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Report on the technical expert review of the first biennial transparency report of Indonesia*

Addendum

Summary

This addendum to the report on the technical expert review of the first biennial transparency report of Indonesia, conducted by a technical expert review team in accordance with the modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement, contains the results of the review of the consistency of the information submitted by the Party with those modalities, procedures and guidelines, and presents capacity-building needs identified by the Party and by the technical expert review team in consultation with the Party during the review. The review took place from 5 to 9 May 2025 in Bonn.

* In the symbol for this document, 2024 refers to the year in which the original biennial transparency report was submitted, not to the year of publication.

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*
AD	activity data
B_o	maximum methane-producing capacity
BTR	biennial transparency report
C_2F_6	hexafluoroethane
CH_4	methane
CKD	cement kiln dust
CO_2	carbon dioxide
CRT	common reporting table
CTF	common tabular format
EEA	European Environment Agency
EF	emission factor
EMEP	Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe
ETF	enhanced transparency framework under the Paris Agreement
FAOSTAT	statistical database of the Food and Agriculture Organization of the United Nations
F-gas	fluorinated gas
FOD	first-order decay
$Frac_{LossMS}$	fraction of managed manure nitrogen lost in the manure management system
FRL	forest reference level
GHG	greenhouse gas
HFC	hydrofluorocarbon
HWP	harvested wood products
IE	included elsewhere
IPCC	Intergovernmental Panel on Climate Change
IPPU	industrial processes and product use
LULUCF	land use, land-use change and forestry
MCF	methane correction factor
MoEF	Ministry of Environment and Forestry
MPGs	modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement
MSW	municipal solid waste
N_2O	nitrous oxide
NA	not applicable
NCV	net calorific value
NDC	nationally determined contribution
NE	not estimated
Nex	nitrogen excretion
NF_3	nitrogen trifluoride
NID	national inventory document
NIR	national inventory report
NO	not occurring
PaMs	policies and measures
QA/QC	quality assurance/quality control

SF_6	sulfur hexafluoride
SOC	soil organic carbon
SOC_{REF}	Reference soil organic carbon stock
SWDS	solid waste disposal site(s)
TERT	technical expert review team
WAM	‘with additional measures’
WM	‘with measures’

I. Areas of improvement[1] identified during the technical expert review of the Party's first biennial transparency report

1. Tables 1–14 present the results of the review of the consistency with the MPGs[2] of the information submitted by Indonesia in its BTR1. All recommendations and encouragements contained in the tables are for the next BTR or NIR, unless otherwise specified.

A. General reporting provisions

Table 1
Areas of improvement relating to general reporting provisions

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
1.1	Specified in paragraph 6 of the MPGs Flexibility	Indonesia noted in its BTR that it applied flexibility to its reporting of information on the GHG inventory, on tracking progress made in implementing and achieving its NDC under Article 4 of the Paris Agreement, and on financial, technology development and transfer, and capacity-building support. However, the Party also used flexibility in areas where this is not provided for under the MPGs, namely with respect to the exclusion from reporting of insignificant emissions; costs and non-GHG benefits of PaMs and interactions among PaMs; impacts of the implementation of response measures; support needed and received; and mitigation co-benefits of adaptation actions. During the review, Indonesia explained that it interpreted the "should" and "may" reporting requirements in those areas as areas of flexibility. The TERT recommends that, when the Party indicates the areas where flexibility was applied, it list only the provisions of the MPGs under which flexibility is explicitly provided for; for example, by referencing the relevant paragraph number of the MPGs for each flexibility provision applied, and that the Party concisely clarify capacity constraints and provide self-determined estimated time frames for improvements in relation to those capacity constraints.
1.2	Specified in paragraphs 6 and 48 of the MPGs Flexibility – HFCs, SF_6, NF_3	Indonesia applied flexibility with respect to including the gases HFCs, SF_6 and NF_3 in its GHG inventory. However, the Party did not concisely clarify its capacity constraints. During the review, Indonesia explained that in line with its government programme for implementing the Kigali Amendment to the Montreal Protocol, data on HFCs will be collected and reported on in 2029, the year in which the amendment enters into force. Indonesia does not produce HFCs or other F-gases domestically; all HFCs used are imported. The GHG inventory depends on data related to HFCs imported in bulk, pre-charged in imported equipment, filled into new equipment domestically, refilled in used equipment, stored in banks or contained in waste products. The Party also explained that collecting data across these various uses is challenging because it only ratified the Kigali Amendment recently and currently lacks an institutional framework for managing data on HFC use. Therefore, a methodology for surveying and collecting data needs to be developed. The Party also indicated that the inventory of other F-gases, namely perfluorocarbons, SF_6 and NF_3, has not yet been addressed owing to limited capacity and data and a lack of institutional arrangements. For future submissions, Indonesia plans to establish institutional arrangements, improve its capacity and begin collecting data on the use of SF_6 and NF_3. The TERT recommends that Indonesia clearly outline its capacity constraints with respect to reporting on HFCs, SF_6 and NF_3 by, for example, reporting information similar to that provided during the review.

[1] As referred to in paras. 7, 8, 146(d) and 162(d) of the MPGs, contained in the annex to decision 18/CMA.1.

[2] Decision 18/CMA.1, annex.

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
1.3	Specified in paragraphs 6 and 32 of the MPGs Flexibility – Insignificant emissions	Indonesia applied flexibility with respect to excluding insignificant emissions from its reporting, explaining in the BTR (p.220) that insignificant sources were defined on the basis of the threshold provided in paragraph 32 of the MPGs. In table 6.1 of the BTR, the Party reported that a total of 20 source or sink categories were reported as "NE", which may indicate insignificance. The Party noted that, for some categories, no data were available for determining significance. However, this flexibility provision is not applicable in this instance, since the lack of AD is not generally a reason for not estimating a category or subcategory. According to the MPGs, Parties should use approximated AD and default IPCC EFs to derive a likely level of emissions for the respective category, which Indonesia did not do. Therefore, this provision was not correctly applied, as the flexibility relates to threshold values. During the review, Indonesia acknowledged that this provision can only be applied when approximated AD are available and used to derive a likely level of emissions for the respective category, which is compared with the selected thresholds. The TERT recommends that the Party estimate the likely level of emissions for categories reported as "NE" before applying the flexibility provision for reporting insignificant emissions.

B. Greenhouse gas emissions and removals

Table 2
Areas of improvement relating to general findings on greenhouse gas emissions and removals

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
2.G.1	Specified in paragraph 19(c) of the MPGs Archiving	The NID reports that Indonesia's Directorate General of Climate Change under the MoEF archives and stores the inventory data in a database and publishes them on the MoEF website. The NID mentions that systematic archiving is part of the Party's QA/QC activities but does not describe what information is archived. During the review, Indonesia indicated that it has developed an information system called SIGN-SMART for estimating GHG emissions and archiving AD and EFs for the reported time series. The system also provides related GHG inventory documents online. The TERT recommends that Indonesia report in the NID the type of information archived for the reported time series.
2.G.2	Specified in paragraph 19(d) of the MPGs Further improvements	The NID states that the Directorate General of Climate Change under the MoEF publishes the inventory but does not specify how the inventory is formally submitted for official approval or who has the authority for final approval. During the review, Indonesia explained that the national GHG inventory report, which is prepared by the Directorate of GHG Inventory, and Monitoring, Reporting and Verification, under the Directorate General of Climate Change, is reviewed and finalized by Working Group I (GHG inventory) in collaboration with experts, then sent to the Director General of Climate Change for initial approval before being shared with the MoEF for final approval. The TERT recommends that Indonesia explain in the NID how the inventory is officially reviewed and approved.
2.G.3	Specified in paragraphs 25, 41 and 42 of the MPGs Key category analysis	Indonesia identified key categories for 2000 and 2022, both including and excluding LULUCF, using approach 1 and a 95 per cent threshold, for level and trend assessment. While the NID reports individual results for level and trend assessments for 21 key categories in total, it does not provide the final combined set of key categories. The TERT noted that the combined result of the analysis includes 23 key categories. During the review, Indonesia acknowledged that the correct number of key categories is 23 and provided a complete list of the key categories. The TERT recommends that Indonesia account for the complete set of key categories identified in its key category analysis.

