Summary information on retirement for the reported year 2016

	AAUs	ERUs	RMUs	CERs	tCERs	ICERs
Year 1 (2013)	NO	NO	NO	NO	NO	NO
Year 2 (2014)	NO	NO	NO	NO	NO	NO
Year 3 (2015)	NO	NO	NO	NO	NO	NO
Year 4 (2016)	NO	NO	NO	NO	NO	NO
Year 5 (2017)	NO	NO	NO	NO	NO	NO
Year 6 (2018)	NO	NO	NO	NO	NO	NO
Year 7 (2019)	NO	NO	NO	NO	NO	NO
Year 8 (2020)	NO	NO	NO	NO	NO	NO
Year 2021	NO	NO	NO	NO	NO	NO
Year 2022	NO	NO	NO	NO	NO	NO
Year 2023	NO	NO	NO	NO	NO	NO
Total	NO	NO	NO	NO	NO	NO

Table 12.26 SEF Table 6(a), Memo item: Corrective transactions relating to additions and subtractions for the reported year 2016

Additions						Subtractions					
AAUs	ERUs	RMUs	CERs	tCERs	ICERs	AAUs	ERUs	RMUs	CERs	tCERs	ICERs

Table 12.27 SEF Table 6 (b), Memo item: corrective transactions relating to replacement for the reported year 2016

Expiry, cancellation and requirement to replace					Replacement			
tCERs	ICERs	AAUs	ERUs	RMUs	CERs	tCERs	ICERs	

Table 12.28 SEF Table 6(c), Memo item: Corrective transactions relating to retirement for the reported year 2016

Retirement					
AAUs	ERUs	RMUs	CERs	tCERs	ICERs

12.2 Discrepancies and notifications

Decision 15/CMP.1 annex I.E paragraphs 12-17, decision 2/CMP.8 and decision 3/CMP.11, require Annex I Parties to report on various possible discrepancies and notifications. Australia's discrepancies and notifications are summarised in Table 12.29 for the reported year 2016.

Table 12.29 Accounting of Kyoto Protocol Units

Annual Submission Item	Report
Decision 15/CMP.1 annex I.E paragraph 11 and 19 as updated by decision 3/CMP.11: Standard electronic format (SEF)	See section 12.1. The SEF tables have been submitted to the UNFCCC.
Decision 15/CMP.1 annex I.E paragraph 12: List of discrepant transaction	Australia had no transaction with discrepancies for the reporting period.
Decision 15/CMP.1 annex I.E paragraph 13 & 14: List of CDM notifications	Australia did not receive any CDM notifications.
Decision 15/CMP.1 annex I.E paragraph 15: List of non-replacements	Australia had no non-replacements.
Decision 15/CMP.1 annex I.E paragraph 16: List of invalid units	Australia had no invalid units.
Decision 15/CMP.1 annex I.E paragraph 17: Actions and changes to address discrepancies	None required.
Decision 15/CMP.1 annex I.E paragraph 18: Commitment period reserve calculation	See section 12.4

12.3 Publically accessible information

In accordance with decision 13/CMP.1 paragraph 44, as amended by decision 3/CMP.11, and Regulation 50 of the *Australian National Registry of Emissions Units Regulations 2011*, public information is available at <https://nationalregistry.cleanenergyregulator.gov.au/report/listPublicReports> under the Public Reports facility. A full description of the information that is available is in Annex 7.

12.4 Calculation of the Commitment Period Reserve

For CP2, Australia's commitment period reserve (CPR) is 4,060,457,844 tonnes CO₂ equivalent, calculated as 90 per cent of its assigned amount in accordance with decisions 11/CMP.1, 1 and 2/CMP.8 and 2/CMP.11.

12.5 KP-LULUCF Accounting

Australia has elected to account for the KP Article 3.3 LULUCF activities on an annual basis and to account for the Article 3.4 activities at the end of the CP2. Table 12.30 shows the accounting quantities.

Table 12.30 Information table on accounting for activities under Articles 3.3 and 3.4 of the Kyoto Protocol

GREENHOUSE GAS SOURCE AND SINK ACTIVITIES	NET EMISSIONS/REMOVALS				Accounting parameters	
	Base Year ⁽²⁾	Total 2013-15 ⁽³⁾			Calibration period total (2000-2012)	Accounting quantity ⁽⁴⁾
		2013	2014	2015		
A. Article 3.3 activities						
A.1. Afforestation/reforestation		-18,183	-16,745	12,614	-47,542	-47,542
Excluded emissions from natural disturbances ⁽⁵⁾		NA	NA	NA	NA	NA
Excluded subsequent removals from land subject to natural disturbances ⁽⁶⁾		NA	NA	NA	NA	NA
A.2. Deforestation		41,527	37,724	31,138	110,388	110,388
B. Article 3.4 activities						
B.1. Forest management					-63,118	NA ⁽¹²⁾
Net emissions/removals excluding emissions from natural disturbances		-21,644	-23,081	18,394	-63,118	NA ⁽¹²⁾
Note: Emissions from anthropogenic wildfire in reporting period		3,895	3,895	8,774	16,565	NA ⁽¹²⁾
Emissions from anthropogenic wildfire in FMRL ⁽⁵⁾⁽¹³⁾		3,895	3,895	3,895	11,686	46,744
(2013–2015: Annual average over calibration period)						
Note 2: Emissions from natural disturbances in reporting period ⁽⁵⁾⁽¹³⁾		10,990	7,912	NO	18,902	
Emissions from natural disturbances in FMRL ⁽⁵⁾⁽¹³⁾		5,236	5,236	5,236	15,709	62,838
(2013–2015: Annual average over calibration period)						
Note 3: Subsequent removals natural disturbances in reporting period ⁽⁶⁾⁽¹³⁾		NA ⁽⁶⁾	NA ⁽⁶⁾	NA ⁽⁶⁾	NA ⁽⁶⁾	
Subsequent removals from natural disturbances in FMRL ⁽⁶⁾⁽¹³⁾		NA ⁽⁶⁾	NA ⁽⁶⁾	NA ⁽⁶⁾	NA ⁽⁶⁾	NA ⁽⁶⁾
(2013 - 2015: Annual average over calibration period)						
Any debits from newly established forest (CEF-ne) ⁽⁷⁾⁽⁸⁾		NA	NA	NA	NA	
Forest management reference level (FMRL) ⁽⁹⁾						4,700
Technical corrections to FMRL ⁽¹⁰⁾						-4,336
Forest management cap ⁽¹¹⁾						-117,214
B.2. Cropland management (if elected)	163	-4,278	-4,724	-4,180	-13,182	NA ⁽¹²⁾
B.3. Grazing land management (if elected)	6,878	826	11,815	8,730	21,371	NA ⁽¹²⁾
B.4. Revegetation (if elected)	103	-101	-86	-112	-299	NA ⁽¹²⁾
B.5. Wetland drainage and rewetting (if elected)	NA	NA	NA	NA	NA	NA

(1) All values are reported in table 4(KP) and tables 4(KP-I), A.1.1, 4(KP-I), B.1.1, 4(KP-I), B.1.2 and 4(KP-I), B.1.3 of the CRF for the relevant inventory year as reported in the current submission and are automatically entered in this table.

(2) Net emissions and removals from cropland management, grazing land management, revegetation and/or wetland drainage and rewetting, if elected, in the Party's base year, as established by decision 9/CP.2.

- (3) Cumulative net emissions and removals for all years of the commitment period reported in the current submission.
- (4) The accounting quantity is the total quantity of units to be added to or subtracted from a Party's assigned amount for a particular activity in accordance with the provisions of Article 7.4 of the Kyoto Protocol.
- (5) A Party that has indicated their intent to apply the natural disturbance provisions may choose to exclude emissions from natural disturbances either annually or at the end of the commitment period.
- (6) All subsequent CO₂ removals from post-wildfire recovery (including in years where the natural disturbances provision applies) are excluded from the calculation of FMRL (that is, the removals are excluded from the calculation of the background level and margin), and from reporting of forest management emissions during the commitment period, as outlined in the NIR Volume 3, Section 11.6.4.3 (consistent with guidance on exclusion of removals where projected reference levels are used – IPCC 2014, page 2.53; and ensuring consistency between the FMRL and the reporting of forest management – IPCC 2014, chapter 2.7.5.2). Because estimated natural disturbance emissions exceeded the background level plus margin in 2013 and 2014, emissions from natural disturbances that exceed the background level in these years are excluded ('excluded natural disturbance emissions'). Therefore the accounting of natural disturbance emissions (the same value as in the FMRL) ensuring that the exclusion of natural disturbance emissions in 2013 and 2014 generates zero net credits (in accordance with avoiding the expectation of net credits or net debits – IPCC 2014, pages 2.49-2.50). More information on the application of the natural disturbances provision is included in Chapter 11.6.4 of the NIR.
- (7) A debit is generated in case the newly established forest does not reach at least the expected carbon stock at the end of the normal harvesting period. Total debits from carbon equivalent forests are subtracted from the accounting quantity forest management.
- (8) In case of a projected forest management reference level, Parties should not fill in this row.
- (9) Forest management reference level as inscribed in the appendix of the annex to decision 2/CMP.7, in kt CO₂ eq per year.
- (10) Technical corrections in accordance with paragraphs 14 and 15 of the annex to decision 2/CMP.7 and reported in table 4(KP-JB.1.1 in kt CO₂ eq per year.
- (11) For the second commitment period, additions to the assigned amount of a Party resulting from forest management shall, in accordance with paragraph 13 of the annex to Decision 2/CMP.7, not exceed 3.5 per cent of the national total emissions excluding LULUCF in the base year times eight. Calculated in this way Australia's forest management cap is 117.214 kt CO₂-e, and is shown here as a negative value to represent the issuance of RMU credits consistently with the accounting of other KP LULUCF activities within this table.
- (12) Australia has opted for end of commitment period reporting for Article 3.4 activities.
- (13) In accordance with footnote (5) in CBF table 4(KP)'accounting' Australia has chosen to exclude emissions from natural disturbances annually, rather than at the end of the commitment period. To ensure that this is correctly reflected in the CRF table (does not allow annual exclusions) excluded emissions from natural disturbances are included in the reporting of net emissions/removals from forest management in 4(KP)B.1. More information on the application of the natural disturbances provision is included in Chapter 11.6.4 of the NIR.

13. Changes to the National System

Under the KP, decision 15/CMP.1 annex I.F paragraph 21, as amended by decisions 3/CMP.11, requires Parties to include in the Report information on any changes that have occurred in its national system compared with its last submission.

Changes in Australia's national systems implemented since the last submission are set out in Table 13.1.

Table 13.1 Change to the national system

Reporting Item	Annual Report
Decision 15/CMP.1 annex II.D paragraph 30 (a) Change of name or contact information	No change since last submission.
Decision 15/CMP.1 annex II.D paragraph 30 (b) Change of roles and responsibilities as well as change of the institutional, legal and procedural arrangements	No change since last submission.
Decision 15/CMP.1 annex II.D paragraph 30 (c) Changes in the process of inventory compilation	The process of inventory compilation continues to incorporate more facility specific data obtained under the NGER system. Recalculations flowing from the change have been identified in the relevant chapters of the Report. Section ES.4 summarises major inventory developments and recalculations.
Decision 15/CMP.1 annex II.E paragraph 30 (d) Change of process for key category identification and archiving	No change in this submission.
Decision 15/CMP.1 annex II.D paragraph 30 (e) Change of process for recalculations	No change in this submission.
Decision 15/CMP.1 annex II.D paragraph 30 (f) Changes with regard to QA/QC plan, QA/QC activities and procedures	Additional QA/QC activities and procedures have been implemented as identified in Chapter 1 and the relevant chapters of the Report.
Decision 15/CMP.1 annex II.D paragraph 30 (g) Change of procedures for the official consideration and approval of the inventory	As stated in Chapter 1, the Deputy Secretary of the Department approves the release and submission to the UNFCCC of each year's inventory. The Deputy Secretary's consideration of this submission was supported by the <i>Evaluation of Outcomes</i> document that records an evaluation of the inventory data against the qualitative and quantitative control measures set out in the <i>National Inventory Systems: Quality Assurance/Quality Control Plan</i> .

14. Changes to the National Registry

Under the KP, Parties are required to put in place a national registry to report annually on acquisition, holding, transfer, cancellation, withdrawal and carryover of assigned amount units, removal units, emission reduction units and certified emission reductions during the previous year. A full description of Australia's national registry system is presented in Annex 7. Australia's national registry is referred to as the Australian National Registry of Emissions Units (ANREU).

Decision 15/CMP.1 annex I.G paragraph 22, as amended by decisions 3/CMP.11, requires Parties to include in the Report information on any changes that have occurred in its national registry compared with its last submission. Changes to Australia's National Registry since its last submission are included in Table 14.1 below.

Table 14.1 Change to the national registry – 2016

Reporting Item	Annual Report
Decision 15/CMP.1 annex II.E paragraph 32 Change of name or contact	Michelle Crosbie and Shaun Keane from the Clean Energy Regulator are designated the Registry System Administrators of Australia's national registry. Full contact details contained in Annex 7.
Decision 15/CMP.1 annex II.E paragraph 32 (b) Change of cooperation arrangement	No change in this submission
Decision 15/CMP.1 annex II.E paragraph 32 (c) Change to database or the capacity of National Registry	On 30 September 2016, the Clean Energy Regulator contracted SRA Australia to take over as third-party providers of ANREU application support from the previous providers SRA International. Functionality to support the Data Exchange Standards (DES) requirements remains unchanged.
Decision 15/CMP.1 annex II.E paragraph 32 (d) Change of conformance to technical standards	No change in this submission.
Decision 15/CMP.1 annex II.E paragraph 32 (e) Change of discrepancies procedures	No change in this submission.
Decision 15/CMP.1 annex II.E paragraph 32 (f) Change of Security	No change in this submission.
Decision 15/CMP.1 annex II.E paragraph 32 (g) Change of list of publicly available information	No change in this submission.
Decision 15/CMP.1 annex II.E paragraph 32 (h) Change of Internet address	No change in this submission.
Decision 15/CMP.1 annex II.E paragraph 32 (i) Change of data integrity measure	No change in this submission.
Decision 15/CMP.1 annex II.E paragraph 32 (j) Change of test results	No change in this submission.

Reporting Item	Annual Report
Response to previous Annual Review recommendations	<p>Recommendation</p> <p>The 2016 Standard Independent Annual Review (SIAR) process identified that the national registry of Australia (the Party) has not fulfilled the requirements regarding the public availability of information in accordance with section II.E of the annex to decision 13/CMP.1.</p> <p>The ERT recommends that the Party update the publicly available 2015 reports to include the CER units in accordance with section II.E of the annex to decision 13/CMP.1, in conjunction with decision 3/CMP.11, and that the Party minimize errors linked to the public report automatic population function.</p> <p>Response</p> <p>The recommendation was accepted. The issue arose from an oversight in the design of the public report automatic population function.</p> <p>Action taken:</p> <ul style="list-style-type: none"> publicly available 2015 reports updated to include CER units, and public report automatic population function re-designed to ensure CER units are included in future reports.

15. Minimisation of adverse impacts in accordance with Article 3.14

Australia is pleased to provide an update on how it is striving, under Article 3, paragraph 14, of the KP, to implement its greenhouse gas emission limitation and reduction commitments in such a way as to minimize adverse social, environmental and economic impacts on developing country Parties, particularly those identified in Article 4, paragraphs 8 and 9, of the UNFCCC.

Australia recognizes that the economic cost of reducing emissions is lower than the cost of inaction on climate change (Stern 2006; Garnaut 2008 and 2011). Curbing emissions in support of the global temperature goal will reduce the economic, social and environmental impacts of climate change, particularly for developing countries that are most vulnerable. This is why Australia is committed to reducing emissions and supporting other countries' efforts to mitigate and adapt to climate change.

Australia also recognizes that measures to address climate change can have social, environmental and economic impacts. In developing its climate change response measures, Australia seeks to identify possible impacts and minimise those that are negative.

How Australia addresses domestic impacts of response measures

Policy development in Australia is typically accompanied by consultation processes that enable those potentially affected to raise concerns and present ideas. For example, the 2017 Review of Australia's climate change policies involves close engagement with business, industry and state and local government, including consultation on a discussion paper.

Departmental officials have attended a range of meetings including workshops, conferences, and on-on-on meetings. As at 6 April 2017, the Department has met with more than 190 stakeholders since the Review Terms of Reference were released. The consultation process provides an opportunity to hear a range of views on the challenges and opportunities of reducing emissions in each sector and the impact of policies on jobs, investment, trade competitiveness, households and regional Australia.

Impact assessment is an integral part of Australia's policy development process. Legislation introduced to the Australian parliament must be accompanied by a Regulatory Impact Statement that assesses the economic and social impacts of a measure.

How Australia addresses the international impacts of response measures

Australia's bilateral consultations with other countries and engagement in international platforms such as the UNFCCC Forum on the Impact of the Implementation of Response Measures helps build understanding of positive and negative impacts and allows countries to raise concerns and suggest ways to minimise adverse impacts. Australia participates actively in the UNFCCC Response Measures Forum and is committed to maximising its effectiveness. An Australian official was a nominated expert for the Ad-Hoc Technical Expert Group on Response Measures that met during the May 2017 UNFCCC session. This enabled Australia to share its experiences in preparing for and managing the economic and social impacts of climate action.

Australia helps minimise the economic and social impacts of response measures on developing countries by supporting their economic diversification and transition towards less polluting forms of energy, employment and growth. Australia provides a range of assistance to support the development and deployment of low emissions technologies in developing countries and to build countries' capacities to implement low emissions development strategies. For example, Australia is supporting:

- The Climate Technology Initiative Private Finance Advisory Network, which provides project development and investment advice, and facilitates the financing of clean energy projects;
- The Clean Energy Solutions Centre, which builds capacity in clean energy policy, technology and finance;
- Multilateral Funds including the Green Climate Fund, World Bank and Asian Development Bank;
- Bilateral initiatives to deploy low carbon technologies and expertise in developing countries; and
- The Global Green Growth Institute, which supports developing countries with green growth planning and implementation.

Mandatory safeguards requirements apply to all Australian aid investments, including our bilateral climate finance programme. These ensure potential adverse social and environmental impacts are identified and adequately addressed.

ANNEX 1: Key category analysis

A1.1 Convention accounting

A *key category* has a significant influence on a country's total inventory of direct greenhouse gases in terms of absolute level of emissions, the trend in emissions, or both. Australia has identified the key sources for the UNFCCC inventory using the tier 1 level and trend assessments as recommended in the 2006 *IPCC Good Practice for National Greenhouse Gas Inventories* (IPCC 2006). This approach identifies sources that contribute to 95% of the total emissions or 95% of the trend of the inventory in absolute terms.

When the LULUCF sector is included in the analysis, Australia has identified *public electricity (solid fuel)*, *road transportation (liquid fuels)* and *land converted to grassland* as the most significant of the key categories (i.e. contributing more than 10% of the level or trend) in 2015. The full results for the 2015 key source analysis are reported in Tables A.1.1 to A.1.3.

When the LULUCF sector is excluded from the analysis the most significant key categories in 2015 are *public electricity (solid fuel)*, *road transportation (liquid fuels)* and *enteric fermentation (sheep)*. The results of this latter analysis are presented in Tables A.1.4 to A.1.6. Table A.1.7 summarises the results of the key category analysis for LULUCF categories under KP accounting.

The Australian analysis has been undertaken using a relatively high degree of disaggregation of sources, as recommended in table 4.1 of the 2006 *IPCC Good Practice for National Greenhouse Gas Inventories* (IPCC 2006). This permits a greater degree of understanding of Australia's key categories. Past analyses by the UNFCCC secretariat of Australian data, using higher levels of aggregation common in the analyses undertaken by other countries, have not produced any important distinctions; however there are some cases where categories not identified as a key category in the key category analysis within the Common Reporting Format (CRF) tables have been identified as a key category in the Australian analysis. This is a consequence of the higher level of disaggregation.

In the trend key category analysis some categories that have been identified as trend key categories in the key category analysis within the CRF tables are not identified as trend key categories in the Australian analysis. This is because when the categories are disaggregated to a higher degree – more sectors are identified as key categories and this can move some categories further down the list where they do not make the 95 per cent cumulative total cut off. For example in the 2015 submission the CRF derived key category analysis identified *5.D Wastewater Treatment and Discharge* as a level and trend key category – however the Australian analysis did not identify it as a trend key category. This is because the higher level of disaggregation ranks other key categories before *5.D Wastewater Treatment and Discharge* and therefore it is placed on the key category list below the 95 per cent cut off.

Table A1.1 Key categories for Australia's 2015 inventory-level assessment including LULUCF

A		B	C	D	E	F
IPCC Source Category		Gas	Base Year Estimate	Current Year Estimate	Level Assessment	Cumulative Total
1.A.1.A	Public Electricity and Heat Production \ Solid Fuels	CO ₂	117909	155642	0.24	0.24
1.A.3.B	Road Transportation \ Liquid Fuels	CO ₂	52645	79259	0.12	0.37
3.A.1	Enteric Fermentation \ Cattle	CH ₄	34106	38545	0.06	0.43
4.C.2	Land converted to Grassland	CO ₂	146818	28701	0.05	0.47
1.A.1.A	Public Electricity and Heat Production \ Gaseous Fuels	CO ₂	8281	27863	0.04	0.52
4.A.1	Forest Land remaining Forest Land	CO ₂	16900	26846	0.04	0.56
1.B.1.a.i	Underground Mines\Mining Activities	CH ₄	16605	17909	0.03	0.59
4.A.2	Land converted to Forest Land	CO ₂	622	13065	0.02	0.61
3.A.2	Enteric Fermentation \ Sheep	CH ₄	30128	11977	0.02	0.63
2.F.1	Refrigeration and air-conditioning	HFC	0	11143	0.02	0.65
1.A.1.C	Manufacture of Solid Fuels and Other Energy Industries \ Gaseous Fuels	CO ₂	4577	9803	0.02	0.66
1.A.3.A	Domestic Aviation	CO ₂	2615	8608	0.01	0.67
5.A	Solid Waste Disposal	CH ₄	15242	8424	0.01	0.69
1.A.4.B	Residential \ Gaseous Fuels	CO ₂	4646	8343	0.01	0.70
1.A.2.F	Other (please specify) \ Mining \ Liquid Fuels	CO ₂	1759	7679	0.01	0.71
1.A.1.C	Manufacture of Solid Fuels and Other Energy Industries \ Liquid Fuels	CO ₂	968	7555	0.01	0.73
1.A.2.B	Non-Ferrous Metals \ Gaseous Fuels	CO ₂	4170	7528	0.01	0.74
2.C.1.d	Industrial Processes\ Coke	CO ₂	9203	6670	0.01	0.75
1.A.4.C	Agriculture/Forestry/Fisheries \ Liquid Fuels	CO ₂	3406	6526	0.01	0.76
4.C.1	Grassland remaining Grassland	CO ₂	4785	5909	0.01	0.77
1.B.1.a.ii	Fugitive Emissions From Fuels\ Solid Fuels\Mining Activities	CH ₄	3351	5879	0.01	0.78
1.A.2.B	Non-Ferrous Metals \ Solid Fuels	CO ₂	4132	5091	0.01	0.78
4.G	Harvested Wood Products	CO ₂	7157	4800	0.01	0.79
1.A.2.C	Chemicals \ Liquid Fuels	CO ₂	3297	4649	0.01	0.80
4.B.1	Cropland remaining Cropland	CO ₂	69	4638	0.01	0.81
4.C.1	Grassland remaining Grassland	CH ₄	3492	4582	0.01	0.81
1.A.1.A	Public Electricity and Heat Production \ Liquid Fuels	CO ₂	2907	4232	0.01	0.82
1.B.2.c1	Fugitives\Venting and Flaring\ Venting\Gas	CO ₂	1966	4150	0.01	0.83
4.C.1	Grassland remaining Grassland	N ₂ O	4261	4079	0.01	0.83
4.B.2	Land converted to Cropland	CO ₂	16077	4016	0.01	0.84
3.D.a.4	Agricultural Soil \ Direct Soil Emissions \ Crop Residue	N ₂ O	2753	3928	0.01	0.85
1.A.2.C	Chemicals \ Gaseous Fuels	CO ₂	1452	3412	0.01	0.85
1.A.1.B	Petroleum Refining \ Liquid Fuels	CO ₂	4931	3357	0.01	0.86

A		B	C	D	E	F
IPCC Source Category		Gas	Base Year Estimate	Current Year Estimate	Level Assessment	Cumulative Total
1.A.3.C	Railways \ Liquid Fuels	CO ₂	1734	3239	0.01	0.86
4.A.1	Forest Land remaining Forest Land	CH ₄	3498	3196	0.01	0.87
2.A.1	Cement Industry	CO ₂	3463	3076	0.00	0.87
3.D.a.3	Agricultural Soils \ Direct Soil Emissions \ Urine and Dung Deposited by Grazing Animals	N ₂ O	4278	3072	0.00	0.88
1.A.4.A	Commercial/Institutional \ Liquid Fuels	CO ₂	1246	3047	0.00	0.88
1.B.2.B.2	Fugitives\Natural Gas\Production	CH ₄	1404	2937	0.00	0.89
1.A.4.A	Commercial/Institutional \ Gaseous Fuels	CO ₂	1824	2905	0.00	0.89
1.A.2.F	Other (please specify) \ Mineral industry \ Gaseous Fuels	CO ₂	2972	2798	0.00	0.89
1.B.2.c.ii	Fugitives\Venting and Flaring\ Flaring\Gas	CO ₂	2426	2690	0.00	0.90
2.C.3	Aluminium Production	CO ₂	2058	2686	0.00	0.90
2.B.1	Ammonia Production	CO ₂	603	2606	0.00	0.91
1.B.2.B.4	Transmission and Storage	CH ₄	4316	2382	0.00	0.91
5.D	Wastewater treatment and discharge	CH ₄	4017	2317	0.00	0.91
3.D.a.1	Agricultural Soils \ Direct Soil Emissions \ Inorganic Fertilisers	N ₂ O	1351	2234	0.00	0.92
3.D.b.2	Agricultural Soils \ Indirect Soil Emissions \ Nitrogen Leaching and Run-Off	N ₂ O	1882	1974	0.00	0.92
1.A.2.F	Other (please specify) \ Mineral industry \ Solid Fuels	CO ₂	2212	1890	0.00	0.92
1.A.2.E	Food Processing, Beverages and Tobacco \ Gaseous Fuels	CO ₂	1255	1886	0.00	0.93
1.A.2.F	Other (please specify) \ Construction \ Liquid Fuels	CO ₂	2838	1552	0.00	0.93
1.A.3.D	Domestic navigation \ Liquid Fuels	CO ₂	2208	1543	0.00	0.93
1.B.2.c1	Fugitives\Venting and Flaring\ Venting\Gas	CH ₄	2114	1447	0.00	0.93
2.A.3	Glass Production	CO ₂	1251	1366	0.00	0.94
3.H	Urea Application	CO ₂	367	1352	0.00	0.94
3.B.3	Manure Management \ Swine	CH ₄	1546	1323	0.00	0.94
1.B.2.c2.i	Fugitives\Venting and Flaring\ Flaring\ Oil	CO ₂	1217	1317	0.00	0.94
1.A.4.B	Residential \ Liquid Fuels	CO ₂	1320	1241	0.00	0.94
2.B.2	Nitric Acid Production	N ₂ O	995	1230	0.00	0.95
3.G	Liming	CO ₂	215	1224	0.00	0.95

Table A1. 2 Key categories for Australia's 2015 inventory—trend assessment including LULUCF

A		B	C	D	E	F	G
IPCC Source Categories		Gas	Base Year Estimate	Current Year Estimate	Trend Assessment	% Contribution to Trend	Cumulative Total of Column F
4.C.2	Land converted to Grassland	CO ₂	146818	28701	0.16	0.26	0.26
1.A.1.A	Public Electricity and Heat Production \ Solid Fuels	CO ₂	117909	155642	0.08	0.12	0.39
1.A.3.B	Road Transportation \ Liquid Fuels	CO ₂	52645	79259	0.05	0.08	0.46
1.A.1.A	Public Electricity and Heat Production \ Gaseous Fuels	CO ₂	8281	27863	0.03	0.05	0.52
3.A.2	Enteric Fermentation \ Sheep	CH ₄	30128	11977	0.02	0.04	0.55
4.A.2	Land converted to Forest Land	CO ₂	622	13065	0.02	0.03	0.59
2.F.1	Refrigeration and air-conditioning	HFC	0	11143	0.02	0.03	0.62
4.B.2	Land converted to Cropland	CO ₂	16077	4016	0.02	0.03	0.64
4.A.1	Forest Land remaining Forest Land	CO ₂	16900	26846	0.01	0.02	0.66
3.A.1	Enteric Fermentation \ Cattle	CH ₄	34106	38545	0.01	0.02	0.68
1.A.1.C	Manufacture of Solid Fuels and Other Energy Industries \ Liquid Fuels	CO ₂	968	7555	0.01	0.02	0.70
1.A.3.A	Domestic Aviation	CO ₂	2615	8608	0.01	0.02	0.72
1.A.2.F	Other (please specify) \ Mining \ Liquid Fuels	CO ₂	1759	7679	0.01	0.02	0.73
1.A.1.C	Manufacture of Solid Fuels and Other Energy Industries \ Gaseous Fuels	CO ₂	4577	9803	0.01	0.01	0.75
5.A	Solid Waste Disposal	CH ₄	15242	8424	0.01	0.01	0.76
4.B.1	Cropland remaining Cropland	CO ₂	69	4638	0.01	0.01	0.77
1.A.4.B	Residential \ Gaseous Fuels	CO ₂	4646	8343	0.01	0.01	0.78
4.C.2	Land converted to Grassland	CH ₄	5058	703	0.01	0.01	0.79
1.A.2.B	Non-Ferrous Metals \ Gaseous Fuels	CO ₂	4170	7528	0.01	0.01	0.80
4.E.2	Land converted to Settlements	CO ₂	4803	820	0.01	0.01	0.81
1.A.4.C	Agriculture/Forestry/ Fisheries \ Liquid Fuels	CO ₂	3406	6526	0.01	0.01	0.82
2.C.3	Aluminum Production	CF ₄	3794	143	0.01	0.01	0.83

