United Nations

Framework Convention on
Climate Change

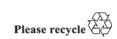FCCC/ARR/2021/AUS

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Report on the individual review of the annual submission of Australia submitted in 2021*

Note by the expert review team

Summary

Each Party included in Annex I to the Convention must submit an annual inventory of emissions and removals of greenhouse gases for all years from the base year (or period) to two years before the inventory due date (decision 24/CP.19). Parties included in Annex I to the Convention that are Parties to the Kyoto Protocol are also required to report supplementary information under Article 7, paragraph 1, of the Kyoto Protocol with the inventory submission due under the Convention. This report presents the results of the individual review of the 2021 annual submission of Australia, conducted by an expert review team in accordance with the "Guidelines for review under Article 8 of the Kyoto Protocol". The review took place from 6 to 11 September 2021 remotely.

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* In the symbol for this document, 2021 refers to the year in which the inventory was submitted, not to the year of publication.

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Contents

Abbreviations and acronyms

2006 IPCC Guidelines	*2006 IPCC Guidelines for National Greenhouse Gas Inventories*
2019 Refinement to the 2006 IPCC Guidelines	*2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*
AAU	assigned amount unit
AD	activity data
Annex A source	source category included in Annex A to the Kyoto Protocol
AR	afforestation and reforestation
Article 8 review guidelines	"Guidelines for review under Article 8 of the Kyoto Protocol"
C	carbon
CER	certified emission reduction
CH_4	methane
CM	cropland management
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
Convention reporting adherence	adherence to the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual greenhouse gas inventories"
CPR	commitment period reserve
CRF	common reporting format
CSIRO	Commonwealth Scientific and Industrial Research Organisation of Australia
EF	emission factor
EF_5	emission factor for nitrous oxide emissions from nitrogen leaching and run-off
ERT	expert review team
ERU	emission reduction unit
FM	forest management
FMRL	forest management reference level
$Frac_{GASF}$	fraction of synthetic fertilizer nitrogen that volatilizes as ammonia and nitrogen oxides
$Frac_{GASM}$	fraction of applied organic nitrogen fertilizer materials and of urine and dung nitrogen deposited by grazing animals that volatilizes as ammonia and nitrogen oxides
$Frac_{LEACH-(H)}$	fraction of nitrogen input to managed soils that is lost through leaching and run-off
$Frac_{LEACH-MS}$	fraction of managed manure nitrogen losses due to leaching and run-off
$Frac_{Limeij}$	fraction of limestone
GHG	greenhouse gas
GM	grazing land management
HFC	hydrofluorocarbon
HWP	harvested wood products
IE	included elsewhere
IEF	implied emission factor
IPCC	Intergovernmental Panel on Climate Change
IPPU	industrial processes and product use
KP-LULUCF	activities under Article 3, paragraphs 3–4, of the Kyoto Protocol
LULUCF	land use, land-use change and forestry
MMS	manure management system(s)
MSW	municipal solid waste

N	nitrogen
N_2O	nitrous oxide
NA	not applicable
NE	not estimated
NF_3	nitrogen trifluoride
NH_3	ammonia
NIR	national inventory report
NO	not occurring
NO_X	nitrogen oxides
PFC	perfluorocarbon
P_j	fractional purity of lime
QA/QC	quality assurance/quality control
RMU	removal unit
RV	revegetation
SEF	standard electronic format
SF_6	sulfur hexafluoride
SIAR	standard independent assessment report
SWDS	solid waste disposal site(s)
UNFCCC Annex I inventory reporting guidelines	"Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual greenhouse gas inventories"
UNFCCC review guidelines	"Guidelines for the technical review of information reported under the Convention related to greenhouse gas inventories, biennial reports and national communications by Parties included in Annex I to the Convention"
VS	volatile solid(s)
WDR	wetland drainage and rewetting
Wetlands Supplement	*2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands*

I. Introduction

1.   This report covers the review of the 2021 annual submission of Australia, organized by the secretariat in accordance with the Article 8 review guidelines (adopted by decision 22/CMP.1 and revised by decision 4/CMP.11). In accordance with the Article 8 review guidelines, this review process also encompasses the review under the Convention as described in the UNFCCC review guidelines, particularly in part III thereof, namely the "UNFCCC guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention" (annex to decision 13/CP.20). The review took place from 6 to 11 September 2021 remotely[1] and was coordinated by Roman Payo, Nashib Kafle and Karen Ortega (secretariat). Table 1 provides information on the composition of the ERT that conducted the review for Australia.

Table 1
Composition of the expert review team that conducted the review for Australia

Area of expertise	Name	Party
Generalist	Phindile Mangwana	South Africa
	Harry Vreuls	Netherlands
Energy	André Amaro	Portugal
	Vincent Camobreco	United States
	Maya Fukuda	Japan
IPPU	Laura Dawidowski	Argentina
	Emma Salisbury	United Kingdom
	Alexander Valencia	Colombia
Agriculture	Abdulkadir Bektas	Turkey
	Paulo Cornejo	Chile
	Mahmoud Medany	Egypt
LULUCF and KP-LULUCF	Atsuko Hayashi	Japan
	Agustín Inthamoussu	Uruguay
	Doru Leonard Irimie	Romania
Waste	Richard Claxton	United Kingdom
	Violeta Hristova	Bulgaria
	Hiroyuki Ueda	Japan
Lead reviewers	Laura Dawidowski	
	Harry Vreuls	

2.   The basis of the findings in this report is the assessment by the ERT of the Party's 2021 annual submission in accordance with the UNFCCC review guidelines and the Article 8 review guidelines.

3.   The ERT has made recommendations that Australia resolve identified findings, including issues[2] designated as problems.[3] Other findings, and, if applicable, the encouragements of the ERT to Australia to resolve related issues, are also included in this report.

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[1] Owing to the circumstances related to the coronavirus disease 2019, the review had to be conducted remotely.

[2] Issues are defined in decision 13/CP.20, annex, para. 81.

[3] Problems are defined in decision 22/CMP.1, annex, paras. 68–69, as revised by decision 4/CMP.11.

4.   A draft version of this report was communicated to the Government of Australia, which provided comments that were considered and incorporated, as appropriate, into this final version of the report.

5.   Annex I presents the annual GHG emissions of Australia, including totals excluding and including LULUCF, indirect CO_2 emissions, and emissions by gas and by sector, and contains background data on emissions and removals from KP-LULUCF, if elected by the Party, by gas, sector and activity.

6.   Information to be included in the compilation and accounting database can be found in annex II.

II.   Summary and general assessment of the Party's 2021 annual submission

7.   Table 2 provides the assessment by the ERT of the Party's 2021 annual submission with respect to the tasks undertaken during the review. Further information on the issues identified, as well as additional findings, may be found in tables 3 and 5.

Table 2
Summary of review results and general assessment of the 2021 annual submission of Australia

Assessment			Issue/problem ID#(s) in table 3 or 5[a]
Date of submission	Original submission: NIR, 15 April 2021; CRF tables (version 1), 15 April 2021; SEF tables, 15 April 2021		
Review format	Centralized review conducted remotely		
Application of the requirements of the UNFCCC Annex I inventory reporting guidelines and the Wetlands Supplement (if applicable)	Have any issues been identified in the following areas:		
	(a) Identification of key categories?	No	
	(b) Selection and use of methodologies and assumptions?	Yes	W.6, W.8
	(c) Development and selection of EFs?	Yes	A.3
	(d) Collection and selection of AD?	Yes	E.3, E.7, L.1, KL.2, KL.4
	(e) Reporting of recalculations?	No	
	(f) Reporting of a consistent time series?	No	
	(g) Reporting of uncertainties, including methodologies?	Yes	G.5, A.21
	(h) QA/QC?	QA/QC procedures were assessed in the context of the national system (see supplementary information under the Kyoto Protocol below)	
	(i) Missing categories, or completeness?[b]	Yes	E.9, W.5, W.7
	(j) Application of corrections to the inventory?	No	
Significance threshold	For categories reported as insignificant, has the Party provided sufficient information showing that the likely level of emissions meets the criteria in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines?	No	E.2
Description of trends	Did the ERT conclude that the description in the NIR of the trends for the different gases and sectors is reasonable?	Yes	
Supplementary information under the Kyoto Protocol	Have any issues been identified related to the following aspects of the national system:		
	(a) Overall organization of the national system, including the effectiveness and reliability of the institutional, procedural and legal arrangements?	No	
	(b) Performance of the national system functions?	No	

Assessment			Issue/problem ID#(s) in table 3 or 5[a]
	Have any issues been identified related to the national registry:		
	(a) Overall functioning of the national registry?	No	
	(b) Performance of the functions of the national registry and the adherence to technical standards for data exchange?	No	
	Have any issues been identified related to the reporting of information on AAUs, CERs, ERUs and RMUs and on discrepancies in accordance with decision 15/CMP.1, annex, chapter I.E, in conjunction with decision 3/CMP.11, taking into consideration any findings or recommendations contained in the SIAR?	No	
	Have any issues been identified in matters related to Article 3, paragraph 14, of the Kyoto Protocol, specifically problems related to the transparency, completeness or timeliness of the reporting on the Party's activities related to the priority actions listed in decision 15/CMP.1, annex, paragraph 24, in conjunction with decision 3/CMP.11, including any changes since the previous annual submission?	No	
	Have any issues been identified related to the following reporting requirements for KP-LULUCF:		
	(a) Reporting requirements of decision 2/CMP.8, annex II, paragraphs 1–5?	No	
	(b) Demonstration of methodological consistency between the reference level and reporting on FM in accordance with decision 2/CMP.7, annex, paragraph 14?	No	
	(c) Reporting requirements of decision 6/CMP.9?	No	
	(d) Country-specific information to support provisions for natural disturbances in accordance with decision 2/CMP.7, annex, paragraphs 33–34?	No	
CPR	Was the CPR reported in accordance with decision 18/CP.7, annex; decision 11/CMP.1, annex; and decision 1/CMP.8, paragraph 18?	Yes	
Adjustments	Has the ERT applied any adjustments under Article 5, paragraph 2, of the Kyoto Protocol?	No	
	Has the Party submitted a revised estimate to replace a previously applied adjustment?	NA	Australia does not have a previously applied adjustment
Response from the Party during the review	Has the Party provided the ERT with responses to the questions raised, including the data and information necessary for assessing conformity with the UNFCCC Annex I inventory reporting guidelines and any further guidance adopted by the Conference of the Parties?	Yes	
Recommendation for an exceptional in-country review	On the basis of the issues identified, does the ERT recommend that the next review be conducted as an in-country review?	No	
Questions of implementation	Did the ERT list any questions of implementation?	No	

[a] Further information on the issues identified, as well as additional findings, may be found in tables 3 and 5.
[b] Missing categories for which methods are provided in the 2006 IPCC Guidelines may affect completeness and are listed in annex III.

III. Status of implementation of recommendations included in the previous review report

8. Table 3 compiles the recommendations from previous review reports that were included in the most recent previous review report, published on 16 March 2021,[4] and had not been resolved by the time of publication of the report on the review of the Party's 2020 annual submission. The ERT has specified whether it believes the Party had resolved, was addressing or had not resolved each issue or problem by the time of publication of this review report and has provided the rationale for its determination, which takes into consideration the publication date of the most recent previous review report and national circumstances.

Table 3
Status of implementation of recommendations included in the previous review report for Australia

ID#	Issue/problem classification[a, b]	Recommendation made in previous review report	ERT assessment and rationale
General			
G.1	Notation keys (G.1, 2020) (G.7, 2019) Transparency	Provide information stating that the total national aggregate estimated emissions for all gases and categories reported as "NE" remain below 0.1 per cent of the national total GHG emissions in line with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.	Resolved. The Party reported in annex 5 to the NIR (vol. 3, p.150) and in CRF table 9 on omitted emission categories and stated in NIR table A5.2 that the total national aggregate of estimated emissions for all gases and categories reported as "NE" is below 0.1 per cent of its national total GHG emissions. The ERT considers that the information reported is consistent with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.
G.2	Recalculations (G.4, 2020) Transparency	Correct the error in NIR table 10.1 regarding recalculations for category 3.E.	Resolved. In the NIR (vol. 2, p.388), the Party corrected the error in NIR table 10.1 identified during the previous review. NIR table 10.3.1 provides information on recalculations and trends by sector and contains a reference to the NIR section where the relevant recalculations and drivers are documented.
G.3	Uncertainty analysis (G.5, 2020) Transparency	Elaborate, in annex 2 to the NIR and the appropriate sectoral chapters, on any changes to the category-specific uncertainty estimates as well as on any changes to the overall uncertainty analysis affecting the uncertainties estimated for the level of and trend in emissions (including and excluding LULUCF) with respect to the uncertainty assessment conducted for the previous annual submission.	Resolved. In the NIR (vol. 3, annex 2, p.108, and tables A2.1–A2.4), the Party reported on the level of and trend in uncertainties for the base year and the latest inventory year, including and excluding LULUCF. Further information regarding changes to the category-specific uncertainty estimates compared with the previous annual submission was provided, including a reference to a new gas facility and a revised uncertainty value for HWP.
Energy			
E.1	International bunkers and multilateral	Correct the AD on international bunkers to avoid discrepancies between CRF tables 1.D and 1.A(b).	Addressing. The discrepancies in AD for international marine bunkers identified for 2017 and reported in CRF tables 1.D and 1.A(b) were

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[4] FCCC/ARR/2020/AUS.