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
2.G.4	Specified in paragraphs 34–35 of the MPGs QA/QC and verification – QA/QC plan	Indonesia applied flexibility in the area of its QA/QC plan. The NID states that formal QA procedures have not yet been implemented. To enhance this process, the Party expects to establish a QA team that will cross-check emission levels and trends using QA tools. During the review, Indonesia explained that ministerial regulation 12/2024 (article 19.2) describes general guidelines for QA procedures in relation to the NDC, and the MoEF has developed QA/QC guidelines in response to that mandate. The TERT encourages Indonesia to implement its QA/QC guidelines within its self-determined time frame for improvements, taking into account the flexibility applied, by establishing and operationalizing a QA team to cross-check emission levels and trends, consistent with ministerial regulation 12/2024 (article 19.2) and the MoEF QA/QC guidelines.
2.G.5	Specified in paragraph 51 of the MPGs Completeness – Precursor gases	Indonesia did not provide information on the following precursor gases: carbon monoxide, nitrogen oxides and non-methane volatile organic compounds, as well as sulfur oxides. In the BTR (p.221), the Party indicated that estimating emissions of these gases requires more advanced methodologies which are difficult to implement, and since emissions of these gases are considered negligible, they were excluded from the national GHG inventory. During the review, Indonesia explained that it did not report precursor gases from the energy and waste sectors owing to insufficient data and the high costs associated with developing the necessary EFs and parameters. The TERT encourages the Party to estimate emissions of precursor gases using available AD and EFs from one of the EMEP/EEA Emission Inventory Guidebooks in line with the 2006 IPCC Guidelines (vol. 1, chap. 7).
2.G.6	Specified in paragraph 52 of the MPGs Completeness – Indirect N_2O emissions	Indonesia did not report indirect N_2O emissions from sources other than those in the agriculture and LULUCF sectors. The NID (p.199) only notes that the Party decided not to report these emissions. During the review, Indonesia explained that indirect N_2O emissions from sources outside the agriculture and LULUCF sectors were not reported owing to a lack of AD and limited resources. Indonesia plans to address this gap and report emissions from these sources in 2030. The TERT encourages the Party to estimate indirect N_2O emissions from sources other than those in the agriculture and LULUCF sectors and report them as a memo item.

Table 3
Areas of improvement of the reporting on greenhouse gas emissions and removals – energy sector

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
3.E.1	Specified in paragraph 36 of the MPGs Fuel combustion – reference approach – CO_2	Annex 3 to the NID (p.254) reports the difference between the sectoral and reference approaches for 2022 as 0.56 per cent for energy consumption and 1.4 per cent for CO_2 emissions. However, these relatively small overall differences mask significant discrepancies for liquid fuels and other fossil fuels, which offset each other. Specifically, in CRT 1.A(c), for liquid fuels, the difference between the two approaches for 2022 is 1,581.7 per cent higher for energy consumption and 1,604.3 per cent higher for CO_2 emissions, while for other fossil fuels, the difference is 41.9 per cent lower for energy consumption and 44.7 per cent lower for CO_2 emissions. During the review, Indonesia provided a revised version of the comparison of the results of the two approaches, in which the fuels that were formerly grouped under other fossil fuels were appropriately distributed under liquid and gaseous fuels. With the revised aggregation, the difference in CO_2 emissions for 2022 is 0.55 per cent higher for solid fuels, 1.58 per cent higher for liquid fuels and 6.31 per cent higher for gaseous fuels. The TERT encourages Indonesia to report the correct fuel aggregation in CRT 1.A(c) for the entire time series.

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
3.E.2	Specified in paragraph 54 of the MPGs Feedstocks, reductants and other non-energy use of fuels – liquid fuels, gaseous fuels – CO_2	Indonesia did not address the use of fuels for non-energy purposes in the energy sector chapter of its NID. In CRT 1.A(d), the only non-energy use reported corresponds to other fossil fuels (185,568.21 TJ for 2022). However, the Party did not specify in either column J of that table or the documentation box where these emissions were reported in the inventory. The TERT notes that the only non-energy use reported in the national energy balance corresponds to natural gas (31.59 million barrels of oil equivalent for 2022). However, no information was reported on reductants and the non-energy use of fuels such as bitumen, lubricants, naphtha or waxes. During the review, Indonesia indicated that the non-energy use reported in CRT 1.A(d) for 2022 (185,568.21 TJ) relates to the amount of natural gas used as feedstock from ammonia production, equivalent to 31.59 million barrels of oil equivalent. The TERT encourages Indonesia to report how feedstocks, reductants and other non-energy use of fuels are addressed in the inventory; specifically, how excluded carbon was estimated under the energy sector and the corresponding emission allocation in the IPPU sector, in accordance with 2006 IPCC guidelines and ensuring consistency with the values reported in CRT 1.A(d).
3.E.3	Specified in paragraphs 31 and 53 of the MPGs International bunkers and multilateral operations – all fuels – CO_2, CH_4, N_2O	Indonesia reported memo items for international aviation (aviation bunkers) and multilateral operations in CRT 1.D as "NE". For international navigation (marine bunkers), the Party reported "NE" and "NO" but did not explain the reasons for doing so in the NID or describe the challenges faced in estimating these emissions. During the review, Indonesia clarified that it is unable to disaggregate fuel consumption under these memo items from fuel use in transportation (domestic navigation and domestic aviation) and acknowledged that the correct notation key in this case is "IE", rather than "NE" or "NO", because emissions from international aviation and international navigation were included elsewhere (under domestic aviation or domestic navigation). Indonesia explained that this was due to a technical error in transferring results from the IPCC inventory software to the report. The TERT notes that this reporting approach resulted in an overestimation of national total emissions. The TERT encourages the Party to develop methodologies for disaggregating emissions corresponding to these memo items from those currently allocated to the national totals, and report international aviation and marine bunker fuel emissions separately from national totals. The TERT recommends that Indonesia report "IE" if emissions from international aviation continue to be reported under domestic aviation and emissions from international navigation continue to be reported under domestic navigation.
3.E.4	Specified in paragraphs 30, 31, 45 and 47 of the MPGs 1. General (energy sector) – all fuels – CO_2, CH_4, N_2O	Indonesia reported in the BTR (table 6-1, p.221) that in the energy sector, the following subcategories were not estimated: other energy industries (1.A.1.c.iii) and fuel transformation – spontaneous combustion and burning coal dumps (1.B.1.b). The BTR indicates that these subcategories are among the source/sink categories reported as "NE", potentially indicating insignificance. The Party also reported that, for some categories, no data are currently available for determining their significance. The TERT notes that in such cases, emission levels may exceed the threshold of significance contained in the MPGs. During the review, Indonesia identified a capacity-building need in this area. The TERT notes that since the 2006 IPCC Guidelines do not provide a methodology for estimating emissions for subcategory 1.B.1.b, the Party is not obliged to estimate emissions for this subcategory. However, fuel combustion associated with activities under subcategory 1.A.1.c.iii, involving the production of charcoal, bagasse, sawdust, cotton stalks and the carbonization of biofuels, as well as for fuel used in coal mining, may occur in the country. If any activity under subcategory 1.A.1.c.iii occurs within the country, and the corresponding emissions are considered significant, the TERT recommends that Indonesia collect the necessary AD for estimating and reporting those emissions, or, if the Party is unable to collect such AD, that it report the subcategory as "NE" and explain why it was excluded from the inventory. Alternatively, if Indonesia considers the subcategory to be insignificant, the TERT encourages the Party to