A		B	C	D	E	F	G
IPCC Source Categories		Gas	Base Year Estimate	Current Year Estimate	Trend Assessment	% Contribution to Trend	Cumulative Total of Column F
4.G	Harvested Wood Products	CO ₂	7157	4800	0.00	0.01	0.83
1.B.1.A.1.1	Underground Mines \ Mining Activities	CH ₄	16605	17909	0.00	0.01	0.84
1.B.1.A.2.1	Surface Mining \ Mining Activities	CH ₄	3351	5879	0.00	0.01	0.85
1.B.2.c1	Fugitives \ Venting and Flaring \ Venting \ Gas	CO ₂	1966	4150	0.00	0.01	0.85
1.A.2.C	Chemicals \ Gaseous Fuels	CO ₂	1452	3412	0.00	0.01	0.86
2.B.1	Ammonia Production	CO ₂	603	2606	0.00	0.01	0.86
1.A.4.A	Commercial / Institutional \ Liquid Fuels	CO ₂	1246	3047	0.00	0.00	0.87
2.C.1.d	Coke	CO ₂	9203	6670	0.00	0.00	0.87
1.A.3.C	Railways \ Liquid Fuels	CO ₂	1734	3239	0.00	0.00	0.88
1.B.2.B.2	Fugitives \ Natural Gas \ Production	CH ₄	1404	2937	0.00	0.00	0.88
1.A.2.C	Chemicals \ Liquid Fuels	CO ₂	3297	4649	0.00	0.00	0.89
1.A.2.B	Non-Ferrous Metals \ Liquid Fuels	CO ₂	2849	948	0.00	0.00	0.89
1.A.1.A	Public Electricity and Heat Production \ Liquid Fuels	CO ₂	2907	4232	0.00	0.00	0.89
1.B.2.B.4	Transmission and Storage	CH ₄	4316	2382	0.00	0.00	0.90
3.D.a.4	Agricultural Soil \ Direct Soil Emissions \ Crop Residue	N ₂ O	2753	3928	0.00	0.00	0.90
4.C.1	Grassland remaining Grassland	CH ₄	3492	4582	0.00	0.00	0.91
1.A.2.B	Non-Ferrous Metals \ Solid Fuels	CO ₂	4132	5091	0.00	0.00	0.91
5.D	Wastewater treatment and discharge	CH ₄	4017	2317	0.00	0.00	0.91
2.B.9	Chemical Industry \ Fluorochemical production	HFC-23	1425	0	0.00	0.00	0.92
1.A.4.B	Residential \ Biomass	CH ₄	2403	888	0.00	0.00	0.92
1.A.1.C	Manufacture of Solid Fuels and Other Energy Industries \ Solid Fuels	CO ₂	2397	913	0.00	0.00	0.92
1.A.4.A	Commercial / Institutional \ Gaseous Fuels	CO ₂	1824	2905	0.00	0.00	0.93
1.A.1.B	Petroleum Refining \ Liquid Fuels	CO ₂	4931	3357	0.00	0.00	0.93

A		B	C	D	E	F	G
IPCC Source Categories		Gas	Base Year Estimate	Current Year Estimate	Trend Assessment	% Contribution to Trend	Cumulative Total of Column F
3.G	Liming	CO ₂	215	1224	0.00	0.00	0.93
1.A.2.F	Other (please specify) \ Construction \ Liquid Fuels	CO ₂	2838	1552	0.00	0.00	0.93
3.H	Urea Application	CO ₂	367	1352	0.00	0.00	0.94
3.D.a.1	Agricultural Soils \ Direct Soil Emissions \ Inorganic Fertilisers	N ₂ O	1351	2234	0.00	0.00	0.94
2.C.3	Aluminium Production	CO ₂	2058	2686	0.00	0.00	0.94
3.D.a.3	Agricultural Soils \ Direct Soil Emissions \ Urine and Dung Deposited by Grazing Animals	N ₂ O	4278	3072	0.00	0.00	0.94
4.C.2	Land converted to Grassland	N ₂ O	1337	460	0.00	0.00	0.94
1.A.2.E	Food Processing, Beverages and Tobacco \ Gaseous Fuels	CO ₂	1255	1886	0.00	0.00	0.95
2.C.3	Aluminium Production	C ₂ F ₆	813	28	0.00	0.00	0.95
3.B.1	Manure Management \ Cattle	CH ₄	492	1154	0.00	0.00	0.95

Table A1.3 Key categories for Australia's 2015 inventory—summary including LULUCF

A		B	C	D
IPCC Source Categories		Direct Greenhouse Gas	Key Source Category Flag	If Column C is Yes, Criteria for Identification
1.A.1.a	Public Electricity and Heat Production \ Solid Fuels	CO ₂	YES	Level, Trend
1.A.1.a	Public Electricity and Heat Production \ Gaseous Fuels	CO ₂	YES	Level, Trend
1.A.1.a	Public Electricity and Heat Production \ Liquid Fuels	CO ₂	YES	Level, Trend
1.A.1.b	Petroleum Refining \ Liquid Fuels	CO ₂	YES	Level, Trend
1.A.1.c	Manufacture of Solid Fuels and Other Energy Industries \ Gaseous Fuels	CO ₂	YES	Level, Trend
1.A.1.c	Manufacture of Solid Fuels and Other Energy Industries \ Liquid Fuels	CO ₂	YES	Level, Trend
1.A.1.c	Manufacture of Solid Fuels and Other Energy Industries \ Solid Fuels	CO ₂	YES	Trend
1.A.2.b	Non-Ferrous Metals \ Gaseous Fuels	CO ₂	YES	Level, Trend
1.A.2.b	Non-Ferrous Metals \ Solid Fuels	CO ₂	YES	Level, Trend
1.A.2.b	Non-Ferrous Metals \ Liquid Fuels	CO ₂	YES	Trend
1.A.2.c	Chemicals \ Liquid Fuels	CO ₂	YES	Level, Trend
1.A.2.c	Chemicals \ Gaseous Fuels	CO ₂	YES	Level, Trend
1.A.2.e	Food Processing, Beverages and Tobacco \ Gaseous Fuels	CO ₂	YES	Level, Trend
1.A.2.f	Other \ Mining \ Liquid Fuels	CO ₂	YES	Level, Trend
1.A.2.f	Other \ Mineral industry \ Gaseous Fuels	CO ₂	YES	Level
1.A.2.f	Other \ Mineral industry \ Solid Fuels	CO ₂	YES	Level
1.A.2.f	Other \ Construction \ Liquid Fuels	CO ₂	YES	Level, Trend
1.A.3.a	Domestic Aviation \ Liquid Fuels	CO ₂	YES	Level, Trend
1.A.3.b	Road Transportation \ Liquid Fuels	CO ₂	YES	Level, Trend
1.A.3.c	Railways \ Liquid Fuels	CO ₂	YES	Level, Trend
1.A.3.d	Navigation \ Liquid Fuels	CO ₂	YES	Level
1.A.4.a	Commercial/Institutional \ Gaseous Fuels	CO ₂	YES	Level, Trend
1.A.4.a	Commercial/Institutional \ Liquid Fuels	CO ₂	YES	Level, Trend
1.A.4.b	Residential \ Liquid Fuels	CO ₂	YES	Level
1.A.4.b	Residential \ Gaseous Fuels	CO ₂	YES	Level, Trend
1.A.4.b	Residential \ Biomass	CH ₄	YES	Trend
1.A.4.c	Agriculture/Forestry/Fisheries \ Liquid Fuels	CO ₂	YES	Level, Trend
1.B.1.A.1.1	Underground Mines\Mining Activities	CH ₄	YES	Level, Trend
1.B.1.A.2.1	Surface Mining\Mining Activities	CH ₄	YES	Level, Trend
1.B.2.B.2	Fugitives\Natural Gas\Production	CH ₄	YES	Level, Trend
1.B.2.B.4	Transmission and Storage	CH ₄	YES	Level, Trend
1.B.2.C.1	Fugitives\Venting and Flaring\Venting\Gas	CO ₂	YES	Level, Trend
1.B.2.C.1	Fugitives\Venting and Flaring\Venting\Gas	CH ₄	YES	Level
1.B.2.c2.i	Fugitives\Venting and Flaring\Flaring\ Oil	CO ₂	YES	Level
1.B.2.c2.ii	Fugitives\Venting and Flaring\Flaring\Gas	CO ₂	YES	Level
2.A.1	Cement Production	CO ₂	YES	Level
2.A.3	Glass Production	CO ₂	YES	Level

A		B	C	D
IPCC Source Categories		Direct Greenhouse Gas	Key Source Category Flag	If Column C is Yes, Criteria for Identification
2.B.1	Ammonia Production	CO ₂	YES	Level, Trend
2.B.2	Nitric Acid Production	N ₂ O	YES	Level
2.B.9	Chemical Industry \ Fluorochemical production	HFC-23	YES	Trend
2.C.1.d	Iron and Steel\Coke	CO ₂	YES	Level, Trend
2.C.3	Aluminium Production	CO ₂	YES	Level, Trend
2.C.3	Aluminium Production	CF ₄	YES	Trend
2.C.3	Aluminium Production	C ₂ F ₆	YES	Trend
2.F.1	Refrigeration and Air Conditioning Equipment	HFC	YES	Level, Trend
3.A.1	Enteric Fermentation \ Cattle	CH ₄	YES	Level, Trend
4.A.2	Enteric Fermentation \ Sheep	CH ₄	YES	Level, Trend
3.B.3	Manure Management \ Swine	CH ₄	YES	Level
3.D.a.1	Agricultural Soils \ Direct Soil Emissions \ Inorganic Fertilisers	N ₂ O	YES	Level, Trend
3.D.a.3	Agricultural Soils \ Direct Soil Emissions \ Urine and Dung Deposited by Grazing Animals	N ₂ O	YES	Level, Trend
3.D.a.4	Agricultural Soil \ Direct Soil Emissions \ Crop Residue	N ₂ O	YES	Level, Trend
3.D.b.2	Nitrogen Leaching and Run-off	N ₂ O	YES	Level
3.G	Liming	CO ₂	YES	Level, Trend
3.H	Urea Application	CO ₂	YES	Level, Trend
4.A.1	Forest Land remaining Forest Land	CO ₂	YES	Level, Trend
4.A.1	Forest Land remaining Forest Land	CH ₄	YES	Level
4.A.2	Land converted to Forest Land	CO ₂	YES	Level, Trend
4.B.1	Cropland remaining Cropland	CO ₂	YES	Level, Trend
4.B.2	Land converted to Cropland	CO ₂	YES	Level, Trend
4.C.1	Grassland remaining Grassland	CO ₂	YES	Level
4.C.1	Grassland remaining Grassland	CH ₄	YES	Level, Trend
4.C.1	Grassland remaining Grassland	N ₂ O	YES	Level
4.C.2	Land converted to Grassland	CO ₂	YES	Level, Trend
4.C.2	Land converted to Grassland	N ₂ O	YES	Trend
4.C.2	Land converted to Grassland	CH ₄	YES	Trend
4.C.2	Land converted to Settlements	CO ₂	YES	Trend
4.G	Harvested Wood Products	CO ₂	YES	Level, Trend
5.A.1	Managed Waste Disposal	CH ₄	YES	Level, Trend
5.D.1	Domestic Wastewater	CH ₄	YES	Level, Trend

Table A1.4 Key categories for Australia's 2015 inventory-level assessment excluding LULUCF

A		B	C	D	E	F
IPCC Source Category		Gas	Base Year Estimate	Current Year Estimate	Level Assessment	Cumulative Total
1.A.1.A	Public Electricity and Heat Production \ Solid Fuels	CO ₂	117909	155642	0.29	0.29
1.A.3.B	Road Transportation \ Liquid Fuels	CO ₂	52645	79259	0.15	0.44
3.A.1	Enteric Fermentation \ Cattle	CH ₄	34106	38545	0.07	0.51
1.A.1.A	Public Electricity and Heat Production \ Gaseous Fuels	CO ₂	8281	27863	0.05	0.57
1.B.1.a.i	Underground Mines \ Mining Activities	CH ₄	16605	17909	0.03	0.60
3.A.2	Enteric Fermentation \ Sheep	CH ₄	30128	11977	0.02	0.62
2.F.1	Refrigeration and air-conditioning	HFC	0	11143	0.02	0.64
1.A.1.C	Manufacture of Solid Fuels and Other Energy Industries \ Gaseous Fuels	CO ₂	4577	9803	0.02	0.66
1.A.3.A	Domestic Aviation	CO ₂	2615	8608	0.02	0.68
5.A	Solid Waste Disposal	CH ₄	15242	8424	0.02	0.69
1.A.4.B	Residential \ Gaseous Fuels	CO ₂	4646	8343	0.02	0.71
1.A.2.F	Other \ Mining \ Liquid Fuels	CO ₂	1759	7679	0.01	0.72
1.A.1.C	Manufacture of Solid Fuels and Other Energy Industries \ Liquid Fuels	CO ₂	968	7555	0.01	0.74
1.A.2.B	Non-Ferrous Metals \ Gaseous Fuels	CO ₂	4170	7528	0.01	0.75
2.C.1.d	Coke	CO ₂	9203	6670	0.01	0.76
1.A.4.C	Agriculture/Forestry/Fisheries \ Liquid Fuels	CO ₂	3406	6526	0.01	0.78
1.B.1.a.ii	Surface Mining \ Mining Activities	CH ₄	3351	5879	0.01	0.79
1.A.2.B	Non-Ferrous Metals \ Solid Fuels	CO ₂	4132	5091	0.01	0.80
1.A.2.C	Chemicals \ Liquid Fuels	CO ₂	3297	4649	0.01	0.80
1.A.1.A	Public Electricity and Heat Production \ Liquid Fuels	CO ₂	2907	4232	0.01	0.81
1.B.2.c1	Fugitives \ Venting and Flaring \ Venting \ Gas	CO ₂	1966	4150	0.01	0.82
3.D.a.4	Agricultural Soil \ Direct Soil Emissions \ Crop Residue	N ₂ O	2753	3928	0.01	0.83
1.A.2.C	Chemicals \ Gaseous Fuels	CO ₂	1452	3412	0.01	0.83
1.A.1.B	Petroleum Refining \ Liquid Fuels	CO ₂	4931	3357	0.01	0.84
1.A.3.C	Railways \ Liquid Fuels	CO ₂	1734	3239	0.01	0.85
2.A.1	Cement Industry	CO ₂	3463	3076	0.01	0.85
3.D.a.3	Agricultural Soils \ Direct Soil Emissions \ Urine and Dung Deposited by Grazing Animals	N ₂ O	4278	3072	0.01	0.86
1.A.4.A	Commercial/Institutional \ Liquid Fuels	CO ₂	1246	3047	0.01	0.86
1.B.2.B.2	Fugitives \ Natural Gas \ Production	CH ₄	1404	2937	0.01	0.87
1.A.4.A	Commercial/Institutional \ Gaseous Fuels	CO ₂	1824	2905	0.01	0.87

A		B	C	D	E	F
IPCC Source Category		Gas	Base Year Estimate	Current Year Estimate	Level Assessment	Cumulative Total
1.A.2.F	Other (please specify) \ Mineral industry \ Gaseous Fuels	CO ₂	2972	2798	0.01	0.88
1.B.2.c2.ii	Fugitives\Venting and Flaring\ Flaring\Gas	CO ₂	2426	2690	0.01	0.88
2.C.3	Aluminium Production	CO ₂	2058	2686	0.01	0.89
2.B.1	Ammonia Production	CO ₂	603	2606	0.00	0.89
1.B.2.B.4	Transmission and Storage	CH ₄	4316	2382	0.00	0.90
5.D	Wastewater treatment and discharge	CH ₄	4017	2317	0.00	0.90
3.D.a.1	Agricultural Soils \ Direct Soil Emissions \ Inorganic Fertilisers	N ₂ O	1351	2234	0.00	0.91
3.D.b.2	Agricultural Soils \ Indirect Soil Emissions \ Nitrogen Leaching and Run-Off	N ₂ O	1882	1974	0.00	0.91
1.A.2.F	Other (please specify) \ Mineral industry \ Solid Fuels	CO ₂	2212	1890	0.00	0.92
1.A.2.E	Food Processing, Beverages and Tobacco \ Gaseous Fuels	CO ₂	1255	1886	0.00	0.92
1.A.2.F	Other (please specify) \ Construction \ Liquid Fuels	CO ₂	2838	1552	0.00	0.92
1.A.3.D	Domestic navigation \ Liquid Fuels	CO ₂	2208	1543	0.00	0.92
1.B.2.c1	Fugitives\Venting and Flaring\ Venting\Gas	CH ₄	2114	1447	0.00	0.93
2.A.3	Glass Production	CO ₂	1251	1366	0.00	0.93
3.H	Urea Application	CO ₂	367	1352	0.00	0.93
3.B.3	Manure Management \ Swine	CH ₄	1546	1323	0.00	0.93
1.B.2.c2.i	Fugitives\Venting and Flaring\ Flaring\ Oil	CO ₂	1217	1317	0.00	0.94
1.A.4.B	Residential \ Liquid Fuels	CO ₂	1320	1241	0.00	0.94
2.B.2	Nitric Acid Production	N ₂ O	995	1230	0.00	0.94
3.G	Liming	CO ₂	215	1224	0.00	0.94
2.A.2	Lime Production	CO ₂	775	1169	0.00	0.95
1.B.1.a.i	Underground Mines\Mining Activities	CO ₂	1122	1165	0.00	0.95

Table A1.5 Key categories for Australia's 2015 inventory—trend assessment excluding LULUCF

A		B	C	D	E	F	G
IPCC Source Categories		Gas	Base Year Estimate	Current Year Estimate	Trend Assessment	% Contribution to Trend	Cumulative Total
3.A.2	Enteric Fermentation \ Sheep	CH ₄	30128	11977	0.06	0.14	0.14
1.A.1.A	Public Electricity and Heat Production \ Gaseous Fuels	CO ₂	8281	27863	0.04	0.09	0.23
1.A.3.B	Road Transportation \ Liquid Fuels	CO ₂	52645	79259	0.03	0.06	0.29
2.F.1	Refrigeration and air-conditioning	HFC	0	11143	0.03	0.06	0.35
5.A	Solid Waste Disposal	CH ₄	15242	8424	0.03	0.06	0.40
1.A.1.C	Manufacture of Solid Fuels and Other Energy Industries \ Liquid Fuels	CO ₂	968	7555	0.02	0.03	0.44
1.A.1.A	Public Electricity and Heat Production \ Solid Fuels	CO ₂	117909	155642	0.01	0.03	0.47
1.A.2.F	Other \ Mining \ Liquid Fuels	CO ₂	1759	7679	0.01	0.03	0.49
1.A.3.A	Domestic Aviation	CO ₂	2615	8608	0.01	0.03	0.52
2.C.1.d	Coke	CO ₂	9203	6670	0.01	0.03	0.55
3.A.1	Enteric Fermentation \ Cattle	CH ₄	34106	38545	0.01	0.02	0.57
2.C.3	Aluminium Production	CF ₄	3794	143	0.01	0.02	0.60
1.A.1.C	Manufacture of Solid Fuels and Other Energy Industries \ Gaseous Fuels	CO ₂	4577	9803	0.01	0.02	0.62
1.B.1.a.i	Underground Mines \ Mining Activities	CH ₄	16605	17909	0.01	0.02	0.63
1.B.2.B.4	Transmission and Storage	CH ₄	4316	2382	0.01	0.02	0.65
1.A.1.B	Petroleum Refining \ Liquid Fuels	CO ₂	4931	3357	0.01	0.02	0.66
5.D	Wastewater treatment and discharge	CH ₄	4017	2317	0.01	0.01	0.68
1.A.2.B	Non-Ferrous Metals \ Liquid Fuels	CO ₂	2849	948	0.01	0.01	0.69
1.A.4.B	Residential \ Gaseous Fuels	CO ₂	4646	8343	0.01	0.01	0.71
3.D.a.3	Agricultural Soils \ Direct Soil Emissions \ Urine and Dung Deposited by Grazing Animals	N ₂ O	4278	3072	0.01	0.01	0.72
1.A.2.B	Non-Ferrous Metals \ Gaseous Fuels	CO ₂	4170	7528	0.01	0.01	0.73

A		B	C	D	E	F	G
IPCC Source Categories		Gas	Base Year Estimate	Current Year Estimate	Trend Assessment	% Contribution to Trend	Cumulative Total
1.A.4.C	Agriculture/Forestry/ Fisheries \ Liquid Fuels	CO ₂	3406	6526	0.01	0.01	0.74
1.A.4.B	Residential \ Biomass	CH ₄	2403	888	0.01	0.01	0.75
1.A.1.C	Manufacture of Solid Fuels and Other Energy Industries \ Solid Fuels	CO ₂	2397	913	0.01	0.01	0.76
1.A.2.F	Other (please specify) \ Construction \ Liquid Fuels	CO ₂	2838	1552	0.00	0.01	0.77
2.B.1	Ammonia Production	CO ₂	603	2606	0.00	0.01	0.78
2.B.9	Chemical Industry \ Fluorochemical production	HFC-23	1425	0	0.00	0.01	0.79
1.B.2.c1	Fugitives\Venting and Flaring\Venting\Gas	CO ₂	1966	4150	0.00	0.01	0.80
1.B.1.a.ii	Mining Activities	CH ₄	3351	5879	0.00	0.01	0.81
1.A.2.C	Chemicals \ Gaseous Fuels	CO ₂	1452	3412	0.00	0.01	0.82
1.A.4.A	Commercial/ Institutional \ Liquid Fuels	CO ₂	1246	3047	0.00	0.01	0.82
2.A.1	Cement Industry	CO ₂	3463	3076	0.00	0.01	0.83
1.A.3.D	Domestic navigation \ Liquid Fuels	CO ₂	2208	1543	0.00	0.01	0.84
1.B.2.c1	Fugitives\Venting and Flaring\Venting\Gas	CH ₄	2114	1447	0.00	0.01	0.84
1.B.2.B.2	Fugitives\Natural Gas\ Production	CH ₄	1404	2937	0.00	0.01	0.85
1.A.2.A	Iron and Steel \ Gaseous Fuels	CO ₂	1393	720	0.00	0.01	0.86
1.A.3.C	Railways \ Liquid Fuels	CO ₂	1734	3239	0.00	0.01	0.86
2.C.3	Aluminium Production	C ₂ F ₆	813	28	0.00	0.01	0.87
1.A.2.F	Other (please specify) \ Mineral industry \ Gaseous Fuels	CO ₂	2972	2798	0.00	0.01	0.87
3.G	Liming	CO ₂	215	1224	0.00	0.00	0.88
1.A.2.F	Other (please specify) \ Mineral industry \ Solid Fuels	CO ₂	2212	1890	0.00	0.00	0.88
3.H	Urea Application	CO ₂	367	1352	0.00	0.00	0.89
1.A.2.C	Chemicals \ Solid Fuels	CO ₂	876	253	0.00	0.00	0.89
1.A.2.A	Iron and Steel \ Solid Fuels	CO ₂	1206	742	0.00	0.00	0.89
1.A.2.E	Food Processing, Beverages and Tobacco \ Solid Fuels	CO ₂	1214	765	0.00	0.00	0.90

A		B	C	D	E	F	G
IPCC Source Categories		Gas	Base Year Estimate	Current Year Estimate	Trend Assessment	% Contribution to Trend	Cumulative Total
1.A.4.A	Commercial/ Institutional \ Solid Fuels	CO ₂	523	9	0.00	0.00	0.90
3.B.3	Manure Management \ Swine	CH ₄	1546	1323	0.00	0.00	0.90
1.B.1.c	Fugitive Emissions From Fuels, Solid Fuels, Other	CO ₂	0	611	0.00	0.00	0.91
1.A.2.F	Other (please specify) \ Mining \ Solid Fuels	CO ₂	671	248	0.00	0.00	0.91
1.A.4.A	Commercial/ Institutional \ Gaseous Fuels	CO ₂	1824	2905	0.00	0.00	0.91
1.A.1.A	Public Electricity and Heat Production \ Liquid Fuels	CO ₂	2907	4232	0.00	0.00	0.92
3.B.1	Manure Management \ Cattle	CH ₄	492	1154	0.00	0.00	0.92
3.D.a.1	Agricultural Soils \ Direct Soil Emissions \ Inorganic Fertilisers	N ₂ O	1351	2234	0.00	0.00	0.92
1.A.3.B	Road Transportation \ Liquid Fuels	CH ₄	560	229	0.00	0.00	0.92
1.A.2.C	Chemicals \ Liquid Fuels	CO ₂	3297	4649	0.00	0.00	0.93
1.A.4.B	Residential \ Liquid Fuels	CO ₂	1320	1241	0.00	0.00	0.93
3.D.a.4	Agricultural Soil \ Direct Soil Emissions \ Crop Residue	N ₂ O	2753	3928	0.00	0.00	0.93
1.B.1.a.i	Post-Mining Activities	CH ₄	566	1146	0.00	0.00	0.93
3.D.b.2	Agricultural Soils \ Indirect Soil Emissions \ Nitrogen Leaching and Run-Off	N ₂ O	1882	1974	0.00	0.00	0.94
1.A.3.D	Domestic navigation \ Solid Fuels	CO ₂	313	0	0.00	0.00	0.94
3.B.1	Manure Management \ Cattle	N ₂ O	259	723	0.00	0.00	0.94
1.B.2.c2.ii	Fugitives \ Venting and Flaring \ Flaring \ Gas	CO ₂	2426	2690	0.00	0.00	0.94
3.C	Rice Cultivation	CH ₄	562	325	0.00	0.00	0.94
1.A.2.g.i	Other (please specify) \ Manufacturing of Machinery	CO ₂	422	165	0.00	0.00	0.95
1.A.5.B	Mobile (please specify) \ Liquid Fuels	CO ₂	419	869	0.00	0.00	0.95
1.B.2.a.4	Refining / Storage	CO ₂	392	171	0.00	0.00	0.95

Table A1. 6 Key categories for Australia's 2015 inventory—summary excluding LULUCF

A		B	C	D
IPCC Source Categories		Gas	Key Source Category Flag	If Column C is Yes, Criteria for Identification
1.A.1.a	Public Electricity and Heat Production \ Solid Fuels	CO ₂	YES	Level, Trend
1.A.1.a	Public Electricity and Heat Production \ Gaseous Fuels	CO ₂	YES	Level, Trend
1.A.1.a	Public Electricity and Heat Production \ Liquid Fuels	CO ₂	YES	Level, Trend
1.A.1.b	Petroleum Refining \ Liquid Fuels	CO ₂	YES	Level, Trend
1.A.1.c	Manufacture of Solid Fuels and Other Energy Industries \ Gaseous Fuels	CO ₂	YES	Level, Trend
1.A.1.c	Manufacture of Solid Fuels and Other Energy Industries \ Liquid Fuels	CO ₂	YES	Level, Trend
1.A.1.c	Manufacture of Solid Fuels and Other Energy Industries \ Solid Fuels	CO ₂	YES	Trend
1.A.2.a	Iron and Steel \ Gaseous Fuels	CO ₂	YES	Trend
1.A.2.a	Iron and Steel \ Solid Fuels	CO ₂	YES	Trend
1.A.2.b	Non-Ferrous Metals \ Gaseous Fuels	CO ₂	YES	Level, Trend
1.A.2.b	Non-Ferrous Metals \ Solid Fuels	CO ₂	YES	Level,
1.A.2.b	Non-Ferrous Metals \ Liquid Fuels	CO ₂	YES	Trend
1.A.2.c	Chemicals \ Liquid Fuels	CO ₂	YES	Level, Trend
1.A.2.c	Chemicals \ Gaseous Fuels	CO ₂	YES	Level, Trend
1.A.2.c	Chemicals \ Solid Fuels	CO ₂	YES	Trend
1.A.2.e	Food Processing, Beverages and Tobacco \ Gaseous Fuels	CO ₂	YES	Level
1.A.2.e	Food Processing, Beverages and Tobacco \ Solid Fuels	CO ₂	YES	Trend
1.A.2.f	Other \ Mining \ Liquid Fuels	CO ₂	YES	Level, Trend
1.A.2.f	Other \ Mineral industry \ Gaseous Fuels	CO ₂	YES	Level, Trend
1.A.2.f	Other \ Mineral industry \ Solid Fuels	CO ₂	YES	Level, Trend
1.A.2.f	Other \ Construction \ Liquid Fuels	CO ₂	YES	Level, Trend
1.A.2.f	Other \ Mining \ Solid Fuels	CO ₂	YES	Trend
1.A.2.g.i	Other \ Mining \ manufacturing of machinery	CO ₂	YES	Trend
1.A.3.a	Domestic Aviation \ Liquid Fuels	CO ₂	YES	Level, Trend
1.A.3.b	Road Transportation \ Liquid Fuels	CO ₂	YES	Level, Trend
1.A.3.b	Road Transportation \ Liquid Fuels	CH ₄	YES	Trend
1.A.3.c	Railways \ Liquid Fuels	CO ₂	YES	Level, Trend
1.A.3.d	Navigation \ Liquid Fuels	CO ₂	YES	Level, Trend
1.A.3.d	Navigation \ Solid Fuels	CO ₂	YES	Trend
1.A.4.a	Commercial/Institutional \ Gaseous Fuels	CO ₂	YES	Level, Trend
1.A.4.a	Commercial/Institutional \ Liquid Fuels	CO ₂	YES	Level, Trend
1.A.4.a	Commercial/Institutional \ Solid Fuels	CO ₂	YES	Trend
1.A.4.b	Residential \ Gaseous Fuels	CO ₂	YES	Level, Trend
1.A.4.b	Residential \ Biomass	CH ₄	YES	Trend
1.A.4.b	Residential \ Liquid Fuels	CO ₂	YES	Level, Trend
1.A.4.c	Agriculture/Forestry/Fisheries \ Liquid Fuels	CO ₂	YES	Level, Trend
1.A.5.B	Mobile (please specify) \ Liquid Fuels	CO ₂	YES	Trend

A		B	C	D
IPCC Source Categories		Gas	Key Source Category Flag	If Column C is Yes, Criteria for Identification
1.B.1.A.1	Fugitives \ Soild fuels \ Underground Mines	CH ₄	YES	Level, Trend
1.B.1.A.1	Fugitives \ Soild fuels \ Underground Mines	CO ₂	YES	Level
1.B.1.a.i	Post-Mining Activities	CH ₄	YES	Trend
1.B.1.A.2.1	Surface Mining\ Mining Activities	CH ₄	YES	Level, Trend
1.B.1.c	Fugitive Emissions From Fuels, Solid Fuels, Other	CO ₂	YES	Trend
1.B.2.a.4	Refining/Storage	CO ₂	YES	Trend
1.B.2.B.2	Fugitive Emissions From Fuels, Oil and Natural Gas, Natural Gas, Production	CH ₄	YES	Level, Trend
1.B.2.B.4	Transmission and Storage	CH ₄	YES	Level, Trend
1.B.2.C.1.2	Fugitives\Venting and Flaring\Venting\Gas	CO ₂	YES	Level, Trend
1.B.2.C.1.2	Fugitives\Venting and Flaring\Venting\Gas	CH ₄	YES	Level, Trend
1.B.2.C.2.1	Fugitives \ Venting and Flaring \ Flaring \ Oil	CO ₂	YES	Level
1.B.2.C.2.2	Fugitives \ Venting and Flaring \ Flaring \ Gas	CO ₂	YES	Level, Trend
2.A.1	Cement Production	CO ₂	YES	Level, Trend
2.A.2	Lime Production	CO ₂	YES	Level
2.A.3	Glass Production	CO ₂	YES	Level
2.B.1	Ammonia Production	CO ₂	YES	Level, Trend
2.B.2	Nitric Acid Production	N ₂ O	YES	Level
2.B.9	Chemical Industry \ Fluorochemical production	HFC-23	YES	Trend
2.C.1.d	Iron and Steel\Coke	CO ₂	YES	Level, Trend
2.C.3	Aluminium Production	CO ₂	YES	Level
2.C.3	Aluminium Production	CF ₄	YES	Trend
2.C.3	Aluminium Production	C ₂ F ₆	YES	Trend
2.F.1	Refrigeration and Air Conditioning Equipment	HFC	YES	Level, Trend
3.A.1	Enteric Fermentation \ Cattle	CH ₄	YES	Level, Trend
3.A.2	Enteric Fermentation \ Sheep	CH ₄	YES	Level, Trend
3.B.1	Manure Management \ Cattle	CH ₄	YES	Trend
3.B.1	Manure Management \ Cattle	N ₂ O	YES	Trend
3.B.3	Manure Management \ Swine	CH ₄	YES	Level, Trend
3.C	Rice Cultivation	CH ₄	YES	Trend
3.D.a.1	Agricultural Soils \ Direct Soil Emissions \ Inorganic Fertilisers	N ₂ O	YES	Level, Trend
3.D.a.3	Agricultural Soils \ Direct Soil Emissions \ Urine and Dung Deposited by Grazing Animals	N ₂ O	YES	Level, Trend
3.D.a.4	Agricultural Soil \ Direct Soil Emissions \ Crop Residue	N ₂ O	YES	Level, Trend
3.D.b.2	Agricultural Soils \ Indirect Soil Emissions \ Nitrogen Leaching and Run-Off	N ₂ O	YES	Level, Trend
3.G	Liming	CO ₂	YES	Level, Trend
3.H	Urea Application	CO ₂	YES	Level, Trend
5.A	Solid Waste Disposal	CH ₄	YES	Level, Trend
5.D	Wastewater treatment and discharge	CH ₄	Yes	Level, Trend

A1.2 Kyoto Protocol LULUCF Activities

The KP-LULUCF key categories have been identified using the method documented in section 2.3.6 of IPCC 2015. The results are presented in Table A.1.7.