ID#	Issue/problem classification[a, b]	Recommendation made in previous review report	ERT assessment and rationale
	operations – liquid fuels – all gases (E.1, 2020) (E.2, 2019) Convention reporting adherence		corrected in the previous annual submission. The values reported for 2018–2019 in CRF tables 1.D and 1.A(b) are also consistent. However, the errors identified for jet kerosene used in international aviation have not been corrected for 2011, 2016 and 2017, and the errors identified for gas/diesel oil and residual fuel oil used in international marine bunkers for 2014 and 2016 have not been corrected. For example, Australia reported consumption of (1) jet kerosene for international aviation for 2011 as 145,020.00 TJ in CRF table 1.D but as 149,760.69 TJ in CRF table 1.A(b); (2) gas/diesel oil for international navigation for 2014 as 1,535.00 TJ in CRF table 1.D but as 1,833.80 TJ in CRF table 1.A(b); and (3) residual fuel oil for international navigation for 2014 as 28,910.00 TJ in CRF table 1.D but as 27,658.70 TJ in CRF table 1.A(b). During the review, Australia explained that, for the 2022 submission, it intends to correct the inconsistencies identified in the CRF tables and implement QA/QC procedures to check for consistency between CRF tables 1.D and 1.A(b) for all fuels.
			The ERT considers that the recommendation has not yet been fully addressed because the Party has not yet corrected the identified errors for jet kerosene, gas/diesel oil and residual fuel oil.
E.2	1.A Fuel combustion – sectoral approach – biomass – CH_4 and N_2O (E.5, 2020) Transparency	Report the correct notation key ("NE") for biomass for categories 1.A.3.d (domestic navigation), 1.A.3.e.ii (other (other transportation)) and 1.A.4.b.ii (off-road and other machinery (residential)) and justify why the emissions were not estimated if they are below the significance threshold in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines and in line with the information provided to the ERT during the 2020 review, or estimate and report CH_4 and N_2O emissions for these categories.	Addressing. Australia reported the correct notation key ("NE") for CH_4 and N_2O emissions from biomass for categories 1.A.3.d (domestic navigation), 1.A.3.e.ii (other (other transportation)) and 1.A.4.b.ii (off-road and other machinery (residential)). However, the Party did not justify in the NIR why those emissions were not estimated in terms of the likely level of emissions (to demonstrate that the emissions are below the significance threshold established in para. 37(b) of the UNFCCC Annex I inventory reporting guidelines). During the review, the Party explained that it will update its methods to enable it to include estimates of non-CO_2 emissions from biomass for the identified categories, which it intends to do for the next annual submission.
			Given that the biomass reported relates to the ethanol component of E10 gasoline sold in some regions of Australia, the ERT applied the biomass IEF for cars (category 1.A.3.b.i) for 2019 (CH_4 IEF of 19.97 kg/TJ; N_2O IEF of 7.07 kg/TJ) for estimating emissions of CH_4 and N_2O. The estimated emissions for the three categories combined of 0.003 kt CH_4 and 0.001 kt N_2O for 2019, as calculated by the ERT, are below the significance threshold (272.58 kt CO_2 eq for 2019) and therefore below the level for including this issue in the list of potential problems and further questions raised by the ERT.
E.3	1.A.1.b Petroleum refining – gaseous fuels	Allocate any known refinery gas used in petroleum refining to liquid fuels or, if the volumes and types of	Addressing. Australia was unable to reallocate emissions from the refinery gas used in petroleum refining to liquid fuels (as recommended in the 2006

ID#	Issue/problem classification[a, b]	Recommendation made in previous review report	ERT assessment and rationale
	– CO_2 (E.6, 2020) Comparability	"other" gaseous fossil fuels are not known with sufficient certainty, allocate them to other fossil fuels under CRF category 1.A.1.b and only report natural gas under gaseous fuels. If the Party is unable to reallocate these other gaseous fossil fuels, explain in the NIR why the CO_2 IEF for gaseous fuels consumed in petroleum refining is comparatively low by including the (non-confidential) information provided to the ERT during the 2020 review (e.g. that a large share of the volume reported under gaseous fuels corresponds to the "other" gaseous fossil fuels reported by a single refinery).	IPCC Guidelines, vol. 2, table 1) or to other fossil fuels (in cases where there is not sufficient knowledge of the volumes and types of "other" gaseous fuels). Moreover, the explanation for the lower values of the CO_2 IEF for gaseous fuels included in the NIR (vol. 1, p.75) does not mention that a large share of the volume reported under gaseous fuels corresponds to "other" gaseous fossil fuels. During the review, Australia informed the ERT that an investigation was conducted into the reporting of fuel use in petroleum refining. The Party clarified that it plans to address the issue for the next annual submission. Owing to the unknown make-up of "other" gaseous fuels, it plans to remove the "other" gaseous fuels portion from total gaseous fuels and separately report these emissions under the "other fossil fuels" category in the CRF tables.
E.4	1.A.2 Manufacturing industries and construction – all fuels – CO_2, CH_4 and N_2O (E.7, 2020) Transparency	Improve the transparency of explanations related to any recalculations under manufacturing industries and construction by providing more specific reasons for the recalculations, for example, by providing any relevant explanations provided by Australian Energy Statistics, together with a link to the annual guide in which such revisions are explained and updated.	Resolved. The Party provided in the NIR (vol. 1, p.86) clear information regarding recalculations in the energy statistics, allowing AD-related recalculations to be identified by fuel and subcategory.
E.5	1.B.2 Oil, natural gas and other emissions from energy production – liquid and gaseous fuels – CH_4 (E.8, 2020) Transparency	Include a table categorizing abandoned wells by plugging status (plugged, unplugged, unknown), production type (oil, gas) and location (onshore, offshore) in the NIR.	Resolved. Table 3.42 of the NIR (vol. 1, p.153) categorizes abandoned wells by plugging status (plugged, unplugged, unknown), production type (oil, gas) and location (onshore, offshore).
E.6	1.B.2.c Venting and flaring – liquid and gaseous fuels – CO_2, CH_4 and N_2O (E.10, 2020) Transparency	More comprehensively explain in the NIR the reasons for any recalculations, for example, by providing information on the specific drivers for the recalculations or the process by which such errors were identified (e.g. QC activities).	Resolved. The Party included in table 3.50 of the NIR (vol. 1, p.169) a summary of the recalculations for category 1.B.2, including subcategory 1.B.2.c. The table contains comprehensive information on the reasons for the recalculations and the years recalculated and a summary of the impact of these recalculations on estimated emissions for specific years.

ID#	Issue/problem classification[a, b]	Recommendation made in previous review report	ERT assessment and rationale
IPPU			
I.1	2.B.1 Ammonia production – CO_2 (I.7, 2020) Transparency	Provide an explanation for the large inter-annual fluctuations in the CO_2 IEF for 2013 onward, for example by describing the fluctuations in the underlying fuel requirement per unit of NH_3 production reported by plants; and correct the data entry error relating to AD for 2014.	Resolved. Australia explained in the NIR (vol. 1, p.232) that the inter-annual changes in the CO_2 IEF reflect the fluctuations in NH_3 production levels at individual facilities, and that one facility reported production combined with imports for 2014–2017, making its actual production data uncertain (NIR vol. 1, p.221). The Party also explained in the NIR that it will continue to take steps to source accurate data for the facility for this period but, in the meantime, it has corrected the AD by indexing production data for 2014–2017 on the basis of the accurate production data and IEF for 2018. During the review, the Party clarified that this approach led to a 1.9 per cent increase in the IEF between 2013 and 2014.
I.2	2.B.8 Petrochemical and carbon black production – CO_2 (I.8, 2020) Completeness	Estimate CO_2 emissions from methanol production (category 2.B.8.a) for all years of the time series by conducting a literature review of the "leading concept methanol" process with a view to identifying the most relevant tier 1 EF, or by applying a mass balance equation (equation 3.17 in vol. 3, chap. 3, of the 2006 IPCC Guidelines).	Resolved. CO_2 emissions from methanol production (category 2.B.8.a) were reported as "IE" in CRF table 2(I).A-Hs1 for the entire time series (they were reported as "NO" in the 2020 submission). The Party explained in CRF table 9 that AD and emissions are confidential. While the ERT considers this issue resolved, it raised a new issue regarding where these emissions are included (see ID# I.11 in table 5).
I.3	2.B.8 Petrochemical and carbon black production – CO_2 (I.9, 2020) Comparability	Report CO_2 emissions from ethylene oxide separately in category 2.B.8, or, if this is not possible, report them as "IE" and indicate in CRF table 9 where the emissions are reported, and provide a description, in the relevant section of the NIR, of the method used for estimating CO_2 emissions for this category.	Not resolved. Australia continued to report CO_2 emissions from ethylene oxide production as "NA" in CRF table 2(I)A-Hs1 and AD as confidential for the entire time series under category 2.B.8.d and included the emissions under category 2.B.10 (other). The Party did not provide the CO_2 EF in the NIR (table 4.15) and continued to include the methodological description for category 2.B.8 in the description of category 2.H. During the review, the Party explained that it will correct its reporting of the EF and emissions to "IE".
I.4	2.C Metal industry – CO_2 (I.2, 2020) (I.8, 2019) (I.7, 2017) (I.11, 2016) (I.34, 2015) Consistency	Investigate whether other drivers could be applied to estimate emissions from lead production, zinc production and other (metal production) for 1990–2008, such as production volumes.	Resolved. Australia obtained production data for lead, zinc and other metals (including magnesium) and estimated emissions from use of reductants using data on production rates and consumption at the facility level. These estimates were reported in the annual submission and an explanation was included in the NIR (vol. 1, section 4.5.2).
I.5	2.C.1 Iron and steel production – CO_2 (I.10, 2020) Comparability	Estimate and report CO_2 emissions from steel production separately under category 2.C.1.a, or, if this is not possible, report the emissions as "IE" under category 2.C.1.a and indicate in CRF table 9 and in the NIR where these emissions are reported.	Resolved. Australia reported CO_2 emissions from steel production as "IE" and explained in CRF table 9 that these emissions were reported under category 2.C.7 because the steel production emission data and AD are confidential.

ID#	Issue/problem classification[a, b]	Recommendation made in previous review report	ERT assessment and rationale
I.6	2.D.1 Lubricant use – CO_2 (I.5, 2020) (I.21, 2019) Comparability	Report emissions from lubricant use in two-stroke engines separately under category 1.A.3.b (road transportation) under the energy sector.	Addressing. Australia reported in the NIR (vol. 1, p.248) that, since it is not yet able to disaggregate data on the quantity of lubricants consumed in two-stroke engines and report the emissions in the energy sector owing to lack of AD, all related CO_2 emissions were accounted for under the IPPU sector. During the review, Australia explained that all AD, methodologies and EFs related to this category are under review, with a particular focus on identifying AD that will enable emissions from lubricant use in two-stroke engines to be reallocated to the energy sector. Australia also explained that a number of factors, including availability of relevant data, will influence how soon the recommendation can be resolved (see ID# E.9 in table 5).
I.7	2.F Product uses as substitutes for ozone-depleting substances – HFCs (I.11, 2020) Transparency	Clarify how the HFC allocation model does or does not explain any large inter-annual percentage changes observed in the volumes of HFCs filled into new manufactured products (closed-cell foams).	Resolved. The Party reported in the NIR (vol. 1, p.256) the methodology applied to allocate bulk gas demand to the different equipment types. Demand is first estimated for classes of equipment where data on stocks are available (namely, light vehicle air conditioning, domestic refrigeration and air conditioning), and the residual bulk gas is allocated to the remaining equipment types. The estimated amount of bulk gas used in these remaining manufactured products (which include closed-cell foams, commercial air conditioners, transport refrigeration and solvents) varies substantially between years, as the amount depends on the quantity of bulk imports remaining after demand is met for filling and replenishing for vehicle air conditioning, domestic refrigeration and air conditioning (NIR vol. 1, p.258).
I.8	2.F.1 Refrigeration and air conditioning – HFCs (I.12, 2020) Transparency	Provide an explanation of the model used for estimating the volumes of HFCs filled into new manufactured products, and describe in the NIR the inter-annual changes resulting from use of that model (domestic refrigeration).	Resolved. The Party reported in the NIR (vol. 1, p.262) the methodology applied to estimate the number of new manufactured products filled with HFCs, which involved calculating the balance of opening and closing stock numbers, imports, exports and retirements. The Party explained in the NIR that the inter-annual changes resulting from the use of the model occur because the estimated amount of gas filled may vary significantly between years. Australia also explained that, where the above-mentioned balance is negative, the volume of HFCs was assumed to be zero.
I.9	2.F.1 Refrigeration and air conditioning – HFCs (I.13, 2020) Transparency	Explain in the NIR that when imports exceed the increase in new vehicle stocks, it is assumed that no domestic filling of new manufactured products occurs (mobile air-conditioning).	Resolved. The Party reported in the NIR (vol. 1, p.267) that the methodology applied to estimate the number of new manufactured vehicles filled with HFCs involved subtracting the number of vehicles imported in a year from the increase in vehicle stocks. When the number of imported vehicles exceeds the increase in new vehicle stocks, it is assumed that no domestic filling of gas into newly manufactured vehicles occurred.
I.10	2.G.3 N_2O from product uses – N_2O (I.6, 2020) (I.15, 2019)	Explain the methodology used for estimating N_2O imports using the per capita usage factor, verify that no under- or	Addressing. Australia has not modified its reporting of N_2O emissions from product uses since the previous annual submission; however, it provided a more in-depth explanation of the methodology used to estimate N_2O imports and included a detailed analysis of the accuracy of the estimates

ID#	Issue/problem classification[a, b]	Recommendation made in previous review report	ERT assessment and rationale
	(I.18, 2017) Transparency	overestimation of emissions occurs and report the results in the NIR.	(NIR vol. 1, section 4.9). During the review, the Party explained that it continues to research new sources of import and production data with a view to refining its approach to estimating emissions for this category. During the review, after analysing the data and carrying out a comparison with a number of other Parties, the ERT determined that emissions were unlikely to be underestimated for this category, and that any underestimation would likely be below the level of significance for including this issue in the list of potential problems and further questions raised by the ERT in accordance with the Article 8 review guidelines, paragraph 80(b). However, the ERT considers that the recommendation has not yet been addressed because the Party has not provided sufficient information on the approach used to estimate emissions on a per capita basis, or on whether such an approach leads to an under- or overestimation of emissions.

Agriculture

ID#	Issue/problem classification[a, b]	Recommendation made in previous review report	ERT assessment and rationale
A.1	3. General (agriculture) – CH_4 and N_2O (A.6, 2020) Transparency	Transparently report data sources for the calculation parameters included in appendices 5.A, 5.B, 5.D, 5.E, 5.F and 5.I of the NIR and indicate where calculation parameters were estimated on the basis of expert judgment.	Resolved. Australia reported data sources for the calculation parameters included in the tables contained in NIR appendices 5.A–5.I (vol. 1, pp.347–385). The NIR (vol. 1, chap. 5) includes information on data sources (table 5.3, p.305) and the process for eliciting expert judgment (p.306), in addition to a table documenting expert judgments (table 5.4, p.307).
A.2	3. General (agriculture) – CH_4 and N_2O (A.7, 2020) Transparency	Provide a clear justification in the NIR for the use of the following country-specific parameters and EFs from the 2019 Refinement to the 2006 IPCC Guidelines: (a) CH_4 EF for enteric fermentation for buffalo; (b) VS excretion rate per animal mass per day for other cattle; (c) Methane conversion factor values for uncovered anaerobic lagoons; (d) The baseline CH_4 EF for rice cultivation and the appropriate scaling factors for a continuously flooded water regime and a non-flooded pre-season.	Resolved. Australia included in its NIR additional information justifying the application of country-specific parameters and EFs from the 2019 Refinement to the 2006 IPCC Guidelines: (a) In the case of the CH_4 EF for enteric fermentation of buffalo, the Asian buffalo factor was adopted since most buffalo in Australia originate from Asia and are found in the Northern Territory, whose monsoonal climate is similar to the climate in parts of Asia (NIR vol. 1, p.315); (b) For the VS excretion rate per animal mass per day for other cattle, the Party used a default VS excretion rate for Oceania from the 2019 Refinement to the 2006 IPCC Guidelines because the 2006 IPCC Guidelines do not provide a default value for Oceania (NIR vol. 1, p.321); (c) Methane conversion factor values for uncovered anaerobic lagoons were taken from the 2006 IPCC Guidelines, which provide the same values as the 2019 Refinement to the 2006 IPCC Guidelines; (d) For the baseline CH_4 EF for rice cultivation and the appropriate scaling factors for a continuously flooded water regime and a non-flooded pre-season, Australia used the EF of 1.19 kg CH_4/ha/day from the 2019 Refinement to the 2006 IPCC Guidelines (vol. 4, chap. 5, table 5.11), with appropriate scaling factors applied for a continuously flooded water regime

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			(1 as the scaling factor for water regime during cultivation) and a non-flooded pre-season of >180 days (0.89 as the scaling factor for water regime before cultivation). Australia selected these factors as they are based on the latest science, are disaggregated by water regime type prior to and during cropping and have lower levels of uncertainty than the default values from the 2006 IPCC Guidelines (NIR vol. 1, p.343).
A.3	3. General (agriculture) – N_2O (A.8, 2020) Accuracy	Revise the estimation of N losses from manure management by updating $Frac_{LEACH-MS}$ to an appropriately justified value within the range provided in the 2006 IPCC Guidelines (vol. 4, chap. 10, equation 10.28) (i.e. 0.01–0.20), or provide a justification for the country-specific value currently used in the calculation model, including any value adopted from the 2019 Refinement to the 2006 IPCC Guidelines.	Not resolved. Australia continues to use a $Frac_{LEACH-MS}$ of 0.24 for N leaching from solid storage MMS (NIR vol. 1, equation 3B.5a_3). During the review, Australia explained that the recommendation has not yet been implemented owing to time constraints. However, the Party included this issue in the NIR section on source-specific planned improvements (vol. 1, section 5.4.12, p.342).