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		estimate approximated AD; for example, by using information on energy use (fuel combusted) per kg of product and information on annual production for the corresponding product.
3.E.5	Specified in paragraph 31 of the MPGs 1. General (energy sector) – all fuels – CO_2, CH_4, N_2O	In addition to the subcategories reported as "NE" in table 6-1 of the BTR (see ID# 3.E.4 above), Indonesia reported the following subcategories as "NE" in the CRTs despite methodologies being available in the 2006 IPCC Guidelines: combined heat and power generation (1.A.1.a.ii), heat plants (1.A.1.a.iiii), manufacture of solid fuels (1.A.1.c.i), manufacturing of machinery (1.A.2.g.i), manufacturing of transport equipment (1.A.2.g.ii), mining (excluding fuels) and quarrying (1.A.2.g.iii), wood and wood products (1.A.2.g.iv), construction (1.A.2.g.v), textile and leather (1.A.2.g.vi), off-road vehicles and other machinery (1.A.2.g.vii), light-duty trucks (1.A.3.b.ii), heavy-duty trucks and buses (1.A.3.b.iii), motorcycles (1.A.3.b.iv), pipeline transportation (1.A.3.e.i), off-road vehicles and other machinery (1.A.4.a.ii, 1.A.4.b.ii and 1.A.4.c.ii), fishing (1.A.4.c.iii), other –stationary (1.A.5.a), underground mines (1.B.1.a.i), pipelines (1.C.1.a) and injection and storage (1.C.2). International aviation (1.D.1.a), international navigation (1.D.1.b), multilateral operations (1.D.2) and waste incineration with energy recovery were also reported as "NE". Additionally, the Party reported "NO" for other (subcategory 1.A.3.e.ii) and stationary – mobile (subcategory 1.A.5.b), where emissions most likely occur in the country. The Party did not explain in the NID the reasons for excluding these subcategories from the inventory. Furthermore, the TERT noted that CRT 9 was not completed. During the review, Indonesia explained that the above-mentioned categories were reported as "NE" due to a technical error in transferring results from IPCC software to the BTR and that those GHG emissions should have been reported as "IE". The Party also clarified that "IE" should have been reported for subcategories 1.A.3.e.ii and 1.A.5.b and provided information on where the estimates were included. The TERT recommends that Indonesia review whether the notation keys reported are appropriate and correct any errors in its use of notation keys. The TERT also recommends that the Party explain where the estimates were included for subcategories reported as "IE" in both the NID and CRT 9.
3.E.6	Specified in paragraphs 39–40 of the MPGs 1.A Fuel combustion – sectoral approach – liquid fuels, gaseous fuels – CO_2	Table 3-3 of the NID (p.35) contains the NCVs and country-specific CO_2 EFs for liquid and gaseous fuels used by Indonesia. Liquid fuels comprise four gasoline types differentiated by research octane number, three diesel oil types differentiated by cetane number, and the following fuels (reported here using the NID terminology): "avtur" (jet fuel), kerosene, diesel fuel and fuel oil. Gaseous fuels include "piped gas", liquefied natural gas and liquefied petroleum gas. While Indonesia is commended for developing country-specific fuel properties, the TERT notes that (1) the NID does not clarify the equivalence between the Party's fuel denominations and those used in the 2006 IPCC Guidelines; (2) distinctions among the three diesel oils (cetane numbers 48, 51 and 53) and diesel fuel are not explained; and (3) the NCV for piped gas (45.20 TJ/Gg) is notably lower than the IPCC default value for natural gas (48.0 TJ/Gg), falls below the 95 per cent confidence interval (46.5–50.4 TJ/Gg) and appears as an outlier in terms of the relationship between the CO_2 EF and NCV compared with other fuels reported in table 3-3 of the NID. Furthermore, the Party did not specify the method for deriving these properties or the update frequency, or explain whether the same values were applied throughout the 2000–2022 time series. During the review, Indonesia indicated that (1) the CO_2 EF and NCV were published by the Ministry of Energy and Mineral Resources and provided a recently published, peer-reviewed reference for the country-specific CO_2 EFs for gaseous fuels used in the inventory (Herlina et al., 2025); and (2) that it will update table 3-3 of the NID to include IPCC-equivalent fuel names along with NCVs, CO_2 EFs, and their status as default or country-specific values. The Party also explained that the CO_2 EF and NCV are not yet periodically updated and the same CO_2 EF and NCV were used for each fuel for 2000–2022. The TERT recommends that Indonesia (1) update table 3-3 in the NID to include IPCC-equivalent fuel names along with NCVs, CO_2 EFs, and their status as

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		default or country-specific values; and (2) include a summary of the information provided during the review on how the country-specific CO_2 EFs and NCVs were developed, including the peer-reviewed sources (e.g. Herlina et al., 2025), the method used for their derivation, and the fact that the same values are applied consistently across the entire 2000–2022 time series and are not yet periodically updated.
3.E.7	Specified in paragraphs 21 and 23 of the MPGs 1.A Fuel combustion – sectoral approach – solid fuels – CO_2	Indonesia estimated CO_2 emissions from coal combustion under the key categories energy industries (1.A.1) and manufacturing industries and construction (1.A.2) using a tier 1 approach. However, since they are key categories, a tier 2 method should have been used in accordance with the 2006 IPCC Guidelines. The NID (p.35) reports that the use of NCVs poses a significant challenge for the energy industries category because actual coal consumption involves various coal types, and the available data only reflect total coal consumption. The improvement plan highlights the need to enhance the accuracy of EFs for coal. During the review, Indonesia explained that the Ministry of Energy and Mineral Resources provided a national CO_2 EF for coal, which is higher than the IPCC default value for lignite. To improve accuracy, the Ministry will perform laboratory analyses of coal from different mines. Once the results are available, a tier 2 approach will be applied for coal combustion in the national GHG inventory, with additional coordination required in order to obtain plant-specific EFs for power plants. The TERT encourages Indonesia to enhance the information collected on coal NCVs, carbon content and other relevant characteristics, as needed, with a view to estimating the corresponding CO_2 EFs and facilitating a transition to a tier 2 approach. The TERT recommends that, if Indonesia is unable to adopt a higher-tier method for fuel combustion categories, the Party clearly document why the methodological choice does not align with the relevant decision tree from the 2006 IPCC Guidelines.
3.E.8	Specified in paragraph 47 of the MPGs 1.A Fuel combustion – sectoral approach – liquid fuels, gaseous fuels – CO_2, CH_4, N_2O	Indonesia reported emissions from stationary combustion categories for other fossil fuels and biomass, where applicable, in CRT 1.A(s) (sheets 1, 2 and 4). For categories energy industries (1.A.1) and manufacturing industries and construction (1.A.2), the Party also reported emissions from solid fuels. Emissions from liquid and gaseous fuels were reported as "NE" for all categories. During the review, Indonesia explained that, owing to a technical error in transferring results from the IPCC inventory software to the ETF GHG inventory reporting tool, liquid and gaseous fuels were included under other fossil fuels. The Party also informed the TERT that this issue has already been resolved, and liquid and gaseous fuels can now be reported separately. The TERT recommends that, having corrected the problem, Indonesia report emissions from liquid and gaseous fuels separately in the next submission.
3.E.9	Specified in paragraph 39 of the MPGs 1.A.2.a Iron and steel – all fuels – CO_2, CH_4, N_2O	The increase in fuel consumption reported in CRT 1.A(a) (sheet 2) for iron and steel (subcategory 1.A.2.a) shows an increase of 240 per cent between 2021 and 2022 (from 300,003.51 to 1,021,102.21 TJ). For the same years, a report by the Centre for Research on Energy and Clean Air shows an increase of just 2.8 per cent (from 14 Mt to 14.1 Mt). During the review, Indonesia indicated that the increase in coal consumption between 2021 and 2022 represents not only the increasing production capacity for iron and steel (as reported by the Centre for Research on Energy and Clean Air), but also increases under other activities and metallurgical production. This is because coal data from the energy balance reported in the Handbook of Energy & Economic Statistics of Indonesia, published by the Ministry of Energy and Mineral Resources, include consumption data for both the iron and steel and metallurgy (non-ferrous metals) industries, and those data have not been disaggregated. Coal consumption rose significantly (by 240 per cent) in 2021–2022, from 300,000 to 1.02 million TJ, owing to substantial increases in production capacity for blast furnaces (from 4 million t in 2021 to 4.7 million t in 2022) and in basic oxygen furnace production capacity (from 1.9 million t in