Table A1.7 Summary overview for key categories for Land use, Land-use Change and Forestry activities under the Kyoto Protocol – 2015

Criteria used for Key Category Identification					
Key Categories of Emissions and Removals	Gas	Associated category in UNFCCC inventory is key	Category contribution is greater than the smallest category considered key in the UNFCCC inventory (including LULUCF)	Other	Comments
Deforestation	CO ₂	forest land converted to grassland	TRUE	NA	
Deforestation	CH ₄	forest land converted to grassland	FALSE	NA	
Deforestation	N ₂ O	forest land converted to grassland	FALSE	NA	
Forest management	CO ₂	forest land remaining forest land	TRUE	NA	Australia has applied the narrow approach to forest management. As a result the forest land remaining forest land classification does not directly correspond to the forest management activity.
Afforestation/Reforestation	CO ₂	grassland converted to forest land	TRUE	NA	
Grazing land management	CO ₂	grassland remaining grassland, land converted to grassland (conversion prior to 1990)	TRUE	NA	
Grazing land management	CH ₄	grassland remaining grassland, land converted to grassland (conversion prior to 1990)	TRUE	NA	
Grazing land management	N ₂ O	grassland remaining grassland, land converted to grassland (conversion prior to 1990)	TRUE	NA	
Cropland management	CO ₂	cropland remaining cropland, land converted to cropland (conversion prior to 1990)	TRUE	NA	

ANNEX 2: Uncertainty analysis

Uncertainty is inherent within any kind of estimation – be it an estimate of the national greenhouse gas emissions, or the national gross domestic product. While it is in some cases possible to continuously monitor emissions, it is not usually practical or economic to do so. This leads to estimations based on samples or studies being used which carry a degree of additional uncertainty attached to them. Uncertainty also arises from the limitations of the measuring instruments, and over the complexities of the modeling of key relationships between observed variables and emissions.

The purpose of estimating the uncertainty attached to emissions estimates is principally to provide information on where inventory resources should be allocated to maximise the future improvements to inventory quality.

Assessing uncertainty is a difficult exercise, especially in the absence of quantitative data. Australia has conducted an uncertainty analysis for the individual sectors in line with the IPCC 2006 *Guidelines for National Greenhouse Gas Inventories*. Monte Carlo and Latin Hypercube approaches were used to estimate emission uncertainty in some sectors, which is equivalent to the IPCC tier 2 methodology. Companies with large single sources of emissions must annually report through NGERs on the level of uncertainty associated with these emissions. Statistical uncertainty must be estimated and reported by NGER reporters with emissions of more than 25 Gg CO₂-e from the combustion of a fuel type, or an IPPU, fugitive or waste source other than fuel combustion. NGER reporters must follow the methods for assessing uncertainty published in the NGER (Measurement) Determination and report a combined estimate for activity data and emission factor uncertainty. Uncertainty estimates associated with single sources of emissions first became available under NGER in 2014.

NGER uncertainty estimates have been incorporated into the national uncertainty assessment in sectors where there are a limited number of large facilities such as electricity generation, cement production, aluminum production, petroleum refining and coal mining. Estimates for other sectors have been prepared using the judgement of the sectoral expert consultants. These estimates of uncertainty were reviewed in 2005 by independent experts under protocols developed by the Australian CSIRO Atmospheric Research Division. The CSIRO report confirmed, with one or two exceptions, the quantitative judgements made in relation to uncertainty of inventory estimates and provide a strong basis for confidence in the assessments reported in this chapter.

The uncertainties for individual sectors are reported in more detail below. The estimated uncertainties tend to be low for carbon dioxide from energy consumption as well as from some industrial process emissions. Uncertainty surrounding estimates from these sources are typically as low as ± 1 –5%. Uncertainty surrounding estimates of emissions are higher for agriculture, land use change and forestry, reflecting inherently high uncertainty due to the very nature of the processes involved (e.g. biological processes). A medium band of uncertainty applies to estimates from fugitive emissions, most industrial processes and non-CO₂ gases in the energy sector. The ranges presented are broadly consistent with the typical uncertainty ranges expected for each sector, as identified in IPCC 2006.

The estimates of uncertainty surrounding the emissions estimates for individual sectors may be combined to present an estimate of the overall uncertainty for the inventory as a whole. The results of the application of the IPCC tier 1 approach to estimating the uncertainty of the inventory as a whole, which identifies separately estimates of uncertainty for both activity and emission factors where available, and which does not account for correlations between variables (unlike some of the sectoral analyses), are presented in Table A2.1.

As indicated in IPCC 2006, the tier 1 approach is valid as long as a number of restrictive assumptions are met. An alternative, more flexible approach, which relies on Monte Carlo analysis and a more detailed specification of the sources of uncertainty, is currently under consideration for development by the DEE for use in future national inventory reports. This analysis would be equivalent to the IPCC tier 2 approach and would take into consideration a number of refinements proposed by the CSIRO independent review.

The tier 1 results presented in Table A.2.1 show the estimated uncertainty surrounding the aggregate inventory estimate for 2015 to be $\pm 3.8\%$. The reported estimated uncertainty for the trend in emissions is $\pm 5.3\%$. This estimate has been calculated on the assumption that the total uncertainty for parts of agriculture, land use, land use change and forestry, and the waste sectors are uncorrelated through time.

Much of the uncertainty for the UNFCCC inventory derives from the LULUCF sector. The uncertainty for the aggregate inventory excluding LULUCF is estimated at $\pm 2.9\%$ and the uncertainty in the trend is estimated $\pm 3.1\%$ (Table A2.2).

Table A2.1 General reporting table for uncertainty including LULUCF

A	B	C	D	E	F	G	H	I	J	K	L	M	Q
IPCC Source category	Gas	Base year emissions Gg CO ₂ -e	Year t emissions Gg CO ₂ -e	Activity data uncertainty %	Emission factor uncertainty %	Combined uncertainty %	Uncert'y in total inventory %	Type A Sensit'y	Type B Sensit'y	Uncert'y in trend of EF %	Uncert'y in trend of activity data %	Uncert'y in total emissions %	footnote ref no.
		1990 Gg CO ₂ -e	2015 Gg CO ₂ -e										
1.A.1.a Electricity generation - black coal	CO ₂ -e	72,928	94,096	1.5	1.5	2.18	0.390	0.048	0.162	0.074	0.4	0.4	2
1.A.1.a Electricity generation - brown coal	CO ₂ -e	45,381	62,060	0.6	0.6	0.81	0.096	0.036	0.107	0.021	0.1	0.1	2
1.A.1.a Electricity generation - natural gas	CO ₂ -e	8,331	28,416	1.3	1.3	1.81	0.098	0.036	0.049	0.046	0.1	0.1	2
1.A.1.a Electricity generation - liquid fuels	CO ₂	2,907	4,232	2.8	2.8	4.00	0.032	0.003	0.007	0.008	0.0	0.0	1
1.A.1.a Electricity generation - liquid fuels	CH ₄	3	5	6.4	6.4	9.00	0.000	0.000	0.000	0.000	0.0	0.0	1
1.A.1.a Electricity generation - liquid fuels	N ₂ O	4	7	4.9	4.9	7.00	0.000	0.000	0.000	0.000	0.0	0.0	1
1.A.1.b Petroleum refining - liquid fuels	CO ₂ -e	4,944	3,360	12.5	12.5	17.72	0.113	-0.002	0.006	-0.024	0.1	0.1	2
1.A.1.b Petroleum refining - gaseous fuels	CO ₂ -e	583	498	6.8	6.8	9.63	0.009	0.000	0.001	0.000	0.0	0.0	2
1.A.1.c Manufacture of solid fuels and other energy industries - fossil fuels	CO ₂	7,942	18,271	2.8	2.8	4.00	0.139	0.019	0.032	0.054	0.1	0.1	1
	CH ₄	7	19	6.4	6.4	9.00	0.000	0.000	0.000	0.000	0.0	0.0	1
	N ₂ O	44	163	8.5	8.5	12.00	0.004	0.000	0.000	0.002	0.0	0.0	1
1.A.2, 1.A.4, 1.A.5 Solid fossil fuels	CO ₂	11,375	9,363	2.8	2.8	4.00	0.071	-0.002	0.016	-0.005	0.1	0.1	1
	CH ₄	3	3	6.4	6.4	9.00	0.000	0.000	0.000	0.000	0.0	0.0	1
	N ₂ O	29	24	8.5	8.5	12.00	0.001	0.000	0.000	0.000	0.0	0.0	1
1.A.2, 1.A.4, 1.A.5 Gaseous fossil fuels	CO ₂	19,644	29,570	2.8	2.8	4.00	0.225	0.020	0.051	0.057	0.2	0.2	1

A	B	C	D	E	F	G	H	I	J	K	L	M	Q
IPCC Source category	Gas	Base year emissions Gg CO ₂ -e	Year t emissions Gg CO ₂ -e	Activity data uncert'y	Emission factor uncert'y	Combined uncert'y	Uncert'y in total inventory	Type A Sensit'y	Type B Sensit'y	Uncert'y in trend of EF	Uncert'y in trend of activity data	Uncert'y in total emissions	footnote ref no.
		1990 Gg CO ₂ -e	2015 Gg CO ₂ -e	%	%	%	%	%	%	%	%	%	
	CH ₄	9	14	6.4	6.4	9.00	0.000	0.000	0.000	0.000	0.0	0.0	1
	N ₂ O	74	118	8.5	8.5	12.00	0.003	0.000	0.000	0.001	0.0	0.0	1
1.A.2, 1.A.4, 1.A.5 Liquid fossil fuels	CO ₂	18,285	27,938	2.8	2.8	4.00	0.213	0.020	0.048	0.055	0.2	0.2	1
	CH ₄	43	62	6.4	6.4	9.00	0.001	0.000	0.000	0.000	0.0	0.0	1
	N ₂ O	178	294	8.5	8.5	12.00	0.007	0.000	0.001	0.002	0.0	0.0	1
1.A.3 Transport fossil fuels	CO ₂	59,822	93,276	2.8	2.8	4.00	0.710	0.067	0.161	0.190	0.6	0.7	
	CH ₄	659	355	17.0	17.0	24.00	0.016	0.000	0.001	-0.007	0.0	0.0	
	N ₂ O	914	1,576	29.7	29.7	42.00	0.126	0.001	0.003	0.038	0.1	0.1	
1.A. Biomass fuels	CH ₄	2,427	1,023	0.0	20.0	20.00	0.039	-0.002	0.002	-0.041	0.0	0.0	8
	N ₂ O	241	291	0.0	20.0	20.00	0.011	0.000	0.001	0.003	0.0	0.0	8
1.B.1.a.i Solid Fuels - Underground Mines	CO ₂ -e	18,763	20,640	12.6	12.6	17.84	0.701	0.006	0.036	0.079	0.6	0.6	2
1.B.1.a.ii Solid Fuels - Open Cut Mines	CO ₂ -e	3,412	6011	23.8	23.8	33.65	0.385	0.005	0.010	0.120	0.3	0.4	2
1.B.1.c Solid Fuels - Other	CO ₂ -e	0	691	5.0	20.0	20.62	0.027	0.001	0.001	0.024	0.0	0.0	1,3
1.B.2.a Oil and Natural Gas - Oil	CO ₂	394	171	5.0	5.0	7.07	0.002	0.000	0.000	-0.002	0.0	0.0	1,4
1.B.2.b Oil and Natural Gas - Natural Gas	CO ₂	95	78	10.0	3.0	10.44	0.002	0.000	0.000	0.000	0.0	0.0	1,4
1.B.2 Oil and Natural Gas - Venting and Flaring	CO ₂	5,610	8,158	5.0	5.0	7.07	0.110	0.005	0.014	0.026	0.1	0.1	1,4
1.B.2.a Oil and Natural Gas - Oil	CH ₄	77	132	5.0	5.0	7.07	0.002	0.000	0.000	0.001	0.0	0.0	1,4
1.B.2.b Oil and Natural Gas - Natural Gas	CH ₄	6,168	6,657	10.0	3.0	10.44	0.132	0.002	0.011	0.005	0.2	0.2	1,4

A	B	C	D	E	F	G	H	I	J	K	L	M	Q
IPCC Source category	Gas	Base year emissions Gg CO ₂ -e	Year t emissions Gg CO ₂ -e	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Uncertainty in total inventory	Type A Sensitivity	Type B Sensitivity	Uncertainty in trend of EF	Uncertainty in trend of activity data	Uncertainty in total emissions	footnote ref no.
		1990 Gg CO ₂ -e	2015 Gg CO ₂ -e	%	%	%	%	%	%	%	%	%	
1.B.2 Oil and Natural Gas - Venting and Flaring	CH ₄	2,589	1,963	5.0	5.0	7.07	0.026	-0.001	0.003	-0.003	0.0	0.0	1,4
1.B.2.a Oil and Natural Gas - Oil	N ₂ O	4	2	2.0	20.0	20.10	0.000	0.000	0.000	0.000	0.0	0.0	1,4
1.B.2.b Oil and Natural Gas - Natural Gas	N ₂ O	1	0	2.0	20.0	20.10	0.000	0.000	0.000	0.000	0.0	0.0	1,4
1.B.2 Oil and Natural Gas - Venting and Flaring	N ₂ O	36	40	2.0	20.0	20.10	0.002	0.000	0.000	0.000	0.0	0.0	1,4
2.A.1 Cement Production	CO ₂	3,463	3,076	4.1	4.1	5.74	0.034	0.000	0.005	0.000	0.0	0.0	2
2.A.2 Lime Production	CO ₂	775	1,169	2.5	2.5	3.54	0.008	0.001	0.002	0.002	0.0	0.0	5
2.A.3 Other Process Uses of Carbonates	CO ₂	1,251	1,366	4.0	2.5	4.72	0.012	0.000	0.002	0.001	0.0	0.0	5
2.B Chemicals	CO ₂	1,113	3,263	5.0	5.0	7.07	0.044	0.004	0.006	0.019	0.0	0.0	5
	CH ₄	11	14	5.0	5.0	7.07	0.000	0.000	0.000	0.000	0.0	0.0	5
	N ₂ O	995	1230	5.0	5.0	7.07	0.017	0.001	0.002	0.003	0.0	0.0	6
	HFCs	1,425	0	0.0	27.0	27.00	0.000	-0.002	0.000	-0.060	0.0	0.1	5
2.C.1 Iron and Steel Production	CO ₂	9,203	6,670	2.5	5.0	5.59	0.071	-0.003	0.012	-0.014	0.0	0.0	5
	CH ₄	71	54	2.0	5.0	5.39	0.001	0.000	0.000	0.000	0.0	0.0	5
	N ₂ O	21	14	2.0	20.0	20.10	0.001	0.000	0.000	0.000	0.0	0.0	6
2.C.3 Aluminium Production	CO ₂	2,058	2,686	4.6	4.6	6.56	0.034	0.001	0.005	0.007	0.0	0.0	2
	PFCs	4,607	171	0.0	27.0	27.00	0.009	-0.007	0.000	-0.187	0.0	0.2	5
2.C.2 Ferroalloys Production	CO ₂ -e	323	486	2.5	5.0	5.59	0.005	0.000	0.001	0.002	0.0	0.0	5
2.C.7 Other	CO ₂ -e	190	93	2.5	5.0	5.59	0.001	0.000	0.000	-0.001	0.0	0.0	5

A	B	C	D	E	F	G	H	I	J	K	L	M	Q
IPCC Source category	Gas	Base year emissions	Year t emissions	Activity data	Emission factor	Combined uncertainty	Uncert'y in total inventory	Type A Sensit'y	Type B Sensit'y	Uncert'y in trend of EF	Uncert'y in trend of activity data	Uncert'y in total emissions	footnote ref no.
		1990 Gg CO ₂ -e	2015 Gg CO ₂ -e	%	%	%	%	%	%	%	%	%	
2.D Non-energy Products from Fuels and Solvent Use	CO ₂	280	181	2.0	3.0	3.61	0.001	0.000	0.000	0.000	0.0	0.0	1
2.H.2 Food and Beverages Industry	CO ₂	83	240	0.0	2.5	2.50	0.001	0.000	0.000	0.001	0.0	0.0	6
2.F Product Uses as Substitutes for Ozone Depleting Substances	HFCs	0	11,483	0.0	27.0	27.00	0.590	0.020	0.020	0.535	0.0	0.5	5
2.G Other Product Manufacture and Use	SF ₆	211	131	0.0	27.0	27.00	0.007	0.000	0.000	-0.003	0.0	0.0	5
3.A Enteric Fermentation	CH ₄	64,626	50,848	10.0	20.0	22.36	2.163	-0.013	0.088	-0.268	1.2	1.3	6
3.B Manure Management	CH ₄	2,085	2,565	22.4	30.0	37.42	0.183	0.001	0.004	0.035	0.1	0.1	6
	N ₂ O	405	1,025	22.4	50.0	54.77	0.107	0.001	0.002	0.057	0.1	0.1	6
3.C Rice Cultivation	CH ₄	562	325	5.0	10.0	11.18	0.007	0.000	0.001	-0.003	0.0	0.0	7
3.D Agricultural Soils	N ₂ O	11,489	12,355	25.0	50.0	55.90	1.314	0.003	0.021	0.167	0.8	0.8	7
3.F Agricultural Residue Burning	CH ₄	292	212	32.4	20.0	38.08	0.015	0.000	0.000	-0.002	0.0	0.0	7
	N ₂ O	139	106	32.4	20.0	38.08	0.008	0.000	0.000	-0.001	0.0	0.0	7
3.G Liming	CO ₂	215	1,224	20.0	50.0	53.85	0.125	0.002	0.002	0.089	0.1	0.1	8
3.H Urea application	CO ₂	367	1,352	10.0	50.0	50.99	0.131	0.002	0.002	0.088	0.0	0.1	9
4.A.1 Forest Land remaining Forest Land	CO ₂	-16,900	-26,846	15.0	30.0	33.54	-1.713	-0.020	-0.046	-0.596	-1.0	1.1	
	CH ₄	3,498	3,196	15.0	30.0	33.54	0.204	0.000	0.006	0.001	0.1	0.1	
	N ₂ O	815	741	15.0	30.0	33.54	0.047	0.000	0.001	0.000	0.0	0.0	
4.A.2 Land converted to Forest Land	CO ₂	622	-13,065	12.0	12.5	17.33	-0.431	-0.024	-0.023	-0.294	-0.4	0.5	
	CH ₄	1	44	12.0	12.5	17.33	0.001	0.000	0.000	0.001	0.0	0.0	
	N ₂ O	21	79	12.0	12.5	17.33	0.003	0.000	0.000	0.001	0.0	0.0	

A	B	C	D	E	F	G	H	I	J	K	L	M	Q
IPCC Source category	Gas	Base year emissions Gg CO ₂ -e	Year t emissions Gg CO ₂ -e	Activity data uncert'y	Emission factor uncert'y	Combined uncert'y	Uncert'y in total inventory	Type A Sensit'y	Type B Sensit'y	Uncert'y in trend of EF	Uncert'y in trend of activity data	Uncert'y in total emissions	footnote ref no.
		1990 Gg CO ₂ -e	2015 Gg CO ₂ -e	%	%	%	%	%	%	%	%	%	
4.B.1 Cropland remaining Cropland	CO ₂	-69	-4,638	25.0	20.0	32.02	-0.283	-0.008	-0.008	-0.158	-0.3	0.3	
4.B.2 Land converted to Cropland	CO ₂	16,077	4,016	11.2	25.5	27.85	0.213	-0.018	0.007	-0.465	0.1	0.5	
	CH ₄	549	115	11.2	25.5	27.85	0.006	-0.001	0.000	-0.017	0.0	0.0	
	N ₂ O	141	55	11.2	25.5	27.85	0.003	0.000	0.000	-0.003	0.0	0.0	
4.C.1 Grassland remaining Grassland	CO ₂	-4,785	-5,909	25.0	20.0	32.02	-0.360	-0.003	-0.010	-0.054	-0.4	0.4	
	CH ₄	3,492	4,582	25.0	20.0	32.02	0.279	0.002	0.008	0.049	0.3	0.3	
	N ₂ O	4,261	4,079	25.0	20.0	32.02	0.248	0.000	0.007	0.007	0.2	0.2	
4.C.2 Land converted to Grasslands	CO ₂	146,818	28,701	11.2	25.5	27.85	1.521	-0.180	0.050	-4.587	0.8	4.7	
	CH ₄	5,058	703	11.2	25.5	27.85	0.037	-0.007	0.001	-0.171	0.0	0.2	
	N ₂ O	1,337	460	11.2	25.5	27.85	0.024	-0.001	0.001	-0.033	0.0	0.0	
4.D.1 Wetlands remaining Wetlands	CO ₂	205	-44	11.0	20.0	22.83	-0.002	0.000	0.000	-0.008	0.0	0.0	
4.D.1 Wetlands remaining Wetlands	N ₂ O	2	33	10.0	100.0	100.50	0.006	0.000	0.000	0.005	0.0	0.0	
4.D.2 Land converted to Wetland	CO ₂	610	-7	11.0	25.0	27.31	0.000	-0.001	0.000	-0.024	0.0	0.0	
4.E.1 Settlements remaining Settlements	CO ₂	-101	-67	11.0	20.0	22.83	-0.003	0.000	0.000	0.001	0.0	0.0	
4.E.2 Land converted to Settlements	CO ₂	4,803	820	11.5	26.0	28.43	0.044	-0.006	0.001	-0.159	0.0	0.2	
4.E.2 Land converted to Settlements	CH ₄	163	18	11.5	26.0	28.43	0.001	0.000	0.000	-0.006	0.0	0.0	
4.E.2 Land converted to Settlements	N ₂ O	44	17	11.5	26.0	28.43	0.001	0.000	0.000	-0.001	0.0	0.0	

A	B	C	D	E	F	G	H	I	J	K	L	M	Q
IPCC Source category	Gas	Base year emissions Gg CO ₂ -e	Year t emissions Gg CO ₂ -e	Activity data uncert'y	Emission factor uncert'y	Combined uncert'y	Uncert'y in total inventory	Type A Sensit'y	Type B Sensit'y	Uncert'y in trend of EF	Uncert'y in trend of activity data	Uncert'y in total emissions	footnote ref no.
		1990 Gg CO ₂ -e	2015 Gg CO ₂ -e	%	%	%	%	%	%	%	%	%	
4.G Harvested Wood Products	CO ₂	-7,157	-4,800	10.0	20.0	22.36	-0.204	0.003	-0.008	0.058	-0.1	0.1	
5.A Solid Waste Disposal	CH ₄	15,242	8,424	0.0	19.0	19.00	0.305	-0.009	0.015	-0.177	0.0	0.2	5
5.D Wastewater Treatment and Discharge	CH ₄	4,017	2,317	0.0	26.6	26.60	0.117	-0.002	0.004	-0.061	0.0	0.1	
	N ₂ O	303	481	0.0	16.0	16.00	0.015	0.000	0.001	0.006	0.0	0.0	
5.C Incineration and Open Burning of Waste	CO ₂	73	30	0.0	40.0	40.00	0.002	0.000	0.000	-0.002	0.0	0.0	
	CH ₄	2	0	0.0	40.0	40.00	0.000	0.000	0.000	0.000	0.0	0.0	
	N ₂ O	11	0	0.0	40.0	40.00	0.000	0.000	0.000	-0.001	0.0	0.0	
5.B Biological treatment of solid waste	CH ₄	9	105	0.0	100.0	100.00	0.020	0.000	0.000	0.017	0.0	0.0	
	N ₂ O	1	11	0.0	100.0	100.00	0.002	0.000	0.000	0.002	0.0	0.0	
Total Emissions (Gg CO₂-e)		579,348	525,565										
Total Uncertainties (%)							3.8					5.3	

1. Energy Strategies; 2. NGER; 3. Dr David Williams, CSIRO; 4. Australian Petroleum Production & Exploration Association; 5. Burnbank Consulting; 6. Dr Mark Howden, CSIRO; 7. Dr Carl Meyer, CSIRO; 8. Dr Gary Richards, Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education.