The ERT noted that, if the Party is overestimating N losses from manure management by using a $Frac_{LEACH-MS}$ value that is too high, this may lead to an underestimation of total N_2O emissions, since an underestimated value of N transferred from manure to agricultural soils would be accounted for under category 3.D.a.2.a (animal manure applied to soils).

The ERT also noted that the 2006 IPCC Guidelines indicate that the typical range for $Frac_{LEACH-MS}$ is 1–20 per cent (vol. 4, chap. 10, p.10.56) but they also indicate that $Frac_{LEACH-MS}$ is highly uncertain and should be developed as a country-specific value applied in the tier 2 method (vol. 4, chap. 10, p.10.61). The ERT considers that the 2006 IPCC Guidelines do not provide a default value or range for $Frac_{LEACH-MS}$, and noted that the value used by the Party for solid storage (0.24) is higher than the default factor of 0.02 for leaching from solid manure storage from the 2019 Refinement to the 2006 IPCC Guidelines (vol. 4, chap. 10, table 10.22). The ERT also noted that using the default factor would increase overall estimated N_2O emissions from the agriculture sector by less than 5 kt CO_2 eq, which is well below the level of significance for Australia (262.35–274.87 kt CO_2 eq for 2013–2019). |
| A.4 | 3.B Manure management – CH_4 (A.10, 2020) Transparency | Provide a more transparent description and justification in the NIR of the approach used for estimating CH_4 emissions from livestock manure deposited onto pasture, range and paddock, and report all data sources for all calculation parameters (CH_4 EFs by animal category (g CH_4/kg VS), typical animal mass (kg), VS excretion rate (g/kg animal mass/day), CH_4 EFs for manure in warm and temperate climates (kg CH_4/kg dry matter), weighting proportions (per cent) and any other parameter, as appropriate), clearly delineating the calculation procedure. | Resolved. Australia described in its NIR (vol. 1, section 5.4.1.1, p.321) the approach used for estimating CH_4 emissions from livestock manure deposited onto pasture, range and paddock, and justified its approach and reported all data sources. The fraction of manure allocated to anaerobic lagoons – 5 per cent of total pasture, range and paddock manure – is calibrated to the estimated difference in CH_4 emissions from constructed ponds servicing livestock and those servicing crop production, with the assumption that this difference is wholly attributable to manure from livestock. Australia used a country-specific EF to calculate CH_4 emissions from pasture-based livestock, primarily from the 2019 Refinement to the |

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			2006 IPCC Guidelines because the 2006 IPCC Guidelines do not provide a default VS excretion rate for Oceania. CH_4 EFs were further disaggregated using the 2019 Refinement to the 2006 IPCC Guidelines to enable the use of different EFs for the different MMS. Additionally, Australia included the EFs used and references to data sources in the NIR (vol. 1, table 5.16, p.322).
A.5	3.B.1 Cattle – CH_4 (A.12, 2020) Transparency	Correct the data entry error in CRF table 3.B(a)s2 and ensure that the cell for temperate climate for beef cattle – feedlot is completed.	Resolved. Australia corrected the data entry error in CRF table 3.B(a)s2 and completed the cell for temperate climate for beef cattle – feedlot under solid storage and dry lot (left blank in the previous annual submission), which it reported as 100 per cent allocation. All data entries are now complete.
A.6	3.B.3 Swine – N_2O (A.13, 2020) Transparency	Provide an explanation in the NIR for the trend in the IEF for N_2O from manure management of swine.	Resolved. Australia provided an explanation for the trend in the IEF for N_2O from manure management of swine in its NIR (vol. 1, p.332). Allocations to the different MMS have changed over time (NIR vol. 1, table 5.E.5, p.389), with an increase in swine housed on deep litter resulting in a decrease in allocations to effluent ponds. Intensification of the industry has also occurred, with typical animal mass increasing for every State in the country throughout the time series, while N excretion rates have fallen. This has resulted in a continual increase in the N_2O IEF, which rose from 0.0245 to 0.0796 kg N_2O/head/year between 1990 and 2019.
A.7	3.B.4 Other livestock – CH_4 (A.14, 2020) Convention reporting adherence	Report correct and consistent data for allocation of manure by climate region for buffalo and deer in CRF tables 3.B(a)s1 and 3.B(a)s2.	Addressing. Australia corrected the information reported in CRF table 3.B(a)s1 for the allocation of buffalo by climate region (e.g. 30.91 per cent for temperate regions and 69.09 per cent for warm regions for 2019) and deer by climate region (e.g. 98.49 per cent for temperate regions and 1.51 per cent for warm regions for 2019). However, the Party reported in CRF table 3.B(a)s2 that 30.91 per cent of buffalo in temperate regions and 69.09 per cent in warm regions, and 98.49 per cent of deer in temperate regions and 1.51 per cent in warm regions, were allocated to pasture, range and paddock. The ERT notes that 100 per cent of buffalo and deer in each climate region should be allocated to pasture, range and paddock in CRF table 3.B(a)s2. During the review, Australia explained that the allocation of buffalo and deer was incorrectly reported in CRF table 3.B(a)s2 as the fraction of the total animal population in each climate region rather than in each MMS. The Party confirmed that emissions from animals in these classes were calculated correctly according to the full allocation to pasture, range and paddock.
A.8	3.D.a.1 Inorganic N fertilizers – N_2O (A.15, 2020) Transparency	Provide transparent information in the NIR on how the different EFs in the study by Shcherbak and Grace (2014) are weighted by crop type, climate region, management system (e.g. irrigation) and fertilizer type (particularly relevant for non-urea fertilizers).	Resolved. Australia included additional information in its NIR (vol. 1, section 5.6.2, p.345) clarifying that the work of Shcherbak and Grace (2014) was reviewed by Australia's Expert Advisory Panel and approved for use in the country's inventory. Additional information on expert judgment was reported in table 5.4 of the NIR (vol. 1, p.307).

ID#	Issue/problem classification[a, b]	Recommendation made in previous review report	ERT assessment and rationale
A.9	3.D.a.1 Inorganic N fertilizers – N$_2$O (A.16, 2020) Transparency	Provide detailed evidence in the NIR to support the country-specific N$_2$O EF for the application of inorganic N fertilizers, including a justification for the application of the EFs in the study by Shcherbak and Grace (2014) to non-urea fertilizers.	Not resolved. The Party continued to apply a country-specific EF for the category, with the IEF varying from 0.007 to 0.004 kg N$_2$O-N/kg N, and did not provide a justification for the application of the country-specific EF in the NIR. The 2019 value (0.004 kg N$_2$O-N/kg N) is well below the IEFs reported by all other Annex I Parties (0.007 to 0.14 kg N$_2$O-N/kg N). During the review, Australia explained that the recommendation has not yet been implemented owing to time constraints. The ERT noted that Australia identified this as an issue in the source-specific planned improvements listed in its NIR (vol. 1, p.357).
A.10	3.D.a.1 Inorganic N fertilizers – N$_2$O (A.17, 2020) Transparency	Provide in the NIR a more detailed justification for the use of country-specific EFs for categories 3.D.a.5 (mineralization/immobilization associated with loss/gain of soil organic matter) and 3.D.b.1 (atmospheric deposition), for example, by referring to measurements, published scientific findings, causal biochemical explanations and country-specific soil and/or climate conditions.	Not resolved. During the review, Australia explained that the recommendation has not yet been implemented owing to time constraints. The Party identified this as an issue in the source-specific planned improvements listed in its NIR (vol. 1, p.357).
A.11	3.D.a.2.a Animal manure applied to soils – N$_2$O (A.18, 2020) Transparency	Explain in the NIR the estimation of the N$_2$O EF for animal manure applied to soils.	Addressing. Australia reported in its NIR (vol. 1, section 5.6.3, p.346) that the default N$_2$O EF from the 2006 IPCC Guidelines (vol. 4, chap. 11, table 11.1) for emissions from animal waste applied to soils (1 per cent) is used for dairies, feedlots and poultry houses. The direct N$_2$O factor of 0.0039 N$_2$O-N/Gg N deposited used for piggeries is based on the output of the PigBal model. However, the ERT considers that Australia could more transparently explain the functionality of the PigBal nutrient-balance model and its calculation process.
A.12	3.D.a.2.b Sewage sludge applied to soils – N$_2$O (A.19, 2020) Transparency	Provide the data source for the amount of sewage sludge applied to soils in the agriculture chapter of the NIR.	Resolved. Australia explained in its NIR (vol. 1, section 5.6.4, p.347) that the quantity of sewage sludge removed from wastewater treatment plants for application to land is reported by wastewater treatment plants under the National Greenhouse and Energy Reporting Scheme.
A.13	3.D.a.5 Mineralization/immobilization associated with loss/gain of soil organic matter – N$_2$O (A.20, 2020) Convention reporting adherence	Report the correct AD for category 3.D.a.5 and ensure consistency between the values reported in the NIR and CRF table 3.D.	Resolved. Australia corrected the AD reported in CRF table 3.D for the entire time series (e.g. the AD reported for 2018 were changed from 47,153.27 in the 2020 submission to 76,350,861.38 kg N/year in the 2021 submission). As a result, the EF of 0.002 kg N$_2$O-N/kg N reported in the NIR (vol. 1, section 5.6.7, p.351) is consistent with the value reported in CRF table 3.D.
A.14	3.D.a.6 Cultivation of organic soils (i.e.	Clearly describe the data source for the area of cultivated organic soils reported in the agriculture chapter of the	Addressing. Australia reported in its NIR (vol. 1, section 5.6.8, p.351) that the land area for histosols was estimated using expert judgment (C. Meyer,

ID#	Issue/problem classification[a, b]	Recommendation made in previous review report	ERT assessment and rationale
	histosols) – N_2O (A.21, 2020) Transparency	NIR, and explain in the NIR any differences between this reported area and the areas reported in CRF tables 4.B and 4.C.	personal communication). The ERT noted that Australia reported in CRF table 3.D a constant area of cultivated organic soils of 4,000 ha for the entire time series. The Party explained in its NIR (vol. 2, section 6.7.1.2, p.101) that, nationally, 4,000 ha histosols were previously identified as being cropped. As this activity involved the drainage of coastal wetlands, the concomitant wetlands area was considered to represent the national total of organic hydrosols that were drained and converted to cropland. The remaining conversions of wetlands to cropland involved mineral hydrosols. The ERT noted that the Party reported in CRF table 4.B 4,000 ha organic soils under wetlands converted to cropland for the entire time series, which is consistent with the area of cultivated organic soils reported in CRF table 3.D. The ERT also noted that the Party reported, in CRF table 4.C, 1,332.74 ha organic soils under wetlands converted to grassland, but did not explain in its NIR the difference between the area of organic soils reported in CRF table 4.C and the area of cultivated organic soils reported in CRF table 3.D.
A.15	3.D.a.6 Cultivation of organic soils (i.e. histosols) – N_2O (A.22, 2020) Accuracy	Report N_2O emissions from the area of cultivated organic soils under category 3.D.a.6 using the appropriate N_2O EFs considering all relevant climate zones.	Resolved. Australia revised the EFs used for category 3.D.a.6 (cultivation of organic soils), such that CRF table 3.D shows an IEF of 14 kg N_2O-N/ha across the time series, rather than the previously reported value of 8 kg N_2O-N/ha. Australia explained in its NIR (vol. 1, section 5.6.8, p.351) that the N_2O EF takes into account the different climatic conditions associated with the two separate areas (Queensland and Victoria). A weighted average of 14 kg N_2O-N/kg N was applied, calculated using EFs of 16 kg N_2O-N/kg N for Queensland (tropical organic cropland and grassland soils) and 8 kg N_2O-N/kg N for Victoria (temperate organic cropland and grassland soils). These EF values are drawn from the 2006 IPCC Guidelines (vol. 4, chap. 11, table 11.1). The ERT agrees with the approach applied by Australia.
A.16	3.D.b.1 Atmospheric deposition – N_2O (A.23, 2020) Convention reporting adherence	Report correct and consistent values for $Frac_{GASM}$ in CRF table 3.D and in the NIR and provide clear evidence in the NIR to support the use of the 2019 Refinement to the 2006 IPCC Guidelines value of $Frac_{GASM}$ as more representative of Australia's circumstances than the default values given in the 2006 IPCC Guidelines (vol. 4, chap. 11, table 11.3).	Resolved. Australia reported a $Frac_{GASM}$ value for soil of 0.21 (kg NH_3-N + NO_X-N) (kg N applied or deposited) in both the NIR (vol. 1, p.353) and CRF table 3.D. Additionally, the Party reported in its NIR (vol. 1, section 5.6.9, p.352) that a country-specific $Frac_{GASM}$ value for soil and $Frac_{GASF}$ values were used to calculate N volatilized from organic and synthetic fertilizers, and animal waste deposited on soils. The values are based on syntheses of the latest internationally assessed science as reported in the 2019 Refinement to the 2006 IPCC Guidelines, which informed improvements to Australia's approaches for estimating country-specific emissions, consistently with paragraph 10 of the UNFCCC Annex I inventory reporting guidelines. A narrower uncertainty range was reported for the revised values, indicating that accuracy has improved compared with the previous approach of applying the default values from the 2006 IPCC Guidelines.

ID#	Issue/problem classification[a, b]	Recommendation made in previous review report	ERT assessment and rationale
A.17	3.D.b.1 Atmospheric deposition – N_2O (A.24, 2020) Accuracy	Report accurate AD and the corresponding N_2O IEF for atmospheric deposition in CRF table 3.D and explain significant trends in the time series in the NIR.	Resolved. Australia reported corrected AD values (including for volatilized N from sheep manure and sewage sludge) and the corresponding N_2O IEF for atmospheric deposition in CRF table 3.D. The resulting change in the N_2O IEF between 1990 and 2019 is less than 2 per cent (from 0.00269 to 0.00273 kg N_2O-N/kg N), and there is not a significant trend.
A.18	3.D.b.2 N leaching and run-off – N_2O (A.25, 2020) Convention reporting adherence	Report the correct value of $Frac_{LEACH-(H)}$ in CRF table 3.D and provide clear evidence to support the use of a country-specific $Frac_{LEACH-(H)}$ of 0.24 kg N/kg N additions or deposition by grazing animals and a country-specific EF_5 of 0.011 kg N_2O-N/kg N from leaching and run-off as a more accurate representation of Australia's circumstances than the default values given in the 2006 IPCC Guidelines (vol. 4, chap. 11, table 11.3).	Resolved. Australia reported a $Frac_{LEACH-(H)}$ value of 0.24 Gg N/Gg N applied and a country-specific EF_5 of 0.011 kg N_2O-N/kg N from leaching and run-off. These values were consistent in the NIR (vol. 1, section 5.6.10, p.353) and CRF table 3.D. Australia reported in its NIR (vol. 1, p.354) that it used a country-specific $Frac_{LEACH-(H)}$ value and a country-specific N_2O EF to calculate N lost through leaching and run-off, based on the latest internationally assessed science as reported in the 2019 Refinement to the 2006 IPCC Guidelines (vol. 4, chap. 11, table 11.3). The 2019 Refinement to the 2006 IPCC Guidelines informed improvements to Australia's approaches for estimating country-specific emissions, consistently with paragraph 10 of the UNFCCC Annex I inventory reporting guidelines, and was used to shape the country-specific approaches where such approaches more accurately reflected Australia's national situation than the default values given in the 2006 IPCC Guidelines. The new estimation approaches have improved the accuracy and completeness of Australia's inventory.