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
		2021 to 2.7 million t in 2022), as well as an expansion of production capacities for new metallurgical smelters. The TERT recommends that Indonesia improve its description of the underlying reasons for the significant increase in coal consumption between 2021 and 2022, for example by including the information provided during the review.
3.E.10	Specified in paragraphs 20, 21, 23 and 40 of the MPGs 1.A.3.a Domestic aviation – liquid fuels – CO_2, CH_4, N_2O	Indonesia did not specify in the NID which aviation activities are included and which are excluded from domestic aviation. In addition, the Party used a fuel-based tier 1 approach, with a country-specific CO_2 EF used to estimate emissions. However, since CO_2 emissions from transport was identified as key category, a tier 2 method, based on the number of landing/take-off cycles and fuel use, should have been applied in accordance with the 2006 IPCC Guidelines. During the review, Indonesia indicated that military aviation and international aviation were included in this subcategory, and that complete information on landing/take-off cycles, which would enable emissions to be estimated using a tier 2 approach, is not available. The TERT recommends that Indonesia exclude emissions from military and international aviation from domestic aviation. In addition, the TERT encourages Indonesia to collect data on landing/take-off cycles and estimate emissions from domestic aviation using a tier 2 approach. If the Party is unable to use a tier 2 approach for this key category owing to a lack of resources, the TERT recommends that it clearly document why the methodological choice does not align with the relevant decision tree from the 2006 IPCC Guidelines.
3.E.11	Specified in paragraph 20 of the MPGs 1.A.3.b Road transportation – liquid fuels – CO_2, CH_4, N_2O	The NID indicates that tier 1 IPCC default EFs were used to estimate emissions from biodiesel but does not specify whether the methanol typically used to synthesize this fuel is of biogenic origin. During the review, Indonesia explained that its biodiesel is not fully biogenic, as fossil-based methanol accounts for about 10 per cent of its mass, and clarified that biomethanol will be used in the future. The Party also noted that CO_2 emissions from fossil-based methanol are not included in the national totals because there are no guidelines for estimating such emissions when methanol is used in biofuel production and not directly combusted in the transport sector. The TERT recommends that Indonesia account for the fossil carbon in biodiesel derived from methanol, estimate the associated CO_2 emissions and report them as part of the national totals. The Party may wish to consult Sebos (2022), which addresses the estimation of CO_2 emissions associated with the fossil carbon content of biofuels.
3.E.12	Specified in paragraphs 20, 21 and 47 of the MPGs 1.A.3.b Road transportation – gas/diesel oil – CO_2, CH_4, N_2O	Indonesia did not report the use of urea-based catalytic converters in diesel oil vehicles. However, urea-based catalysts are used in the country in diesel vehicles (including trucks and marine vessels) in order to meet increasingly stringent emission standards and reduce pollution from nitrogen oxides. During the review, Indonesia confirmed that urea-based catalytic converters are used in the country and explained that emissions from this source were not estimated because the GHG estimates were based on AD for bulk fuel sales. The TERT recommends that Indonesia collect data on the amount of urea-based additive consumed for use in catalytic converters, which can be obtained independently from fuel sales data, estimate the corresponding emissions and report them under the IPPU sector.
3.E.13	Specified in paragraphs 20, 21 and 47 of the MPGs 1.A.3.b.iv Motorcycles – liquid fuels – CO_2, CH_4, N_2O	Indonesia did not estimate emissions from the use of lubricants as additives in two-stroke engines. During the review, the Party indicated that the lubricating oil used as an additive in two-stroke engines was not included in the inventory owing to a lack of data, while emissions from the use of lubricants in road transportation and for other subcategories were reported under the IPPU sector. The TERT recommends that Indonesia collect data on the use of lubricants as additives in two-stroke engines and estimate and report the related emissions under motorcycles (subcategory 1.A.3.b.iv), avoiding double counting with regard to the emissions reported under the IPPU sector.

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
3.E.14	Specified in paragraphs 20, 21 and 47 of the MPGs 1.A.3.c Railways – liquid fuels – CO_2, CH_4, N_2O	Indonesia did not report in the NID whether fuel use in other railway-related activities, such as stationary railway sources, off-road machinery, vehicles and track machines, was excluded from the railway fuel use reported. During the review, Indonesia clarified that it was unable to separate fuel used for stationary combustion in railway-related activities from that used in transportation. The TERT recommends that Indonesia disaggregate fuel use into stationary and mobile combustion in railway-related activities, estimate related emissions and report stationary combustion activities under commercial/institutional (subcategory 1.A.4.a) and mobile combustion activities under railways (subcategory 1.A.3.c).
3.E.15	Specified in paragraphs 20, 21, 47 and 53 of the MPGs 1.A.3.d Domestic navigation – liquid fuels – CO_2, CH_4, N_2O	The NID does not provide specific information on domestic navigation or indicate whether military navigation and international navigation were excluded from this subcategory. In CRT 1.A(a) (sheet 3), Indonesia reported fuel use for domestic navigation, which totals 1,991.29 TJ in 2022. However, this amount represents just 0.08 per cent of total fuel consumption across all transport modes in this archipelagic nation. During the review, Indonesia indicated that (1) fuel use for military and international navigation is included in or associated with this subcategory; (2) the AD reported in CRT 1.A(a) (sheet 3) correspond to the consumption of marine fuel oil; and (3) data for gasoil used in navigation activities could not be separated from data for gasoil used in road transportation. The TERT recommends that Indonesia report information on domestic navigation accurately. For that purpose, Indonesia could exclude military and international navigation and subsequently estimate and report those emissions under the subcategories other – mobile (1.A.5.b) and international navigation (marine bunkers) (1.D.1.b) respectively in line with the MPGs. The TERT also recommends that Indonesia investigate the relatively low value reported for marine fuel oil consumption, make any necessary corrections and estimate and report emissions for the entire time series. Furthermore, the TERT recommends that Indonesia disaggregate diesel oil consumption into road transportation and the different navigation modes and estimate and report the corresponding emissions in accordance with the MPGs.
3.E.16	Specified in paragraphs 20–21 of the MPGs 1.B.1.a Coal mining and handling – solid fuels – CO_2, CH_4	The NID did not specify whether the AD used to estimate emissions from coal mining and handling are based on raw coal production or marketable coal production. During the review, Indonesia clarified that fugitive emissions from coal mining were estimated using coal production data from the energy balance. Since the energy data in the Handbook of Energy & Economic Statistics of Indonesia represent sales data, the AD used in the inventory for coal mining and handling are based on coal sold. The TERT recommends that Indonesia collect data on raw coal production for use as AD for estimating emissions from coal mining and handling. If the Party is unable to obtain such data, the TERT recommends applying the correction factor provided in the 2006 IPCC Guidelines (vol. 2, ch.4, section 4.1.3.3) to avoid an underestimation of emissions for this subcategory.
3.E.17	Specified in paragraphs 31 and 39 of the MPGs 1.B.1.a Coal mining and handling – solid fuels – CO_2, CH_4	The NID does not address underground coal mines (subcategory 1.B.1.a.i), which were reported as “NE” in CRT 1.B.1. However, although underground coal mining does not currently take place in the country, there is at least one abandoned underground coal mine. During the review, Indonesia stated that it does not have abandoned underground mines, clarifying that although the Ombilin mine began as an underground operation in 1892, available information suggests that underground mining at the site likely ceased in the early twentieth century. The TERT recommends that if Indonesia has evidence showing that emissions do not occur from the abandoned Ombilin coal mine, it report this information in the NID and report subcategory 1.B.1.a.i as “NO” in CRT 1.B.1.