Table A2.2 General reporting table for uncertainty excluding LULUCF

A	B	C	D	E	F	G	H	I	J	K	L	M	Q
IPCC Source category	Gas	Base year emissions CO ₂ -e	Year t emissions CO ₂ -e	Activity data uncert'y	Emission factor uncert'y	Combined uncert'y	Uncert'y in total inventory	Type A Sensit'y	Type B Sensit'y	Uncert'y in trend of EF	Uncert'y in trend of activity data	Uncert'y in trend of total emissions	footnote ref.no.
		1990 Gg CO ₂ -e	2015 Gg CO ₂ -e	%	%	%	%	%	%	%	%	%	
1.A.1.a Electricity generation - black coal	CO ₂ -e	72,928	94,096	1.54	1.54	2.18	0.384	0.003	0.224	0.005	0.5	0.5	2
1.A.1.a Electricity generation - brown coal	CO ₂ -e	45,381	62,060	0.58	0.58	0.81	0.095	0.011	0.148	0.006	0.1	0.1	2
1.A.1.a Electricity generation - natural gas	CO ₂ -e	8,331	28,416	1.28	1.28	1.81	0.096	0.042	0.068	0.054	0.1	0.1	2
1.A.1.a Electricity generation - liquid fuels	CO ₂	2,907	4,232	2.83	2.83	4.00	0.032	0.001	0.010	0.004	0.0	0.0	1
1.A.1.a Electricity generation - liquid fuels	CH ₄	3	5	6.36	6.36	9.00	0.000	0.000	0.000	0.000	0.0	0.0	1
1.A.1.a Electricity generation - liquid fuels	N ₂ O	4	7	4.95	4.95	7.00	0.000	0.000	0.000	0.000	0.0	0.0	1
1.A.1.b Petroleum refining - liquid fuels	CO ₂ -e	4,944	3,360	12.53	12.53	17.72	0.112	-0.007	0.008	-0.087	0.1	0.2	2
1.A.1.b Petroleum refining - gaseous fuels	CO ₂ -e	583	498	6.81	6.81	9.63	0.009	-0.001	0.001	-0.004	0.0	0.0	2
1.A.1.c Manufacture of solid fuels and other energy industries - fossil fuels	CO ₂	7,942	18,271	2.83	2.83	4.00	0.137	0.019	0.044	0.055	0.2	0.2	1
1.A.2, 1.A.4, 1.A.5 Solid fossil fuels	CH ₄	7	19	6.36	6.36	9.00	0.000	0.000	0.000	0.000	0.0	0.0	1
	N ₂ O	44	163	8.49	8.49	12.00	0.004	0.000	0.000	0.002	0.0	0.0	1
	CO ₂	11,375	9,363	2.83	2.83	4.00	0.070	-0.012	0.022	-0.034	0.1	0.1	1
1.A.2, 1.A.4, 1.A.5 Gaseous fossil fuels	CH ₄	3	3	6.36	6.36	9.00	0.000	0.000	0.000	0.000	0.0	0.0	1
	N ₂ O	29	24	8.49	8.49	12.00	0.001	0.000	0.000	0.000	0.0	0.0	1
	CO ₂	19,644	29,570	2.83	2.83	4.00	0.222	0.011	0.070	0.031	0.3	0.3	1
	CH ₄	9	14	6.36	6.36	9.00	0.000	0.000	0.000	0.000	0.0	0.0	1

A	B	C	D	E	F	G	H	I	J	K	L	M	Q
IPCC Source category	Gas	Base year emissions CO ₂ -e	Year t emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Uncertainty in total inventory	Type A Sensitivity	Type B Sensitivity	Uncertainty in trend of EF	Uncertainty in trend of activity data	Uncertainty in trend of total emissions	footnote ref no.
		1990 Gg CO ₂ -e	2015 Gg CO ₂ -e	%	%	%	%	%	%	%	%	%	
1.A.2, 1.A.4, 1.A.5 Liquid fossil fuels	N ₂ O	74	118	8.49	8.49	12.00	0.003	0.000	0.000	0.000	0.0	0.0	1
	CO ₂	18,285	27,938	2.83	2.83	4.00	0.210	0.011	0.067	0.032	0.3	0.3	1
	CH ₄	43	62	6.36	6.36	9.00	0.001	0.000	0.000	0.000	0.0	0.0	1
	N ₂ O	178	294	8.49	8.49	12.00	0.007	0.000	0.001	0.001	0.0	0.0	1
1.A.3 Transport fossil fuels	CO ₂	59,822	93,276	2.83	2.83	4.00	0.700	0.041	0.222	0.116	0.9	0.9	
	CH ₄	659	355	16.97	16.97	24.00	0.016	-0.001	0.001	-0.019	0.0	0.0	
	N ₂ O	914	1,576	29.70	29.70	42.00	0.124	0.001	0.004	0.029	0.2	0.2	
1.A. Biomass fuels	CH ₄	2,427	1,023	0.00	20.00	20.00	0.038	-0.005	0.002	-0.098	0.0	0.1	8
	N ₂ O	241	291	0.00	20.00	20.00	0.011	0.000	0.001	-0.001	0.0	0.0	8
1.B.1.a.i Solid Fuels - Underground Mines	CO ₂ -e	18,763	20,640	12.61	12.61	17.84	0.690	-0.008	0.049	-0.096	0.9	0.9	2
1.B.1.a.ii Solid Fuels - Open Cut Mines	CO ₂ -e	3,412	6,011	23.79	23.79	33.65	0.379	0.004	0.014	0.095	0.5	0.5	2
1.B.1.c Solid Fuels - Other	CO ₂ -e	0	691	5.00	20.00	20.62	0.027	0.002	0.002	0.033	0.0	0.0	1,3
1.B.2.a Oil and Natural Gas - Oil	CO ₂	394	171	5.00	5.00	7.07	0.002	-0.001	0.000	-0.004	0.0	0.0	1,4
1.B.2.b Oil and Natural Gas - Natural Gas	CO ₂	95	78	10.00	3.00	10.44	0.002	0.000	0.000	0.000	0.0	0.0	1,4
1.B.2 Oil and Natural Gas - Venting and Flaring	CO ₂	5,610	8,158	5.00	5.00	7.07	0.108	0.002	0.019	0.012	0.1	0.1	1,4
1.B.2.a Oil and Natural Gas - Oil	CH ₄	77	132	5.00	5.00	7.07	0.002	0.000	0.000	0.000	0.0	0.0	1,4
1.B.2.b Oil and Natural Gas - Natural Gas	CH ₄	6,168	6,657	10.00	3.00	10.44	0.130	-0.003	0.016	-0.008	0.2	0.2	1,4
1.B.2 Oil and Natural Gas - Venting and Flaring	CH ₄	2,589	1,963	5.00	5.00	7.07	0.026	-0.003	0.005	-0.016	0.0	0.0	1,4
1.B.2.a Oil and Natural Gas - Oil	N ₂ O	4	2	2.00	20.00	20.10	0.000	0.000	0.000	0.000	0.0	0.0	1,4

A	B	C	D	E	F	G	H	I	J	K	L	M	Q
IPCC Source category	Gas	Base year emissions CO ₂ -e	Year t emissions CO ₂ -e	Activity data uncert'y	Emission factor uncert'y	Combined uncert'y	Uncert'y in total inventory	Type A Sensit'y	Type B Sensit'y	Uncert'y in trend of EF	Uncert'y in trend of activity data	Uncert'y in trend of total emissions	footnote ref no.
		1990 Gg CO ₂ -e	2015 Gg CO ₂ -e	%	%	%	%	%	%	%	%	%	
1.B.2.b Oil and Natural Gas - Natural Gas	N ₂ O	1	0	2.00	20.00	20.10	0.000	0.000	0.000	0.000	0.0	0.0	1,4
1.B.2 Oil and Natural Gas - Venting and Flaring	N ₂ O	36	40	2.00	20.00	20.10	0.001	0.000	0.000	0.000	0.0	0.0	1,4
2.A.1 Cement Production	CO ₂	3,463	3,076	4.06	4.06	5.74	0.033	-0.003	0.007	-0.013	0.0	0.0	2
2.A.2 Lime Production	CO ₂	775	1,169	2.50	2.50	3.54	0.008	0.000	0.003	0.001	0.0	0.0	5
2.A.3 Other Process Uses of Carbonates	CO ₂	1,251	1,366	4.00	2.50	4.72	0.012	-0.001	0.003	-0.001	0.0	0.0	5
2.B Chemicals	CO ₂	1,113	3,263	5.00	5.00	7.07	0.043	0.004	0.008	0.022	0.1	0.1	5
	CH ₄	11	14	5.00	5.00	7.07	0.000	0.000	0.000	0.000	0.0	0.0	5
	N ₂ O	995	1,230	5.00	5.00	7.07	0.016	0.000	0.003	0.000	0.0	0.0	6
	HFCs	1,425	0	0.00	27.00	27.00	0.000	-0.004	0.000	-0.116	0.0	0.1	5
2.C.1 Iron and Steel Production	CO ₂	9,203	6,670	2.50	5.00	5.59	0.070	-0.012	0.016	-0.060	0.1	0.1	5
	CH ₄	71	54	2.00	5.00	5.39	0.001	0.000	0.000	0.000	0.0	0.0	5
	N ₂ O	21	14	2.00	20.00	20.10	0.001	0.000	0.000	-0.001	0.0	0.0	6
2.C.3 Aluminium Production	CO ₂	2,058	2,686	4.64	4.64	6.56	0.033	0.000	0.006	0.001	0.0	0.0	2
	PFCs	4,607	171	0.00	27.00	27.00	0.009	-0.014	0.000	-0.365	0.0	0.4	5
2.C.2 Ferroalloys Production	CO ₂ -e	323	486	2.50	5.00	5.59	0.005	0.000	0.001	0.001	0.0	0.0	5
2.C.7 Other	CO ₂ -e	190	93	2.50	5.00	5.59	0.001	0.000	0.000	-0.002	0.0	0.0	5
2.D Non-energy Products from Fuels and Solvent Use	CO ₂	280	181	2.00	3.00	3.61	0.001	0.000	0.000	-0.001	0.0	0.0	1
2.H.2 Food and Beverages Industry	CO ₂	83	240	0.00	2.50	2.50	0.001	0.000	0.001	0.001	0.0	0.0	6
2.F Product Uses as Substitutes for Ozone Depleting Substances	HFCs	0	11,483	0.00	27.00	27.00	0.581	0.027	0.027	0.738	0.0	0.7	5

A	B	C	D	E	F	G	H	I	J	K	L	M	Q
IPCC Source category	Gas	Base year emissions CO ₂ -e	Year t emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Uncertainty in total inventory	Type A Sensitivity	Type B Sensitivity	Uncertainty in trend of EF	Uncertainty in trend of activity data	Uncertainty in trend of total emissions	footnote ref no.
		1990 Gg CO ₂ -e	2015 Gg CO ₂ -e	%	%	%	%	%	%	%	%	%	
2.G Other Product Manufacture and Use	SF ₆	211	131	0.00	27.00	27.00	0.007	0.000	0.000	-0.009	0.0	0.0	5
3.A Enteric Fermentation	CH ₄	64,626	50,848	10.00	20.00	22.36	2.132	-0.074	0.121	-1.486	1.7	2.3	6
3.B Manure Management	CH ₄	2,085	2,565	22.36	30.00	37.42	0.180	0.000	0.006	-0.006	0.2	0.2	6
	N ₂ O	405	1,025	22.36	50.00	54.77	0.105	0.001	0.002	0.061	0.1	0.1	6
3.C Rice Cultivation	CH ₄	562	325	5.00	10.00	11.18	0.007	-0.001	0.001	-0.009	0.0	0.0	7
3.D Agricultural Soils	N ₂ O	11,489	12,355	25.00	50.00	55.90	1.295	-0.005	0.029	-0.266	1.0	1.1	7
3.F Agricultural Residue Burning	CH ₄	292	212	32.40	20.00	38.08	0.015	0.000	0.001	-0.008	0.0	0.0	7
	N ₂ O	139	106	32.40	20.00	38.08	0.008	0.000	0.000	-0.003	0.0	0.0	7
3.G Liming	CO ₂	215	1,224	20.00	50.00	53.85	0.124	0.002	0.003	0.113	0.1	0.1	8
3.H Urea application	CO ₂	367	1,352	10.00	50.00	50.99	0.129	0.002	0.003	0.106	0.0	0.1	9
5.A Solid Waste Disposal	CH ₄	15,242	8,424	0.00	19.00	19.00	0.300	-0.026	0.020	-0.495	0.0	0.5	5
5.D Wastewater Treatment and Discharge	CH ₄	4,017	2,317	0.00	26.60	26.60	0.116	-0.007	0.006	-0.176	0.0	0.2	
5.C Incineration and Open Burning of Waste	N ₂ O	303	481	0.00	16.00	16.00	0.014	0.000	0.001	0.004	0.0	0.0	
	CO ₂	73	30	0.00	40.00	40.00	0.002	0.000	0.000	-0.006	0.0	0.0	
	CH ₄	2	0	0.00	40.00	40.00	0.000	0.000	0.000	0.000	0.0	0.0	
	N ₂ O	11	0	0.00	40.00	40.00	0.000	0.000	0.000	-0.001	0.0	0.0	
5.B Biological treatment of solid waste	CH ₄	9	105	0.00	100.00	100.00	0.020	0.000	0.000	0.022	0.0	0.0	
	N ₂ O	1	11	0.00	100.00	100.00	0.002	0.000	0.000	0.002	0.0	0.0	
Total Emissions (Gg CO₂-e)		419,843	533,283										
Total Uncertainties (%)							2.9					3.1	

1. Energy Strategies; 2. NGER; 3. Dr David Williams, CSIRO; 4. Australian Petroleum Production & Exploration Association; 5. Burnbank Consulting; 6. Dr Mark Howden, CSIRO; 7. Dr Carl Meyer, CSIRO; 8. Dr Gary Richards, Department of Climate Change and Energy Efficiency.

A2.1 Energy

A2.1.1 Stationary energy

Uncertainty analyses were conducted for emissions from three sectors: 1.A.1.a. *Electricity*, 1.A.1.b. *Petroleum refining* and 1.A.1.c. *Manufacture of solid fuels and other energy industries* (Table A2.3).

In the electricity generation sector (black coal, brown coal and natural gas) and petroleum refining sector (liquid fuels and natural gas) the uncertainty associated with most of Australia's emissions in these sectors are reported under NGERs as source specific uncertainty estimates. The reported CO₂-e uncertainties for NGER facilities were combined to derive an overall estimate that has been applied against the sector and fuel.

In the electricity generation sector, CO₂ emissions from the combustion of coal or gas for electricity generation must be estimated using facility specific measurements. The use of facility specific measurements based on sampling and analysis of fuels results in relatively low uncertainty estimates as published in Table A2.3.

Table A2.3 Quantified uncertainty values for key stationary energy subcategories

Greenhouse gas source and sink category	Uncertainty (%) ^(a)			
	CO ₂	CH ₄	N ₂ O	Total CO ₂ -e
1.A.1.a Electricity				
Black coal ^(b)				±1.7
Brown coal ^(b)				±0.9
Petroleum	±4	±9	±7	± 4
Natural gas ^(b)				±1.6
1.A.1.b Petroleum refining				
Petroleum ^(b)				±18.4
Gas ^(b)				±9.2
1.A.1.c Manufacture of solid fuels and other energy industries				
Coal	±4	±9	±12	± 4
Petroleum	±4	±9	±12	± 4
Gas	±4	±9	±12	± 4

(a) Uncertainty reported at 95% confidence limits estimated using Latin Hypercube (a type of Monte Carlo) analysis and preliminary estimates for electricity incorporating NGER uncertainty estimates.

(b) Derived from NGER

In the fuel combustion sector the uncertainty associated with emissions of N₂O and CH₄ has negligible impact on overall uncertainty.

A2.1.2 Transport

Monte Carlo analyses were conducted for all subsectors and fuel types. The uncertainty distributions for emission factors and activity data were developed on the basis of expert judgement.

The total estimated uncertainties in the *transport* subsector were ±4% for CO₂, ±24% for CH₄, and ±42% for N₂O. Uncertainties in the emissions from individual source categories ranged from ±1% to ±24% for CO₂, ±23% to ±59% for CH₄, and ±32% to ±63% for N₂O. The largest source of uncertainty is in the emission factors.

The estimates also reflect the relatively higher uncertainty attached to the emission estimates for particular vehicle types, which are drawn from ABS data and its survey of motor vehicle use, than for the sector as a whole. This outcome reflects the dependency between activity variables; and because overall transport fuel consumption is more accurately known than the individual segments.

Table A2.4 Emissions and quantified uncertainty values for key transport subcategories

Greenhouse gas source and sink category	Uncertainty (%) ^(a)		
	CO ₂	CH ₄	N ₂ O
1.A.3. Transport	±4	±24	±42
a. Civil aviation	±9	±52	±52
b. Road transport	±4	±25	±42
i. Passenger cars	±6	±31	±44
ii. Light trucks	±7	±38	±41
iii. Medium trucks	±9	±41	±60
iv. Heavy trucks	±10	±44	±61
v. Buses	±8	±36	±53
vi. Motorcycles	±10	±43	±61
c. Railways	±5	±39	±39
d. Navigation	±8	±59	±32
e. Other transportation	±24	±46	±63
International bunkers			
Aviation	±10	±58	±59
Marine	±4	±47	±52

(a) Uncertainty reported at 95% confidence limits.

A2.1.3 Fugitives

In the coal fugitives sector uncertainty associated with most of Australia's emissions in this sector are reported under NGRS. The reported CO₂-e uncertainties for each large underground and open cut coal mine have been combined to derive a sector estimate which is reported in Table A2.5.

In the coal fugitives sector underground coal mines must directly monitor their CH₄ emissions while open cut coal mines either undertake analysis and measurements or use state based default emission factors.

The uncertainty estimates reported in Table A2.5 reflect the uncertainty associated with these measurement approaches.

Uncertainties in oil and natural gas emissions were estimated to be ±4% for CO₂, ±5% for CH₄ and ±4% for N₂O, and will be updated in future submissions.

Table A2.5 Quantified uncertainty values for key fugitive emissions subcategories

Greenhouse gas source and sink category	Uncertainty (%) ^(a)			
	CO ₂	CH ₄	N ₂ O	CO ₂ -e
1.B.1. Solid fuels				
1B1ai Underground mines				±11.7
1.B.1.a.ii. Surface mining				±26.1
1.B.2. Oil and natural gas	±4	±5	±4	±4
1.B.2.a. Oil	±8	±5	±8	±7
1.B.2.b. Natural gas	±9	±9	NA	±9
1.B.2.c. Venting and flaring	±4	±4	±4	±4

(a) Uncertainty reported at 95% confidence limits estimated using Latin Hypercube analysis.

A2.2 Industrial Processes and Product Use

An analysis of uncertainty was conducted using the methods and random sampling techniques described in IPCC 2006. Uncertainty estimates from CO₂ emissions from cement production and CO₂ from aluminum production are derived from NGER. Uncertainty estimates of the other sectors (activity levels and emission factors) are based on expert judgement.

As the IPCC tier 1 approach is not suitable for assessing uncertainty where approximately normal distribution assumptions cannot be sustained, an analysis was undertaken using Latin Hypercube techniques. These techniques can take into account asymmetric probability distributions associated with emission factors. For example, as the average emission factor for PFCs tends to the minimum limit that is understood to be technically feasible, the probability of the emission factor being lower than estimated is less than the probability of it being higher than estimated.

The uncertainty in the *industrial processes* subsectors ranged from ±4% to ±20%.

Table A2.6 Quantified uncertainty values for key industrial processes subsectors using different techniques

Source	Uncertainties and distribution ^(a)		Emission factors – uncertainties and distributions								
	Production/use	Distribution	CO ₂	Distribution	CH ₄	Distribution	N ₂ O	Distribution	CF ₄	Distribution	C ₂ F ₆
Cement production ^(b)	±3.63	Normal	±3.63	Normal	NA	NA	NA	NA	NA	NA	NA
Commercial lime	±5.00	Normal	±4.99	Normal	NA	NA	NA	NA	NA	NA	NA
In-house lime	±4.01	Normal	±5.01	Normal	NA	NA	NA	NA	NA	NA	NA
Limestone use	±8.01	Normal	±5.00	Normal	NA	NA	NA	NA	NA	NA	NA
Dolomite use	±8.00	Normal	±4.99	Normal	NA	NA	NA	NA	NA	NA	NA
Soda ash production	±5.00	Normal	NA	Stoichiometry	NA	NA	NA	NA	NA	NA	NA
Soda ash use	±5.00	Normal	NA	Stoichiometry	NA	NA	NA	NA	NA	NA	NA
Magnesia	±5.00	Normal	±5.00	Normal	NA	NA	NA	NA	NA	NA	NA
Ammonia	±7.02	Normal	±5.00	Normal	NA	NA	NA	NA	NA	NA	NA
Nitric acid	±10.00	Normal	NA	NA	NA	NA	±9.99	Normal	NA	NA	NA
Nitrous oxide	±5.00	Normal	NA	NA	NA	NA	NA	NA	NA	NA	NA
Synthetic rutile	±5.00	Normal	±5.00	Normal	NA	NA	NA	NA	NA	NA	NA
Titanium dioxide	±20.00	Normal	±5.00	Normal	NA	NA	NA	NA	NA	NA	NA
Iron and steel	±5.01	Normal	±2.05	Triangular	±3.82	Triangular	±16.33	Triangular	NA	NA	NA
Hot briquetted iron	±5.00	Normal	±4.08	Triangular	±4.34	Triangular	±9.07	Triangular	NA	NA	NA
Aluminium ^(b)	±4.61	Normal	±4.61	Normal	NA	NA	NA	NA	±27.0	Triangular	Function of CF ₄

(a) Uncertainty reported at 95% confidence limits assuming approximately normal distributions. (b) Uncertainty derived from NGER data. Source: NGER, Burnbank Consulting 2007.

A2.3 Agriculture

An uncertainty analysis was undertaken for the *agriculture* subsectors using the approach 1 propagation of error method. The uncertainties applied to activity data and emission factors were based on IPCC (2006) uncertainty estimates and expert judgement (see Table A2.7). It is planned in the future to develop approach 2 uncertainty estimates to better reflect data correlations and the complex tier 2 functions used to estimate emissions.

Table A.2.7 Uncertainty in emission estimates for agriculture sectors

Greenhouse gas source and sink categories	Uncertainty (%)		
	CH ₄	N ₂ O	CO ₂
A. Enteric fermentation	22		
B. Manure management	37	55	
C. Rice cultivation	11		
D. Agricultural soils		56	
E. Prescribed burning of savannas Burning	47	48	
F. Agricultural residue burning	38	38	
G. Liming			54
H. Urea application			51

A2.4 Land Use, Land Use Change and Forestry

Uncertainty analysis for the LULUCF sector was undertaken using the IPCC Approach 1, propagation of error method as described in IPCC 2006.

Forest land

In the sub-sector *forest land remaining forest land* activity data is derived from national statistics of forest harvesting (ABARES 2014). The uncertainty of these activity data has not been published and so is estimated to be +/-15%. The uncertainties regarding the emission factor used are also unpublished and are estimated to be +/-30%.

The sub-sector *land converted to forest land* includes *grassland converted to forest* and *wetlands converted to forest*. The uncertainty associated with the detection of forest cover gains is reported to be +/-3.5% (see Appendix 6.A). Field sampling results presented by Paul et al. 2014 indicate an uncertainty of +/-11.5% for the estimation of standing biomass. As explained in Volume 2, Section 6.5.3, the higher uncertainty around *wetlands converted forest land* contributes only a small increment to the overall uncertainty for the sub-sector.

Cropland

Cropland remaining cropland activity data are derived from ABS reporting of agricultural management practices as a regional level. The uncertainty associated with these reported activity data is estimated to be +/-25% and the uncertainty associated with model results is estimated to be +/-20%.

The sub-sector *land converted to cropland* includes *forest land converted to cropland* and *wetlands converted to cropland*. For *forest land converted to cropland*, remote sensing-based data are used and the uncertainty in these data is reported to be +/-3.5%. The key input variable to the estimation of biomass at the time of forest conversion to other land uses is the initial assumed above ground biomass. Based on data presented by Richards and Brack (2004) uncertainty in this parameter is estimated to be +/-25%.

For *wetlands converted to cropland*, as explained in Volume 2, Section 6.7.3, the higher uncertainty around *wetlands converted cropland* contributes only a small increment to the overall uncertainty for the sub-sector.

Grassland

Grassland remaining grassland activity data are derived from ABS reporting of agricultural management practices as a regional level, and from remote-sensed area changes in sparse woody vegetation.. The uncertainty associated with these reported activity data is estimated to be +/-25% and the uncertainty associated with model results is estimated to be +/-20%.

The sub-sector *land converted to grassland* includes *forest land converted to grassland* and *wetlands converted to grassland*. The remote-sensing-based activity data and FullCAM modelling of carbon stock changes for *forest converted to grassland* are similar to *forest converted to cropland*, and the activity data and estimation method for *wetlands converted to grassland* is similar to that for *wetlands converted to cropland*. As such, overall uncertainty is also similar to *land converted to cropland*.

Wetlands

Wetlands remaining wetlands data includes sparse woody vegetation cover changes based on satellite imagery and ABARES aquaculture production statistics with similar levels of uncertainty. Estimation of net emissions from sparse woody vegetation is via a Tier 2 spreadsheet model. The higher overall uncertainty around aquaculture emissions (Table A2.8 below) is driven by that of the simple Tier 1 model used to estimate N₂O emissions from aquaculture.

The sub-sector *land converted to wetlands* comprises forest land converted to flooded land (e.g. reservoirs). Activity data collection and emissions estimates, and thus uncertainty, are similar to that for forest converted to grassland.

Settlements

Settlements remaining settlements data comprises sparse woody vegetation cover changes based on satellite imagery with net emissions estimated via a Tier 2 spreadsheet model. As such, the level of uncertainty is similar to the CO₂ component of *wetlands remaining wetlands* (Table A2.8 below).

The sub-sector *land converted to settlements* includes *forest land* (both terrestrial and coastal mangrove) *converted to settlements* and *wetlands converted to settlements*. Terrestrial forest conversions exert the dominant influence on overall uncertainty. As such, although the uncertainties around emissions from mangrove forest and tidal marsh conversions are greater than for terrestrial forest conversions, their impact is relatively small.

Harvested wood products

The harvested wood products model uses the same source of activity data as the *forest land remaining forest land* model. Uncertainties associated with these activity data are estimated to be +/-10%. Estimated uncertainty associated with the harvested wood products carbon stock change were derived as reduced form outputs of monte carlo analyses (see chapter 6.13) providing an uncertainty of +/-20%.

Table A2.8 Estimation of uncertainties in components of the land use change and forestry subsectors

Greenhouse gas source and sink categories	Uncertainty (%)		
	CO ₂	CH ₄	N ₂ O
A.1 Forest land remaining forest land	± 33.5	± 33.5	± 33.5
A.2 Land converted to forest land	± 17.3	± 17.3	± 17.3
B.1/C.1 Cropland/Grassland remaining	± 32.0	± 32.0	± 32.0
B. 2/C.2 Forest land converted to Cropland/Grassland	± 27.9	± 27.9	± 27.9
D.1 Wetlands remaining Wetlands	± 22.8		± 100.5
D.2 Land converted to Wetlands	± 27.3		
E.1 Settlements remaining Settlements	± 22.8		
E.2 Land converted to Settlements	± 28.4		
G Harvested wood products	± 20.0		

A2.5 Waste

Estimates for uncertainty for emissions from solid waste disposal and wastewater treatment were estimated by Blue Environment. Estimates of uncertainty for biological treatment and incineration are based on expert judgement.

Table A2.9 Relative uncertainty in emission estimates for key waste subsectors

Greenhouse gas source and sink categories	Uncertainty (%)		
	CO ₂	CH ₄	N ₂ O
Waste			
A. Solid waste disposal on land ^(a)	NA	± 19.00	NA
D. Biological treatment of solid waste	NA	± 100	± 100
C. Incineration and open burning of waste	± 40	± 40	± 40
D. Wastewater treatment and discharge ^(a)	NA	± 26.60	± 16.00

(a) Source Blue Environment 2016

ANNEX 3: Other Detailed Methodological Descriptions

The Australian methodology for the estimation of this inventory is documented in the relevant chapters.

ANNEX 4: Carbon dioxide reference approach for the energy sector

A4.1 Estimation of CO₂ using the IPCC reference approach

The reference approach estimates CO₂ emissions from *fuel combustion activities* (covering both *stationary energy* and *transport*). It is calculated using a top-down approach based on Australia's energy balance statistics for production, imports, exports and stock change. Data are obtained from the Australian Energy Statistics published by the Department of Industry, Innovation and Science (DIIS) with supplementary sectoral-specific data where available. The Australian Petroleum Statistics are used as a basis for the liquid fossil fuel data.

A4.2 Comparison of Australian methodology with IPCC reference approach

For 2015, the total CO₂ emissions estimated using Australia's sectoral approach methodology are 370.0 Mt. Total CO₂ emissions estimated using the reference approach are 370.1 Mt – this is a 0.01% difference between the two methods.

The sectoral approach has been recalculated for the period from 2003 to 2014. This was made in response to improvements made in the Australian Energy Statistics (AES) by DIIS. The reference approach has also been recalculated for the period from 2003 to 2014 due to improved data from AES. The recalculations are presented in Table A4.1.

Table A4.1 Reference approach and sectoral approach comparison for 1990 to 2015

Year	IPCC Reference (CO ₂ (Mt))	Sectoral (CO ₂ Mt)	Difference in %
1990	254	252	1.12%
1991	258	254	1.46%
1992	259	258	0.19%
1993	266	262	1.32%
1994	269	265	1.30%
1995	277	276	0.33%
1996	287	283	1.47%
1997	291	291	0.03%
1998	306	304	0.52%
1999	314	313	0.28%
2000	319	318	0.25%
2001	324	326	-0.59%
2002	331	331	0.02%
2003	337	336	0.04%
2004	349	349	0.11%
2005	356	355	0.50%
2006	355	359	-1.01%
2007	365	365	-0.09%

Year	IPCC Reference (CO ₂ (Mt))	Sectoral (CO ₂ Mt)	Difference in %
2008	370	372	-0.57%
2009	380	378	0.74%
2010	374	373	0.35%
2011	373	370	0.75%
2012	381	375	1.47%
2013	370	367	0.71%
2014	361	363	-0.56%
2015	370	370	0.01%

The overall difference between the reference approach and the sectoral approach is within 2% for all years. In the case of petroleum fuels, the difference between the reference approach and the sectoral approach exceeds 2% for some years (up to 3.78% in 1996). The main reason for the differences in petroleum fuels relates to the sensitivity of final apparent consumption and emissions to the average density and energy content values used to convert production, exports, imports and stock changes from volume/mass units into energy units.

ANNEX 5: Assessment of Completeness

The UNFCCC guidelines require inventory compilers to assess inventories for the level of completeness of national inventories. The sources of greenhouse gas emissions are many and diverse and, in general, are not directly observable without considerable cost. Many emission sources are minor and resource intensive to estimate. Consequently, all national inventories have minor omissions which, for transparency, need to be identified. This section addresses the completeness of key activity datasets, such as the consumption of fossil fuels, and the completeness of the coverage of emissions and removals sources for the Australian inventory.

A5.1 Completeness of activity data

The emission estimates were reviewed for internal consistency and completeness through the application of mass balance approaches to ensure the reconciliation of carbon supplies and carbon uses within the economy for fossil fuels, carbonates and biomass entering the economy. Details have been provided in the respective sectoral chapters. An overview of the mitigation strategies and control measures adopted, monitoring mechanisms employed and quality objectives or targets results specified is provided in Annex 6.

A5.2 Omitted emission sources

The UNFCCC reporting guidelines provide standard reporting templates that are designed to accommodate the circumstances of as many countries as possible. The reporting templates are not always closely aligned with Australia's circumstances. Consequently, in Australia's reporting tables there are a number of categories where the term "not occurring" has been reported for certain cells because of an absence of a certain economic activity. An example is *adipic acid* production, which does not occur in Australia.

Nonetheless, there are a small number of emission sources which are believed to be minor and which are reported as "not estimated" either because of a lack of data or because the emission processes are not well enough understood to permit the development of reliable methodologies. In these instances, default methodologies are not specified by the IPCC due to limited understanding internationally of these processes. One example is CO₂ from Burning of Coal Deposits and Waste Piles (1.B.1). The spontaneous combustion of waste piles is a known source of CO₂ emissions. Research undertaken on the measurement of this emission source has not yet been able to develop any reliable approach to the estimation of this emission source. The *2006 IPCC Guidelines* do not include a default methodology that could be applied in the absence of information on this source.

The UNFCCC reporting guidelines (FCCC/CP/2013/10/Add.3) also allow minor emission sources to be reported as "not estimated" where a disproportionate amount of effort would be required to collect data for a category that would be insignificant in terms of the overall level and trend in national emissions (i.e. <0.05% of national emissions excluding LULUCF and not exceeding 500 kt CO₂-e). Sources reported as NE under this provision include: 2.G.3 N₂O from product uses (imports), 3.D.1.d other organic fertilisers, and 5.C.1 Incineration and open burning of waste – clinical waste (CH₄ and N₂O).