LULUCF

ID#	Issue/problem classification[a, b]	Recommendation made in previous review report	ERT assessment and rationale
L.1	4. General (LULUCF) – CO_2, CH_4 and N_2O (L.2, 2020) (L.3, 2019) (L.4, 2017) (L.29, 2016) Comparability	Provide 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, provide in the NIR an update of the status of efforts to provide estimates for these pools.	Addressing. The Party reported in CRF table 4.A the AD and estimates for the categories and pools for cropland, wetlands and settlements converted to forest land, which were previously reported as "IE". However, cropland converted to grassland, and cropland and grassland converted to settlements were still reported as "IE". During the review, the Party clarified that a project is under way to develop new spatial data that will enable the identification of cropland and grassland converted to settlements.
L.2	4.B Cropland – CO_2 (L.5, 2020) (L.9, 2019) Accuracy	Stratify cropland areas on organic soils by natural zone and calculate the CO_2 emissions by applying corresponding EFs, for example from the 2006 IPCC Guidelines (vol. 4, chap. 5, table 5.6).	Resolved. Australia reported in its NIR (vol. 1, section 5.6.8, p.351) that the land area for histosols was estimated using expert judgment, and explained the reason for the difference in the areas reported in CRF tables 3.D, 4.B and 4.C (see ID# A.14 above). Additionally, the Party explained in its NIR (vol. 2, section 6.7.1.2, p.102) that the 4,000 ha cropped histosols included in CRF table 4.B are primarily in coastal Queensland and related to sugar cane farming (vol. 1, section 5.6.8, p.351). As this activity involved the drainage of coastal wetlands, the concomitant wetlands area was considered to represent the national total of organic hydrosols that were drained and converted to cropland. The Party reported in the NIR (vol. 2, section 6.7.1.2, p.102) that the tropical IPCC default EF was applied (2006 IPCC

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			Guidelines, vol. 4, table 5.6) owing to the tropical location of the wetlands ecosystems in North Queensland.
L.3	4.A.2.3 Wetlands converted to forest land – CO_2 (L.8, 2020) Transparency	Include in the NIR the reason for using organic soils for reporting carbon stock changes for establishment or reforestation of mangrove forest on degraded coastal (tidal) wetlands, and the scientific basis for the relatively significant carbon gain in organic soils.	Addressing. During the review, the Party clarified that this recommendation will be addressed for the next annual submission following the implementation of a planned improvement, which involves developing a tier 3 model for mangroves using the Full Carbon Accounting Model FullCAM. This improvement will update the scientific basis for soil carbon calculations.
L.4	4.B.2.3 Wetlands converted to cropland – CO_2 (L.9, 2020) Accuracy	Calculate CO_2 emissions for organic soils on wetlands converted to cropland using a consistent cultivated area to that reported under category 3.D.a.6, and reconsider the assumption that all wetlands converted to cropland contain organic soils.	Not resolved. Australia reported in its NIR (vol. 1, section 5.6.8, p.351) that the land area for histosols was estimated using expert judgment. The Party explained that the 4,000 ha cropped histosols reported across the time series are primarily in coastal Queensland and were formed by draining coastal wetlands, and that the remaining conversions of wetlands to cropland involved mineral hydrosols. The area reported for category 3.D.a.6 in CRF table 3.D (4,000 ha cultivated organic soils) does not include the area of organic soils reported in CRF table 4.C (1.33 kha) and is therefore, incorrectly, the same as the area of organic soils for wetlands converted to cropland (4.00 kha) reported in CRF table 4.B (see also ID# A.14 above). The ERT noted that the areas of organic soils under agriculture (category 3.D.a.6) and the sum of the areas of organic soils in CRF tables 4.B and 4.C should be consistent.
L.5	4.C.2.3 Wetlands converted to grassland – CO_2 (L.10, 2020) Accuracy	To ensure consistent reporting of organic soils areas between the agriculture and LULUCF sectors: (1) Explain the relationship between the areas reported under the agriculture and LULUCF sectors (specifically categories 4.B and 4.C); (2) Assess whether using the EF for cropland is appropriate for cultivated grassland organic soils in Australia; (3) Assess and report appropriate areas of drained or cultivated organic soils grassland as AD for GHG estimation and undrained or uncultivated organic soils on grassland; (4) Recalculate the emissions for the entire time series and describe the impact of the recalculation in the NIR.	Resolved. (1) Resolved. Australia reported in its NIR (vol. 1, section 5.6.8, p.351) that the land area for histosols was estimated using expert judgment and explained the reason for the difference in the areas reported in CRF tables 3.D, 4.B and 4.C (see ID#s A.14 and L.2 above); (2) Resolved. The Party reported in the NIR (vol. 2, p.133) a recalculation for wetlands converted to grassland between 1990 and 2018. This recalculation was carried out because the applied EFs were stratified according to soil type and climate zone for the first time. Table 6.59 of the NIR (vol. 2, p.133) compares the reported estimates between the 2020 and 2021 submissions; (3) Resolved. Estimates for CO_2 emissions from organic soils were updated using a cultivated area that is consistent with that reported for the agriculture sector. In addition, several soil-related EFs were applied, stratified by soil type (mineral or organic) and climate zone, and reported in the NIR (vol. 2, sections 6.9.1.2 and 6.9.5.2); (4) Resolved. CO_2 emissions were recalculated for the entire time series. Net CO_2 emissions for the entire time series were reported as 896.09 kt in

ID#	Issue/problem classification[a, b]	Recommendation made in previous review report	ERT assessment and rationale
			the 2020 submission, compared with 455.53 kt in the 2021 submission. NIR table 6.59 shows the impact of the recalculation.
L.6	4(II) Emissions/ removals from drainage and rewetting and other management of organic/mineral soils – CO_2 (L.11, 2020) Convention reporting adherence	Complete the cells for CO_2 emissions from drained organic soils in forest land, cropland and grassland in CRF table 4(II) consistently with the reporting of carbon stock changes in organic soils in background CRF tables 4.A–4.C to enhance comparability.	Not resolved. The Party continued to report "NE" for drained organic soils in CRF table 4(II) instead of "IE". During the review, the Party informed the ERT that it will update the notation key used for the next annual submission to fully address this recommendation. The Party clarified two issues for the ERT: firstly, emissions from drained organic soils in cropland and grassland are reported in CRF tables 4.B and 4.C consistent with footnote 4 to CRF table 4(II), but this has not yet been reflected in the notation keys used in CRF table 4(II), which should be "IE"; and secondly, notation keys have not yet been corrected for CO_2 and N_2O emissions from drained organic soils under other land uses in CRF table 4(II), to reflect that drained organic soils do not occur in these areas.
L.7	4(II) Emissions/ removals from drainage and rewetting and other management of organic/mineral soils – N_2O (L.11, 2020) Transparency	Report N_2O emissions from drained forest organic soils, using the same AD that were used to estimate CO_2 emissions from drained forest organic soils, to enhance completeness.	Addressing. The Party continued to report emissions and removals from drainage and rewetting and other as "NE" in CRF table 4(II). During the review, the Party clarified three issues for the ERT. Firstly, N_2O emissions were not reported for drained forest organic soils because drained forest organic soils do not occur in Australia. It appears that the previous ERT confused emissions from conversion of wetlands to forest land with drainage of organic soils reported in the NIR; however, the reported emissions relate to mangrove expansion into tidal marshes, which does not involve drainage of organic soils. It is not clear from the previous ERT assessment why drained forest organic soils were included in this recommendation when the assessment of issues primarily relates to wetlands converted to cropland and grassland.
			Secondly, emissions from drained organic soils in cropland and grassland were reported in CRF tables 4.B and 4.C consistently with footnote 4 to CRF table 4(II). However, the notation keys reported in CRF table 4(II) do not reflect this ("IE" should be reported).
			Thirdly, the notation keys were not corrected for the reporting of CO_2 and N_2O emissions from drained organic soils under other land uses in CRF table 4(II) to reflect the fact that drained organic soils do not occur in these areas.
L.8	4.H Other (LULUCF) – N_2O (L.12, 2020) Transparency	Accurately report N_2O emissions from aquaculture production by expressing the emissions in CRF table 4 as N_2O instead of N_2O-N and also include the AD for aquaculture production in the same table, showing the estimated emissions, in the NIR (vol. 2, table 6.56).	Addressing. The Party reported in the NIR (vol. 2, p.145) that it recalculated emissions from aquaculture production by incorporating an update to Australia's aquaculture production statistics for 2016–2017 and 2017–2018. During the review, the Party confirmed that N_2O estimates were reported on an N_2O basis in CRF table 4. However, the ERT considers that the recommendation has not yet been fully addressed because the Party did not include AD in either CRF table 4 or the NIR. During the review, the Party

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			informed the ERT that the AD for the estimations relate to kg fish/crustaceans produced per year, which is reported voluntarily, and explained that AD will be included in the next NIR (vol. 2, table 6.62).

Waste

ID#	Issue/problem classification[a, b]	Recommendation made in previous review report	ERT assessment and rationale
W.1	5.A Solid waste disposal on land – CH_4 (W.1, 2020) (W.10, 2019) Transparency	Explain how data from background studies conducted in 2008 were used to estimate the waste composition for the most recent years of the time series.	Addressing. The Party explained in the NIR (vol. 2, p.345) that waste composition data that are not covered by the National Greenhouse and Energy Reporting Scheme were derived as a simple average of waste mixes from studies conducted in 2008. In addition, these mixes were verified in 2014 as part of a desktop audit of waste composition data. However, the ERT considers that it remains unclear in the NIR why estimates based on 2008 study data are applicable to more recent years in the time series.
W.2	5.B Biological treatment of solid waste – CH_4 (W.2, 2020) (W.11 2019) Transparency	Explain in the NIR the method used for calculating the CH_4 emissions and the Party's adherence to the IPCC tier 1 method, and revise the reference to the method in the NIR and CRF summary table 3, as needed.	Resolved. The Party used a tier 1 methodology for this category and the method is referenced correctly in CRF summary table 3s2.
W.3	5.B.2 Anaerobic digestion at biogas facilities – CH_4 (W.6, 2020) Transparency	Provide a rationale for reporting CH_4 emissions from anaerobic digestion as "NE" in CRF table 9.	Resolved. Australia provided a rationale in CRF table 9, explaining that these emissions are insignificant in accordance with paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines. The Party reported in the NIR (vol. 2, p.356) that the likely maximum level of annual emissions (2.6 kt CO_2 eq) is below the significance threshold for Australia (262.35–274.87 kt CO_2 eq for 2013–2019).
W.4	5.C.1 Waste incineration – CO_2 (W.7, 2020) Comparability	Correct the missing information for 2018 and include AD for clinical waste incineration in CRF table 5.C.	Resolved. The error was corrected and AD for clinical waste incineration for 2018 (16.13 kt) were included in CRF table 5.C.

KP-LULUCF

ID#	Issue/problem classification[a, b]	Recommendation made in previous review report	ERT assessment and rationale
KL.1	General (KP-LULUCF) – CO_2, CH_4 and N_2O (KL.6, 2020) Convention reporting adherence	Consistently and accurately report areas of AR, deforestation and RV in background CRF tables 4(KP-I)A.1, 4(KP-I)A.2 and 4(KP-I)B.4, respectively, and CRF table NIR-2 (KP-LULUCF land matrix).	Resolved. The Party reported in the NIR (vol. 3, section 11.2.3) and CRF tables NIR-2, 4(KP-I)A.1, 4(KP-I)A.2 and 4(KP-I)B.4 accurate and consistent AD for AR, deforestation and RV. During the review, the Party clarified that, as noted in the NIR (vol. 3, table A6.6i), it applied the corrected data, consistent with those provided to the ERT during the previous review, in the NIR and sectoral tables.
KL.2	CM – CO_2 (KL.7, 2020) Accuracy	Report the correct area used for estimation of CO_2 emissions from drainage of organic soils under CM, ensuring consistency with the area reported for the LULUCF sector, as appropriate.	Not resolved. The ERT noted that there is still a difference in the allocation of areas for mineral and organic soils under wetlands converted to cropland between CRF tables 4.B and 4(KP-I)B.2. For example, for organic soils, the

ID#	Issue/problem classification[a, b]	Recommendation made in previous review report	ERT assessment and rationale
			Party reported 4.00 kha in CRF table 4.B but 8.66 kha in CRF table 4(KP-1B.2).
KL.3	GM – CO_2 (KL.8, 2020) Accuracy	Report the correct area used for estimation of CO_2 emissions from drainage of organic soils under GM, ensuring consistency with the area reported for the LULUCF sector, as appropriate.	Resolved. The Party reported in CRF tables 4.C (wetlands converted to grassland) and 4(KP-I)B.3 (GM: wetlands converted to grassland) the correct area and EF. During the review, the Party clarified that the recommendation has been addressed and explained that it recalculated GM emissions, which are now consistent with the estimates for the LULUCF sector.
KL.4	RV – CO_2 (KL.4, 2020) (KL.7, 2019) Comparability	Report the carbon stock changes for different carbon pools separately and eliminate the error in the reporting of the notation key in CRF table 4(KP-I)B.4.	Addressing. The Party continued to report below-ground biomass, litter, deadwood and soils as "IE" in CRF table 4(KP-I)B.4. In the NIR (vol. 3, table A6.6a), the Party explained that it is developing a new model that will enable estimates to be included for all pools in the next annual submission.
KL.5	RV – CO_2, CH_4 and N_2O (KL.9, 2020) Accuracy	Report and account for only net emissions and removals from human-induced RV activities that have occurred since 1990.	Resolved. The Party reported in the NIR (vol. 3, chap. 11.9.2, p.67, and chap. 11.9.6, p.69) that RV is related to woody vegetation management, which involves human-induced activities, and that corrections were made in response to the recommendation to ensure that only activities since 1990 are taken into account. During the review, the Party clarified that woody vegetation management in RV areas is governed by a comprehensive framework of government regulations at the local, State and federal level and planning regulations.
KL.6	HWP – CO_2 (KL.5, 2020) (KL.4, 2019) (KL.7, 2017) (KL.8, 2016) Transparency	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 decision 2/CMP.7, annex, paragraph 29.	Addressing. The Party reported in the NIR (vol. 3, chap. 11.6.3.2) that a country-specific (tier 3) method was used to estimate HWP from FM. The ERT noted that the Party did not document the process for deriving the country-specific half-lives for HWP or provide information to justify that the methodologies used are at least as detailed or accurate as those prescribed in decision 2/CMP.7, annex, paragraph 29. During the review, the Party clarified that a project is under way to develop a tier 2 model using default half-lives for comparison with Australia's tier 3 model. The Party expects the work to be completed for the next annual submission.