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
3.E.18	Specified in paragraphs 20, 21, 23, 39 and 40 of the MPGs 1.B.2 Oil, natural gas and other emissions from energy production – liquid and gaseous fuels – CO_2, CH_4, N_2O	The NID provides limited information on the data used to estimate fugitive emissions from oil and natural gas (category 1.B.2). Section 3.6.2.3 (p.51) of the NID only states that the methodology for estimating fugitive emissions from oil and natural gas is appropriate and equation 4.2.2 from the 2006 IPCC Guidelines was used, along with tier 1 IPCC default EFs. Additionally, the AD in CRT 1.B.2 are described as unspecified for most subcategories. The TERT notes that the 2006 IPCC Guidelines provide two sets of EFs for developed and developing countries, generally given as ranges that may span one or two orders of magnitude, and, since no relevant information was provided by the Party, the TERT was unable to ascertain which set of these technology-dependent EFs was applied by the Party. Moreover, CH_4 and CO_2 emissions from oil and natural gas were identified as key categories. During the review, Indonesia indicated that, in accordance with the tier 1 approach from the 2006 IPCC Guidelines, it based the AD for estimating fugitive emissions from oil and gas fields on crude oil and natural gas production, and the midpoint of the EF range was used rather than specific selection criteria. The TERT recommends that Indonesia indicate in the NID which set of EFs (for developed or developing Parties) was selected and clarify the value chosen when giving the EFs as a range. The TERT also recommends that Indonesia provide a description of the AD used in CRT 1.B.1, noting that oil and natural gas production is not the only source of AD for all industry segments. The TERT further encourages Indonesia to enhance its understanding of the technological characteristics of its oil and natural gas industry to enable the selection of more appropriate EF values and facilitate the transition to a tier 2 approach in future. If the Party is unable to adopt a tier 2 approach for this key category owing to a lack of resources, the TERT recommends that Indonesia clearly document why the methodological choice does not align with the relevant decision tree from the 2006 IPCC Guidelines.
3.E.19	Specified in paragraph 31 of the MPGs 1.B.2.d Other (oil, natural gas and other emissions from energy production) – geothermal power – CO_2, CH_4, N_2O	Indonesia reported the subcategory other (1.B.2.d) as "NO". However, as of 2022, the Party had an installed geothermal capacity of 2,356 MW. There is no methodology available from the 2006 IPCC Guidelines for estimating emissions from geothermal power production. During the review, Indonesia indicated that there are many geothermal fields in the country, spread across various regions, and collecting data on GHGs released as fugitive emissions from these fields is currently a difficult and costly process. The TERT recommends that Indonesia report emissions from geothermal power under subcategory 1.B.2.d as "NE".

Table 4
Areas of improvement of the reporting on greenhouse gas emissions and removals – industrial processes and product use sector

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
4.I.1	Specified in paragraph 24 of the MPGs 2.A.1 Cement production – CO_2	CO_2 emissions from cement production were estimated using a tier 2 approach. Indonesia applied the IPCC default correction factor of 1.02 for CKD in the absence of a country-specific value. According to the 2006 IPCC Guidelines (vol. 3, section 2.2.1.2), the use of a national CKD correction factor, derived from actual plant-level data on CKD generation and recycling, can significantly improve the accuracy of emission estimates and make them more representative. During the review, Indonesia noted that its improvement plan includes quantifying CKD released from cement plants where the carbonate content in CKD can be assumed as the same as that in the raw materials used in clinker production and that it has already applied the carbonate content of the raw materials to estimate GHG emissions from clinker production under the tier 2 method. The TERT encourages Indonesia to collect the data needed to develop a country-specific CKD correction factor.

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
4.I.2	Specified in paragraph 27 of the MPGs 2.B.1 Ammonia production – CO_2	Indonesia estimated historical natural gas consumption for ammonia production (category 2.B.1) between 2000 and 2009 using extrapolation owing to missing AD. The NID does not provide information on the existing constraints or possible future improvements regarding this information gap. The 2006 IPCC Guidelines advise against using long-term extrapolation without periodic validation and suggest using surrogate data for extrapolation, where appropriate. During the review, Indonesia explained that the data provided directly by industries for 2000–2009 can be improved, and efforts to collect data are ongoing, including efforts to collect historical AD for 2000–2009 directly from industrial stakeholders. The TERT encourages Indonesia to undertake the planned data-collection activities with a view to improving the accuracy of the time series of emissions from ammonia production.
4.I.3	Specified in paragraph 47 of the MPGs 2.D.1 – Non-energy product use of lubricants – CO_2	Indonesia reported lubricant use under category 2.D.1 as a non-energy product use, accounting for some 6 per cent of total IPPU emissions in 2022. The NID provides limited information on whether the reported emissions were exclusively from industrial and maintenance uses, or whether they also include lubricants combusted in transport applications, such as in two-stroke engines. According to the 2006 IPCC Guidelines (vol. 2, chap. 3), lubricant combustion in two-stroke engines should be reported under the energy sector (subcategory 1.A.3.b.iv – motorcycles). During the review, Indonesia explained that the amount of lubricant used as an additive in two-stroke engines was allocated under category 2.D.1 owing to data limitations. The TERT recommends that Indonesia collect the necessary data for disaggregating lubricant use into energy purposes and non-energy purposes and allocate the corresponding emissions to the energy and IPPU sectors respectively. If Indonesia is unable to disaggregate this information, the TERT recommends that it provide a corresponding explanation in the NID.
4.I.4	Specified in paragraph 31 of the MPGs 2.C.3 Aluminium production – C_2F_6	C_2F_6 emissions from aluminium production (category 2.C.3) were reported as "NE" for 2011–2022, but emissions of this F-gas were reported for previous years. During the review, Indonesia clarified that C_2F_6 has not been emitted since 2011 owing to changes in the aluminium production process. The Party confirmed that the correct notation key for years after 2011 is "NO" and that there was an error in transferring the information from the IPCC inventory software to the ETF GHG inventory reporting tool, which resulted in "NO" appearing as "NE". The TERT recommends that Indonesia report C_2F_6 emissions from aluminium production as "NO" for 2011–2022 and include a brief explanation for the reporting of this notation key in the NID.

Table 5
Areas of improvement of the reporting on greenhouse gas emissions and removals – agriculture sector

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
5.A.1	Specified in paragraph 39 of the MPGs 3.B.4.g Poultry – CH_4, N_2O	The NID lacks specific information on assumptions for livestock populations; in particular, no information was provided on the use of equation 10.1 (annual average population) from the 2006 IPCC Guidelines. This is significant for poultry populations and often for swine populations, where livestock are slaughtered before they reach one year of age. During the review, Indonesia clarified that although it applied equation 10.1 from the 2006 IPCC Guidelines for poultry subcategories, it did not do so within the IPCC inventory software. Information on the population of swine was sourced from the Ministry of Agriculture, and it is assumed that swine live for one year. The TERT recommends that the Party enhance transparency by adequately documenting the assumptions used for calculating the annual average population of poultry using equation 10.1 from the 2006 IPCC Guidelines. The TERT also