Australia's emissions of N₂O from product uses (imports) (2.G.3) are not estimated since no data is available on imports. Australia will investigate the availability of import data with the aim to include this source of emissions in future inventory submissions.

The organic fertilisers used in Australia are principally derived from animal wastes (3.D.1.d). Emissions from this organic N source are covered elsewhere. Data on the application of other organic N fertiliser is not available through either ABS or industry data collections, nor is a comprehensive list of organic fertiliser producers

available. To assess the significance of the category, data was sourced from one of the largest commercial producers. They reported production of meat and fish meal containing 117.8 tonnes of Nitrogen. Applying the IPCC default EF of 1% this equates to 0.55kt CO₂-e of emissions. Even allowing for the complete estimate to be over 900 times greater, this category can be considered insignificant (<500 kt CO₂-e.).

The use of urea based additives (diesel emissions fluid DEF) in catalytic converters is occurring in Australia. A certain proportion of heavy vehicles and passenger vehicles designed to meet Euro 5 emission standards are equipped with engine emission control systems using selective catalyst reduction (SCR) technology. The vast majority of DEF consumption will be in the heavy vehicle fleet. In Australia, around 4 million kL of diesel fuel is consumed by heavy vehicles. Manufacturers of heavy diesel engines cite around 2% consumption of DEF to diesel. Assuming every Euro 5 compliant heavy vehicle used SCR technology, this consumption equates to around 3000 tonnes of CO₂ attributed to urea based catalysts. Therefore, this category can be considered insignificant (<500 kt CO₂-e.).

For the incineration of clinical waste and solvents (5.C.1), the 2006 IPCC guidelines do not provide default CH₄ and N₂O emission factors. Furthermore, when the highest 2006 IPCC default EFs for CH₄ and N₂O listed for municipal solid and general industrial waste incineration are applied to the AD for clinical waste and solvents incineration, emissions estimates contribute around 0.0001% (0.7 Gg CO₂-e) of total emissions from all sectors. Accordingly, emissions of CH₄ and N₂O from this source can be considered insignificant (<500 kt CO₂-e.).

In LULUCF, Australia uses a combination of Approach 3 (for conversions to and from forest land) and Approach 1 (for other land uses) for land representation, as described by the IPCC 2006 Guidelines Vol. 4, chapter 3. As such, some conversion categories cannot be separately reported, but in accordance with the IPCC 2006 Guidelines, this does not represent a lack of completeness. Some conversions to croplands, grasslands, wetlands or settlements are included in lands remaining in that category. For conversions where separate estimates and activity data are not provided, table A.5.1 identifies where these conversion categories are included elsewhere. Planned improvements are underway to develop a fully spatially explicit time series of land-use maps to apply Approach 3, land representation, to all land-uses. Such improvements will enable reporting of separate activity data and emissions estimates for all conversion categories.

Table A.5.1 LULUCF reporting matrix

Final land use	Initial land-use						
	from to	Forest land (a)	Cropland (a)	Grassland (a)	Wetlands (a)	Settlements (a)	Other land
	Forest land (a)	R	Reported under <i>Grassland converted to Forest land</i>	R	R	Reported under <i>Grassland converted to Forest land</i>	NO
	Cropland (a)	R	R	Included in <i>Cropland remaining Cropland</i> (crop-pasture rotations)	R	NO	NO
	Grassland (a)	R	Included in <i>Cropland remaining Cropland</i> (crop-pasture rotations)	R	R	NO	NO
	Wetlands (a)	R	Included in Wetlands remaining wetlands (b)	Included in Wetlands remaining wetlands (b)	R	NO	NO
	Settlements (a)	R	Included in Settlements remaining settlements (b)	Included in Settlements remaining settlements (b)	R	R	NO
	Other land	NO	NO	NO	NO	NO	R

(a) Australia considers all land to be managed, except for *other land*, therefore there is no land in unmanaged land sub-categories and there are no transitions from managed to unmanaged land or vice-versa.

(b) Australia applies Approach 3 spatially explicit tracking of annual conversions to and from forest lands and Approach 1 for areas under grasslands, wetlands and settlements. As a result, only total areas are known for the areas under the latter conversion categories, not the prior land-use. In accordance with the *IPCC 2006 Guidelines*, emissions and removals are estimated using the methods for land remaining in a land category where the prior land-use is not known.

In this submission, Australia has prepared estimates for the voluntary reporting category of wetlands for the first time, based on the *2013 Wetlands Supplement*. This initial submission captures activities relating to coastal wetlands, with a focus on mangrove forest and tidal marsh habitats, along with aquaculture production. As explained in Chapter 6, planned improvements, Australia plans to extend coastal wetland coverage to seagrass habitats and later expand scope to activities relating to inland wetland habitats.

ANNEX 6: Additional information: quality controls including Australia's National Carbon Balance

A6.1 Additional information on the QA/QC Plan

The management of the QA/QC activities relating to the inventory are undertaken by the National Inventory Team within the Department of the Environment and Energy (DEE) and detailed in the *National Greenhouse Accounts: Quality Assurance-Quality Control Plan*. An overview of the quality control system is provided in Chapter 1 while sector-specific information on quality control activities has been included in the QA/QC sections of each chapter. This Annex provides additional information and, in particular, provides information in relation to three aspects of the quality control system: i) a detailed description of the quality control measures in place; ii) results of the carbon balance for the economy; and iii) a description of Australia's responses to the recommendations contained in the previous UNFCCC ERT report.

The objectives of the national inventory quality system are to support the provision of emission estimates that meet the UNFCCC criteria of accuracy; time series consistency; transparency, completeness and comparability of estimates with those of other parties.

Key risks to the attainment of the defined quality objectives are identified at each level of inventory preparation including the measurement of data at the facility level; the collation of activity and other input data by DE and other agencies; and the process of emissions estimation.

Specified mitigation strategies, measures and routine actions are deployed to control the identified risks.

These strategies range from utilisation of data measurements governed by existing national measurement systems such as the National Measurement Act or various taxation acts to the use of automated quality control tools embedded in the Australian Greenhouse Emissions Information System (AGEIS). Principal mitigation strategies and control measures are set out in Table A6.1.

Monitoring of the quality measures and evaluation of the results are critical to the goal of maintaining the system's effectiveness. In particular, control measures include the use of mass balance checks for all years to assess completeness and accuracy. All carbon entering the market economy is accounted for – either as emissions or stored in products or stored in wastes. Carbon balances for fuels, biomass, carbonates, synthetic gases and wastewater consumption have been constructed and the results presented as Australia's National Carbon Balance in Table A6.2.

In response to a recommendation by the previous UNFCCC ERT reports, models have been developed to demonstrate the flows of fugitive methane and carbon dioxide associated with underground and surface coal mines. The underground coal mine model shown in Figure A6.2 also demonstrates the effectiveness of methane capture for electricity generation and flaring in reducing the net fugitive emissions – capturing 40% of the gross methane generated from underground coal mining.

External review of the inventory is a critical part of the process of ensuring the quality of the estimates. In principle, the Australian inventory is subject to audit by the Australian National Audit Office (ANAO), and a performance audit was conducted by the ANAO in 2009 and 2016-17. In addition, each year the inventory is reviewed by international experts organised as part of the UNFCCC expert review team process. In Tables A6.6a to A6.6e, the recommendations of previous UNFCCC ERT reports have been included for increased transparency and a summary of Australia's responses included. These tables provide a tool for tracking the management of the ERT recommendations and suggestions.

Table A6.1 Summary of principal mitigation strategies and quality control measures

Measure No.	Quality objective	Mitigation strategy or control measure	Target	Monitoring mechanism	2006 IPCC Guidelines Vol 1 cross reference
Measurement					
1.A.1	Accuracy, completeness and time series consistency	National emissions reporting system subject to national measurement system and Australian regulations and international standards as specified in the NGER Measurement Determination 2008	Compliance	Department of the Environment and Energy	6.7.2.2, page 6.16
1.A.1 (ii)	Accuracy, completeness and time series consistency	Agriculture and transport data subject to measurement standards of the Australian Bureau of Statistics	Compliance	Department of the Environment and Energy	6.7.2.2,
1.A.1 (iii)	Accuracy, completeness and time series consistency	Geospatial data	<10% of SLATS forest clearing	Department of the Environment and Energy	6.7.2.2,
1.A.1 (iv)	Accuracy, completeness and time series consistency	Climate data received by the Department subjected to rigorous visual and quantitative checks based on ensuring 1) no null values 2) coverage of entirety of Australia 3) free of errors while ingesting into FullCAM	Compliance	Department of the Environment and Energy	6.7.2.2,
1.A.2	Accuracy	Data submitted under NGER subject to Clean Energy Regulator Scheme Audit and Assurance unit	Compliance	Department of the Environment and Energy	6.7.2.2, page 6.16
1.B.1	Comparability	Integration of national and facility estimation methods within National Greenhouse Accounts Framework	Compliance	Department of the Environment and Energy	6.7.1.2 page 6.12
1.D.1	Transparency	Company level data published by the Clean Energy Regulator under the NGER Act 2007	Compliance	Department of the Environment and Energy	6.5, page 6.8
Collated data used for national emissions estimation					
2.A.1	Accuracy	Comparison of energy data with independent sources of activity data	<2%	AGEIS Automated Report	6.7.2.1, page 6.15
2.A.2	Accuracy	External consultants operate QC protocol	Compliance	National Inventory Team	6.4, page 6.16
2.A.3	Accuracy	Quality control systems for external data providers	Compliance	Agency governance boards	6.4, page 6.16

Measure No.	Quality objective	Mitigation strategy or control measure	Target	Monitoring mechanism	2006 IPCC Guidelines Vol 1 cross reference
2.B.1	Completeness	Application of standardised rules for use of facility level data in national inventory	Compliance	National Inventory Team	Table 6.1, page 6.11; Section 6.7.2.1, page 6.15
2.B.2 (i)	Completeness	Reconciliation of estimates of carbon in fuel supplies to the Australian economy and carbon contained in emissions; or stored in products; or non-oxidised; or in permanent storage	<0.1%	AGEIS Automated Report	Table 6.1, page 6.11; Section 6.7.2.1, page 6.15
2.B.2 (ii)	Completeness	Reconciliation of estimates of carbon in carbonate supplies to the Australian economy and carbon contained in emissions; or stored in products; or waste residues or in permanent storage	<0.1%	AGEIS Automated Report	Table 6.1, page 6.11; Section 6.7.2.1, page 6.15
2.B.2 (iii)	Completeness	Reconciliation of estimates of carbon in biomass supplies to the Australian economy and carbon contained in emissions or stored in products or waste residues or in permanent storage	<1%	AGEIS Automated Report	Table 6.1, page 6.11; Section 6.7.2.1, page 6.15
2.B.2 (iv)	Completeness	Reconciliation of estimates of carbon in wastewater to the Australian economy and carbon contained in emissions or stored in products or waste residues or in permanent storage	<1%	AGEIS Automated Report	Table 6.1, page 6.11; Section 6.7.2.1, page 6.15
2.B.2 (v)	Completeness	Reconciliation of estimates of nitrogen in wastewater to the Australian economy and nitrogen contained in emissions or stored in products or other by-products	<1%	AGEIS Automated Report	Table 6.1, page 6.11; Section 6.7.2.1, page 6.15
2.B.2 (vi)	Completeness	Reconciliation of estimates of carbon in synthetic gases supplied to the Australian economy and synthetic gases contained in emissions or stored in products or destroyed	<1%	AGEIS Automated Report	Table 6.1, page 6.11; Section 6.7.2.1, page 6.15

Measure No.	Quality objective	Mitigation strategy or control measure	Target	Monitoring mechanism	2006 IPCC Guidelines Vol 1 cross reference
2.B.2 (viii)	Completeness	Reconciliation of estimates of land allocated to land use and land use change classifications and aggregated total land supply.	<0.1%	National Inventory Report	Table 6.1,
National Emissions Estimation					
3.A.1 (i)	Accuracy	Selection of emission estimation methodologies should be consistent with IPCC Good Practice and comparable with international practice	Compliance	NGGI Committee	IPCC Good Practice Guidance
3.A.1 (ii)	Accuracy	Tier 2 (3) model parameters should not be significantly different to the mean of NGERs facility-specific data.	Compliance	National Inventory Team	IPCC Good Practice Guidance
3.A.1 (iii)	Accuracy	Tier 2 (3) model parameters should not be significantly different to results from the public empirical research program that meet specified conditions for quality	Compliance	National Inventory Team	IPCC Good Practice Guidance
3.A.1 (iv)	Accuracy	Tier 2 (3) model parameters should not be significantly different to results from privately measured datasets that meet specified conditions for quality	Compliance	National Inventory Team	IPCC Good Practice Guidance
3.A.2 (i)	Accuracy	AGEIS development in accordance with COBIT	Compliance	AGEIS and FullCAM Advisory Board	AGEIS implementation report
3.A.2 (ii)	Accuracy	AGEIS operation in accordance with COBIT	Compliance	AGEIS and FullCAM Advisory Board	AGEIS implementation report
3.A.2 (iii)	Accuracy	Allocation of separate staff roles and responsibilities	Compliance	AGEIS and FullCAM Advisory Board	6.4, page 6.7
3.A.2 (iv)	Accuracy	FullCAM development in accordance with COBIT	Compliance	AGEIS and FullCAM Advisory Board	AGEIS implementation report
3.A.2 (v)	Accuracy	FullCAM operation in accordance with COBIT	Compliance	AGEIS and FullCAM Advisory Board	AGEIS implementation report
3.A.3	Accuracy	Validation of selected AGEIS estimates by sectoral experts	<0.1%	National Inventory Team	6.7.3, page 6.16

Measure No.	Quality objective	Mitigation strategy or control measure	Target	Monitoring mechanism	2006 IPCC Guidelines Vol 1 cross reference
3.A.4	Accuracy	The estimated uncertainty of the overall inventory should decline over time	Compliance	National Inventory Team	6.9, page 6.18
3.A.5	Accuracy	Number of significant accuracy issues raised by the UNFCCC ERT 2016, and agreed by the Department, should reduce over time	Compliance	Department of the Environment and Energy Assessment of UNFCCC ERT report	6.8, page 6.18
3.B.1 (i)	Completeness	Reconciliation of fuel data submitted into the AGEIS and carbon contained in emissions or stored in products or non-oxidised or permanent storage	<0.001%	AGEIS Automated Report	Table 6.1, page 6.10; 6.7.3 page 6.16
3.B.1 (ii)	Completeness	Reconciliation of carbonate data submitted into the AGEIS and carbon contained in emissions or stored in products or waste residues or in permanent storage	<0.001%	AGEIS Automated Report	Table 6.1, page 6.10; 6.7.3 page 6.16
3.B.1 (iii)	Completeness	Reconciliation of biomass data submitted into the AGEIS and carbon contained in emissions or stored in products or waste residues or in permanent storage	<0.001%	AGEIS Automated Report	Table 6.1, page 6.10; 6.7.3 page 6.16
3.B.1 (iv)	Completeness	Reconciliation of carbon in wastewater data submitted into the AGEIS and carbon contained in emissions or stored in products or waste residues or in permanent storage	<0.001%	AGEIS Automated Report	Table 6.1, page 6.10; 6.7.3 page 6.16
3.B.1 (v)	Completeness	Reconciliation of nitrogen in wastewater data submitted into the AGEIS and nitrogen contained in emissions or stored in other by-products	<0.001%	AGEIS Automated Report	Table 6.1, page 6.10; 6.7.3 page 6.16
3.B.1 (vi)	Completeness	Reconciliation of carbon in synthetic gases in data submitted into the AGEIS and carbon contained in emissions or stored in products or destroyed	<0.001%	AGEIS Automated Report	Table 6.1, page 6.10; 6.7.3 page 6.16

Measure No.	Quality objective	Mitigation strategy or control measure	Target	Monitoring mechanism	2006 IPCC Guidelines Vol 1 cross reference
3.B.1 (vii)	Completeness	Reconciliation of carbon in forests and soils in data submitted into the FullCAM and carbon contained in emissions or stored in products or destroyed	<0.001%	ABARES Australia's State of Forests Report	Table 6.1,
3.B.1 (viii)	Completeness	Reconciliation of carbon in fossil fuels, carbonates, biomass, synthetic gases and wastewater in data submitted into the AGEIS and carbon contained in emissions or stored in products or destroyed.	<0.001%	AGEIS Automated Report	Table 6.1, page 6.10; 6.7.3 page 6.16
3.B.2 (i)	Completeness	Reconciliation of National Inventory with aggregate of State and Territory inventories	<0.1%	AGEIS Automated Report	Table 6.1, page 6.10; 6.7.3 page 6.16
3.B.2 (ii)	Completeness	Reconciliation of the National Greenhouse Gas Inventory with the National Inventory by Economic Sector	<0.1%	AGEIS Automated Report	6.7.2.1, page 6.14
3.B.2 (iii)	Completeness	Reconciliation of the National Greenhouse Gas Inventory against OLAP output from the AGEIS database	<0.1%	AGEIS Automated Report	Table 6.1, page 6.10
3.B.3	Completeness	Number of emission sources 'not estimated', for which IPCC methods exist, comparable with international practice	Compliance	Department of the Environment and Energy assessment of UNFCCC ERT report	6.7.2.1, page 6.14
3.B.4	Completeness	Number of significant completeness issues raised by the UNFCCC ERT 2015, and agreed by the Department should reduce over time	Compliance	Department of the Environment and Energy assessment of UNFCCC ERT report	6.8, page 6.18
3.C.1	Comparability	Implied emission factors for key variables should not be significantly different to those of other UNFCCC reporting parties	Compliance	AGEIS Automated Report	6.8, page 6.18
3.C.2	Comparability	The number of significant comparability issues raised by the UNFCCC ERT 2016 and agreed by the Department, should reduce over time	Compliance	Department of the Environment and Energy assessment of UNFCCC ERT report	6.8, page 6.18

Measure No.	Quality objective	Mitigation strategy or control measure	Target	Monitoring mechanism	2006 IPCC Guidelines Vol 1 cross reference
3.C.3	Comparability	Recalculation percentages for the national inventory Annex A sectors should not be significantly different to those of other UNFCCC reporting parties over time	Compliance	AGEIS automated report	6.8, page 6.18
3.D.1	Time series	Analysis by category for time series consistency	Compliance	AGEIS automated report	Table 6.1, page 6.11
3.D.2	Time series	The number of significant time-series consistency issues raised by the UNFCCC ERT 2016, and agreed by the Department, should reduce over time	Compliance	Department of the Environment and Energy assessment of UNFCCC ERT report	Table 6.1, page 6.11
3.E.1	Transparency	Publication of assumptions, methodologies, data sources and emission estimates in the National Inventory Report and related products	Compliance	National Inventory Team	6.5, page 6.8
3.E.2	Transparency	Publication of the AGEIS emissions database on the Department of the Environment and Energy website	Compliance	National Inventory Team	6.5, page 6.
3.E.3	Transparency	The number of significant clarifications on methodological descriptions required by the UNFCCC ERT 2015, and agreed by the Department, should reduce over time	Compliance	Department of the Environment and Energy assessment of UNFCCC ERT report	6.5, page 6.8

A6.2 Australia's National Carbon Balance

Table A6.2 Australia's National Carbon Balance 2015

Supply	Kt C	Uses	Kt C
Fossil fuel consumption* (a)	110,259	<i>Emissions</i>	
Carbonate consumption (a)	1,895	1.A Combustion emissions (fossil fuels)	100,911
Hydrofluorocarbon consumption (d)	3,954	1.B Fugitive emissions	47
		2.A Industrial process fossil fuel emissions	3,846
		Memo: International bunker fuels	3,688
		2.A Mineral product carbonate emissions	1,864
Biomass consumption		2.F Hydrofluorocarbon emissions (d)	3,132
Wood and paper products (a)	5,591	Memo: Combustion emissions (wood products and waste)	361
Bagasse, ethanol, biogas (b)	3,115	Memo: Combustion emissions (bagasse, ethanol, biogas)	3,115
Firewood (b)	1,061	Memo: Combustion emissions (all wood)	1,912
		5.A Landfill emissions from HWP	302
Waste disposal (food, garden, textiles, rubber – landfill)(c)	1,251	5.A Landfill emissions from non-HWP	742
		Aerobic treatment processes (paper, wood and wood waste)	1,308
		<i>Increment to product stocks</i>	
		Petrochemical and steel products	49
		Carbonate products	10
		Hydrofluorocarbon products (d)	701
		Increment to HWP stocks	2,343
		Biomass fibre recycled	1,005
		<i>Increment to waste stocks and residues</i>	
		Carbon dioxide captured for permanent storage	0
		Non-oxidised carbon*	867
		Carbonate wastes	21
		Increment to HWP waste in landfill	271
		Increment to non-HWP waste in landfill	510
		<i>Miscellaneous</i>	
		Hydrofluorocarbons destroyed	121
		Residual	-1
Total supply	127,126	Total uses	127,126

Notes: (a) entering market; (b) final consumption; (c) entering waste stream; (d) based on carbon dioxide equivalents.

* Coal fuelled electricity generation assumes the NGERs oxidation factor of less than 100% oxidation.

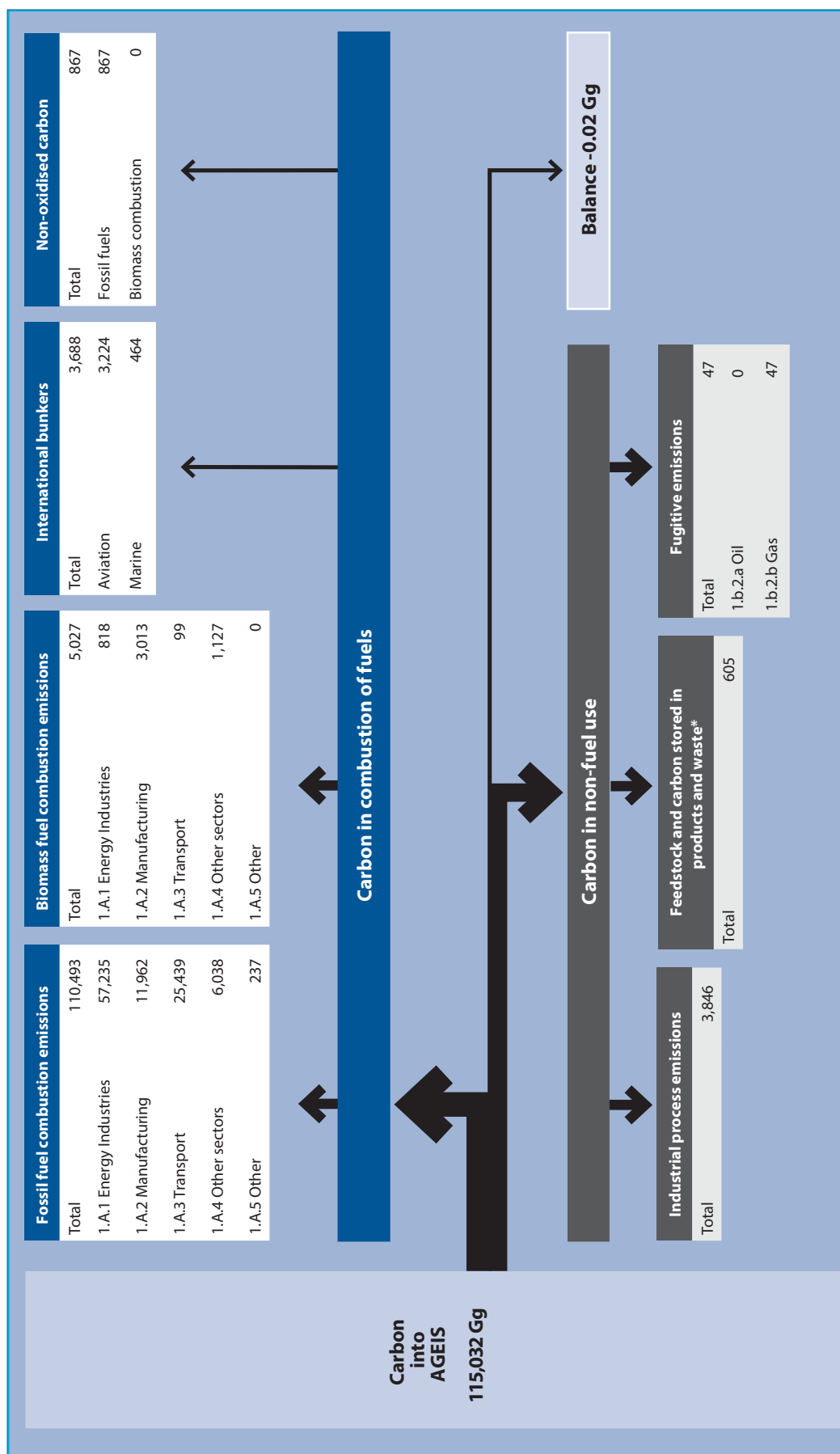
Australia's National Carbon Balance records the supply of carbon entering the market economy through the most important channels and tracks the uses or fates of that carbon allocated amongst greenhouse emissions, increments to the stock of carbon in products and increments to the stock of carbon in waste residues. Of the 127,126 kt C of carbon entering the market economy, 121,228 kt C is estimated to result in greenhouse gas emissions; 4,109 kt C is estimated to result in increments of the carbon stock in products and 1,668 kt C is estimated to result in increments to carbon stored in waste product and residues.

Assessments of the total amount of carbon in stock are more difficult to assess and depend critically on starting assumptions. Bearing this in mind, it is estimated that there is approximately 39 Mt of carbon stored in harvested wood products in Australia and about 91 Mt of carbon stored in landfills. The latter estimate relies on the relatively strong assumption that all landfills have been maintained in order to fulfil anaerobic conditions. If the alternative assumption was adopted, such that it was assumed that all landfills were eventually exposed to aerobic conditions, then the amount of carbon stored in landfills would tend to zero over very long time periods.

The National Carbon Balance is also used as a quality control tool. The Australian inventory utilises a very large number of disaggregated data inputs for energy-related emission calculations (~15 000 per year). Consequently, a carbon balance is undertaken to compare carbon input to carbon output for all years. The carbon input represents the carbon embodied within the total quantity of energy and non-energy fuels which have been consumed in a year, and are entered into the AGEIS for calculation. The carbon output represents the distribution of the carbon utilised throughout the economy, as determined by the output of the calculations within the AGEIS. The carbon output is distributed as either emissions from fuel combustion, emissions from the use of fossil fuels as reductants, non-energy uses (e.g. feedstocks, bitumen, coal oils and tar), use of biomass sources of energy and international bunkers. While the predominant outcome of carbon entering the economy is emissions, a small portion of the carbon is stored in carbon-containing products or non-oxidised as ash. A flow chart detailing the results of the carbon balance for 2015 is at Figure A6.1.

Results from the carbon balance have shown that all carbon is effectively accounted for. For 2015, all carbon has been accounted for down to 0.0005%, which is within the tolerance levels prescribed in the Quality Assurance/Quality Control Plan.