[a] References in parentheses are to the paragraph(s) and the year(s) of the previous review report(s) in which the issue or problem was raised. Issues are identified in accordance with paras. 80–83 of the UNFCCC review guidelines and classified as per para. 81 of the same guidelines. Problems are identified and classified as problems of transparency, accuracy, consistency, completeness or comparability in accordance with para. 69 of the Article 8 review guidelines in conjunction with decision 4/CMP.11.

[b] The report on the review of the 2018 annual submission of Australia was not available at the time of this review. Therefore, 2018 is excluded from the list of review years in which issues could have been identified.

IV. Issues and problems identified in three or more successive reviews and not addressed by the Party

9. In accordance with paragraph 83 of the UNFCCC review guidelines, the ERT noted that the issues and/or problems included in table 4 have been identified in three or more successive reviews, including the review of the 2021 annual submission of Australia, and had not been addressed by the Party at the time of publication of this review report.

Table 4
Issues and/or problems identified in three or more successive reviews and not addressed by Australia

ID#	Previous recommendation for issue	Number of successive reviews issue not addressed[a]
General	No issues identified.	
Energy		
E.1	Correct the AD on international bunkers to avoid discrepancies between CRF tables 1.D and 1.A(b).	3 (2019–2021)
IPPU		
I.6	Report emissions from lubricant use in two-stroke engines separately under category 1.A.3.b (road transportation) under the energy sector.	3 (2019–2021)
I.10	Explain the methodology used for estimating N_2O imports using the per capita usage factor, verify that no under- or overestimation of emissions occurs and report the results in the NIR.	4 (2017–2021)
Agriculture	No issues identified.	
LULUCF		
L.1	Provide 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, provide in the NIR an update of the status of efforts to provide estimates for these pools.	5 (2016–2021)
Waste		
W.1	Explain how data from background studies conducted in 2008 were used to estimate the waste composition for the most recent years of the time series.	3 (2019–2021)
KP-LULUCF		
KL.4	Report the carbon stock changes for different carbon pools separately and eliminate the error in the reporting of the notation key in CRF table 4(KP-I)B.4.	3 (2019–2021)
KL.6	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 decision 2/CMP.7, annex, paragraph 29.	5 (2016–2021)

[a] The report on the review of the 2018 annual submission of Australia has not yet been published. Therefore, 2018 was not included when counting the number of successive years for this table.

V. Additional findings made during the individual review of the Party's 2021 annual submission

10. Table 5 presents findings made by the ERT during the individual review of the 2021 annual submission of Australia that are additional to those identified in table 3.

Table 5
Additional findings made during the individual review of the 2021 annual submission of Australia

ID#	Finding classification	Description of finding with recommendation or encouragement	Is finding an issue/problem?[a]
General			
G.4	Uncertainty analysis	The Party reported in its NIR (vol. 1, p.34, and vol. 3, p.108) that the uncertainty for the aggregate inventory excluding LULUCF for 2019 is ±3.1 per cent and the uncertainty in the trend for the same year is ±4.7 per cent. However, NIR table A2.4 indicates that the level and trend uncertainties for 2019 are ±3.1 and ±3.5 per cent, respectively. In addition, the NIR (vol. 1, p.116) indicates that the results of the uncertainty analysis are provided in annex 7. However, annex 7 to the NIR provides a description of the national registry. During the review, the Party clarified that pages 34 (vol. 1) and 108 (vol. 3) of the NIR incorrectly reference the trend for uncertainty including LULUCF instead of the trend excluding LULUCF, and that the values reported in NIR table A2.4 for the level and trend uncertainties (±3.1 and ±3.5 per cent, respectively) are correct.	Yes. Convention reporting adherence
		The ERT recommends that the Party rectify the errors in its uncertainty analysis reporting in the NIR (vol. 1, pp.34 and 116, and vol. 3, p.108) by providing the correct uncertainty values.	
G.5	Uncertainty analysis	The Party reported in the NIR (vol. 3, annex 2, tables A2.1–A2.4, pp.107–131) on sources for uncertainty estimates and the assumptions used to derive uncertainty estimates. Expert judgment was used for uncertainty values for transport (energy sector) and the IPPU, agriculture and waste sectors. During the review, the Party clarified that it provided sector-specific assumptions and sources for uncertainty estimates in the NIR (vol. 3, annex 1, sections A2.1–A.2.5). Australia directed the ERT to page 107 of annex 2 to the NIR (vol. 3), which provides details of external reviews confirming the appropriateness of uncertainty estimates. The ERT noted that the use of expert judgment is not documented in accordance with the 2006 IPCC Guidelines (vol. 1, chap. 3, section 3.2.2.3, and vol. 1, chap. 2, section 2.2 and annex 2A.1 on expert elicitation) because details were not included. Moreover, according to paragraph 15 of the UNFCCC Annex I inventory reporting guidelines, Parties shall quantitatively estimate the uncertainty of the data used, and Australia used expert judgments in some of its uncertainty estimations.	Yes. Transparency
		The ERT recommends that, when using expert judgment in the uncertainty analysis, the Party include the information required by the 2006 IPCC Guidelines (vol. 1, chap. 3, section 3.2.2.3, and vol. 1, chap. 2, section 2.2 and annex 2A.1 on expert elicitation).	
Energy			
E.7	1.A Fuel combustion – sectoral approach	Data on production of waste (non-biomass fraction) were reported to the International Energy Agency, but not to the UNFCCC. During the review, the Party explained that these data are reported in the NIR and CRF tables under the production of the relevant solid, liquid and gaseous fuel types, as there are no available AD that would allow the waste	Yes. Comparability

ID#	Finding classification	Description of finding with recommendation or encouragement	*Is finding an issue/problem?*[a]
	– solid fuels – CO_2, CH_4 and N_2O	portion to be identified. Australia clarified that, under its National Greenhouse and Energy Reporting Scheme, it receives AD for the biomass and non-biomass fractions of waste combusted for energy. In the CRF tables, the relevant emissions are reported under solid fuels for the non-biomass fraction, and under biomass for the biomass part. The Party justified its reporting of emissions from waste combustion (non-biomass fraction) under solid fuels by explaining that, since this specific fuel type is identified by the scheme, it provided data on that fuel type in CRF Reporter rather than reporting them under other fossil fuels, with a view to enhancing transparency and accuracy.	
		The ERT recommends that the Party allocate the emissions from combustion of waste (non-biomass fraction) to other fossil fuels, under the appropriate subcategory of category 1.A, in line with the 2006 IPCC Guidelines (vol. 2, table 1.1). The ERT also recommends that, for categories where combustion of waste for energy occurs, the Party include in the NIR information on the fuel mix and background methodological data, such as EFs and calorific values.	
E.8	1.A.3.b Road transportation – CO_2	The Party included in its NIR (vol. 3, annex 5.2, p.150) an assessment of the significance of emissions from use of urea-based additives (diesel exhaust fluid) in catalytic converters. However, some of the assumptions contained in the methodological description for this assessment, including the exclusion of buses and heavy vehicles that comply with the Euro 4 standard; a diesel exhaust fluid consumption rate of 2 per cent for heavy vehicles; and use of 2013 data, which excludes a significant part of the fleet of new vehicles with selective catalytic reduction systems, may lead to an underestimation of these emissions. In addition, the NIR (vol. 1, p.105) refers to a significance assessment that uses data for 2018. The methodology described differs from the assumptions considered in annex 5.2 to the NIR (vol. 3) and presents different emission estimates for this category. For example, the significance assessment presented in annex 5.A to the NIR gives an emission estimate of 3 kt CO_2 eq for this category, compared with 14 kt CO_2 eq in chapter 3.5.2 of the NIR (vol. 1) on the methodology for urea-based catalysts (category 1.A.3.b.vi).	Yes. Transparency
		During the review, the Party clarified the assumptions used and confirmed that it used equation 3.3.4 from the 2006 IPCC Guidelines (vol. 2, chap. 3) to estimate emissions for this category. The Party provided a spreadsheet for deriving a conservative estimate of consumption of diesel and diesel exhaust fluid in Euro 5-compliant heavy trucks equipped with selective catalytic reduction systems. Australia also provided updated estimates of emissions from urea-based catalytic converters, which took into account additional data and revised some of the assumptions considered. The ERT agreed with the Party's provisional estimates, which resulted in estimated emissions of approximately 33 kt CO_2 eq, which is below the significance threshold established in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines (262.35–274.87 kt CO_2 eq for 2013–2019 for Australia) and can therefore be considered insignificant.	
		If the Party considers emissions from urea-based catalytic converters to be insignificant, the ERT recommends that it include an estimation of the likely level of emissions in the NIR to demonstrate that it is below the significance threshold established in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines. Otherwise, the ERT recommends that the Party report emissions from urea-based catalytic converters in the CRF tables and describe in the NIR the estimation methodology and assumptions used.	
E.9	1.A.3.b Road transportation – CH_4 and N_2O	Since Australia was unable to disaggregate emissions from lubricant use in two-stroke engines and reallocate them to the energy sector, all CO_2 emissions were reported under category 2.D.1 (see ID# I.6 in table 3). As a result, the associated CH_4 and N_2O emissions were not estimated.	Yes. Completeness
		The ERT recommends that the Party estimate CH_4 and N_2O emissions from lubricant use in two-stroke engines and report them under category 1.A.3.b.	

ID#	Finding classification	Description of finding with recommendation or encouragement	Is finding an issue/problem?[a]
IPPU			
I.11	2.B.8 Petrochemical and carbon black production – CO_2	The Party explained in CRF table 9 that CO_2 emissions from methanol production (2.B.8.a) are reported as "IE" because AD and emissions are confidential. However, it did not explain under which category those emissions are included.	Yes. Transparency
		The ERT recommends that the Party indicate in CRF table 9 under which category CO_2 emissions from methanol production (2.B.8.a), reported as "IE" in the CRF tables, are included.	
I.12	2.C.1 Iron and steel production – CO_2	Australia reported AD for sinter production (category 2.C.1.d) as "NO" for the entire time series in CRF table 2(I).A-Hs2. On the basis of the information made public by Australian organizations (e.g. CSIRO, 2021), the ERT concluded that sinter production occurs in the country. During the review, Australia clarified that the corresponding emissions have been accounted for, as the emission estimates for iron and steel production are based on the carbon balance data provided by iron and steel producers at facility level. The Party also clarified that with these data, process sinter emissions were reported under category 2.C, while emissions associated with natural gas consumption in sintering processes were included under category 1.A.2.a (iron and steel).	Yes. Convention reporting adherence
		The ERT recommends that Australia correct the notation key in CRF table 2(I).A-Hs2 from "NO" to "IE" and provide in the NIR a comprehensive explanation of how emissions from sinter production are estimated.	
I.13	2.C.4 Magnesium production – SF_6	Australia reported estimates of SF_6 emissions from magnesium production (category 2.C.4) for 1996–2000 and reported these emissions as "NO" for 1990–1995 and for 2001 onward in CRF tables 2(I)s1 and 2(II)B-Hs1. In the NIR (vol. 1, p.242), the Party explained that these emissions are related to the use of SF_6 as a cover gas in an experimental foundry, as part of the preparatory activities undertaken to develop a commercial magnesium casting plant. Australia also explained in the NIR that the data were supplied by CSIRO. However, the description of the AD in CRF table 2(II)B-Hs1 reads "amount of magnesium casted" and AD are reported as "NE", although SF_6 emissions are reported in the same table. During the review, the Party clarified that the data provided correspond to the amount of SF_6 consumed and that the amount used was assumed to be equal to the amount emitted.	Yes. Transparency
		The ERT recommends that Australia correct the description of the AD in CRF table 2(II)B-Hs1 and replace the notation key "NE" for AD with the estimates for 1996–2000.	
I.14	2.F.1 Refrigeration and air conditioning – HFCs	Australia reported in the NIR (vol. 1, pp.252–253 and table 4.2) that, as part of the methodology applied to estimate HFC emissions from refrigeration and air conditioning, it used a country-specific model. The Party explained that the model is based on emission estimates calculated by the country in line with the 2006 IPCC Guidelines but corrected using national emission estimates from CSIRO (2019), with values obtained by applying an inverse model using atmospheric HFC concentration data from Cape Grim monitoring station in Tasmania. In the NIR, Australia further explained that it adopted the CSIRO modelling results to improve the accuracy of its HFC emission estimates because the country's emission estimates presented lower uncertainties (±20 per cent) than the estimates calculated using the 2006 IPCC Guidelines methodology (±27 per cent). During the review, Australia explained that it used an updated version of the 2019 CSIRO report and the publication by Dunse et al. (2020) to estimate emissions for the 2021 submission. However, the latter was not included in the NIR reference list.	Yes. Transparency
		The ERT agrees with Australia that its use of these techniques is in line with the 2006 IPCC Guidelines and also agrees on their applicability to fluorinated gases for which there are no natural sources and other gas interferences, considering the	

		geographical conditions of the monitoring site. However, the uncertainties of the CSIRO model are a key consideration in deciding whether to use atmospheric HFC concentration data for correcting the emission estimates.	
		During the review, Australia shared with the ERT its calculations made using the emissions and uncertainties estimated by applying the inverse model (Dunse et al., 2020, table 4, p.12), which show that the uncertainties calculated for total HFC emissions are below 20 per cent for the entire time series. However, the ERT noted that this source of information reveals that all the uncertainties reported for each individual gas for the entire time series are greater than 30 per cent. For example, they vary between 31.2 per cent (1,687 ± 530 t for HFC-134a) and 70.9 per cent (16 ± 12 t for HFC-236fa) for 2005, and between 31.7 per cent (28 ± 9 for HFC-23) and 34.2 per cent (2 ± 1 for HFC-236fa) for 2018.	
		The ERT recommends that the Party clearly document the methodology used for estimating the emissions, including summary information and references to all background data used, including to Dunse et al. (2020), in the NIR. The ERT also recommends that the Party include in the NIR a detailed description of the methodology applied to calculate the uncertainties of the emissions estimated with the inverse model, and the uncertainty estimates for the entire time series.	
I.15	2.F.1 Refrigeration and air conditioning – HFCs	Australia explained in the NIR (vol. 1, p.252) that the annual leakage rate of HFCs emitted during the life cycle of equipment was initially estimated using a mix of the average EF from the 2006 IPCC Guidelines and country-specific factors. For 2006 onward, these initial values were adjusted according to changes in the implied leakage rate following the application of the CSIRO inverse model of air quality measurements from the Cape Grim (Tasmania) monitoring station (NIR p.253). The Party also explained that the adjustment methodology has changed since the previous annual submission (NIR p.284), for which the annual leakage rate was calibrated according to fluctuations in the three-year averages of CSIRO estimates. For the 2021 submission, the annual leakage rate was calibrated in the same way, in addition to being divided by an estimate of the national HFC bank. Australia explained in the NIR that these changes improved consistency between the CSIRO and inventory estimates, with an average difference of approximately 16 per cent for 2005–2015. During the review, Australia shared with the ERT the calculations that produced these results. The ERT noted that these changes had a significant impact on the total HFC emissions reported by Australia. For example, HFC emissions for this category were reported as 11,574.50 kt CO_2 eq for 2018 in the 2020 submission, compared with 8,795.56 kt CO_2 eq in the 2021 submission (a 24 per cent decrease). Moreover, while the methodologies applied by CSIRO have been widely peer reviewed, the adjustments between the CSIRO and inventory estimates, which are a key component of Australia's emission model, have not yet been subject to external verification and, for that reason, the Party's description must be transparent enough to enable the results to be reproduced.	Yes. Transparency
		The ERT recommends that Australia improve the description of the model provided in the NIR, including by specifying the formulae used to adjust the annual leakage rates, the values of the national HFC bank considered, the estimated values of the implied leakage rates and the final fractional changes obtained. The ERT also recommends that the Party include in the NIR a justification for the methodology adopted for the corrections between the CSIRO and inventory estimates.	
Agriculture			
A.19	3. General (agriculture) – CO_2, CH_4 and N_2O	Australia has made significant progress in implementing the previous ERT recommendations, mainly in relation to improving the transparency of its NIR. When the previous recommendations were not implemented, they were included in Australia's improvement plan. Furthermore, the Party has made progress in implementing higher-tier estimation methods for the key categories identified in line with the 2006 IPCC Guidelines.	Not an issue/problem