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
		recommends that the Party explain why equation 10.1 was not used for swine subcategories.
5.A.2	Specified in paragraphs 39–40 of the MPGs 3.A Enteric fermentation, 3.B Manure management, 3.C Rice cultivation, 3.D Managed soils, 3.E Prescribed burning of savannahs, 3.F Field burning of agricultural resides, 3.G Liming, 3.H Urea application – CO_2, CH_4, N_2O,	The NID lacks specific information on assumptions, references and details of information sources with regard to the EFs and AD used to compile the GHG inventory. While some information was provided on the methodology and calculation parameters, all reporting categories lack complete information. During the review, Indonesia provided the supporting information used in the IPCC inventory software. This gave the TERT clarity around the AD, parameters and EFs used. However, no information was provided in the NID for calculations made outside of the software (e.g. enteric fermentation, country-specific EFs for sheep and goats). Moreover, the information provided lacked details on references and information sources used. The TERT clarified with the Party that the IPCC inventory software file is not part of the BTR1, so the NID must include the relevant information used in the software. The TERT recommends that the Party provide transparent information on assumptions, references and details of information sources for the EFs and AD used to compile the GHG inventory in the NID. For example, among the categories reported in the NID, transparency could be enhanced by providing: • For category 3.A enteric fermentation, AD on livestock populations, as well as information on the parameters used to inform the tier 2 calculations, including total animal mass, dry matter intake, feed energy density and the methane conversion rate value. The Party should document the use of the simplified tier 2 method, as well as the source of country-specific information, and/or reference and justify its use of IPCC default values (i.e. by explaining why they are suitable for local conditions); • For category 3.B manure management, AD on livestock populations, as well as parameters used, including total animal mass, urinary energy fraction, ash content, B_o and methane conversion factor values. The Party should include references to country-specific information, as well as information on the selection of relevant IPCC default values; • For category 3.C rice cultivation, AD on annual harvested area, as well as parameters used, including relevant scaling factors, water regime, cultivation period and the EFs. The Party should include references to country-specific information, as well as information on the selection of relevant IPCC default values; • For categories 3.E prescribed burning of savannahs and 3.F field burning of agricultural residues, AD on burned area, as well as the fuel mass, combustion factor and EFs used. The Party should include a reference to the parameters or EFs used, as well as a justification for their use; • For category 3.G liming, AD on total lime/dolomite applied and the EFs used, as well as references to country-specific data and the EFs used; • For category 3.H urea, AD on total urea applied and the EFs used, as well as references to country-specific data and the EFs used.
5.A.3	Specified in paragraph 31 of the MPGs 3.I Other carbon-containing fertilizers – CO_2	The Party's use of notation keys is inconsistent with regard to its reporting of emissions for category 3.I other carbon-containing fertilizers. "NO" and "NE" were reported throughout the NID, and the Party did not provide the reasons for not reporting the emissions. During the review, Indonesia clarified that carbon-containing fertilizers are not used in the country, and "NO" should be reported. The TERT recommends that the Party use the correct notation key when reporting emissions for category 3.I other carbon-containing fertilizers and provide a brief rationale for its decision in the NID.
5.A.4	Specified in paragraph 39 of the MPGs 3.B Manure Management – CH_4	The Party states in the NID (p.88, table 5-16) that an IPCC tier 2 methodology and country-specific EFs were used for reporting CH_4 emissions for all livestock categories. However, in the supplementary information provided by Indonesia in the IPCC inventory software, IPCC tier 1 methodologies were specified for sheep, swine, goats, horses and poultry. While default EFs were used for swine, horses and poultry, a country-specific EF appears to have been used for sheep and goats; however, no additional information was provided.

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
		During the review, Indonesia confirmed that it used IPCC tier 1 methodology and default EFs for swine, horses and poultry. The Party clarified that it used country-specific IPCC tier 2 EFs for sheep and goats, which were not calculated using the IPCC inventory software, and provided a reference for this (Widiawati et al., 2021, annex B). The TERT recommends that Indonesia update table 5-16 of the NID to reflect the method and EFs used and provide additional information in the NID to document the source of country-specific EFs, providing, where possible, references to publications used for the NID.
5.A.5	Specified in paragraphs 21 and 23 of the MPGs 3.D.1 Direct N_2O from managed soils, 3.B(b) N_2O from manure management – N_2O	The Party provided in its NID a key category analysis using a level assessment, both with and without LULUCF (tables A1-1 and A1-2). In both tables, key categories for agriculture include rice cultivation, enteric fermentation, direct N_2O from managed soils, and manure management (N_2O). Where emissions sources are identified as key categories, it is good practice to use the recommended method (tier level) in accordance with the 2006 IPCC Guidelines. IPCC tier 1 methodologies were used for direct N_2O emissions from managed soils and manure management (N_2O). Indonesia noted in its improvement plan that it intends to transition to the use of country-specific data or EFs. During the review, Indonesia clarified that country-specific EFs were not available for direct N_2O from managed soils and manure management (N_2O), and that it is working to transition to the use of higher-tier methods for these key categories. Additionally, N_2O emissions from manure management was not previously a key category and only became one under the level assessment for the BTR1. The TERT recommends that Indonesia clearly document why the methodological choice was not in line with the corresponding decision tree of the 2006 IPCC Guidelines and encourages Indonesia to use the recommended method (tier level) for key categories in accordance with the 2006 IPCC Guidelines.
5.A.6	Specified in paragraphs 21, 39 and 40 of the MPGs 3.B Manure management – CH_4, N_2O	Indonesia reported in the NID (p.86) information on the prevalent manure management systems used for livestock in the country. However, it is unclear from the terminology used whether the systems referred to by the Party account for 100 per cent of total manure or whether they indicate the prevalent manure systems for the associated livestock categories. During the review, Indonesia clarified that only manure from beef cattle is associated with two different manure systems (70:30 dry lot to pasture ratio), and 100 per cent of manure from all other livestock is allocated to the manure system listed for that category. Regarding its use of the IPCC default value for $Frac_{LossMS}$ (2006 IPCC Guidelines, vol. 4, chap. 10, table 10.23) for poultry (15 per cent, for solid storage manure management systems for other livestock), Indonesia explained that an error occurred in its calculations, and this will be corrected to the appropriate values for poultry with and without litter (50 and 55 per cent respectively) in the next submission. The TERT recommends that Indonesia apply the correct IPCC default values for $Frac_{LossMS}$ for the poultry livestock categories, recognizing poultry with and without litter. Additionally, the TERT encourages Indonesia to list the share of manure management systems and to include the source of information (e.g. a focus group discussion with agricultural experts).
5.A.7	Specified in paragraphs 21 and 39 of the MPGs 3.B.4.g Poultry – N_2O	The NID does not provide information on the Nex rate used for calculating N_2O emissions from manure management. During the review, Indonesia clarified that the Nex rate was calculated using equation 10.30 from the 2006 IPCC Guidelines. However, the TERT observed that Indonesia used the default Nex rate for poultry across all poultry subcategories, even though more disaggregated default values are provided for broilers and ducks. Indonesia clarified that the default Nex rate of 0.82 was selected for all poultry categories owing to an error, and the disaggregated default Nex rates should have been used. The TERT recommends that Indonesia use the appropriate IPCC default Nex rate values for poultry or provide a justification for using a different approach.

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
5.A.8	Specified in paragraphs 39–40 of the MPGs 3.C Rice cultivation – CH_4	Indonesia stated in the NID (section 5.4.6, p.101) that in the comparison of recalculated emissions between its third biennial update report and BTR1 (for 2000–2019), the difference was less pronounced in 2015 compared with all other years. Indonesia stated that this was the result of mitigation strategies involving intermittent irrigation systems and low-emission crop varieties. However, the NID does not provide sufficient information on how prevalent these irrigation systems are across all reporting years, and table 5–26 in the NID does not provide information on low-emission rice varieties. During the review, Indonesia provided additional information on the scaling factors (NID table 5–26) used, noting that factors of less than one indicate a low-emission variety, and factors of more than one indicate a variety that is not low in emissions. Additionally, the Party clarified that two of the regimes stratified in the IPCC software, the Integrated Crop Management Field School and System of Rice Intensification, were part of a water-saving programme of the Ministry of Agriculture, and therefore lower scaling factors were used compared with other water regimes involving continuous irrigation. The TERT recommends that Indonesia provide additional information in the NID on the scaling factors used for calculating CH_4 emissions from rice cultivation and provide references where appropriate. Additionally, the TERT recommends that Indonesia provide additional information in the NID on the use of low-CH_4 rice varieties and how they are included in the emission calculations.