Figure A6.1 Balance flow chart showing carbon inputs and distribution of outputs for 2015



* Include CO₂ captured for temporary storage and transfer offsite

Figure A6.2 Fugitive gas balance flow chart for underground mines, 2015

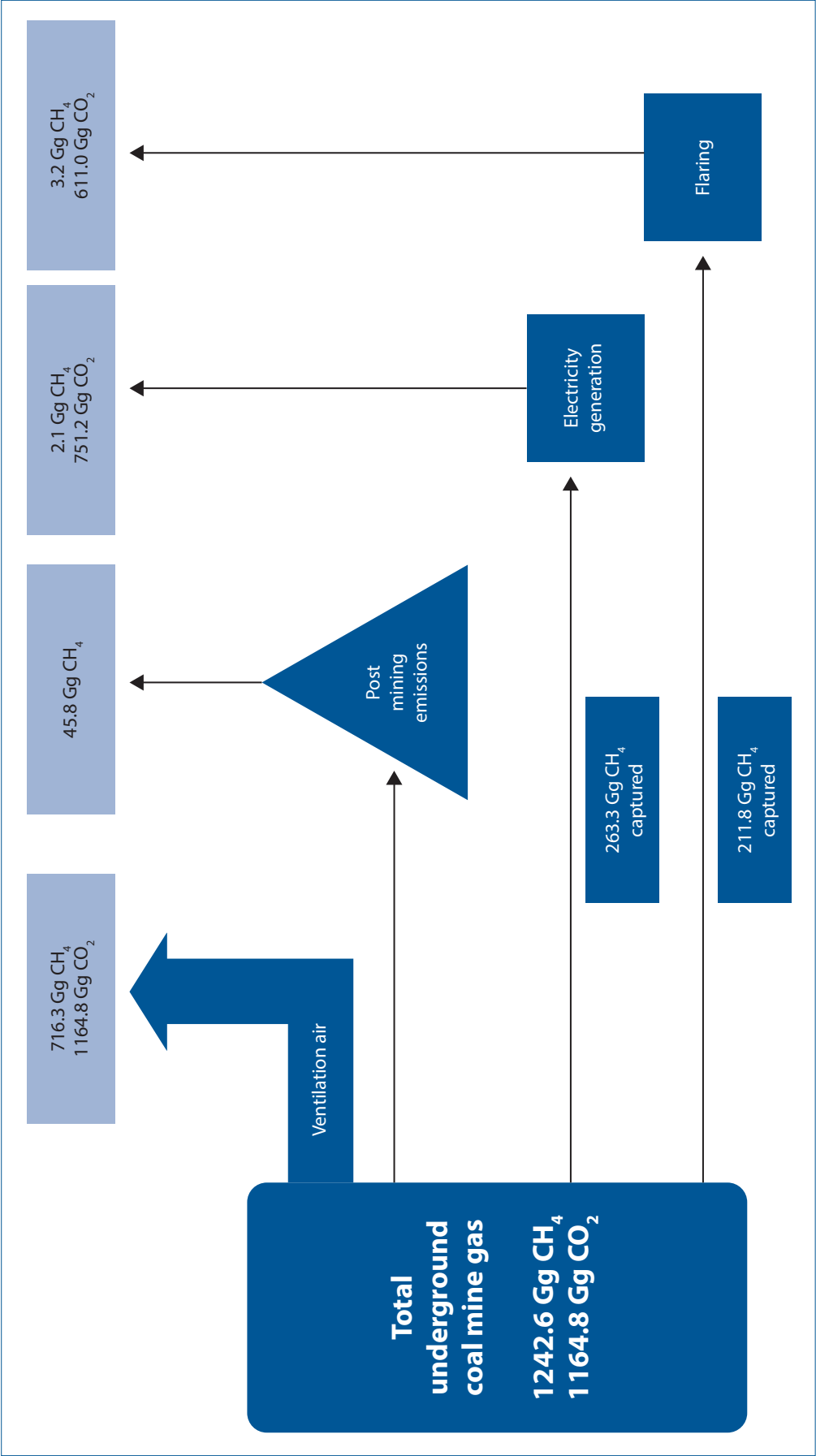


Figure A6.3 Fugitive gas balance flow chart for open cut mines, 2015

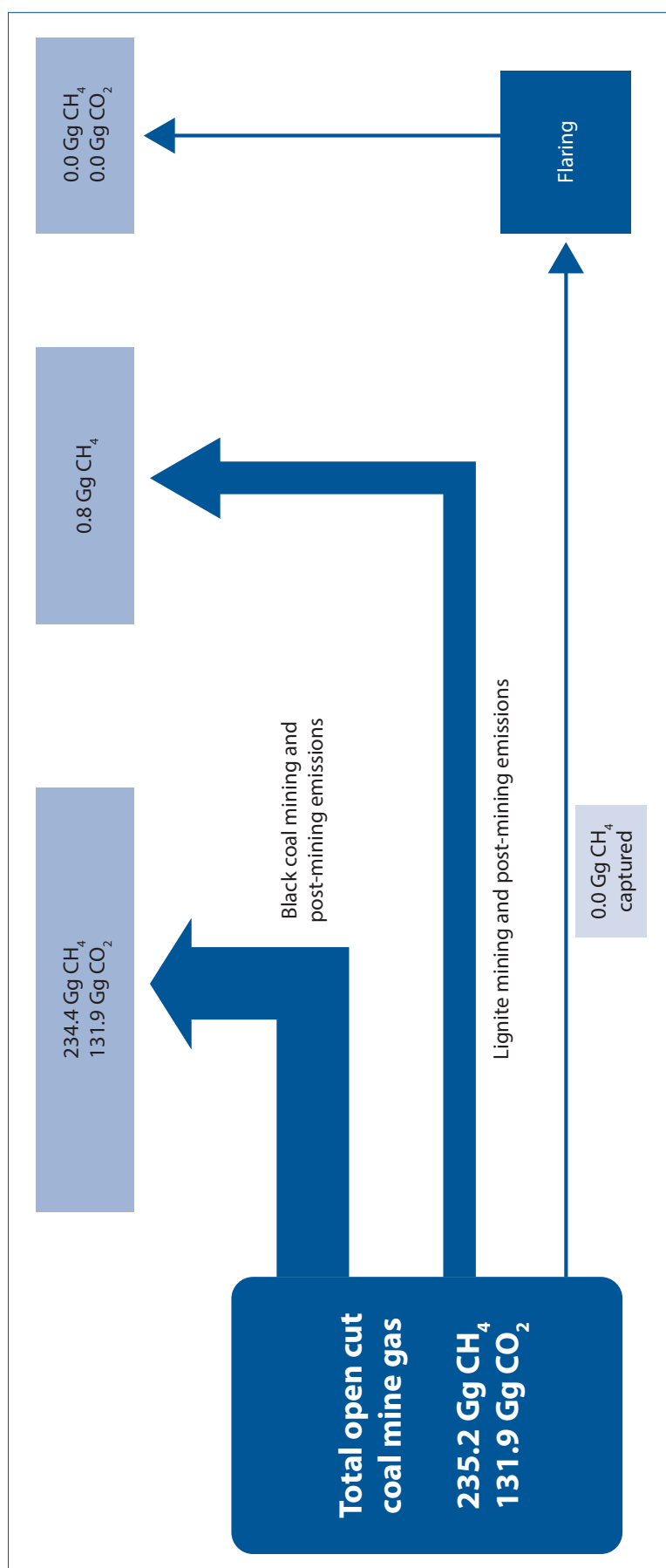


Table A6.3 Underground mining raw coal production, by coal field

Year	Coal Production by Basin (tonnes of production)							
	HUNTER	SOUTHERN	WESTERN	NEWCASTLE	BOWEN NORTHERN CENTRAL	BOWEN CENTRAL	BOWEN SOUTHERN	QLD SOUTHERN
1990	4,344,800	17,771,200	8,685,300	18,971,900	684,542	5,173,984	591,808	523,410
1991	4,848,129	18,134,150	9,433,269	18,435,910	659,348	6,549,461	635,513	779,744
1992	5,197,075	18,071,525	7,806,943	18,423,863	508,221	8,175,110	548,438	595,156
1993	4,622,113	17,566,298	9,947,807	17,705,992	589,456	8,782,642	632,108	692,298
1994	3,371,283	16,217,123	10,377,687	16,824,755	1,159,564	10,711,371	629,277	618,883
1995	6,364,090	14,663,729	11,613,380	16,061,104	2,564,908	13,172,078		687,236
1996	9,192,400	15,314,900	13,002,300	16,804,600	1,612,780	10,992,009		597,411
1997	10,813,245	15,784,757	12,697,898	15,346,470	3,846,835	13,756,322		558,769
1998	14,144,563	15,360,353	12,010,638	16,783,447	4,543,003	19,158,765		
1999	13,680,481	13,112,341	10,860,591	13,664,985	7,398,073	20,290,940		
2000	15,252,463	11,805,638	10,447,917	15,257,326	13,169,231	25,006,028		
2001	14,589,035	12,602,477	12,775,399	13,751,733	11,214,891	27,105,717		
2002	13,081,548	12,693,281	12,984,571	13,831,303	12,196,246	26,580,624		
2003	12,257,057	11,174,159	12,683,711	10,842,531	11,661,140	23,111,145		
2004	16,582,600	10,434,890	10,924,964	11,412,069	9,618,348	22,058,438		
2005	15,207,383	12,142,786	13,655,101	10,901,574	11,953,481	22,731,234		
2006	15,674,644	13,340,369	12,676,749	10,540,319	11,754,358	22,534,011		
2007	16,875,285	13,412,166	12,929,478	14,023,563	14,351,067	21,268,729		
2008	17,311,462	11,507,490	12,741,554	13,917,235	16,842,856	25,972,448		
2009	19,245,169	12,707,969	16,562,805	14,552,747	16,778,503	24,262,219		
2010	19,580,571	12,985,314	15,082,379	15,156,042	21,775,029	30,182,038		
2011	16,028,421	14,261,975	16,146,188	15,697,532	17,056,976	28,099,846		
2012	11,579,449	16,559,350	16,262,355	16,060,680	10,634,861	24,734,441		
2013	18,719,469	16,059,422	17,306,310	16,907,142	19,811,148	26,869,534		
2014	21,502,396	15,008,927	21,269,733	16,311,233	18,420,997	28,550,873		
2015	15,011,591	17,257,917	28,540,355	16,935,960	22,856,422	30,662,361		

Source: Queensland Department of Energy and Water, Coal Services Pty Ltd

Table A6.4 Australian Petroleum refining activity data

Year	Fuel type (PJ)		
	Solid	Liquid	Gas
1990	-	76.0	11.3
2000	-	80.1	18.6
2001	-	80.6	20.0
2002	-	78.9	20.7
2003	-	75.4	22.3
2004	-	67.0	22.7
2005	-	65.1	24.1
2006	-	56.1	24.6
2007	-	63.3	23.6
2008	-	60.7	22.8
2009	-	68.2	14.1
2010	-	72.4	12.5
2011	-	75.6	14.5
2012	-	69.5	17.6
2013	-	69.2	14.1
2014	-	66.1	10.9
2015	-	55.6	10.3

Source: Australian Energy Statistics and NGER

Carbon stock account for Australia's forests 2001–2010

Introduction

This summary of the carbon stock account for Australia's forests is adapted from material presented in *Australia's State of the Forests Report 2013 (ABARES 2013)*. It represents a prototype carbon stock account for forests that will be elaborated and updated in future submissions.

Development of the carbon stock account for Australia's forests

The carbon stock accounts for Australia's forest have been derived under the national inventory system. These estimates provide information for policy makers and act as a quality control tool which will be used to assess the quality of inventory estimates.

Causes of carbon stock changes in forest systems

Major events that cause reductions in national carbon stocks that are monitored and estimated include:

- Harvest from production forests;
- Natural disturbance events such as fires; and
- Forest clearing.

Major events that cause increases in carbon pools include planting events. Increases in carbon stocks also occur in forest lands that have been subject to past disturbance events such as harvest or fire; regrowth from harvest events may take 100 years for the regrowth trees to approach maturity.

Results of the carbon stocks analysis 2001–05 and 2006–10

The stock of carbon in Australia's forests in 2010 is estimated to be 12,841 Mt C (Table A6.5). It is estimated that the stock of carbon in forests decreased by 81 Mt C (0.6 per cent) between 2001 and 2010. While these figures are indicative, time frames longer than one decade are needed to properly assess trends in carbon stocks in Australia's forests.

The key feature of this decade is the shift from a net loss of carbon in the period 2001–05 (91 Mt C) to a small net gain in the period 2006–10 (10 Mt C; Table A6.5).

Key drivers of the decline in the period 2001–05 were wildfire (a loss of 93 Mt C) and reclassification to non-forest of land that lost its forest cover through clearing together with a change in land use (a loss of 97 Mt C) (Table A6.5). In the period 2001–2005 the millennium drought had taken hold. With fuel loads that had built up over decades and the hot dry conditions due to the drought, wildfire caused a high loss of carbon from Australia's forests; especially in 2003.

Over the period 2006–10, the recovery of forest carbon stocks was driven by a combination of reduced reclassification of forest land to non-forest land, less wildfire losses, and growth in stock associated with recovery of forests following wildfires in the period 2001–05.

Carbon stock gains – Growth in stock

Over the period 2001–10, gross⁷ increases in carbon stocks in Australia's forests (due to tree growth and increases in the debris and soil pools) were estimated to be 416 Mt C (Table A6.5). The majority of the gross carbon stock gains (357 Mt, 88 per cent) occurred in Australia's native forests (Table A6.5). Gains in both plantations and native forests were slightly higher in the period 2006–10 compared to 2001–05 (Table A6.5). The increased growth in carbon stock in native forests was likely due to forests regrowing after fire early in the decade, and the increased growth in carbon stock in plantations was likely due to the growth of young plantations following the peak planting period between 2000 and 2005.

Carbon stock gains – Reclassification to forest

The reclassification of land from grassland to forest appears as a gain in stock in the carbon accounts (Table A6.5); however it does not represent a gain in carbon from the atmosphere. This item represents carbon stocks on the land transferred in to the forest land base. Thus, when a plantation is established on ex-agricultural land or when native forests regenerate naturally, all of the soil and debris carbon on that land is transferred into the forest land classification.

Carbon stock losses – Transfer to product pools

Transfer of carbon to product pools occurred at a relatively stable rate between 2001–05 and 2006–10 (Table A6.5). There was a slight increase (from 34 per cent to 38 per cent) in the proportion of carbon transferred to the product pool that originated from plantations (Table A6.5).

In the period 2001–10, an estimated 50 Mt of firewood was burned for heating, equivalent to the consumption of around 24.5 Mt of carbon.

Carbon stock losses – Managed losses

Managed losses are losses of carbon directly from forests to the atmosphere that are associated with the management of forests, for example prescribed burning or post-harvest burning. Post-harvest burning as part

⁷ Gross increases do not include losses to atmosphere (e.g. fire), transfers out of forest land (e.g. to harvested products), or land reclassification: which are detailed separately in Table A6.3.

of native forest harvesting operations and for the purpose of fire suppression was estimated to cause the loss of approximately 15 Mt C in 2001–05 and 16 Mt C 2006–10. However, the largest source of carbon stock loss in this category occurs when forests are cleared for agriculture or other development. As part of this process, forest debris is generally burnt, resulting in a direct loss of greenhouse gases to the atmosphere.

No emissions from this source are recorded for plantation forests as part of this analysis. The carbon stock changes associated with post-harvest burning in plantations are included in the modelling of carbon stocks in these forests, and embedded in the overall carbon stock gain data from this source.

Carbon stock losses – Catastrophic losses

Losses of carbon stocks due to wildfire were 93 Mt C in 2001–05, and declined by 40 per cent to 55 Mt C in the period 2006–10. The higher losses of carbon stocks due to wildfire in the period 2001–05 were a key contributor to the net loss of carbon from Australia's forests recorded for that period. The lower carbon stock losses from this source in the period 2006–2010, and the carbon stock increase resulting from regrowth from fires in 2001–05, were key drivers of net increase in carbon stocks in Australia's forests in the period 2006–10.

Relative to the carbon stock losses due to wildfire in native forests, the loss of carbon stocks due to wildfires in plantations is minor (0.01 per cent and 0.03 per cent of total catastrophic losses in 2001–05 and 2006–11, respectively). The low losses from this source are due to the small area of plantations relative to native forest, and may also be due to management of some plantations to limit exposure to the effects of wildfire.

Carbon stock losses – Re-classification to non-forest

Reclassification of forest to non-forest occurs when forest cover is lost (excepting temporary losses in forests which are managed on a harvesting and regrowth cycle, or in forests which degrade and regenerate in response to physiological drivers of growth). This re-classification occurs because forests are cleared for agriculture, urban development or mining.

Over the period 2001–10, re-classification of forest land to non-forest land resulted in a reported decrease of carbon stocks in forest lands of approximately 169 Mt C (Table A6.5).

The decline in human-induced forest clearing in 2001–05 and 2006–10 (Table A6.5) was one of the main reasons why Australia's forest changed from a net source to a net sink of carbon between 2001–05 and 2006–10.

The conversion of plantations to non-forest became an increasing issue towards the end of the decade. It is expected that data will be available on the effect of this activity on carbon stocks in Australia's plantation forests in the near future.

Net exchange with atmosphere and net effect of transfers and re-classification

The net change in Australia's forest carbon stocks was -91 Mt C in 2001–05, and +10 Mt C in 2006–10 (Table A6.5). This net change can be separated into the net exchange with the atmosphere (e.g. through tree growth and fire) and the net transfers in and out of the forest (e.g. through harvesting wood products) (Table A6.5). In the decade to 2010, net exchange with the atmosphere increased from a gain of 51 Mt C during 2001–05 to a gain of 127 Mt C during 2006–10 (Table A6.5). This was primarily due to a reduction in losses associated with fire and an increase in carbon stock gains associated with recovery from fire during 2006–10. Over this same period, there was a decrease in losses associated with carbon stock transfers and the re-classification of land, from 142 Mt C in 2001–05 to 117 Mt C in 2006–11. The key cause of this reduced rate of loss was a decline in losses from re-classification of land to non-forest (forest clearing).

Table A6.5 Stock of carbon in Australia's living forests, 2001-10 (Source: Table 5.1, *Australia's State of the Forests Report 2013* (ABARES 2013))

	2001-05 Mt C	2006-10 Mt C	2001-10 Mt C
Opening stock	12,922	12,831	12,922
Gains in stock			
Growth in stock			
Native forests	175	182	357
Plantations	27	32	59
Total	202	214	416
Reclassification to forest ¹			
Native forests	-	-	-
Plantations	8	5	12
Total	8	5	12
Total additions to stock	209	219	428
Losses from stock			
Transfer to product pools ²			
Native forests	35	31	66
Plantations	18	19	37
Total	53	50	103
Managed losses ³			
Native forests	58	32	90
Plantations	-	-	-
Total	58	32	90
Catastrophic losses			
Native forests	93	55	148
Plantations	0	0	0
Total	93	55	148
Reclassification to non-forest ⁴			
Native forests	97	72	169
Plantations	-	-	-
Total	97	72	169
Total reductions in stock	300	209	509
Closing stock	12,831	12,841	12,841
Net change	-91	10	-81
Net exchange with atmosphere ⁵	51	127	178
Net change from re-classification of land to and from forest and transfers to products ⁶	-142	-117	-259

1 Gain by sector of carbon in debris and soil associated with transfer of land into sector

2 Transfers to wood and wood products in service

3 Emissions from prescribed burns, post-harvest burns, and burning as part of forest clearing

4 Loss from sector of carbon in debris and soil associated with transfer out of sector of cleared forest land or land where forest cover has been lost through dieback or degradation

5 Sum of growth in stock, managed losses and catastrophic losses

6 Sum of reclassification to forest, transfer to product pools and reclassification to non-forest

A6.3 Summary of Responses to UNFCCC ERT Recommendations and Comments

Table A6.6(a) Status of Issues raised in the previous report

Sector	Report and paragraph reference	ERT Recommendation	Response	Implementation
E.7	1.B.2.b Natural gas – natural gas – CO ₂ and CH ₄ (E.17, 2015) Accuracy*	Collect data on emissions from any new plant types, and update the country-specific CO ₂ and CH ₄ EFs, where appropriate (the previous ERT noted that a new liquefied natural gas plant had started operation).	Addressing. The Party reported in the NIR (Volume 3, Table 6.6(a), page 172) that it plans to analyse the plant-specific data for the new liquefied natural gas plant when they become available, with a view to incorporating .	In this submission, the Department significantly updated methods, activity data, and emission factors for the fugitive emissions from natural gas sub-sector. This allows for greater disaggregation of emissions, including by different plant and gas types (including the new LNG and CSG developments in Australia). These new methods are detailed in NIR Volume 1 under Chapter 3.9.2.
E.8	1.B.2.b Natural gas – liquid and solid fuels – CO ₂ and CH ₄ (E.18, 2015) Accuracy*	Collect data on emissions from any new plant types, and update the country-specific CO ₂ and CH ₄ EFs, where appropriate (the previous ERT noted that a new liquefied natural gas plant had started operation).	Addressing. The Party explained during the review that the first phase of taking measurements from non-conventional production facilities has been completed and a second phase is under way. The Party considers that this work may lead to the development of more representative EFs in future submissions.	In this submission, the Department significantly updated methods, activity data, and emission factors for the fugitive emissions from natural gas sub-sector. These refinements included the implementation of the Australian-based EF for onshore coal seam gas wells from the CSIRO 2014 study, as described in NIR Volume 1 under Chapter 3.9.2.

Sector	Report and paragraph reference	ERT Recommendation	Response	Implementation
2. General (IPPU) – HFCs and SF ₆ (I.25, 2015) Transparency*	I.2	<p>When provisional data for AD are used or reported in the NIR (e.g. identical data to those reported for the previous year as was identified by the previous ERT for the year 2013), provide transparent information that the Party is doing so and the rationale for doing so (for example for 2.F.1 refrigeration and air conditioning and 2.G.1 electrical equipment).</p> <p>Addressing. The AD for consumption of halocarbons and SF₆ (2.F) have been corrected for 2013 as described in the NIR (section 4.8.5). The national stock of electrical equipment (2.G.1) presented in table 4.40 of the NIR included different values for 2012, 2013 and 2014 indicating that provisional data were not used. However, in table 4.27 of the NIR, the domestic refrigeration stock is constant for 2012-2014. Below the table, the Party included footnote (c) indicating that the value is a "projection" and footnote (d) stating that "data unavailability at time of publication required stocks to be held constant. To be updated for following submissions". However, it is not clear to which data in table 4.27 these footnotes referred to.</p>	Accepted.	Table 4.27 has revised stock data for domestic refrigeration and the footnote removed.
2.A.1 Cement production – CO ₂ (I.7, 2015) Accuracy*	I.4	<p>Confirm or update the CaO and MgO content ratios in order to ensure the accuracy of the values for more recent years and the consistency of the time series .</p> <p>Addressing. The Party informed the ERT that it is investigating the availability and/or derivation of content ratios, and that this would be incorporated into future submissions.</p>	Accepted.	Australia is investigating the availability and/or derivation of content ratios.
2.B.1 Ammonia production – CO ₂ (I.10, 2015) Transparency*	I.7	<p>Improve the level of transparency used to report disaggregated subcategory emission data for ammonia production, while preserving the legally required confidentiality in the overall reporting of emissions.</p> <p>Addressing. No disaggregated information on emissions related to ammonia production has been provided in section 4.4.1 of the NIR, volume 1. In the CRF table 2(I).A-H, the notation key "C" has been used to report the AD and the notation key "IE" has been used to report the emissions. Nevertheless, the emissions have been represented in a disaggregated manner in the key category analysis in the NIR (Volume 3, page 109).</p>	Accepted.	The Department will ensure consistency between the key category analysis and the CRF table.

Sector	Report and paragraph reference	ERT Recommendation	Response	Implementation
2.B.1 Ammonia production – CO ₂ (I.10, 2015) Transparency*	I.8	Ensure consistency between the emission levels reported in the IPPU chapter of the NIR and in the key category analysis. Not resolved. See I.7.	Accepted.	The Department will ensure consistency between the key category analysis and the CRF table.
2.C Metal industry – CO ₂ (I.34, 2015) Consistency*	I.11	Investigate whether other drivers could be applied to estimate emissions from lead production, zinc production and other (metal production) for the period 1990–2008, such as production volumes. Not resolved. The same approach was used in the 2015 and 2016 annual submissions. During the review, Australia stated that it plans to investigate other applicable indicators such as production volumes for lead and zinc production and other (metal production).	Accepted.	Australia has sourced data to derive emissions for pre NGERS data years for Nickel and Silver production. Australia will continue to research the availability of data to support pre NGERS estimates for other metals.
2.C.1 Iron and steel production – CH ₄ (I.17, 2015) Transparency*	I.15	Correct the AD for steel production in the CRF tables and improve the QA/QC tests for the reporting in the NIR and the CRF tables in order to avoid data entry errors. Not resolved. The data for steel production reported in the NIR (page 199) (5,186 kt in 2014) are not consistent with the data reported in CRF table 2(I).A-H (4,446.23 kt crude steel in 2014).	Accepted.	The Department will ensure consistency between the NIR and CRF tables.
2.F. Product uses as substitutes for ozone-depleting substances – HFCs (I.23, 2015) Transparency*		Include in the methodological description in the NIR a more accurate description of the methodology used, in particular the use of the vintage stock model. Addressing. Australia has included additional text on IEFs in the NIR; however, a more detailed explanation of the vintage stock model use is required to ensure transparency.	Accepted.	Australia is assessing the model with a view to incorporating additional country specific data. This will include the vintage stock model and as such future submissions will include an expanded and updated description of all methods.
2.F.5 Solvents – HFCs (I.30, 2015) Accuracy*		Align the calculation method with the definition provided in the NIR, and apply an operational loss of 25%, 50% and 25%, respectively, for use of F-gases as solvents. Not resolved. Australia confirmed that it is planning to update its calculation model to use the proposed values for operational losses (NIR, section 4.8.6).	Accepted.	Australia will incorporate the recommended alteration to the model in the 2018 submission.

Sector	Report and paragraph reference	ERT Recommendation	Response	Implementation
4.A.2 Land converted to forest land – CO ₂ , CH ₄ and N ₂ O (L.28, 2015) Consistency	L.7	Implement the planned improvement to allocate the AD and emissions/removals from forest conversion events that occurred before 1990 and that are followed by natural regeneration in a consistent manner and in accordance with the 2006 IPCC Guidelines. Not resolved. In the NIR, volume 3 p. 194, the Party stated that improvement of the allocation of lands in these complex circumstances is included in the inventory improvement plan.	Accepted	A project to improve the allocation of lands in these complex circumstances is an ongoing part of the inventory improvement plan, see section 6.5.6
4.A.2 Land converted to forest land – CO ₂ , CH ₄ and N ₂ O (L.28, 2015) Consistency	L.8	In the specific case of subsequent land-use changes within a period shorter than 50 years, base the rule for the allocation of AD and estimates in each reporting year on the end-use category of the land in that year. Not resolved. In the NIR, volume 3 p. 194, the Party stated that improvement of the allocation of lands in these complex circumstances is included in the inventory improvement plan.	Accepted	A project to improve the allocation of lands in these complex circumstances is an ongoing part of the inventory improvement plan, see section 6.5.6
4.A.2 Land converted to forest land – CO ₂ , CH ₄ and N ₂ O (L.29, 2015) Completeness	L.9	Report emissions/removals occurring throughout the reporting period owing to natural forest regeneration before 1990. Not resolved. According to the NIR (volume 2, section 6.5.5), Australia is planning to continue refinements to the FullCAM modelling parameters for forest/plantation growth and regeneration (including for the pre-1990 period), informed by empirical research.	Accepted	Reporting of regeneration from natural seed sources prior to 1990 is a planned improvement for the next inventory submission, see section 6.5.6
4(V) Biomass burning – CO ₂ (L.35, 2015) Comparability	L.16	Find ways to report CO ₂ immediate emissions resulting from fires in CRF table 4(V) and report subsequent carbon stock changes on these areas as carbon stock changes in CRF tables 4.A–4.E, where appropriate. Addressing. The ERT noted that CO ₂ emissions are reported in CRF table 4(V) for the following categories: forest land remaining forest land; land converted to forest land; grassland remaining grassland; and land converted to grassland. For the last two categories, Australia reported negative values (removals). This has not been transparently explained in the documentation box, following the requirements in CRF table 4(V), footnote 5. For other categories such as cropland remaining cropland (wildfires), land converted to cropland, wetlands remaining wetlands and land converted to wetlands (wildfires), Australia reported CO ₂ emissions as "IE".	Accepted	CO ₂ emissions and removals have been transparently reported in CRF tables 4(V) and 4.A–4.E where appropriate, and transparently explained in the documentation box in accordance with Footnote 5. Where emission are included elsewhere this has been transparently explained in CRF Table 9.

Sector	Report and paragraph reference	ERT Recommendation	Response	Implementation
4(V) Biomass burning – CO ₂ , CH ₄ and N ₂ O (L.36, 2015) Accuracy	L.17	<p>Make further efforts to find more effective ways to differentiate the impact of non-anthropogenic emissions/removals on the forest carbon dynamics in accordance with the 2006 IPCC Guidelines.</p> <p>Addressing. Compared to the 2015 submission, Australia has implemented a revised method to differentiate the impact of non-anthropogenic emissions/removals. The method is explained transparently in the NIR: Australia identifies and separates natural disturbances from anthropogenic emissions/removals from biomass burning in temperate forests in its reporting under the Convention, citing concepts developed in the Kyoto Protocol Supplement (see, e.g., NIR volume 2, page 4). The ERT notes that the natural disturbances were identified in temperate forests only and considers that Australia should make further efforts to find ways to differentiate the impact of non-anthropogenic emissions/removals on the forest carbon dynamics in accordance with the 2006 IPCC Guidelines for all forests.</p>	Accepted	<p>A consistent method for identifying non-anthropogenic natural disturbances on all forests including non-temperate forests has been applied.</p> <p>Improved information has been provided on the effective differentiation of the impact of non-anthropogenic emissions/removals on forest carbon dynamics in NIR Chapter 6.4.1 and 6.4.6.</p>

Sector	Report and paragraph reference	ERT Recommendation	Response	Implementation
4(V) Biomass burning – CO ₂ , CH ₄ and N ₂ O (L.37, 2015) Accuracy	L.20	<p>Either report the actual emissions/removals from wildfires in forest land in the year in which they occur, or find ways to demonstrate in the NIR that the averaging procedure applied does not represent a correction of estimates and how the quality (i.e. accuracy), transparency and comparability of the estimates of forest fires could be improved and the uncertainty reduced by the application of this procedure. In the latter case, the ERT further recommends that Australia include in the NIR the entire time series of both raw (not averaged) and final estimates to ensure transparency and comparability.</p> <p>Addressing. Australia recalculated the emissions from wildfires in forest land. In the 2015 submission, the Party used five-year averaging of final net emission estimates, whereas in the 2016 annual submission, the Party smoothed the activity data for area burned according to a five-year moving average. The Party also explained that this procedure does not represent a correction to its estimates, because it does not affect the long-term trend. Furthermore, Australia improved transparency by presenting raw and averaged estimates in the NIR volume 2 (figure 6.17, p.47). However, the ERT considers that the Party should improve transparency by elaborating how multi-year averaging may be used to improve accuracy and comparability of the annual estimates of biomass stocks while avoiding increased uncertainty by the application of this procedure. The Party explained during the review that 2006 IPCC Guidelines (volume 1, chapter 2, page 2.11) refer to use of multi-year averaging in the context of high inter-annual variability, which is the case for biomass stocks in areas prone to wildfires in Australia.</p>	Accepted	Carbon stock changes have been estimated using IPCC 2006 Guidelines Equation 2.18, as described in Section 6.4.1.3.