ID#	Finding classification	Description of finding with recommendation or encouragement	Is finding an issue/problem?[a]
		The ERT commends Australia for its efforts to improve the overall quality of its reporting on the agriculture sector and encourages the Party to continue improving its inventory.	
A.20	3. General (agriculture) – CO_2, CH_4 and N_2O	The chapter of the NIR on the agriculture sector contains information about AD, parameters and EFs applied by Australia to estimate its GHG emissions. However, some values are missing units, which could lead to a lack of transparency in terms of understanding how the GHG emissions were estimated. Examples from volume 1 of the NIR include the number of dairy cattle in each class for each State and season (N_{ij}) in equation 3A.1a_4 (p.310), additional intake for milk production ($MA_{ijk=4}$) in equation 3A.2_3 (p.313), the inorganic fertilizer EF for non-irrigated cropping (EF_{ij}) in equation 3B.5d_2 (p.335), mass of limestone and dolomite applied to soils (M_{ij}) in equation 3G_1 (p.361), the default EFs for limestone ($EF_{j=1}$) and dolomite ($EF_{j=2}$) in equation 3G_1 (p.361), mass of urea applied to soils (M_i) in equation 3H_1 (p.362) and the default EF for urea in equation 3H_1 (p.362).	Yes. Transparency
		The ERT recommends that the Party add an appropriate unit for all AD, parameters and EFs included in the NIR, including for the following in volume 1: the number of dairy cattle in each class for each State and season (N_{ij}) in equation 3A.1a 4 (p.310), additional intake for milk production ($MA_{ijk=4}$) in equation 3A.2_3 (p.313), the inorganic fertilizer EF for non-irrigated cropping (EF_{ij}) in equation 3B.5d_2 (p.335), mass of limestone and dolomite applied to soils (M_{ij}) in equation 3G_1 (p.361), the default EFs for limestone ($EF_{j=1}$) and dolomite ($EF_{j=2}$) in equation 3G_1 (p.361), mass of urea applied to soils (M_i) in equation 3H_1 (p.362) and the default EF for urea in equation 3H_1 (p.362).	
A.21	3. General (agriculture) – CH_4 and N_2O	Australia reported uncertainties for each agriculture category in its NIR (vol. 1, sections 5.3.6, 5.4.9, 5.5.2, 5.6.11, 5.8.2, 5.9.2 and 5.10.2) and provided further details on the uncertainty analysis in annex 2 to the NIR (vol. 3, p.107). Australia also reported in its NIR that uncertainties were estimated to be approximately 22 per cent for enteric fermentation (vol. 1, section 5.3.6, p.316), approximately 11 per cent for rice cultivation (vol. 1, section 5.5.2, p.343) and approximately 38 per cent for the burning of agricultural residues (vol. 1, section 5.8.2, p.360). However, in the NIR (vol. 3, tables A2.1–A2.4, pp.107–127), the Party reported uncertainties of 24.6 per cent for CH_4 from enteric fermentation, 50.2 per cent for CH_4 from rice cultivation and 59.6 per cent for both CH_4 and N_2O from agricultural residue burning. During the review, Australia acknowledged the discrepancy between the text in the agriculture chapter of the NIR and the tables in annex 2 to the NIR.	Yes. Convention reporting adherence
		The ERT recommends that Australia report the correct uncertainty values for CH_4 from enteric fermentation, CH_4 from rice cultivation and both CH_4 and N_2O from agricultural residue burning, ensuring consistency between the agriculture chapter of the NIR and the tables in annex 2 to the NIR, including for enteric fermentation (vol. 1, section 5.3.6, p.316), rice cultivation (vol. 1, section 5.5.2, p.343) and burning of agricultural residues (vol. 1, section 5.8.2, p.360). In addition, the ERT encourages Australia to perform appropriate QC activities to ensure consistency between the text and tables in the NIR.	
A.22	3.B.1 Cattle – N_2O	Australia reported in its NIR (vol. 1, p.321) that emissions from swine and poultry manure management add up to more than 100 per cent under MMS allocation because manure from intensive livestock industries may pass through multiple treatment stages. However, the ERT noted that in CRF table 3.B(a)s2 emissions reported under "Beef Cattle - Feedlot - Option_C_Allocation (%) – Temperate" also add up to more than 100 per cent under MMS allocation (1.8 per cent to anaerobic lagoon, 100.0 per cent to solid storage and dry lot and 19.0 per cent to composting). Moreover, in CRF table 3.B(b), total N excreted per animal waste management system for beef cattle – feedlot (107,712,856.6 kg N/year) is higher than the value of total N excreted obtained by multiplying the animal population size (1,111,816.9 head) by the N excretion rate for beef cattle – feedlot (71.0 kg N/head/year). During the review, Australia explained that, since manure management	Yes. Convention reporting adherence

		of feedlot cattle may also involve multiple treatment stages, the total emissions reported under MMS allocation may add up to more than 100 per cent. In addition, the Party clarified that it applied a tier 3 mass flow approach to estimating emissions, whereby the VS and N inputs and losses were estimated at each treatment stage. Inputs into the secondary treatment stage take into account losses from the primary stage. The value for the N excretion rate for feedlot cattle provided in CRF table 3.B(b) (71.0 kg N/head/year) represents the input to the first stage ("dry lot") of the multi-stage treatment process. The ERT was satisfied with the answer provided by the Party during the review.	
		The ERT recommends that Australia include the information needed to ensure consistency between the NIR and CRF tables 3.B(a)s2 (allocation by MMS) and 3.B(b) (total N excreted per animal waste management system for beef cattle – feedlot). In particular, the ERT recommends that the Party amend the text in the NIR (vol. 1, section 5.4.1.1, p.321) with regard to feedlot beef cattle, swine and poultry to indicate that emissions from the manure of animals under these three categories add up to more than 100 per cent under MMS allocation because manure from intensive livestock industries may pass through multiple treatment stages.	
A.23	3.C Rice cultivation – CH$_4$	Australia reported CH$_4$ emissions from rice cultivation, calculated by multiplying the area under rice cultivation (in ha) by an EF for the whole season (158.9 kg CH$_4$/ha). However, the NIR does not include the area under rice cultivation by State. During the review, Australia provided information on the area under rice cultivation by State for 2019 (New South Wales: 7,062.43 ha; Northern Territory: 107.96 ha; Queensland: 763.93 ha; total: 7,934.32 ha).	Yes. Transparency
		The ERT recommends that Australia include in its NIR the area under rice cultivation by State for the entire time series.	
A.24	3.D.a.1 Inorganic N fertilizers – N$_2$O	Australia reported in its NIR (vol. 1, p.345) that it calculated the amount inorganic fertilizer applied to each production system on the basis of data provided by Fertilizer Australia. The fraction of fertilizer applied to each production system was determined for each State by estimating first the mass of N fertilizer applied to irrigated crops, irrigated pasture, cotton, sugar cane and horticulture using the production areas reported by the Australian Bureau of Statistics, and then the average fertilizer application rates for each of these areas (80 kg N/ha for both irrigated crops and irrigated pasture, 246 kg N/ha for cotton and 125 kg N/ha for horticulture crops; the Party reported a variable application rate for sugar cane in appendix 5.H to the NIR). However, the NIR does not include the data on production areas reported by the Australian Bureau of Statistics, which are key to understanding how the amount of fertilizer applied to each production system was estimated. During the review, Australia provided information on the production area for non-irrigated and irrigated crops, non-irrigated and irrigated pasture, cotton, horticulture/vegetables and sugar cane by State for 2019, where the different land uses were derived from the Australian Bureau of Statistics.	Yes. Transparency
		The ERT recommends that Australia include the production areas reported by the Australian Bureau of Statistics by State for the entire time series, especially where that information is key to understanding how Australia calculated the fraction of fertilizer applied to each production system.	
A.25	3.D.a.2.b Sewage sludge applied to soils – N$_2$O	According to CRF table 3.D, the amount of N in sewage sludge applied to soils totalled 11,489,935.0 kg N in 2019. However, the amount of N in sludge reused in land application in 2019 is reported in the NIR (vol. 2, table 7.19, p.362) as 11,491 t N. During the review, Australia explained that the correct quantity of N in sewage sludge applied to agricultural soils in 2019 is 11,491,474.98 kg N, and that the value reported in CRF table 3.D is incorrect. The Party noted that the data entry error in the CRF table did not affect the emission estimates. This was confirmed by the ERT, which used the EF of 0.009 Gg N$_2$O-N/Gg N reported in the NIR (vol. 1, p.348).	Yes. Convention reporting adherence

ID#	Finding classification	Description of finding with recommendation or encouragement	Is finding an issue/problem?[a]
		The ERT recommends that Australia report the correct amount of sewage sludge applied to agricultural soils in 2019 (11,491,474.98 kg N) in CRF table 3.D consistently with the information reported in the NIR (vol. 2, table 7.19).	
A.26	3.D.a.3 Urine and dung deposited by grazing animals – N_2O	Australia reported in CRF table 3.D that a total of 1,545,338,132.0 kg N was excreted on pasture, range and paddock in 2019. However, CRF table 3.B(b) reports total N excretion on pasture, range and paddock of 1,545,419,375.1 kg N, disaggregated by animal category as follows: beef cattle – pasture (793,143,704.6 kg N); dairy cattle (259,978,227.1 kg N); sheep (476,757,993.8 kg N); buffalo (203,520.5 kg N); camels (108,972.6 kg N); deer (397,617.7 kg N); goats (3,222,265.9 kg N); horses (8,789,934.0 kg N); mules and asses (8,532.6 kg N); poultry (1,808,809.1 kg N); ostriches (68,676.2 kg N); and other (931,120.8 kg N). During the review, Australia explained that the discrepancy was due to an incorrect N excretion value being entered in CRF table 3.B(b) for poultry on pasture, range and paddock. The Party noted that this data entry error in the CRF table did not affect the emission estimates and will be corrected for its next annual submission. The ERT recommends that Australia report the correct N excretion value for poultry on pasture, range and paddock for 2019 in CRF table 3.B(b) so that the total N excretion on pasture, range and paddock for all animal categories is consistent with the value reported in CRF table 3.D (1,545,338,132.0 kg N).	Yes. Convention reporting adherence
A.27	3.D.b.1 Atmospheric deposition – N_2O	Australia reported in CRF table 3.D the amount of volatilized N from agricultural inputs of N as 504,061,660.3 kg N for 2019. Additionally, Australia reported the following amounts for N applied to soils: 1,337,593,241.1 kg N input from application of inorganic fertilizers to cropland and grassland; 99,508,857.4 kg N input from manure applied to soils; 11,489,935.0 kg N input from sewage sludge applied to soils; and 1,545,338,132.0 kg N excretion on pasture, range and paddock. Furthermore, Australia reported values of 0.11 kg NH_3-N + NO_X-N/kg N applied as $Frac_{GASF}$ and 0.21 kg NH_3-N + NO_X-N/kg N applied as $Frac_{GASM}$ in accordance with the 2019 Refinement to the 2006 IPCC Guidelines (vol. 4, chap. 11, table 11.3). Considering that it is reported in the NIR (vol. 1, p.352–353) that annual N_2O production from atmospheric deposition was calculated as $E = \Sigma_i\Sigma_j (M_{ij} \times EF_{ij} \times Cg)$, where M_{ij} is the sum of $M_{ij=1} + M_{ij=2} + M_{ij=3}$, the ERT estimated the mass of N volatilized for each subsector as 494,966,010.6 kg N (i.e. (1,337,593,241.1 × 0.11) + (99,508,857.4 × 0.21) + (11,489,935.0 × 0.21) + (1,545,338,132.0 × 0.21)), which is lower than the amount of volatilized N from agricultural inputs of N reported in CRF table 3.D for 2019. During the review, Australia explained that the discrepancies occurred because the full amount of N in sewage sludge applied to agricultural soils, rather than just the volatilized component, was included in the total N volatilized. However, the Party noted that it used the correct quantity of N volatilized in sewage sludge when calculating emissions. The ERT recommends that Australia report the correct value for volatilized N from agricultural inputs of N for 2019 (494,966,010.6 kg N) in CRF table 3.D.	Yes. Convention reporting adherence
A.28	3.G Liming – CO_2	Australia reported in its NIR (vol. 1, p.361) that annual emissions of CO_2 were calculated as $((M_{ij} \times Frac_{Limeij} \times P_{j=1} \times EF_{j=1}) + (M_{ij} \times (1-Frac_{Limeij}) \times P_{j=2} \times EF_{j=2})) \times Cg / 1,000$. However, the NIR does not specify the $Frac_{Limeij}$ applied to estimate annual CO_2 emissions from liming. Furthermore, the IEFs reported for 2019 in CRF table 3.G-I (0.108 t CO_2-C/t limestone and 0.124 t CO_2-C/t dolomite) differ from the default EFs provided in the 2006 IPCC Guidelines (vol. 4, chap. 11, section 11.3.1), namely 0.12 t CO_2-C/t limestone and 0.13 t CO_2-C/t dolomite. During the review, Australia explained that the $Frac_{Limeij}$ values were derived from the Australian Bureau of Statistics report "Land Management and Farming in Australia". Values for "Soil management – Soil enhancer use – Lime (including lime sand and stone) – Amount applied (t)" and "Soil management – Soil enhancer use – Dolomite – Amount applied (t)" were reported in the data tables for each State. Because there are no available data for the latest inventory year (2019), the most recent data were extrapolated for	Yes. Transparency

that year. Australia also explained that the IEFs reported for 2019 in CRF table 3.G-I differ from the EFs reported in the NIR (vol. 1, p.361) by the factor P_j (0.9 for limestone and 0.95 for dolomite).

The ERT recommends that Australia report all $Frac_{Limeij}$ values used to estimate CO_2 emissions from liming, including all the assumptions made to extrapolate data for the latest year, and ensure that differences between the EFs reported in the NIR and the IEFs reported in the CRF tables are explained in the NIR.

LULUCF

No findings for the LULUCF sector additional to those included in table 3 were made by the ERT during the review.