Sector	Report and paragraph reference	ERT Recommendation	Response	Implementation
4(V) Biomass burning – CH ₄ and N ₂ O (L.38, 2015) Accuracy	L.22	<p>Either report actual emissions/removals from fires in grassland remaining grassland in the year in which they occur, or find ways to demonstrate in the NIR that the averaging procedure applied does not represent a correction of estimates and how the quality (i.e. accuracy), transparency and comparability of the fire estimates on grassland can be improved and the uncertainty reduced by the application of this procedure. In the latter case, the ERT further recommends that Australia include in the NIR the entire time series of both raw (not averaged) and final estimates to ensure transparency and comparability.</p> <p>Addressing. Australia recalculated the emissions from wildfires in grassland remaining grassland. In the 2015 submission, the Party used five-year averaging of final net emission estimates, whereas in the 2016 annual submission, the Party smoothed the activity data for area burned according to a five-year moving average. The Party also explained that this procedure does not represent a correction to its estimates, because it does not affect the long-term trend. Furthermore, Australia improved transparency by presenting raw and averaged estimates in the NIR volume 2 (table 6.47). However, the ERT considers that the Party should improve transparency by elaborating how multi-year averaging may be used to improve accuracy and comparability of the annual estimates of biomass stocks while avoiding increased uncertainty by the application of this procedure. The Party explained during the review that 2006 IPCC Guidelines (volume 1, chapter 2, page 2.11) refer to use of multi-year averaging in the context of high inter-annual variability, which is the case for biomass stocks in areas prone to wildfires in Australia.</p>	Accepted	Carbon stock changes have been estimated using IPCC 2006 Guidelines Equation 2.18, as described in Section 6.4.1.3.
4.G Harvested wood products – CO ₂ (L.40, 2015) Transparency	L.24	<p>Improve the transparency of the reporting of harvested wood products by explicitly reporting these carbon losses (related to fuelwood consumption) in CRF table 4.G (e.g. by using an appropriate subdivision under other (4.G.3)) or alternatively in the NIR.</p> <p>Addressing. Australia reported in the NIR the fuelwood consumed (in kt C) for selected years of the time series (1990, 2000, 2005–2014) (table 6.52, volume 2). The information was not presented for the year 1995, in line with the UNFCCC Annex I inventory reporting guidelines.</p>	Accepted	Australia has now included information on the fuelwood consumed in 1995 in Table 6.65, Volume 2, accordance with the UNFCCC Annex I inventory reporting guidelines

Sector	Report and paragraph reference	ERT Recommendation	Response	Implementation
5. General (waste) – CO ₂ , CH ₄ and N ₂ O (W.4, 2015) Adherence to the UNFCCC Annex I inventory reporting guidelines	W.1	Implement a new uncertainty analysis in line with the 2006 IPCC Guidelines and update the information and data on the uncertainty analysis.	Accepted	Waste sector uncertainty has been updated and is reported on in section A2.5 of the NIR.
5.C.1 Waste incineration – CH ₄ (W.7, 2015)	W.2	Report CH ₄ emissions from the incineration of MSW for each year of the period 1990–1996.	Accepted	Resolved. Australia reported CH ₄ emissions from the incineration of MSW for each year of the period 1990–1996 in CRF table 5.C
5.C.1 Waste incineration – CH ₄ and N ₂ O (W.1, 2015) (77, 2014).	W.3	If no new information is reported for clinical waste or solvents, replace the notation key “NA” with “NE”.	Accepted	Resolved. See W.2
5.C.1 Waste incineration – CH ₄ and N ₂ O (W.8, 2015)	W.4	Report CH ₄ and N ₂ O emissions from incineration of clinical wastes and solvents as “NE” and provide in the NIR of the next inventory submission the reasons why such emissions or removals have not been estimated in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines, or report emissions from these categories when data are available.	Accepted	Resolved. Australia reported CH ₄ and N ₂ O emissions from incineration of clinical wastes and solvents as “NE” and explained in the NIR (volume 2, section 7.5) that the emissions were estimated to contribute around 0.0001% of national total emissions.
5.D Wastewater treatment and discharge – N ₂ O (W.9 2015)	W.5	Correct the statement in the NIR (volume 2, page 182) that reads: “Emissions of N ₂ O from land application are not included in the agriculture sector but are included within the wastewater sector itself”.	Accepted	Resolved. Australia reported in the NIR (volume 2, section 7.6.1) that emissions of N ₂ O from land application are included in the agriculture sector under category 3.D (agricultural soils)

Table A6.6(b) Issues identified in three or more successive reviews and not addressed by the Party

No issues identified.

Table A6.6(c) General

Sector	Report and paragraph reference	ERT Recommendation	Response	Implementation
Article 3, paragraph 14, of the Kyoto Protocol	G.6	According to decision 15/CMP.1, annex, paragraph 24, in conjunction with decision 3/CMP.11, Parties included in Annex II shall incorporate, in their annual submissions, information on how they give priority, in implementing their commitments under Article 3, paragraph 14, of the Kyoto Protocol, to the actions listed in that paragraph. In addition, according to paragraph 25 of the same decision, Parties included in Annex I shall include information in their NIR on any changes that have occurred, compared with the information reported in their last submission, on how they are striving, under Article 3, paragraph 14, of the Kyoto Protocol, to implement their commitments mentioned in Article 3, paragraph 1 bis, of the Kyoto Protocol in such a way as to minimize adverse social, environmental and economic impacts on developing country Parties, particularly those identified in Article 4, paragraphs 8 and 9, of the Convention. During the review, the ERT asked the Party to explain how it gives priority to the actions listed in decision 15/CMP.1, annex, paragraph 24, including any changes since the previous annual submission. Australia explained that social and environmental impacts are considered in the context of its domestic processes for assessing the impacts of implementing policy initiatives, and that the Party actively participates in international processes that contribute to addressing the actions listed in decision 15/CMP.1.	Accepted	NIR Volume 1, Chapter 16, has been updated to more clearly explain how the actions Australia is taking are helping to address the impacts of response measures, including new forms of support to developing countries.
Recalculations	G.8	<p>Australia reported downward recalculations of total GHG emissions including LULUCF for the year 2013 in its 2016 annual submission of 24 October (–8,016.60 kt CO₂ eq). There were also substantial upward recalculations in total GHG emissions including LULUCF for 1990 (16,003.95 kt CO₂ eq), which had an impact on the deforestation emissions included in the assigned amount. The reasons for these recalculations can be found in chapter 10 of the NIR, but there was no quantification of the impact in chapter 10, as noted also in the 2015 inventory review report (finding G.2). During the 2016 review, the Party provided the ERT with quantitative information regarding the largest recalculations, which allowed the ERT to verify that the emissions were not underestimated in the last reported year or overestimated in the base year</p> <p>The ERT recommends that the Party transparently report, in chapter 10 of its NIR, the reasons and associated quantitative impacts of the largest recalculations.</p>	Accepted	The recommendation has been addressed in this submission in NIR Chapter 10 of Volume 1.

Sector	Report and paragraph reference	ERT Recommendation	Response	Implementation
National Registry	G.9	According to the 2016 SIAR, the national registry of Australia has not fulfilled the requirements regarding the public availability of information in accordance with section II.E of the annex to decision 13/CMP.1. During the review, the Party provided information regarding recent developments since the publication of the SIAR. The Party explained that the discrepancy can be attributed to an oversight in the design of the public report automatic population function. The Party further informed the ERT of its plans to update the publicly available information regarding the year 2015 and to redesign the public report automatic population function to include the clean development mechanism CER units. The ERT recommends that the Party update the publicly available 2015 reports to include the CER units in accordance with section II.E of the annex to decision 13/CMP.1, in conjunction with decision 3/CMP.11, and that the Party minimize errors linked to the public report automatic population function.	Accepted	The recommendation has been addressed in this submission by: 1. updating the publicly available 2015 reports to include CER units (see https://nationalregistry.cleanenergyregulator.gov.au/report/listPublicReports), and 2. re-designing the public report automatic population function to ensure CER units are included in future SIARs.

Table A6.6(a) Energy

Sector	Report and paragraph reference	ERT Recommendation	Response	Implementation
Comparison with international data	E.10	The ERT noted discrepancies in the time series of the Party's energy statistics and the IEA data. For example, the amount of crude oil production in 1992–2001 is systematically higher in the CRF tables (by up to 42%) than in the IEA data. For the same period, the NGL production reported in the CRF tables is lower (by 50–70%) than in the IEA data. During the review, the Party explained that part of the crude oil production in 1992–2001 may be classified as NGL in the IEA data. The Party further noted that the lack of a time-series recalculation by the Australian Department of Industry, Innovation and Sciences of the data reported to IEA is an important factor contributing to the discrepancy. The ERT encourages Australia to strive to ensure as much consistency as possible between the data reported to IEA and those reported under the Convention.	Accepted	Australia will continue to ensure as much as possible time series consistency between the data reported to IEA and those reported under the Convention.

Table A6.6(c) Industrial processes and product use

Sector	Report ref	ERT Recommendation	Response	Implementation
2.A.1 Cement production – CO ₂	I.32	<p>The emissions from cement production decreased from 3,518.24 kt CO₂ in 2012 to 3,137.57 kt CO₂ in 2014.</p> <p>According to the NIR (section 4.3.1), there are three clinker producers in Australia. During the review, the Party explained that the production of clinker in Australia responds to market conditions. Competition with imported products has become a significant issue for domestic production, especially in recent years. In 2012, one clinker production facility ceased operation.</p> <p>The ERT recommends that the Party provide explanatory information with regard to the fluctuation of emissions related to the clinker production trend in the NIR, including the information that domestic production has decreased due to competition with imported products, and that in 2012 a clinker production facility ceased operation.</p>	Accepted.	Text has been added to section 4.3.1 Cement Production (2.A.1) noting that clinker production in Australia is sensitive to market conditions and imports of clinker.
2.A.4 Other process uses of carbonates – CO ₂	I.33	<p>Australia has calculated emissions from use of limestone in iron and steel production, ferroalloys, magnesia, zinc, glass, ceramics and brick production under the category other process uses of carbonates (NIR section 4.3.4). The 2006 IPCC Guidelines (volume 3, page 2.33) state that “it is good practice to report emissions from the consumption of carbonates in the source category where the carbonates are consumed and the CO₂ emitted”. During the review, Australia explained that the emissions from the consumption of carbonates cannot be included with their associated sectors, due to issues of confidentiality.</p> <p>The ERT recommends that the Party report, in accordance with the 2006 IPCC Guidelines, the emissions from the use of carbonates in the category in which they are used, where possible, or justify the inclusion of the emissions under 2.A.4 other process uses of carbonates by explaining in the NIR that confidentiality reasons do not allow reporting the use of carbonates in the category in which they are used.</p>	Accepted.	Text has been included in section 4.3.4 Other process uses of carbonates (2.A.4) outlining the reasons for protecting the confidentiality of facility specific data.
2.G.3 N ₂ O from product uses – N ₂ O	I.34	<p>The previous review report (Table 5, issue I.35) stated that a potential underestimation of N₂O emissions had occurred as Australia could not confirm whether imports of N₂O existed (see I.31 in table 3 above). In the 2016 NIR, Australia states that it is planning to investigate this issue. During the review, Australia confirmed that imported N₂O is accounted for as the estimation method is based on the consumption of N₂O, instead of production only. The Party also provided confidential data indicating that, from 2003 onwards, one of the two N₂O producing plants in Australia ceased production and the Party started to import gas. Prior to that time, there were no imports of N₂O in Australia. Therefore, the ERT concludes that there is no underestimation of Australia's N₂O emissions from this category</p> <p>The ERT recommends that the Party include in the NIR the information that from 2003 onwards, one of the two N₂O producing plants in Australia ceased production and the Party started to import N₂O and that for 2003 onwards, N₂O emissions from product uses are estimated based on imports in addition to domestic production</p>	Accepted.	Text has been included in section 4.4.2 Nitric acid production (2.B.2) noting the shift to importation of N ₂ O of one facility.

Table A6.6(d) Agriculture

Sector	Report ref	ERT Recommendation	Response	Implementation
3. General (agriculture) – CH ₄ and N ₂ O	A.3	Implement an approach 2 uncertainty analysis for the agriculture sector in accordance with the timelines defined in the improvement plan	Accepted	Enhancement of the approach to estimating uncertainties for the Agriculture sector remains part of the inventory improvement plan. The DoEE will look to address this encouragement as resources allow.
General (agriculture) – CH ₄ and N ₂ O	A.4	Include in the NIR an explanation of the approach and assumptions (e.g. average life cycle of animal categories that are alive for part of a year only) used to derive the average annual livestock population.	Accepted	An explanation is included in section 5.3.2.2 of the NIR
General (agriculture) – CH ₄ and N ₂ O	A.5	Continue with the improvements to the accuracy of the livestock population data.	Accepted	The work to develop a dynamic livestock model is ongoing.
3.A.2 Sheep – CH ₄	A.6	Include in the NIR the explanatory information provided to the ERT during the review, that is that the method for estimating the amount of feed consumed by sheep (NIR, equation 3A.2_1) takes full account of the feed energy requirements identified by the ERT such as wool production, grazing in large areas and growing rate.	Accepted	Explanatory information is provided in section 5.3.3 of the NIR
3.A.2 Sheep – CH ₄	A.7	Include explanatory information in the NIR on the drivers that influence the inter-annual changes in the CH ₄ IEFs for enteric fermentation of sheep, together with supporting charts (e.g. correlation analysis).	Accepted	Work to address this encouragement is ongoing
3.B Manure management – CH ₄	A.8	Include explanatory information in the NIR on the drivers that influence the substantial inter-annual changes in the CH ₄ IEFs for cattle and swine manure management, together with supporting charts (e.g. correlation analysis)	Accepted	Work to address this encouragement is ongoing
3.B.1 Cattle – CH ₄	A.9	Include in the NIR the reference for the methane density value.	Accepted	The reference for the value of methane density is included in the NIR where this value is cited.
3.B.1 Cattle – CH ₄	A.10	Include the reference to the country-specific data for the ash content of manure in the NIR	Accepted	The reference for the CS value for the ash content of manure is included in section 5.4.4 of the NIR

Sector	Report ref	ERT Recommendation	Response	Implementation
3.B.1 Cattle – CH ₄	A.11	Include information in the NIR on the justification of the use of the IPCC default Bo value for North America. The ERT further encourages the Party to continue investigating country-specific CH ₄ -producing potential values	Accepted	A justification for the use of the IPCC default value of Bo for North America is provided in section 5.4.4.1 of the NIR
3.C Rice cultivation – CH ₄	A.12	Include in the NIR the explanation of the water regime prior to the cultivation period (i.e. that after rice harvesting, Australian rice growers use the subsoil moisture remaining in the soil to plant either wheat or pasture for animals), with supporting references	Accepted	An additional explanation of Australian rice growing practices is provided in section 5.5.1 of the NIR
3.C Rice cultivation – CH ₄	A.13	Include an explanation in the NIR for the large inter-annual changes in emissions from rice cultivation.	Accepted	Information on significant trends in emissions from rice cultivation is included in section 5.1 of the NIR.
3.D.a Direct N ₂ O emissions from managed soils – N ₂ O	A.14	Report correct AD for N input from animal manure applied to soils, urine and dung deposited by grazing animals as well as N mineralization/ immobilization associated with loss/gain of soil organic matter in CRF table 3.D.	Accepted	Refer to CRF table 3.D.
3.D.a.1 Inorganic N fertilizers – N ₂ O	A.15	Conduct a comparison analysis of the national inorganic N fertilizer consumption data with the data from IFA and FAO, and report in the NIR explanations of any substantial discrepancies found, in line with the 2006 IPCC Guidelines (volume 4, page 11.26).	Accepted	This analysis is ongoing and will be reported in in future NIR submissions.
3.D.a.1 Inorganic N fertilizers – N ₂ O	A.16	Include explanatory information in the NIR on the drivers that influence the substantial inter-annual changes in the N ₂ O IEFs, with supporting charts (e.g. a correlation analysis).	Accepted	Work to address this encouragement is ongoing
3.D.b.2 Nitrogen leaching and run-off – N ₂ O	A.17	Report the applied value 0.3 for FracLEACH-(H) instead of the notation key "NA" in CRF table 3.D	Accepted	Refer to CRF table 3.D.

Table A6.6(e)Waste

Sector	Report ref	ERT Recommendation	Response	Implementation
5.A.1.a Anaerobic – CH ₄	W.6	The ERT reiterates the encouragement in the 2015 inventory review report (finding W.5) that Australia assess the use of monthly data in the FOD model and report thereon in its annual submission.	Accepted	Australia's approach to estimating emissions from solid waste is consistent with the 2006 IPCC Guidelines. Australia will continue work to assess the practicality of this improvement as resources allow.
5.C.1 Waste incineration – CH ₄ and N ₂ O	W.7	The ERT encourages Australia, in addition to explaining the magnitude of CH ₄ and N ₂ O emissions from the incineration of clinical wastes and solvents in terms of the percentage of total emissions, to also include information in the NIR in units of kt CO ₂ eq	Accepted	This information is provided in section 7.5 of the NIR.

Table A6.6(f) Land Use Land Use Change and Forestry

Sector	Report ref	ERT Recommendation	Response	Implementation
4. General (LULUCF) – CO ₂ , CH ₄ and N ₂ O	L.26	The ERT encourages Australia to further improve transparency by cross-referencing recalculations tables and the description of the recalculations in chapter 10, volume 2, of the NIR	Accepted	Descriptions of recalculations in Chapter 10 of the NIR are now cross-referenced with the information included for each sub-sector in Chapter 6.
4. General (LULUCF) – CO ₂ , CH ₄ and N ₂ O	L.27	The ERT agrees with the estimates and corrections to the notation keys included in the October submission, and recommends that Australia include, in its NIR, the descriptions, references and sources of information for the methodologies, assumptions, EFs and AD, as well as the rationale for their selection for wetlands converted to cropland, wetlands converted to grassland and settlements remaining settlements	Accepted	Information on the methodologies, assumptions emission factors and activity data are now included in the NIR in Chapter 6.7.1.2 for <i>wetlands converted to croplands</i> 6.8.1.2 for <i>wetlands converted to grasslands</i> and 6.12.1 for <i>settlements remaining settlements</i> .
4. General (LULUCF) – CO ₂ , CH ₄ and N ₂ O	L.28	The ERT recommends that Australia explain in the NIR and CRF table 9 that emissions and removals from grassland converted to cropland are reported under cropland remaining cropland because annual variations in area under cropping in Australian agricultural systems do not constitute a permanent land-use change	Accepted	This information is now included in the NIR chapter 6.6.1 and in CRF table 9.

Sector	Report ref	ERT Recommendation	Response	Implementation
4. General (LULUCF) – CO ₂ , CH ₄ and N ₂ O	L.29	The ERT recommends that Australia explain in the NIR and CRF table 9 under which categories the estimates for the following categories and pools are reported: cropland, wetlands and settlements converted to forest land (all pools except organic soils); cropland converted to grassland (all pools); and cropland and grassland converted to settlements (all pools). The ERT also recommends that Australia improve comparability and transparency in its future submissions by providing separate AD and estimates for the following categories and pools currently reported as "IE": cropland, wetlands and settlements converted to forest land (all pools except organic soils); cropland converted to grassland (all pools); and cropland and grassland converted to settlements (all pools). Until this is done, the ERT recommends that Australia provide in its NIR an update of the status of its efforts to provide estimates for these pools	Accepted	This information is now included in the NIR chapter 6.3.2, Annex 5 (completeness) and in CRF table 9.
4.G Harvested wood products – CO ₂	L.30	The ERT noted that Australia did not report the AD and carbon stock changes in HWP for the period 1960–1989 in CRF table 4.Gs2 The ERT recommends that the Party complete CRF table 4.Gs2 and the additional information box on factors used to convert from product units to carbon. Parties can do this by setting a custom node year within the data entry screen for HWP in the CRF Reporter software	Accepted	A planned improvement is underway to enable AD and carbon stock changes to be included for the period 1960–1989 in CRF table 4.Gs2 in future inventory submissions. See section 6.1.5.6 of the NIR.
Deforestation – CO ₂ , CH ₄ and N ₂ O	KL.4	In its response to the list of potential problems and further questions raised by the ERT, Australia explained that it had reviewed and slightly revised the areas of forest land converted to grassland, wetlands and settlements, whereas the deforestation area was confirmed to be correct. However, the Party also revised the methodology used for the estimation of the carbon stock changes from deforestation. In particular, the Party used the method from the 2006 IPCC Guidelines (volume 4, page 7.20) to estimate the carbon stock changes due to deforestation in relation to forest land converted to wetlands. Australia provided revised estimates for deforestation in its submission of revised CRF tables on 24 October 2016. The net greenhouse gas emissions from deforestation provided in the 24 October 2016 submission were 199.39 kt CO ₂ eq lower than in the 9 August 2016 submission for 2014 and 237.88 kt CO ₂ eq lower for 2013. The ERT agreed with the revised estimates. The Party also reported the carbon stock changes in the information item of CRF table 4(KP-I)A.2 for wetlands and settlements under deforestation, which improved the transparency of the reporting The ERT recommends that the Party provide, in its NIR, a transparent description of the methodology used to estimate emissions and removals from deforestation. The ERT further recommends that the Party explain in the NIR how the areas subject to deforestation under the Kyoto Protocol are related to the areas of forest land converted to other land uses under the Convention	Accepted	A description of the method for reporting forest land converted to flooded land is now included in the NIR Section 6.11.1 Information on how deforestation areas under the Kyoto Protocol relate to areas of forest land converted to other land uses under the Convention is included in NIR Section 11.4

Sector	Report ref	ERT Recommendation	Response	Implementation
Forest management – CO ₂	KL.5	Considering the additional information presented by Australia on its long-term fire history, and acknowledging the impact of wildfires in Australia, the ERT recommends that Australia consider a longer time series (including the years 1990–2009) for determining the calibration period for applying the natural disturbance provision (e.g. using (part of) the information presented on wildfires for 1850–2009) and avoid restricting the calibration period to 2000–2012	Accepted	The use of a longer time series including the years 1990–2009, and possibly part of the information on the long-term fire history, is under consideration. This is part of a planned improvements described in NIR Section 11.6.4
Revegetation – CO ₂	KL.6	The ERT recommends that the Party review the preliminary methodology and data sources used for revegetation and revise them, if appropriate (see also KL.7 below). The ERT further recommends that Australia improve transparency by explaining, in the NIR, the methods and data sources used to estimate the carbon stock changes in revegetation. Further, the ERT recommends that Australia explain how the definition contained in decision 16/CMP.1 (in conjunction with decisions 6/CMP.9 and 3/CMP.11), annex, section C for revegetation, is associated with Australia's reporting on the land-use categories under the Convention, and explain how revegetation in settlements and wetlands does not meet the definition of forest	Accepted	Information on the methods and data sources used to estimate the carbon stock changes in revegetation is included in Section 11.9 Information on the definition of revegetation and how it relates to land-use categories under the convention, including how revegetation activity is distinguished from afforestation/reforestation is included in Section 11.2.
Revegetation – CO ₂	KL.7	The ERT recommends that Australia continue to work on updating the sparse woody vegetation data for any remaining map sheets in order to achieve a complete land representation of sparse woody vegetation, as these areas may be subject to revegetation activity under Article 3, paragraph 4	Accepted	In accordance with the information provided in response to KL.6, on the definition of revegetation activity and how it relates to land-use classifications under the Convention, revegetation activities only occur on wetlands and settlements. As these land-use classifications are not occurring in the rangeland tiles referred to by the ERT and therefore the reporting of revegetation activity is complete.

Sector	Report ref	ERT Recommendation	Response	Implementation
Harvested wood products – CO ₂	KL.8	The ERT recommends that Australia document the process for deriving the country-specific half-lives for HWP and provide information to justify that the methodologies used are at least as detailed or accurate as those prescribed in paragraph 29 of the annex to decision 2/CMP.7	Accepted	Australia has applied a tier 3 modelling approach based on country specific information to estimate the HWP pool, which is significantly more detailed and more accurate than the default half-lives listed in paragraph 29 of the annex to decision 2/CMP.7. Consistent with paragraph 30 of the decision, transparent information on the methodology applied, including rates of loss for different product pools and ages of material in use, is included in Section 6.15.1 of the NIR and Table 6.66). A planned improvement is underway to provide a comparison of the results of the Tier 3 model with the default half-lives and first-order decay method described in paragraph 29 of the annex to decision 2/CMP.7.
Harvested wood products – CO ₂	KL.9	The ERT recommends that Australia describe, in the NIR, the methodology used to distinguish HWP from deforestation from afforestation/reforestation and from forest management. The ERT further recommends that Australia transparently explain that HWP from deforestation is accounted for on the basis of instantaneous oxidation	Accepted	Detailed information clarifying the application of this provision and its impact on estimates of HWP is included in Section 11.4

ANNEX 7: Description of Australia's National Registry

The description of Australia's national registry follows the reporting guidance set down in decision 15/CMP.1, part II (Reporting of supplementary information under Article 7, paragraph 1, E. National registries), as amended by decision 3/CMP.11, under the KP.

A7.1 Name and contact information of the registry administrator designated by the Party to maintain the national registry

In October 2015, the following person was designated the Registry System Administrator of Australia's national registry:

Michelle Crosbie
Joint Registry System Administrator
Clean Energy Regulator
GPO Box 621
CANBERRA ACT 2601
Tel: +61 2 6159 3592
Email: michelle.crosbie@cleanenergyregulator.gov.au

Shaun Keane
Joint Registry System Administrator
Clean Energy Regulator
GPO Box 621
CANBERRA ACT 2601
Tel: +61 2 6159 3593
Email: shaun.keane@cleanenergyregulator.gov.au

A7.2 Names of any other party with which the party cooperates by maintaining their respective registries in a consolidated system

The ANREU is not operated in a consolidated system with any other party's registry.

A7.3 A description of the database structure and capacity of the national registry

The following is an extract from the Software Specifications for the ANREU.

Front end server

The ANREU runs Microsoft Internet Information Services 8 (IIS) for its front-end web servers. All incoming requests will enter and outgoing responses will exit through the IIS server. The IIS server rewrites URLs, then either passing it to the application server or back to the client. SSL termination happens on this tier. Secure Socket Layer (SSL) provides a secure connection between the ANREU and a client's web browser or the ITL. SSL uses a certificate which has been issued by a security authority to encrypt data moving over the unsecured internet. Beyond this point data will travel unencrypted between this IIS web front-end server and the application server. This is considered internal to the application. The IIS server converts all inbound and outbound HTTP communication to HTTPS secure communications.

Requests from the ITL and responses from the ANREU follow the same pattern. However, the front end server is not used for outgoing connections to the ITL initiated by the ANREU.

Application server

The middle tier serves the ANREU web application and uses Apache Tomcat 7.0. Apache Tomcat is an open source implementation of the Java Servlet and JavaServer Pages specifications that originally started as Sun Microsystems' original reference implementation. Tomcat runs the compiled Java Bytecode and allows for external access to application. Tomcat also provides externalized configuration for the application such as database connection details.

For outgoing requests to the ITL initiated by the ANREU web application, SSL origination occurs in the ANREU web application itself. Encrypted responses from the ITL return directly to the web application.

Database

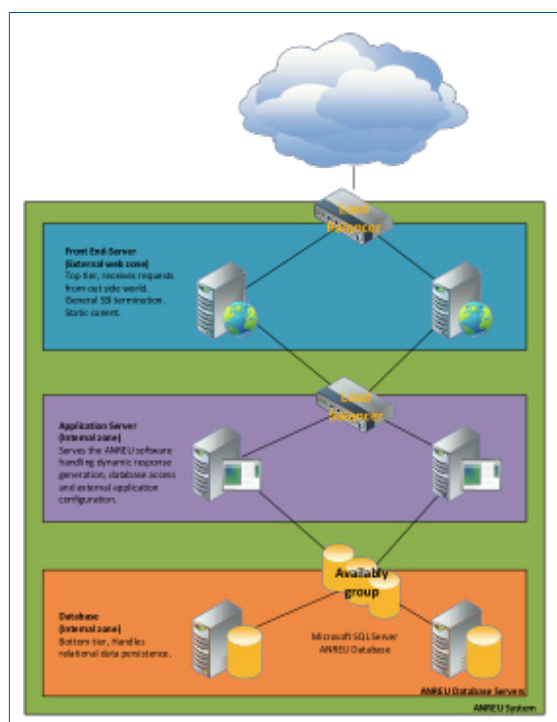
Microsoft SQL Server 2012 provides a relational database back-end for persistent storage of data for the application.

International Transaction Log Services

Transactions performed between the ANREU and the ITL take place through web service interfaces, following the Data Exchange Standards for Registry Systems under the Kyoto Protocol (DES). These web service interfaces are implemented using Apache Axis1 (Axis) which is an open source implementation of the Simple Object Access Protocol (SOAP). Axis supports generation of Java stub code based on the RPC/Encoded Web Service Definition Language (WSDL) specified by the DES. SOAP web services map to an internal service layer, isolating the web service code from the application code so that changes to the application can be made without affecting the ITL web service contract.

There are two web service interfaces that run, the client interface which allows the sending of messages to the ITL, and the server interface which allows the ANREU to receive messages from the ITL. Both of these interfaces are defined as WSDLs in the DES.

Figure A7.1 ANREU Logical Network Topology (Production Environment)



A7.4 A description of how the national registry conforms to the technical standards for the purpose of ensuring the accurate, transparent and efficient exchange of data between national registries, the clean development registry and the independent transaction log, including (i) to (vi) below

The ANREU contains the functionality to perform issuance, conversion, external transfer, (voluntary) cancellation, retirement and Reconciliation processes using XML messages and web-services as specified in the latest version of the Data Exchange Standards for Registry Systems under the Kyoto Protocol (DES).

In addition, the ANREU also contains: 24 Hour Clean-up, Transaction Status enquiry, Time Synchronisation, Data Logging requirements (including, Transaction Log, Reconciliation Log, Internal Audit Log and Message Archive) and the different identifier formats as specified in the UNFCCC DES document.

(i) A description of the formats used in the national registry for account numbers, serial numbers for ERUs, CERs, AAUs, and RMUs, including project identifiers and transaction numbers

The formats used in the ANREU are as specified in Data Exchange Standards for Registry Systems under the Kyoto Protocol (DES). Annex F – Definition of identifiers.

(ii) A list, and the electronic format, of the information transmitted electronically when transferring ERUs, CERs, AAUs, and/or RMUs to other registries

The formats used in the ANREU to transmit information to other registries are specified in the Data Exchange Standards for Registry Systems under the Kyoto Protocol (DES).

(iii) A list, and the electronic format, of the information transmitted electronically when acquiring ERUs, CERs, AAUs, and/or RMUs from other national registries or the CDM registry

The formats used in the ANREU to acknowledge the messages transmitted to other registries are specified in the Data Exchange Standards for Registry Systems under the Kyoto Protocol (DES).

(iv) A list, and the electronic format, of the information transmitted electronically from the national registry to the independent transaction log when issuing, transferring, acquiring, cancelling and retiring ERUs, CERs, AAUs, and/or RMUs

Information will be transmitted to the ITL in the message formats specified in the Data Exchange Standards for Registry Systems under the Kyoto Protocol (DES).

(v) An explanation of the procedures employed in the national registry to prevent discrepancies in the issuance, transfer, acquisition, cancellation and retirement of ERUs, CERs, AAUs, and/or RMUs

In order to minimise discrepancies between the ANREU and the ITL, the following approach has been adopted:

- Communications between the registry and the ITL are via web-services using XML messages – as specified in the Data Exchange Standards for Registry Systems under the Kyoto Protocol (DES). These web services, XML message format and the processing sequence are checked by the registry to ensure the compliance with the DES;
- The registry validates data entries against the formats of information as specified in Annex F of the DES;
- The registry implements internal controls in accordance with the checks performed by the ITL – as documented in Annex E of the DES.
- All units that are involved in a transaction are earmarked internally within the registry; thereby preventing the units from being involved in another transaction until a response has been received from the ITL and the current transaction has been completed;
- The web service that sends the message to the ITL for processing will ensure that a message received acknowledgement is received from the ITL before completing the submission of the message. Where no acknowledgement message has been received following a number of retries, the web-service would terminate the submission and roll back any changes made to the unit blocks that were involved;
- Where a 24 hour clean-up message is received from the ITL, the existing web service would roll back any pending transactions for the units that were involved, thereby preventing any discrepancies in the unit blocks between the registry and the ITL;
- Finally, if an unforeseen failure were to occur, the data discrepancies between our registry and the ITL can be corrected via a manual intervention function. Following this, reconciliation will be performed to validate that the data is in sync between the registry and the ITL. If a discrepancy reoccurs in the registry, the following measures will be applied:
 - Identification, and registration of the discrepancy;
 - Identification of the source of the discrepancy (DES, registry specifications, erroneous programming code);
 - Elaboration of a resolution plan and testing plan;
 - Correction and testing of the software;
 - Release and deployment of the corrected software.

(vi) An overview of the security measures employed in the national registry to deter unauthorised manipulations and minimize operator error

Below is a brief description of security measures implemented by the ANREU. For more detailed information, please refer to the formal readiness documentation which has been submitted as required to the ITL.

A7.5 Identification and Authentication

All applicants looking to open an account in the ANREU are required to provide specified proof of identity documentation, along with completing a “fit and proper” person test. These identity requirements are defined in the *Australian National Registry of Emissions Unit Act 2011* and the *Australian National Registry of Emissions Unit Regulations 2011*.

Access to the registry is allowed via a personal username and password – allocated as a part of a Registration process performed by the Clean Energy Regulator. Passwords have an expiry date and any reset requires revalidation of the user’s identity. Password configuration is as per Australian Government guidelines.

A7.6 Access control

Users of the ANREU are divided into five security groups. These groups control the access and security at the application level. A user’s login information is assigned to a user group, which determines what the user can and cannot do within the system.

The Registry supports the following user groups.

System Administrator

The System Administrator group has global authority throughout the Registry. This user is responsible not only for the day-to-day functionality of the system, but also for administrative support. This may include user management, managing and setting batch jobs, and reviewing audit and transaction logs. The system administrator is only available to personnel employed by the Clean Energy Regulator and is IP restricted.

IT Administrator

The IT Administrator group has authority to update system settings. These users are responsible for the day to day operation of the ANREU. An IT Administrator is unable to perform any transaction or administer accounts.

Business Administrator

This role is limited to users within the Clean Energy Regulator and possesses all the abilities of the account administrator, but also has the ability to initiate issuance transactions (domestic Australian units) and to approve issuance transactions initiated by a separate individual. In certain restricted instances, business administrators may initiate transfer transactions on behalf of the Clean Energy Regulator.

Account Administrator

This role is limited to selected users within the Clean Energy Regulator and allows access to account administration functions within the ANREU (creation/editing/deletion of account holders, accounts and users). An Account Administrator is unable to perform any transactions (e.g. unit transfers) in the ANREU.

Approval Officer

This role is limited to users within the Clean Energy Regulator. The approval officer user group has permissions to view all data related to accounts, account holders (organisations), and registered users (people). The approval officer user group may not alter any data related to accounts, account holders (organisations), and registered users (people), with the exception of their own personal data. The approval officer user group is permitted to approve (but not initiate) issuance transactions. They may not edit or delete any other transactional data.

Systems Auditor

A Systems Auditor has read only access to ANREU Account and Transaction information. A Systems Auditor is unable to update any information on an Account, nor is able to perform any transactions. Systems Auditor access is only available to personnel employed by the Clean Energy Regulator.

Industry User/Account Holders

Industry Users are external persons who require access to specific accounts within the ANREU. Users at this level are established when an ANREU account is initially created. All Industry Users must pass required Proof of Identity and Fit and Proper person validations prior to being associated with an account. Additional security permissions are maintained for each Industry User associated with each account e.g. the ability to initiate or approve transactions for that account. These permissions are set by the Clean Energy Regulator upon advice from the account holder.

A7.7 Access protection

In order to prevent operator errors, the ANREU incorporates validations on all user inputs to ensure that only valid details are submitted for processing; The ANREU displays confirmation of user input to help the user to spot any errors that had been made and implements an internal approval process (input of relevant password details) for secondary approval for relevant operations before submitting the details to the ITL for processing.

Additional Security measures

In addition to the above, the ANREU incorporates an initiator / approver design to assist in mitigating the risks associated with high risk unit transfer functions. The initiator / approver function requires a transaction to be initiated by one identity (authorised representative) and be approved by another (authorised representative). The approval step includes validating the transaction by entering a single use PIN issued to the approver when the “initiate” transaction component is completed.

This measure supports the recommendations as outlined by the ITL Change Advisory Board.

A7.8 A list of the information publicly accessible through the user interface to the national registry

Non-confidential information has been made accessible to the public in line with the requirements of decision 13/CMP.1 annex II.E, as amended by decision 3/CMP.11, on the National Registry website under the Public Reports menu.

Up to date information on accounts as required by paragraph 45 of decision 13/CMP.1, as amended by decision 3/CMP.11, has been included under Public Reports > Accounts. No ERUs have been issued to date so no information is available.

Information available to the public includes:

- Account name: the holder of the account;
- Account type: the type of account;
- Commitment period;
- Representative identifier;
- Representative name and contact information (CP1 only).

Information relating to projects as required by paragraph 46 has been included under [Public Reports > Joint Implementation Project Information Report](#).

Holding and transaction information as required by paragraph 47 is published as described below:

- (a) The total quantity of ERUs, CERs, AAUs and RMUs in each account at the beginning of the year is available under [Public Reports > Account Information Report, with Unit Block Holdings](#) for each account.
- (b) The total quantity of AAUs issued on the basis of the assigned amount pursuant to Article 3, paragraphs 7 and 8 is available at [Public Reports > Annual Holding and Transaction Summary Report](#).
- (c) The total quantity of ERUs issued on the basis of Article 6 projects is available at [Public Reports > Annual Holding and Transaction Summary Report](#).
- (d) The total quantity of ERUs, CERs, AAUs, and RMUs acquired from other registries and the identity of the transferring accounts and registries is available at [Public Reports > Annual Holding and Transaction Summary Report](#).
- (e) The total quantity of RMUs issued on the basis of each activity under Article 3 paragraphs 3 and 4 is available at [Public Reports > Annual Holding and Transaction Summary Report](#).
- (f) The total quantity of ERUs, CERs, AAUs, and RMUs transferred to other registries and the identity of the acquiring accounts and registries is available at [Public Reports > Annual Holding and Transaction Summary Report](#).
- (g) The total quantity of ERUs, CERs, AAUs, and RMUs cancelled on the basis of activities under Article 3, paragraphs 3 and 4 is available at [Public Reports > Annual Holding and Transaction Summary Report](#).
- (h) The total quantity of ERUs, CERs, AAUs, and RMUs cancelled following determination by the Compliance Committee that the party is not in compliance with its commitment under Article 3, paragraph 1 is available at [Public Reports > Annual Holding and Transaction Summary Report](#).
- (i) The total quantity of other ERUs, CERs, AAUs and RMUs cancelled is available at [Public Reports > Annual Holding and Transaction Summary Report](#).
- (j) The total quantity of ERUs, CERs, AAUs and RMUs retired is available at [Public Reports > Annual Holding and Transaction Summary Report](#).
- (k) The total quantity of ERUs, CERs and AAUs carried over from the previous commitment period is available at [Public Reports > Annual Holding and Transaction Summary Report](#).
- (l) Current holdings of ERUs, CERs, AAUs and RMUs in each account.

Public reports pertaining to paragraph 17 of Annex I to decision 3/CMP.11 will be made available when such transactions take place.

A7.9 An explanation of how to access information through the user interface of the national registry

Access to the ANREU is available through the internet at <http://nationalregistry.cleanenergyregulator.gov.au/>

A7.10 Measures to safeguard, maintain and recover data in the event of a disaster

The servers (main and backup sites) that host the ANREU are in physically secure data centres fitted with secure access control systems. All data centres are fitted with smoke detection and automatic fire suppression systems. Anti-virus software upgrades are downloaded and installed autonomously on to the servers as soon as they are released.

A full backup of each database and an hourly transaction log backup during business hours take place every day with the back-up media being held at an offsite third party secure storage facility. The database content will also be replicated at a minimum of 30 minute intervals to a secondary data centre location when the clustering environment is implemented. This will serve as the hosting platform for Disaster Recovery.

In the event of a disaster a decision will be taken (between the Clean Energy Regulator and the IT contract supplier) to invoke disaster recovery. This will involve:

- Stopping all transactions to the main platform.
- Ensuring that the committed transactions are replicated to the DR site.
- Switching all external interaction with the main site over to the secondary location.

The IT contract supplier is committed to resuming the service for the Regulator operators within 8 hours of the decision being made.

A7.11 Results of previous test procedures

Comprehensive testing information has been submitted as part of the ITL readiness documentation in December 2013. Please refer to this documentation for details.

Australia's independent assessment reports are available from the UNFCCC website https://unfccc.int/kyoto_protocol/registry_systems/independent_assessment_reports/items/4061.php

ANNEX 8: General notes, glossary and abbreviations

A8.1 General notes

Units

The units mainly used in this inventory are joules (J), grams (g), tonnes (t), metres (m) and litres (L), together with their multiples. Standard metric prefixes used in this inventory are:

kilo (k) = 10^3 (thousand)

mega (M) = 10^6 (million)

giga (G) = 10^9

tera (T) = 10^{12}

peta (P) = 10^{15}

Emissions are generally expressed in gigagrams (Gg) in the inventory tables, as called for under international guidelines, and in megatonnes (Mt) in the text of the inventory report:

gigagram (Gg) = 1,000 tonnes = 1 kilotonne (kt)

megatonne (Mt) = 1,000,000 tonnes = 1,000 Gg

Gases

CF ₄	perfluoromethane (a perfluorocarbon)
C ₂ F ₆	perfluoroethane (a perfluorocarbon)
CH ₄	methane
CO	carbon monoxide
CO ₂	carbon dioxide
HFCs	hydrofluorocarbons
NF ₃	nitrogen trifluoride
N ₂ O	nitrous oxide
NMVOC	non-methane volatile organic compounds
NO _x	oxides of nitrogen
PFCs	perfluorocarbons
SF ₆	sulphur hexafluoride
SO ₂	sulphur dioxide

Global warming potentials

$\text{CO}_2 = 1$ HFC-23 = 14,800

$\text{CH}_4 = 25$ HFC-125 = 3,500

$\text{N}_2\text{O} = 298$ HFC-134a = 1,430

$\text{CF}_4 = 7,390$ HFC-143a = 4,470

$\text{C}_2\text{F}_6 = 12,200$ $\text{SF}_6 = 17,700$

Conversion factors

From element basis to molecular mass

From molecular mass to element basis

C CO_2 : $x \ 44/12 = 3.67$ CO_2 C: $x \ 12/44 = 0.27$

C CH_4 : $x \ 16/12 = 1.33$ CH_4 C: $x \ 12/16 = 0.75$

N N_2O : $x \ 44/28 = 1.57$ N_2O N: $x \ 28/44 = 0.64$

Indicators

In the tables, the following standard indicators are used:

NO (not occurring) when the activity or process does not occur in Australia

NA (not applicable) when the activity occurs in Australia but the nature of the process does not result in emissions or removals

NE (not estimated) where it is known that the activity occurs in Australia but there are no data or methodology available to derive an estimate of emissions

IE (included elsewhere) where emissions or removals are estimated but included elsewhere in the inventory

C (confidential) where reporting at a disaggregated level could lead to the disclosure of confidential information

A8.2 Glossary

Term	Description
Accounting quantity	The accounting quantity for the Kyoto Protocol <i>land use, land use change and forestry</i> activities represents RMU credits issued or assigned amount units (AAUs) cancelled for a given year of the commitment period. A net removal will result in the issuance of RMU credits while a net source will result in the deletion of AAUs.
Activity	A process that generates greenhouse gas emissions or uptake. In some sectors it refers to the level of production or manufacture for a given process or category.
Automotive Diesel Oil (ADO)	A middle distillate petroleum product used as a fuel in high-speed diesel engines. It is mostly consumed in the road and rail transport sectors and agriculture, mining and construction sectors.
Anaerobic	A process relying on bacteria that can live without oxygen.
Anthropogenic	Resulting from human activities. In the inventory, anthropogenic emissions are distinguished from natural emissions.
Bagasse	The fibrous residue of the sugar cane milling process which is used as a fuel in sugar mills.
Briquettes	A composition fuel manufactured from brown coal, which is crushed, dried and moulded under high pressure without the addition of binders.
Calibration	Model calibration is the estimation and adjustment of model parameters and constants to improve the agreement between model outputs and a data set. Calibration requires high quality data that represent the range of conditions under which the model is required to perform so as to avoid possible bias in emission estimates.
Clinker	An intermediate product from which cement is made.
Coke	The solid product obtained from the carbonisation of suitable types of coal at high temperature. It is low in moisture and volatile matter and is mainly used in the iron and steel industry as an energy source and chemical agent. Semi-coke or coke obtained by carbonisation at low temperatures is included in this category.
Dolomite	A naturally occurring mineral ($\text{CaCO}_3 \cdot \text{mg CO}_3$) which can be used to produce lime, iron and steel.
Emission Factor	The quantity of greenhouse gases emitted per unit of some specified activity.
Emission Intensity	The total emissions divided by the total energy content of the fuels or the total energy used in a sector. The overall emissions intensity of coal used in Australia, for example, is determined by the quantity and emission factors for each of the many types and grades of coal used.
Enteric Fermentation	The process in animals by which gases, including methane, are produced as a by-product of microbial fermentation associated with digestion of feed.
Feedlot	A confined yard area with watering and feeding facilities where livestock (mainly beef cattle) are completely handfed for the purpose of production. It does not include the feeding or penning of cattle for weaning, dipping or similar husbandry purposes or for drought or other emergency feeding, or at a slaughtering place or in recognised saleyards.
Feedstocks	Products derived from crude oil and destined for further processing in the refining industry, other than blending. Products include those imported for refinery intake and those returned from the petrochemical industry to the refining industry, such as naphtha.
Flaring	The process of combusting unwanted or excess gases and/or oil at a crude oil or gas production site, a gas processing plant or an oil refinery.
Forest	Parties are required to select single minimum values for land area, tree crown cover and tree height. Australia uses a criteria of 20% tree crown cover, 2 metre minimum tree height, and a minimum of 0.2 hectares in land area for inclusion. These minimum criteria are within the ranges outlined in the Marrakech Accords.

Term	Description
Fuel Oil	Covers all residual (heavy) fuel oils including those obtained by blending.
Fugitive Emissions	Generally deliberate but not fully controlled emissions that typically result from leaks, including those from pump seals, pipe flanges and valve stems. Fugitive emissions also include methane emitted from coal mine seams. During petroleum storage tank filling, venting loss of vapour is a fugitive emission.
Global Warming Potential (GWP)	Represents the relative warming effect of a unit mass of a gas compared with the same mass of CO ₂ over a specific period. Multiplying the actual amount of gas emitted by the GWP gives the CO ₂ -equivalent emissions.
Greenhouse Gases	Gases that contribute to global warming, including carbon dioxide (CO ₂), methane (CH ₄), nitrous oxide (N ₂ O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF ₆) and nitrogen trifluoride (NF ₃). In addition, the photochemically important gases – NMVOCs, oxides of nitrogen (NO _x) and carbon monoxide (CO) – are also considered. NMVOC, NO _x and CO are not direct greenhouse gases. However, they contribute indirectly to the greenhouse effect by influencing the rate at which ozone and other greenhouse gases are produced and destroyed in the atmosphere.
Hydrofluorocarbons (HFCs)	Used as substitutes for chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs).
Initial Assigned Amount	Represents Australia's emissions target for the first commitment period of the Kyoto Protocol. The initial assigned amount for the first commitment period was calculated as 108% of the base year emissions and is established as 591.5 Mt CO ₂ -e a year for each year of the first commitment period 2008-2012. At such time as the government ratifies the Doha Amendment to the KP, Australia's assigned amount for the second commitment period will be calculated based on its target of 99.5% of base year emissions.
Intergovernmental Panel on Climate Change (IPCC)	The international body responsible for assessing the state of knowledge about climate change. The IPCC increases international awareness of climate change science and provides guidance to the international community on issues related to climate change response.
Key Category	The IPCC Good Practice report (IPCC 2000) introduces the concept of key categories for prioritising the inventory development process. A key category has a significant influence on a country's total inventory of direct greenhouse gases in terms of absolute level of emissions, the trend in emissions, or both. The tier 1 key category analysis identifies categories that contribute to 95% of the total emissions or 95% of the trend of the inventory in absolute terms. Tier 2 analysis identified categories that contribute to 90% of total uncertainty in the inventory.
Kyoto Protocol	The Kyoto Protocol to the convention on climate change was developed through the UNFCCC negotiating process. The protocol was negotiated in Kyoto, Japan, in 1997. It sets binding greenhouse gas emissions targets for UNFCCC developed country Parties that ratify the agreement. The first commitment period of the KP ran from 2008-2012. In 2012 Parties to the KP agreed to the Doha Amendment, establishing a second commitment period (CP2) to run from 2013 – 2020. The CP2 is yet to enter into force.
Liquefied Petroleum Gas (LPG)	A light hydrocarbon fraction of the paraffin series. It occurs naturally, associated with crude oil and natural gas in many oil and gas deposits, and is also produced in the course of petroleum refinery processes. LPG consists of propane (C ₃ H ₈) and butane (C ₄ H ₁₀), or a mixture of the two. In Australia, LPG as marketed contains more propane than butane.
Lubricants	Hydrocarbons that are rich in paraffin and not used as fuels. They are obtained by vacuum distillation of oil residues.
Military Transport	Includes all activity by military land vehicles, aircraft and ships.
Natural Gas	Consists primarily of methane (around 90%, with traces of other gaseous hydrocarbons, as well as nitrogen and carbon dioxide) occurring naturally in underground deposits. As a transport fuel it is generally used in compressed or liquefied form.

Term	Description
Navigation	All civilian (non-military) marine transport of passengers and freight. Domestic marine transport consists of coastal shipping (freight and cruises), interstate and urban ferry services, commercial fishing, and small pleasure craft movements. International shipping using marine bunker fuel purchased in Australia is reported but not included in the national inventory emissions total.
NMVO	Non-methane volatile organic compounds such as alkanes, alkenes and alkynes, aromatic compounds and carbonyls that are gases at standard temperature and pressure (i.e. Boiling points below 200°C) and normally 10 or less carbon atoms per molecule; excludes chlorofluorocarbons (CFCs).
PFC	Perfluorocarbons, chemical compounds containing carbon and fluorine atoms only (e.g. CF ₄ and C ₂ F ₆).
Prescribed Burning	The intentional burning of forests to reduce the amount of combustible material present and thereby reduce the risk of wildfires. In Australia this is known as 'fuel reduction burning'.
Process Emission	The gas released as a result of chemical or physical transformation of materials from one form to another.
Reference approach	A 'top-down' tier 1 IPCC methodology for estimating CO ₂ emissions from fuel combustion activities (1.a).
Sink	Any process, mechanism, or activity that removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the atmosphere.
Solid Waste	Waste from various activities; includes municipal solid waste (waste from domestic premises and council activities largely associated with servicing residential areas; such as street sweepings, street tree lopping, parks and gardens and litter bins), commercial and industrial waste, and building and demolition waste.
Solvent	An organic liquid used for cleaning or to dissolve materials.
Source	Any process or activity that releases a greenhouse gas, an aerosol or a precursor of a greenhouse gas into the atmosphere.
Tier	The IPCC methods for estimating emissions and removals are divided into 'tiers' encompassing different levels of activity and technology detail. Tier 1 methods are generally very simple (activity multiplied by default emissions factor) and require less data and expertise than the most complicated tier 3 methods. Tier 2 and 3 methods generally require more detailed country-specific information on things such as technology type or livestock characteristics. The concept of tiers is also used to describe different levels of key source analysis, uncertainty analysis, and quality assurance and quality control activities.
Town Gas	Includes all manufactured gases that are typically reticulated to consumers, including synthetic natural gas, reformed natural gas, tempered LPG, and tempered natural gas.
Uncertainty	Uncertainty is a parameter associated with the result of measurement that characterises the dispersion of values that could be reasonably attributed to the measured quantity (e.g. The sample variance or coefficient of variation). In general inventory terms, uncertainty refers to the lack of certainty (in inventory components) resulting from any causal factor such as unidentified sources and sinks, lack of transparency etc.
United Nations Framework Convention on Climate Change (UNFCCC)	An international environmental treaty which entered into force in 1994. Parties to the convention have agreed to work towards achieving the ultimate aim of stabilising 'greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system'.

Term	Description
Validation	Model validation is a demonstration that a model, within its domain of applicability, possesses a satisfactory range of accuracy consistent with the intended application of the model. Validation compares simulated system output with real system observations using data not used in model development. It is used to test the model performance and that the calibration of the model has not produced biased emission estimates.
Verification	In terms of the inventory verification refers to the collection of activities and procedures that can be followed during the planning and development, or after completion of an inventory that can help establish its reliability for the intended application of that inventory. Typically methods external to the inventory are used to verify the truth of the inventory, including comparisons with estimates made by other bodies. Verification as it pertains to modelling is a demonstration that the modelling formalism is correct. It is a check that calculations, inputs, and computer code is correct.
Venting	The process of releasing gas into the atmosphere without combustion. This may be done either at the production site or at the refinery or stripping plants. It is done to dispose of non-commercial gas or to relieve system pressure.

A8.3 Abbreviations

AAA	Aerosol Association of Australia
AAC	Australian Aluminium Council
ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ABARE	Australian Bureau of Agricultural and Resource Economics
ABR	Australian Business Register
ABS	Australia Bureau of Statistics
ACARP	Australian Coal Association Research Program
ACT	Australian Capital Territory
AD	Activity Data
ADB	Asian Development Bank
ADC	Aluminium Development Council
ADO	Automotive Diesel Oil
ADR	Australian Design Rule
AEMO	Australian Energy Market Operator
AES	Australian Energy Statistics
AEZ	Agro Ecological Zones
AFIC	Australian Feeds Information Centre
AFRC	Agriculture and Food Research Council
AGA	Australian Gas Association
AGEIS	Australia Greenhouse Emissions Information System
AGO	Australian Greenhouse Office
AIHW	Australian Institute of Health and Welfare
ALFA	Australian Lot Feeders Association
ANAO	Australian National Audit Office
ANREU	Australian National Registry of Emissions Units
ANU	Australian National University
ANZSIC	Australia New Zealand Standard Industrial Classification
APEC	Asia Pacific Economic Corporation
API	American Petroleum Institute

APPEA	Australian Petroleum Production and Exploration Association
APS	Australian Petroleum Statistics
ARC	Agricultural Research Council
ARRBTR	Australian Road Research Board Transport Research
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers Inc.
ASRIS	Australian Soil Resource Information System
ASS	Acid Sulphate Soils
AUASB	Auditing and Assurance Standards Board
AUSLIG	Australian Surveying and Land Information Group
AVHRR	Advanced Very High Resolution Radiometer
Avtur	Aviation turbine fuel
BEF	Burning Efficiency
BITRE	Bureau of Infrastructure, Transport and Regional Economics
BoM	Bureau of Meteorology
BTX	Benzene, Toluene, Xylene
BREE	Bureau of Resources and Energy Economics
BRS	Bureau of Rural Science
C&D	Construction and Demolition waste
C&I	Commercial and Industrial waste
CAAANZ	Conservation Agriculture Alliance of Australia and New Zealand
CAB	Change Advisory Board
CCS	Carbon Capture and Storage
CCUS	Carbon Capture Use and Storage
CEF	Clean Energy Future package
CEM	Clean Energy Ministerial
CER	Clean Energy Regulator
CERI	Clean Energy Research Institute
CFTT	Centre for Forest Tree Technology
COBIT	Control Objectives for Information and related Technology
COD	Chemical Oxygen Demand

CP2	Kyoto Protocol/ Second Commitment Period
CPN	Conditional Probability Network
CRC SI	Cooperative Research Centre for Spatial Information
CRES	Centre for Resource and Environmental Studies
CRF	Common Reporting Format
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CUEDC	Composite Urban Emissions Drive Cycle
DAFF	Department of Agriculture, Fisheries and Forestry
DCC	Department of Climate Change
DCCEE	Department of Climate Change and Energy Efficiency
DE	Department of the Environment
DEE	Department of the Environment and Energy
DEEDI	Department of Employment, Economic Development and Innovation
DEM	Digital Elevation Model
DES	Data Exchange Standards
DEWHA	Department of Environment, Water, Heritage and the Arts
DIS	Department of Industry and Science
DIT	Department of Infrastructure and Transport
DM	Dry Matter
DMD	Dry Matter Digestibility
DMITRE	Department of Manufacturing, Innovation, Trade, Resources and Energy
DMP	Department of Mines and Petroleum
DNRM	Department of Natural Resources and Mines
DOC	Degradable Organic Carbon
DOC _f	fraction of Degradable Organic Carbon dissimilated
DOM	Database Operations Manager
DRET	Department of Resources, Energy and Tourism
DSDBI	Department of State Development, Business and Innovation
DSITI	Queensland Department of Science, Information Technology and Innovation
E&P Forum	Exploration and Production Forum

EDC	Emission Decay Curve
EDS	Early Dry Season
EF	Emission Factor
EGCFE	Expert Group on Clean Fossil Energy
EIS	Environmental Impact Statements
EITEI	Emissions Intensive Trade Exposed Industries
EPA	Environmental Protection Agency
ERIC	Environmental Research and Information Consortium Pty Ltd
ERT	Expert Review Team
ESAA	Energy Supply Association of Australia
ESAS	Electricity Sector Adjustment Scheme
EU ETS	European Union Emissions Trading Scheme
EVAO	Estimated Value of Agricultural Operations
FAO	Food and Agriculture Organisation
FITR	Fourier Transform Infrared Spectroscopy
FOD	First Order Decay
FORS	Federal Office of Road Safety
FPA	Forest Practices Authority
FullCAM	Full Carbon Accounting Model
G8	The Group of Eight
GCL	Geosynthetic Clay Liner
GCV	Gross Calorific Equivalents
GE	Gross Energy
GEDO	Greenhouse and Energy Data Officer
GHG	Greenhouse Gas
GIS	Geographic Information Systems
GRDC	Grains Research and Development Corporation
GWA	George Wilkenfeld and Associates
GWP	Global Warming Potential
HDPE	High Density Polyethylene

IBRA	Interim Biogeographic Regionalisation for Australia
IDF	Industrial Diesel Fuel
IEA	International Energy Agency
IEF	Implied Emission Factor
IPCC	Intergovernmental Panel on Climate Change
IAR	Initial Assessment Report
ISC	Interspecies correlation
ISO	International Organization for Standardization
IUFRO	International Union of Forest Research Organizations
JCP	Jobs and Competitiveness Program
JCPAA	Joint Committee of Public Accounts and Audit
KP	Kyoto Protocol
LDS	Late Dry Season
LKD	Lime Kiln Dust
LNG	Liquefied Natural Gas
LPG	Liquid Petroleum Gas
LTO	Landing/Takeoff
LULUCF	Land use, land use change and forestry
M2M	Methane to Markets
MCF	Methane Correction Factor
MDI	Metered Dose Inhaler
MDP	Metropolitan Development Program
ME	Metabolizable Energy
MEF	Manure Emission Factor
MMS	Manure Management Systems
MRT	Mineral Resources Tasmania
MSW	Municipal Solid Waste
MVG	Major Vegetation Groups
MWTP	Municipal Wastewater Treatment Plants
NAISMA	North Australian Indigenous Land & Sea Management Alliance

NATA	National Association of Testing Authorities
NCAS	National Carbon Accounting System
NEA	National Energy Administration
NFI	National Forest Inventory
NG	Natural Gas
NGERS	National Greenhouse and Energy Reporting Scheme
NGGI	National Greenhouse Gas Inventory
NGGIC	National Greenhouse Gas Inventory Committee
NIAES	National Institute for Agro-Environmental Sciences
NIR	National Inventory Report
NLWRA	National Land and Water Resources Audit
NORP	Nitrous Oxide Research Program
NRC	National Research Council
NSW	New South Wales
NT	Northern Territory
OECD	Organisation for Economic and Co-operation Development
OSCAR	Online System for Comprehensive Activity Reporting
PCC	Post Combustion Capture
PVC	Polyvinyl Chloride
QA/QC	Quality assurance/Quality control
QDME	Queensland Department of Mines and Energy
QDNRME	Queensland Department of Natural Resources, Mines and Energy
QLD	Queensland
RET	Department of Resources, Energy and Tourism
RIRDC	Rural Industries Research and Development Corporation
ROU	Recycled Organics Unit
RRA	Refrigerant Reclaim Australia
RSA	Registry System Administrators
SA	South Australia
SCA	Standing Committee on Agriculture

SCaRP	Soil Carbon Research Program
SECV	State Electricity Commission of Victoria
SEF	Standard Electronic Format
SEWPaC	Department of Sustainability, Environment, Water, Population and Communities
SIAR	Standard Independent Annual Review
SUV	Sports Utility Vehicle
SWDS	Solid Waste Disposal Site
TAS	Tasmania
TOC	Total Organic Carbon
UAG	Unaccounted for Gas
UNFCCC	United Nations Framework Convention on Climate Change
USEPA	United States Environmental Protection Agency
VIC	Victoria
VKT	Vehicle Kilometres Travelled
VOC	Volatile Organic Compounds
WA	Western Australia
WALFA	Western Arnhem Land Fire Abatement
WBCSD	World Business Council for Sustainable Development
WMAA	Waste Management Association of Australia
WRI	World Resource Institute
WSAA	Water Services Association of Australia
YSLB	Years Since Last Burnt

ANNEX 9: References

Volume 1

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Volume 2

6. Land Use, Land Use Change and Forestry

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Volume 3

11. Kyoto Protocol LULUCF

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