Waste

ID#	Finding classification	Description of finding with recommendation or encouragement	Is finding an issue/problem?[a]
W.5	5.C.1 Waste incineration – CO_2, CH_4 and N_2O	The Party reported CO_2 emissions from incineration of waste for only solvents, MSW and clinical waste. However, in response to a question raised by the ERT during the review, the Party mentioned that waste lubricant, hazardous waste, grit from pre-treatment screening and biosolids are also incinerated. The ERT provisionally estimated the omitted emissions to be less than 10 kt CO_2 eq, which is well below the significance threshold defined in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines (262.35–274.87 kt CO_2 eq for 2013–2019 for Australia). The ERT recommends that the Party check for the occurrence of unreported incinerated waste, especially waste lubricant and hazardous waste, for which there are default CO_2 EFs, and biosolids, for which there are default N_2O EFs in tables 5.2 and 5.5, respectively, of the 2006 IPCC Guidelines (vol. 5); and, if occurring, estimate and report the relevant emissions and explain the recalculation in the NIR. If these emissions occur but the Party considers them to be insignificant, the ERT recommends that the Party demonstrate that the likely level of emissions is below the significance threshold, as defined in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.	Yes. Completeness
W.6	5.C.1 Waste incineration – CO_2	The NIR (table 7.17) gives the oxidation factor for clinical waste as 0.95. However, the default oxidation factor for clinical waste provided in the 2006 IPCC Guidelines (vol. 5, chap. 5, table 5.2) is 1.0. In response to a question raised by the ERT during the review, the Party explained that the value of 0.95 was taken from the *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and will be revised to 1.0 to be consistent with the 2006 IPCC Guidelines. The ERT provisionally estimated the omitted emissions to be approximately 1 kt CO_2, which is well below the significance threshold defined in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines (262.35–274.87 kt CO_2 eq for 2013–2019 for Australia). The ERT recommends that the Party estimate and report emissions from incineration of clinical waste using the default oxidation factor of 1.0 provided in the 2006 IPCC Guidelines (vol. 5, chap. 5, table 5.2) and explain any recalculations in the NIR. If the Party considers these emissions to be insignificant, the ERT recommends that the Party demonstrate that the likely level of emissions is below the significance threshold established in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.	Yes. Accuracy
W.7	5.C.2 Open burning of waste – CO_2, CH_4 and N_2O	According to the 2006 IPCC Guidelines (vol. 5, chap. 5, section 5.2, p.5.6), emissions from open burning of waste and unintentional fires (accidental fires on SWDS) should be estimated and reported using the methodology and guidance provided for open burning of waste. However, the Party did not report estimates of CO_2, CH_4 and N_2O emissions from accidental fires on SWDS, despite the fact that Australian Government publications mention that accidental fires occur on SWDS (e.g. Fattal et al., 2016). The ERT provisionally estimated the omitted emissions to be approximately 10 kt CO_2 for	Yes. Completeness

ID#	Finding classification	Description of finding with recommendation or encouragement	*Is finding an issue/problem?[a]*
		the applicable years, which is well below the significance threshold defined in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines (262.35–274.87 kt CO_2 eq for 2013–2019 for Australia).	
		The ERT recommends that the Party estimate and report CO_2, CH_4 and N_2O emissions from accidental fires on SWDS using the existing literature and explain any recalculations in the NIR. If the Party considers these emissions to be insignificant, the ERT recommends that it demonstrate that the likely level of emissions is below the significance threshold established in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines.	
W.8	5.D.1 Domestic wastewater – CH_4	The Party used a country-specific method to estimate CH_4 emissions from domestic wastewater. According to the NIR (vol. 2, p.366) the chemical oxygen demand in the wastewater after treatment is subtracted from AD for estimating CH_4 emissions. However, the ERT noted that this methodology is not in line with equation 6.1 of the 2006 IPCC Guidelines (vol. 5). The ERT provisionally estimated the missing emissions to be approximately 30 kt CO_2, which is well below the significance threshold defined in paragraph 37(b) of the UNFCCC Annex I inventory reporting guidelines (262.35–274.87 kt CO_2 eq for 2013–2019 for Australia).	Yes. Accuracy
		The ERT recommends that the Party justify the use of the country-specific method of subtracting the chemical oxygen demand in the wastewater after treatment; or, alternatively, use equation 6.1 of the 2006 IPCC Guidelines (vol. 5), without any subtraction, to estimate CH_4 emissions and explain any recalculation in the NIR.	
W.9	5.D.2 Industrial wastewater – CH_4	The CH_4 recovery rate in the beer industry increased from 64 to 80 per cent between 2017 and 2018, rising to 100 per cent in 2019 (NIR vol. 2, table 7.26). The recovery rate in the pulp and paper industry increased sharply, rising from 2 to 70 per cent between 2017 and 2018 and reaching 93 per cent in 2019 (NIR vol. 2, table 7.26). During the review, the Party explained that capture and flaring of CH_4 from on-site wastewater treatment plants in the beer and pulp and paper industries has increased rapidly since 2017.	Yes. Transparency
		The ERT recommends that the Party clearly report in the NIR the reasons for the significant increase in CH_4 recovery from industrial wastewater in the beer, and pulp and paper industries since 2017.	
KP-LULUCF			
		No findings for KP-LULUCF additional to those included in table 3 were made by the ERT during the review.	

[a] Recommendations made by the ERT during the review are related to issues as defined in para. 81 of the UNFCCC review guidelines or problems as defined in para. 69 of the Article 8 review guidelines.

VI. Application of adjustments

11.   The ERT did not identify the need to apply any adjustments for the 2021 annual submission of Australia.

VII. Accounting quantities for activities under Article 3, paragraph 3, and, if any, activities under Article 3, paragraph 4, of the Kyoto Protocol

12.   Australia elected annual accounting for AR and deforestation. Table I.5 presents the accounting quantities for those activities reported by Australia and the final values agreed by the ERT. The final quantities of units to be issued and cancelled are presented in table I.6.

13.   Australia elected commitment period accounting for FM, CM, GM and RV and therefore the issuance and cancellation of units for those activities is not applicable to the 2021 review.

VIII. Questions of implementation

14.   No questions of implementation were identified by the ERT during the individual review of the Party's 2021 annual submission.

Annex I

Overview of greenhouse gas emissions and removals and data and information on activities under Article 3, paragraphs 3–4, of the Kyoto Protocol, as submitted by Australia in its 2021 annual submission

1.   Tables I.1–I.4 provide an overview of the total GHG emissions and removals as submitted by Australia.

Table I.1
Total greenhouse gas emissions and removals for Australia, base year–2019
(kt CO$_2$ eq)

	Total GHG emissions excluding indirect CO$_2$ emissions		Total GHG emissions and removals including indirect CO$_2$ emissions[a]		Land-use change (Article 3.7 bis as contained in the Doha Amendment)[b]	KP-LULUCF (Article 3.3 of the Kyoto Protocol)[c]	KP-LULUCF (Article 3.4 of the Kyoto Protocol)	
	Total including LULUCF	Total excluding LULUCF	Total including LULUCF	Total excluding LULUCF			CM, GM, RV, WDR	FM
FMRL								4 700.00
Base year[d]	615 477.99	423 672.22	NA	NA	148 163.36		26 160.28	
1990	615 477.99	423 672.22	NA	NA				
1995	494 961.72	437 276.55	NA	NA				
2000	542 258.31	487 777.76	NA	NA				
2010	600 322.45	535 549.22	NA	NA				
2011	572 773.90	537 205.50	NA	NA				
2012	560 441.05	539 511.05	NA	NA				
2013	547 464.50	530 311.91	NA	NA		5 878.54	17 195.09	9 762.10
2014	535 807.50	524 709.40	NA	NA		7 590.62	17 441.96	−59.89
2015	533 591.41	533 063.83	NA	NA		894.51	13 059.77	−12 563.72
2016	518 915.30	542 287.87	NA	NA		−4 173.68	−758.08	5 571.96
2017	515 535.48	549 330.02	NA	NA		−5 978.41	−6 586.62	−5 520.04
2018	527 223.32	549 731.94	NA	NA		5 780.87	1 474.32	−12 865.27
2019	518 865.55	545 152.52	NA	NA		4 623.98	−6 467.24	−3 595.59

Note: Emissions and removals reported in the sector other (sector 6) are not included in the total GHG emissions.
[a] The Party did not report indirect CO$_2$ emissions in CRF table 6.
[b] The value reported in this column relates to GHG emissions from conversion of forests (deforestation) in 1990 as contained in the report on the review of the Party's report to facilitate the calculation of the assigned amount for the second commitment period of the Kyoto Protocol.
[c] Activities under Article 3, para. 3, of the Kyoto Protocol, namely AR and deforestation.
[d] "Base year" refers to the base year under the Kyoto Protocol, which is 1990 for all gases. The base year for CM, GM and RV under Article 3, para. 4, of the Kyoto Protocol is 1990. For activities under Article 3, para. 3, of the Kyoto Protocol and FM under Article 3, para. 4, only the inventory years of the commitment period must be reported.

Table I.2

Greenhouse gas emissions and removals by gas for Australia, excluding land use, land-use change and forestry, 1990–2019

(kt CO_2 eq)

	$CO_2{}^a$	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3
1990	278 155.40	123 253.76	16 010.81	1 424.68	4 607.01	NO	220.56	NO
1995	305 002.59	113 861.10	15 498.42	1 067.40	1 530.84	NO	316.21	NO
2000	349 635.06	115 904.57	19 090.75	1 647.90	1 287.06	NO	212.43	NO
2010	405 106.17	104 167.20	19 346.90	6 515.84	283.32	NO	129.81	NO
2011	403 830.20	105 714.33	20 091.67	7 149.83	301.30	NO	118.16	NO
2012	406 152.01	105 789.98	20 418.82	6 740.38	294.88	NO	114.98	NO
2013	397 888.45	105 411.52	19 247.94	7 463.84	192.00	NO	108.17	NO
2014	393 952.98	102 666.23	19 674.25	8 117.77	192.54	NO	105.63	NO
2015	401 499.31	103 029.60	19 080.91	9 166.52	171.32	NO	116.17	NO
2016	410 968.52	102 675.21	19 083.39	9 218.70	224.92	NO	117.13	NO
2017	414 597.82	104 363.55	20 800.03	9 250.63	202.63	NO	115.36	NO
2018	415 339.71	105 111.45	19 626.07	9 273.45	236.00	NO	145.27	NO
2019	416 563.53	98 903.82	18 800.57	10 444.59	303.14	NO	136.86	NO
Percentage change 1990–2019	**49.8**	**–19.8**	**17.4**	**633.1**	**–93.4**	**NA**	**–37.9**	**NA**

Note: Emissions and removals reported in the sector other (sector 6) are not included in this table.

^{a} Australia did not report indirect CO_2 emissions in CRF table 6.

Table I.3

Greenhouse gas emissions and removals by sector for Australia, 1990–2019

(kt CO_2 eq)

	Energy	IPPU	Agriculture	LULUCF	Waste	Other
1990	292 890.63	25 902.44	84 853.14	191 805.76	20 026.01	NO
1995	317 470.88	25 100.24	75 851.00	57 685.17	18 854.43	NO
2000	363 331.90	26 524.14	82 259.90	54 480.55	15 661.82	NO
2010	417 013.44	33 537.84	69 776.40	64 773.23	15 221.54	NO
2011	414 037.80	34 244.63	74 341.46	35 568.41	14 581.60	NO
2012	419 555.49	31 101.04	75 771.19	20 929.99	13 083.34	NO
2013	412 812.64	29 065.29	75 964.25	17 152.59	12 469.74	NO
2014	406 768.54	28 969.27	76 418.38	11 098.10	12 553.21	NO
2015	417 062.59	30 386.84	73 559.67	527.58	12 054.73	NO

	Energy	IPPU	Agriculture	LULUCF	Waste	Other
2016	426 881.82	30 167.14	72 641.87	−23 372.57	12 597.03	NO
2017	429 455.18	30 619.18	76 557.02	−33 794.54	12 698.64	NO
2018	430 583.02	31 406.62	75 154.74	−22 508.62	12 587.57	NO
2019	430 392.60	32 568.55	69 752.73	−26 286.97	12 438.64	NO
Percentage change 1990–2019	**46.9**	**25.7**	**−17.8**	**−113.7**	**−37.9**	**NA**

Note: Australia did not report indirect CO_2 emissions in CRF table 6.

Table I.4

Greenhouse gas emissions and removals from activities under Article 3, paragraphs 3–4, of the Kyoto Protocol by activity, base year–2019, for Australia
(kt CO_2 eq)

	Article 3.7 bis as contained in the Doha Amendment[a]	Activities under Article 3.3 of the Kyoto Protocol		FM and elected activities under Article 3.4 of the Kyoto Protocol				
	Land-use change	AR	Deforestation	FM	CM	GM	RV	WDR
FMRL				4 700.00				
Technical correction				185.32				
Base year[b]	148 163.36				25 178.71	956.67	24.90	NA
2013		−30 110.44	35 988.98	9 762.10	2 136.06	15 006.90	52.13	NA
2014		−30 671.82	38 262.44	−59.89	2 788.47	14 587.30	66.19	NA
2015		−29 188.05	30 082.56	−12 563.72	−1 085.18	14 055.84	89.12	NA
2016		−31 830.41	27 656.72	5 571.96	−5 689.01	4 847.56	83.38	NA
2017		−32 895.53	26 917.12	−5 520.04	−5 644.19	−1 073.53	131.10	NA
2018		−23 556.05	29 336.92	−12 865.27	−3 715.91	5 030.06	160.18	NA
2019		−17 659.66	22 283.63	−3 595.59	−4 292.43	−2 346.85	172.03	NA
Percentage change base year–2019					**−117.0**	**−345.3**	**590.8**	**NA**

Note: Values in this table include emissions from land subject to natural disturbances, if applicable.
[a] The value reported in this column relates to 1990.
[b] The base year for CM, GM and RV under Article 3, para. 4, of the Kyoto Protocol is 1990. For activities under Article 3, para. 3, of the Kyoto Protocol and FM under Article 3, para. 4, only the inventory years of the commitment period must be reported.

2.   Table I.5 provides information on the Party's accounting quantities for reporting under Article 3, paragraphs 3–4, of the Kyoto Protocol.

Table I.5

Accounting quantities for activities under Article 3, paragraph 3, and forest management and any elected activities under Article 3, paragraph 4, of the Kyoto Protocol for Australia

(kt CO_2 eq)

| GHG source/sink activity | Base year[a] | Net emissions/removals | | | | | | | | Accounting parameters | Accounting quantity[c] |
		2013	2014	2015	2016	2017	2018	2019	Total[b]		
A.1. AR		−30 110.440	−30 671.817	−29 188.054	−31 830.409	−32 895.531	−23 556.047	−17 659.658	−195 911.957		−195 911.957
Excluded emissions from natural disturbances[d]		NA	NA	NA	NA	NA	NA	NA	NA		NA
Excluded subsequent removals from land subject to natural disturbances		NA	NA	NA	NA	NA	NA	NA	NA		NA
A.2. Deforestation		35 988.984	38 262.441	30 082.561	27 656.725	26 917.121	29 336.917	22 283.634	210 528.382		210 528.382
B.1. FM		NA	NA	NA	NA	NA	NA	NA	NA		NA
Net emissions/ removals		NA	NA	NA	NA	NA	NA	NA	NA		
Excluded emissions from natural disturbances[d]		NA	NA	NA	NA	NA	NA	NA	NA		NA
Excluded subsequent removals from land subject to natural disturbances		NA	NA	NA	NA	NA	NA	NA	NA		NA
Any debits from newly established forest		NA	NA	NA	NA	NA	NA	NA	NA		NA
FMRL[e]										NA	
Technical corrections to FMRL										NA	
FM cap										NA	NA
B.2. CM (if elected)	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
B.3. GM (if elected)	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
B.4. RV (if elected)	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
B.5. WDR (if elected)	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA

Note: Australia has elected annual accounting for AR and deforestation; for other activities, the Party has elected commitment period accounting. The information presented in this table is only for those activities for which the Party has elected annual accounting.

[a] Net emissions and removals from CM, GM, RV and/or WDR, if elected, in the Party's base year as established in decision 9/CP.2.

[b] The accounting quantity is the total quantity of units to be issued or cancelled for a particular activity.

[c] Cumulative net emissions and removals for all years of the commitment period reported in the annual submission under review.

[d] The Party indicated that it is excluding emissions from natural disturbances at the end of the commitment period.

[e] As inscribed in the appendix to the annex to decision 2/CMP.7 in kt CO_2 eq per year.

3. Table I.6 provides an overview of key relevant data from Australia's reporting under Article 3, paragraphs 3–4, of the Kyoto Protocol.

Table I.6
Key relevant data for Australia under Article 3, paragraphs 3–4, of the Kyoto Protocol from its 2021 annual submission

Parameter	Data values
Periodicity of accounting	(a) AR: annual accounting
	(b) Deforestation: annual accounting
	(c) FM: commitment period accounting
	(d) CM: commitment period accounting
	(e) GM: commitment period accounting
	(f) RV: commitment period accounting
	(g) WDR: not elected
Elected activities under Article 3, paragraph 4, of the Kyoto Protocol	CM, GM and RV
Election of application of provisions for natural disturbances	Yes, for FM
3.5% of total base-year GHG emissions, excluding LULUCF	14 651.806 kt CO_2 eq (117 214.453 kt CO_2 eq for the duration of the commitment period)
Cancellation of AAUs, CERs and ERUs and/or issuance of RMUs in the national registry for:	
1. AR	Issue 24 219 477 RMUs
2. Deforestation	Cancel 30 451 189 units
3. FM	NA
4. CM	NA
5. GM	NA
6. RV	NA

Note: Values in this table reflect the difference in the accounting quantities for activities under Article 3, para. 3, and FM and any elected activities under Article 3, para. 4, of the Kyoto Protocol as reported in table I.5 between this report and the previously published review report for the Party.

Annex II

Information to be included in the compilation and accounting database

Tables II.1–II.7 include the information to be included in the compilation and accounting database for Australia. Data shown are from the Party's annual submission, including the latest revised estimates submitted, adjustments (if applicable) and the final data to be included in the compilation and accounting database.

Table II.1
Information to be included in the compilation and accounting database for 2019, including on the commitment period reserve, for Australia
(t CO_2 eq)

	Original submission	Revised submission	Adjustment	Final value
CPR	4 060 457 844	–	–	4 060 457 844
Annex A emissions				
CO_2	416 563 533	–	–	416 563 533
CH_4	98 903 817	–	–	98 903 817
N_2O	18 800 573	–	–	18 800 573
HFCs	10 444 591	–	–	10 444 591
PFCs	303 142	–	–	303 142
Unspecified mix of HFCs and PFCs	NO	–	–	NO
SF_6	136 862	–	–	136 862
NF_3	NO	–	–	NO
Total Annex A sources	**545 152 518**	–	–	**545 152 518**
Activities under Article 3, paragraph 3, of the Kyoto Protocol				
AR	–17 659 658	–	–	–17 659 658
Deforestation	22 283 634	–	–	22 283 634
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				
FM	–3 595 588	–	–	–3 595 588
CM	–4 292 427	–	–	–4 292 427
CM for the base year	25 178 713	–	–	25 178 713
GM	–2 346 848	–	–	–2 346 848
GM for the base year	956 666	–	–	956 666
RV	172 030	–	–	172 030
RV for the base year	24 901	–	–	24 901

Table II.2
Information to be included in the compilation and accounting database for 2018 for Australia
(t CO_2 eq)

	Original submission	Revised submission	Adjustment	Final value
Annex A emissions				
CO_2	415 339 709	–	–	415 339 709
CH_4	105 111 448	–	–	105 111 448
N_2O	19 626 069	–	–	19 626 069
HFCs	9 273 449	–	–	9 273 449
PFCs	236 003	–	–	236 003
Unspecified mix of HFCs and PFCs	NO	–	–	NO
SF_6	145 265	–	–	145 265

	Original submission	Revised submission	Adjustment	Final value
NF₃	NO	–	–	NO
Total Annex A sources	**549 731 942**	**–**	**–**	**549 731 942**
Activities under Article 3, paragraph 3, of the Kyoto Protocol				
AR	–23 556 047	–	–	–23 556 047
Deforestation	29 336 917	–	–	29 336 917
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				
FM	–12 865 274	–	–	–12 865 274
CM	–3 715 915	–	–	–3 715 915
CM for the base year	25 178 713	–	–	25 178 713
GM	5 030 059	–	–	5 030 059
GM for the base year	956 666	–	–	956 666
RV	160 176	–	–	160 176
RV for the base year	24 901	–	–	24 901

Table II.3
Information to be included in the compilation and accounting database for 2017 for Australia
(t CO₂ eq)

	Original submission	Revised submission	Adjustment	Final value
Annex A emissions				
CO₂	414 597 818	–	–	414 597 818
CH₄	104 363 555	–	–	104 363 555
N₂O	20 800 035	–	–	20 800 035
HFCs	9 250 632	–	–	9 250 632
PFCs	202 626	–	–	202 626
Unspecified mix of HFCs and PFCs	NO	–	–	NO
SF₆	115 357	–	–	115 357
NF₃	NO	–	–	NO
Total Annex A sources	**549 330 022**	**–**	**–**	**549 330 022**
Activities under Article 3, paragraph 3, of the Kyoto Protocol				
AR	–32 895 531	–	–	–32 895 531
Deforestation	26 917 121	–	–	26 917 121
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				
FM	–5 520 038	–	–	–5 520 038
CM	–5 644 195	–	–	–5 644 195
CM for the base year	25 178 713	–	–	25 178 713
GM	–1 073 527	–	–	–1 073 527
GM for the base year	956 666	–	–	956 666
RV	131 101	–	–	131 101
RV for the base year	24 901	–	–	24 901

Table II.4
Information to be included in the compilation and accounting database for 2016 for Australia
(t CO₂ eq)

	Original submission	Revised submission	Adjustment	Final value
Annex A emissions				
CO₂	410 968 520	–	–	410 968 520
CH₄	102 675 207	–	–	102 675 207
N₂O	19 083 387	–	–	19 083 387
HFCs	9 218 702	–	–	9 218 702
PFCs	224 924	–	–	224 924

	Original submission	Revised submission	Adjustment	Final value
Unspecified mix of HFCs and PFCs	NO	–	–	NO
SF$_6$	117 125	–	–	117 125
NF$_3$	NO	–	–	NO
Total Annex A sources	**542 287 865**	–	–	**542 287 865**
Activities under Article 3, paragraph 3, of the Kyoto Protocol				
AR	–31 830 409	–	–	–31 830 409
Deforestation	27 656 725	–	–	27 656 725
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				
FM	5 571 963	–	–	5 571 963
CM	–5 689 011	–	–	–5 689 011
CM for the base year	25 178 713	–	–	25 178 713
GM	4 847 556	–	–	4 847 556
GM for the base year	956 666	–	–	956 666
RV	83 377	–	–	83 377
RV for the base year	24 901	–	–	24 901

Table II.5
Information to be included in the compilation and accounting database for 2015 for Australia
(t CO$_2$ eq)

	Original submission	Revised submission	Adjustment	Final value
Annex A emissions				
CO$_2$	401 499 306	–	–	401 499 306
CH$_4$	103 029 599	–	–	103 029 599
N$_2$O	19 080 911	–	–	19 080 911
HFCs	9 166 520	–	–	9 166 520
PFCs	171 324	–	–	171 324
Unspecified mix of HFCs and PFCs	NO	–	–	NO
SF$_6$	116 172	–	–	116 172
NF$_3$	NO	–	–	NO
Total Annex A sources	**533 063 832**	–	–	**533 063 832**
Activities under Article 3, paragraph 3, of the Kyoto Protocol				
AR	–29 188 054	–	–	–29 188 054
Deforestation	30 082 561	–	–	30 082 561
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				
FM	–12 563 716	–	–	–12 563 716
CM	–1 085 182	–	–	–1 085 182
CM for the base year	25 178 713	–	–	25 178 713
GM	14 055 840	–	–	14 055 840
GM for the base year	956 666	–	–	956 666
RV	89 117	–	–	89 117
RV for the base year	24 901	–	–	24 901

Table II.6
Information to be included in the compilation and accounting database for 2014 for Australia
(t CO$_2$ eq)

	Original submission	Revised submission	Adjustment	Final value
Annex A emissions				
CO$_2$	393 952 980	–	–	393 952 980
CH$_4$	102 666 226	–	–	102 666 226
N$_2$O	19 674 250	–	–	19 674 250

	Original submission	Revised submission	Adjustment	Final value
HFCs	8 117 772	–	–	8 117 772
PFCs	192 536	–	–	192 536
Unspecified mix of HFCs and PFCs	NO	–	–	NO
SF$_6$	105 633	–	–	105 633
NF$_3$	NO	–	–	NO
Total Annex A sources	**524 709 397**	**–**	**–**	**524 709 397**
Activities under Article 3, paragraph 3, of the Kyoto Protocol				
AR	–30 671 817	–	–	–30 671 817
Deforestation	38 262 441	–	–	38 262 441
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				
FM	–59 890	–	–	–59 890
CM	2 788 469	–	–	2 788 469
CM for the base year	25 178 713	–	–	25 178 713
GM	14 587 303	–	–	14 587 303
GM for the base year	956 666	–	–	956 666
RV	66 191	–	–	66 191
RV for the base year	24 901	–	–	24 901

Table II.7
Information to be included in the compilation and accounting database for 2013 for Australia
(t CO$_2$ eq)

	Original submission	Revised submission	Adjustment	Final value
Annex A emissions				
CO$_2$	397 888 448	–	–	397 888 448
CH$_4$	105 411 515	–	–	105 411 515
N$_2$O	19 247 937	–	–	19 247 937
HFCs	7 463 841	–	–	7 463 841
PFCs	192 001	–	–	192 001
Unspecified mix of HFCs and PFCs	NO	–	–	NO
SF$_6$	108 170	–	–	108 170
NF$_3$	NO	–	–	NO
Total Annex A sources	**530 311 914**	**–**	**–**	**530 311 914**
Activities under Article 3, paragraph 3, of the Kyoto Protocol				
AR	–30 110 440	–	–	–30 110 440
Deforestation	35 988 984	–	–	35 988 984
FM and elected activities under Article 3, paragraph 4, of the Kyoto Protocol				
FM	9 762 098	–	–	9 762 098
CM	2 136 056	–	–	2 136 056
CM for the base year	25 178 713	–	–	25 178 713
GM	15 006 903	–	–	15 006 903
GM for the base year	956 666	–	–	956 666
RV	52 133	–	–	52 133
RV for the base year	24 901	–	–	24 901

Annex III

Additional information to support findings in table 2

Missing categories that may affect completeness

The categories for which estimation methods are included in the 2006 IPCC Guidelines that were reported as "NE" or for which the ERT otherwise determined that there may be an issue with the completeness of the reporting in the Party's inventory are the following:

(a)   1.A.3.b road transportation (CH_4 and N_2O) (see ID# E.9 in table 5);

(b)   5.C.1 waste incineration (CO_2, CH_4 and N_2O) (see ID# W.5 in table 5);

(c)   5.C.2 open burning of waste (CO_2, CH_4 and N_2O) (see ID# W.7 in table 5).

Annex IV

Reference documents

A. Reports of the Intergovernmental Panel on Climate Change

IPCC. 2000. *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*. J Penman, D Kruger, I Galbally, et al. (eds.). Hayama: IPCC/Organisation for Economic Co-operation and Development/International Energy Agency/Institute for Global Environmental Strategies. Available at https://www.ipcc.ch/publication/good-practice-guidance-and-uncertainty-management-in-national-greenhouse-gas-inventories/.

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IPCC. 2014. *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands*. T Hiraishi, T Krug, K Tanabe, et al. (eds.). Geneva: IPCC. Available at https://www.ipcc.ch/publication/2013-supplement-to-the-2006-ipcc-guidelines-for-national-greenhouse-gas-inventories-wetlands/.

IPCC. 2019. *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*. E Calvo Buendia, K Tanabe, A Kranjc, et al. (eds.). Geneva: IPCC. Available at https://www.ipcc.ch/report/2019-refinement-to-the-2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/.

B. UNFCCC documents

Annual review reports

Reports on the individual reviews of the 2015, 2016, 2017, 2019 and 2020 annual submissions of Australia, contained in documents FCCC/ARR/2015/AUS, FCCC/ARR/2016/AUS, FCCC/ARR/2017/AUS, FCCC/ARR/2019/AUS and FCCC/ARR/2020/AUS, respectively.

Other

Aggregate information on greenhouse gas emissions by sources and removals by sinks for Parties included in Annex I to the Convention. Note by the secretariat. Available at https://unfccc.int/sites/default/files/resource/AGI_2021_Final%20Version.pdf.

Annual status report for Australia for 2021. Available at https://unfccc.int/sites/default/files/resource/asr2021_AUS.pdf.

C. Other documents used during the review

Responses to questions during the review were received from Nicola McPherson and Robert Sturgiss (Department of Industry, Science, Energy and Resources of Australia), including additional material on the methodology and assumptions used. The following references may not conform to UNFCCC editorial style as some have been reproduced as received:

Australian Bureau of Statistics 2018. Land Management and Farming in Australia. Available at https://www.abs.gov.au/statistics/industry/agriculture/land-management-and-farming-australia/latest-release.

CSIRO 2019, Australian PRC, HFC and SF_6 emissions. CSIRO Light Metals Flagship and Marine and Atmospheric Research, Victoria.

CSIRO 2021. Improving iron ore sintering process performance. Available at https://www.csiro.au/en/work-with-us/industries/mining-resources/Processing/Iron-ore-processing.

Dunse, BL, Derek, N, Fraser, PJ, Krummel, PB & Steele, LP 2020. Australian and global HFC, PFC, Sulfur Hexafluoride, Nitrogen Trifluoride and Sulfuryl Fluoride Emissions. Report prepared for the Australian Government Department of Agriculture, Water and the Environment, CSIRO Oceans and Atmosphere, Climate Science Centre, Aspendale, Australia, vi, 42 p.

Fattal, A, Kelly, S, Liu, A, Giurco, D 2016. Waste Fires in Australia: Cause for Concern? Prepared for the Department of Environment, Canberra by the UTS Institute for Sustainable Futures, Sydney. Available at http://environment.gov.au/protection/publications/waste-fires-australia.

Shcherbak I. and Grace P. 2014. Determination of emission factors for estimating fertiliser-induced nitrous oxide emissions from Australia's rural production systems. Report to the Department of the Environment.