Table 6
Areas of improvement of the reporting on greenhouse gas emissions and removals – land use, land-use change and forestry sector

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
6.L.1	Specified in paragraphs 39 and 47 of the MPGs 4. Land representation (LULUCF)	The Party reported in the NID (section 6.2.2) that land uses were classified using land-cover maps for 2000–2022. However, the Party did not report information on the methods or IPCC approach used to assess land classifications, or on the data sources. During the review, the Party clarified that annual land-use changes were estimated for 2000–2022 by overlaying two land-cover maps in a geographic information system (e.g. by overlaying the 2021 map with the 2022 map); the Party also explained that annual land use/cover data were used in the GHG inventory. The resulting intermediate outcome was overlaid with a soil map (peat and mineral). The Party also explained that the methodology used to generate the annual land-use and land-cover change is described in its second FRL submission. However, it is unclear how the methodology described in section 5.2.2 of that document was applied to derive the IPCC land-use categories, particularly with regard to the classification of non-forest land-use types, and the need for an assessment of the annual land use and annual land-use changes. During the review, the Party explained that, while the methodology contained in the second FRL was also used in developing the GHG inventory, an annual time series of land-use and land-cover data was used for the GHG inventory, while the only two data sources (i.e. 2006/2007–2019/2020) were used to assess the second FRL. The Party also noted that the land-use data for 2020 were derived from satellite data compiled for the whole country between June 2019 and July 2020. The TERT recommends that Indonesia enhance the transparency of the information and data reported while ensuring the accuracy of the estimated emissions and removals by providing a description of the methodology used to assess the consistency of land representation in line with the 2006 IPCC Guidelines (vol. 4, chap. 3), as well as summary tables containing (1) all data sources, the assessment year and the related uncertainties; (2) the annual time series of land use and land-use changes; and (3) the time series of land use and land-use changes, considering the 20-year transition period.
6.L.2	Specified in paragraphs 20, 39 and 47 of the MPGs	CRT 4.1 only includes annual areas for land-use categories without reporting conversions to different land-use categories, whereas background CRTs 4.A–4.E include categories for land converted to other land uses, considering the 20-year transition period.

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
	4. General (LULUCF)	During the review, the Party explained that since the whole territory of Indonesia is considered to be managed land, there is no unmanaged land, and land conversions to unmanaged land were reported as "NO" for all types of conversion in CRT 4.1. The TERT, noting that land-use categories involving conversion to managed land are not included in CRT 4.1, recommends that Indonesia ensure consistency in its reporting by providing annual land use and land-use changes in CRT 4.1, consistently with the AD provided in background CRTs 4.A–4.E.
6.L.3	Specified in paragraphs 20, 21, 45 and 47 of the MPGs 4.A Forest land – CO_2	The Party reported in the NID (section 6.3.3.3.1 on forest land remaining forest land) that annual stock changes for deadwood and litter were assessed by applying equation 2.23 from the 2006 IPCC Guidelines (vol. 4, chap. 2). However, equation 2.23 is used for estimating annual carbon stock changes in deadwood and litter due to land conversion, and carbon stock changes for deadwood and litter were reported as zero in CRT 4.A. During the review, the Party clarified that emissions and removals from the deadwood and litter pools were not estimated for either forest land remaining forest land or land converted to forest land. The Party highlighted its plan to estimate emissions and removals from the litter and deadwood pools for forest land remaining forest land and land converted to forest land for the next BTR. The TERT recommends that Indonesia estimate and report deadwood and litter emissions and removals for forest land-use categories, providing estimates for both forest land remaining forest land and land converted to forest land.
6.L.4	Specified in paragraphs 20, 40 and 47 of the MPGs 4.A Forest land – CO_2	The Party reported in its NID (table 6–11) the EFs and parameters used for the estimation of gains (increases) in forest biomass. However, the NID did not provide information on the underlying data sources for those EFs and parameters. During the review, the Party explained that the EFs and parameters reported in table 6–11 were developed on the basis of an analysis of national forest inventory data, noting that a detailed explanation can be found in its second FRL submission. The Party also provided references for the above-ground growth parameter, in a policy scenario for reducing carbon emissions from Indonesia's peatlands, published by the Ministry of National Development Planning in 2010. However, since the EFs and parameters included in table 6 of the referenced document seem to pertain to peatland and different land-use categories, the TERT requested the Party to provide the values used in the estimation of gains for forest land. The Party clarified that those values are included in table 6–17 of the NID, adding that the AD for land cover were derived from satellite imagery (Landsat, ALOS, PALSAR) processed by the Ministry of Forestry following the standard procedure developed by the Ministry. The Party also provided a list of the EFs and parameters applied, including the relevant data sources. The TERT recommends that Indonesia enhance the transparency of the information and data reported, while ensuring the accuracy of the estimated emissions and removals, by providing a description of the methodology used to estimate carbon stock changes in biomass for forest land remaining forest land, as well specifying the data sources of the EFs and parameters used to assess carbon stock changes in biomass.
6.L.5	Specified in paragraph 39 of the MPGs 4.A.2 Land converted to forest land – CO_2	The Party reported in the NID (section 6.3.3.4.1 on mineral soils) that equation 2.23 from the 2006 IPCC Guidelines (vol. 4, chap. 2) was used to estimate carbon stock changes in soil, and that the reference values for SOC and other parameters utilize default values corresponding to different land-use types. The TERT noted that the above-mentioned equation in the 2006 IPCC Guidelines is to be used to estimate the annual carbon stock changes in deadwood and litter due to land conversion, and the Party did not provide information in the NID on the specific factors (e.g. climate, soil type and management practices) used to assess SOC stocks for land-use conversions to forest land, or the SOC_{REF} values applied for these calculations. During the review, the Party explained that the soil type used in the estimation of emissions and removals from mineral soils under land converted to forest land is low-activity clay mineral, while the climate region is tropical wet, resulting in a SOC_{REF} of 60 (for low-activity clay mineral). The Party also provided the values used for the relative carbon stock change factors: land use = 1; management = 1 = full tillage; and input = 1. The Party also clarified that land-use categories for forest

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
		land and non-forest land in the NID are the same as those in its second FRL submission (tables 2–3). To enable the assessment of the accuracy and consistency of the reported carbon stock changes in mineral soils, the TERT sought clarification on annual areas converted to grassland, disaggregated by land-use category; the Party explained that the AD for land cover were derived from satellite imagery (see ID# 6.L.4 above), and the 2019 Refinement to the 2006 IPCC Guidelines was used for EFs. The Party also provided the TERT with its IPCC inventory software database, which included the AD and EFs used, as well as the relevant IPCC equations used in the estimation process. The TERT recommends that Indonesia enhance the transparency of the information and data reported while ensuring the accuracy of the estimated emissions and removals by providing (1) a description of the methodology used to estimate carbon stock changes for mineral soils; (2) information on the specific factors (e.g. climate, soil type and management practices) used to assess SOC stocks for different land-use conversions to forest land; (3) the SOC_{REF} values applied, including for peat soils; and (4) a table containing the annual areas for each category associated with a land-use conversion to forest land, consistently with the recommendations under ID#s 6.L.1 and 6.L.2 above.
6.L.6	Specified in paragraph 39 of the MPGs 4.B.2 Land converted to cropland – CO_2	The Party reported in the NID (section 6.4.3.3.1 on mineral soils) that equation 2.25 from the 2006 IPCC Guidelines (vol. 4, chap. 2) was used to estimate soil carbon stock changes. The NID also states that the Party applied default values for reference measurements of SOC and other parameters. However, the NID does not provide information on the specific factors (e.g. climate, soil type and management practices) used to assess SOC stocks for land-use conversions to cropland, or the SOC_{REF} values applied for these calculations. During the review, the Party explained that the soil type used in the estimation of emissions and removals from mineral soils under land converted to cropland is low-activity clay mineral, while the climate region is tropical wet, resulting in a SOC_{REF} of 60 (for low-activity clay mineral). The Party also provided the values used for the relative carbon stock change factors: land use = 1.1 = paddy rice; management = 1 = full tillage; and input = 1.1 = high input without manure. The Party also clarified that land-use categories for forest land and non-forest land in the NID are the same as those in its second FRL submission (tables 2–3). To enable the assessment of the accuracy and consistency of the reported carbon stock changes in mineral soils, the TERT sought clarification on annual areas converted to cropland, disaggregated by land-use category; the Party explained that the AD for land cover were derived from satellite imagery (see ID# 6.L.4 above), and the 2019 Refinement to the 2006 IPCC Guidelines was used for EFs. The Party also provided the TERT with its IPCC inventory software database, which included the AD and EFs used, as well as the relevant IPCC equations used in the estimation process. The TERT recommends that Indonesia enhance the transparency of the information and data reported while ensuring the accuracy of the estimated emissions and removals by providing (1) a description of the methodology used to estimate carbon stock changes for mineral soils; (2) information on the specific factors (e.g. climate, soil type and management practices) used to assess SOC stocks for different land-use conversions to cropland; (3) the SOC_{REF} values applied, including for peat soils; and (4) a table containing the annual areas for each category associated with a land-use conversion to cropland, disaggregated by annual and perennial crops, consistently with the recommendations under ID#s 6.L.1 and 6.L.2 above.
6.L.7	Specified in paragraph 20 of the MPGs 4.C.2 Land converted to grassland – CO_2	The Party reported in the NID (section 6.5.3.3.1 on mineral soils) that equation 2.25 from the 2006 IPCC Guidelines (vol. 4, chap. 2) was used to estimate soil carbon stock changes. The NID also states that default values were used for parameters such as SOC_{REF} values before and after conversion. However, the NID does not contain information on the specific factors (e.g. climate, soil type and management practices) used to assess SOC stocks for land-use conversions to grassland, or the SOC_{REF} values applied for these calculations. During the review, the Party explained that two soil types were used in the estimation of emissions and removals from mineral soils under land converted to grassland, namely mineral with low-activity clay and peat soil, while the climate region is tropical wet, resulting in a SOC_{REF} of 60 (for low-activity clay mineral). The Party also provided the values used for the relative carbon stock change factors:

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
		land use = 1; management = 1 = non-degraded; input = 1 = medium. In response to a question from the TERT on annual areas converted to grassland, disaggregated by land-use category, the Party explained that the AD for land cover were derived from satellite imagery (see ID# 6.L.4 above), and the 2019 Refinement to the 2006 IPCC Guidelines was used for EFs. The Party also provided the TERT with its IPCC inventory software database, which included the AD and EFs used, as well as the relevant IPCC equations used in the estimation process. The TERT recommends that Indonesia enhance the transparency of the information and data reported while ensuring the accuracy of the estimated emissions and removals by providing (1) a description of the methodology used to estimate carbon stock changes for mineral soils; (2) the specific factors (e.g. climate, soil type and management practices) used to assess SOC stocks for different land-use conversions to grassland; (3) the SOC_{REF} values applied, including for peat soils; and (4) a table containing the annual areas for each category associated with a land-use conversion to grassland, disaggregated by grazing land and woody grassland.
6.L.8	Specified in paragraph 47 of the MPGs 4.G HWP – CO_2	The Party did not report CO_2 emissions and removals for the HWP category. The Party reported in its NID (section 6.1.1) that emissions and removals associated with HWP were excluded from the GHG inventory because of insufficient information and data. AD related to the three HWP subcategories (sawnwood, wood-based panels, and paper and paperboard) are available for 1961 onward from the FAOSTAT database, as noted in the 2019 Refinement to the 2006 IPCC Guidelines (vol. 4, chap. 12, section 12.4.1.1). Additionally, the Party included in CRTs 4.Gs1 and 4.Gs2 the half-life values and the factors used to convert product units to carbon. During the review, the Party explained that the IPCC software was not used for HWP estimation since it does not provide the HWP data, which are, however, available in the IPCC worksheet and can be transferred to the IPCC software to enable estimation of emissions and removals from HWP. The Party stated that it plans to estimate HWP emissions and removals for the next BTR. The TERT, noting that the IPCC software offers the possibility to collect HWP data and estimate gains and losses for HWP in use and associated net emissions and removals, recommends that Indonesia estimate and report emissions and removals for the HWP category.
6.L.9	Specified in paragraph 39 of the MPGs 4(IV) Biomass burning – CH_4 and N_2O	Indonesia reported in the NID that emissions may occur as a result of the burning of agricultural residues, particularly annual crops. The TERT noted that CH_4 and N_2O emissions are included in CRT 4(IV) for wildfires, while "NE" was reported for controlled burning. The TERT further noted that emissions from field burning of agricultural residues were included in the agriculture sector and reported in CRT 3.F for both CH_4 and N_2O. The TERT notes that it was not clear whether the fires occurring in cropland areas are wildfires (reported in CRT 4(IV) under the wildfires category) or represent controlled burning of agricultural residues. During the review, the Party clarified that fires affecting agricultural land reported in CRT 4(IV) are fires occurring in estate crops, pure dry agriculture, mixed dryland agriculture and transmigration areas and are classified as wildfires. In contrast, fires in paddy fields are classified as controlled burning and reported under burning of agricultural residues. The TERT recommends that Indonesia provide a detailed description of the sources of emissions reported in CRT 4(IV) in order to enhance the transparency of the information and data reported.

Table 7
Areas of improvement of the reporting on greenhouse gas emissions and removals – waste sector

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
7.W.1	Specified in paragraphs 39–40 of the MPGs 5. Waste – All gases	The NID does not provide sufficient documentation on the methodologies, AD, parameters, EFs, assumptions or sources of information used to estimate emissions from the waste sector. During the review, Indonesia provided its IPCC inventory software database containing the calculation files, AD and EFs used for the waste sector. Indonesia

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
		also clarified the methods used and the rationale for using them. The TERT explained to Indonesia that the IPCC inventory software does not contain contextual information on assumptions, references and sources to facilitate understanding of how the inventory was compiled, and transparency is lacking when separate intermediate calculations are made to derive national or averaged parameters. The TERT also explained that the IPCC inventory software is not part of the NID submission (see para. 38 of the MPGs); therefore, information on AD, EFs and parameters entered in the IPCC inventory software is to be reported in the NID. The TERT recommends that Indonesia transparently report detailed information by category and gas on the methodologies, AD, parameters, EFs and assumptions used to estimate emissions from the waste sector, including the sources of the information reported and references. For example, of the categories reported in the NIR, transparency could be enhanced by providing: For category 5.A.1 managed waste disposal sites, AD on the quantity, characteristics and composition of industrial waste deposited in SWDS and information on changes over the time series, as well as information on the operating conditions of industrial SWDS (including CH_4 flaring and/or energy recovery or lack thereof), with their MCFs and all associated parameters and assumptions used under the IPCC FOD model; For category 5.A.2 unmanaged waste disposal sites, AD on the quantity, characteristics and composition of MSW deposited in SWDS and information on changes over the time series; techniques and assumptions used to estimate historical data; and the operating conditions for MSW disposal sites (including CH_4 flaring and/or energy recovery or lack thereof), with their MCFs and all associated parameters, EFs and assumptions used under the IPCC FOD model; For category 5.B.1 composting, AD on the quantity, characteristics and composition of composted waste and information on changes over the time series, as well as information on all associated parameters, EFs and assumptions used in the estimations; For category 5.C.2 open burning of waste, AD on the quantity, characteristics and composition of waste for open burning, with information on changes over the time series, as well as information on all associated parameters, EFs and assumptions used in the estimations; For category 5.D.1 domestic wastewater, information on the utilization rate for all domestic wastewater treatment and discharge systems and pathways, including changes over the time series, using the diagrams and good practice contained in the 2006 IPCC Guidelines (vol. 5, chap. 6, p.6.18); the existence of industrial wastewater co-discharge into domestic sewer systems, quantity of sludge recovered and the relevant treatment or application methods, and quantities for CH_4 flaring and energy recovery, as applicable; and all other associated parameters, EFs and assumptions used in the estimations, such as MCFs, biochemical oxygen demand, B_o, correction factor for additional industrial biochemical oxygen demand discharged into sewers, protein consumption, fraction of nitrogen in protein, fraction of non-consumed protein added to wastewater, and fraction of industrial and commercial co-discharged protein into the sewer system;. For category 5.D.2 industrial wastewater, a description of the MCFs, B_o, and chemical oxygen demand values selected for each type of industrial wastewater treatment and discharge system and pathway; information on the quantities for sludge recovery, including information on the corresponding treatment or application methods, and on quantities for CH_4 flaring and energy recovery, as applicable; and all other associated parameters, EFs and assumptions used in the estimations.
7.W.2	Specified in paragraphs 27 and 45 of the MPGs 5.A.1 Managed waste disposal sites – CH_4	Indonesia estimated and reported CH_4 emissions from the anaerobic managed disposal of industrial waste for 2007–2022 and reported “NE” for 2000–2006 under subcategory 5.A.1.a managed waste disposal sites – anaerobic without explaining why these emissions were not estimated for years prior to 2007. During the review, Indonesia clarified that CH_4 emissions from anaerobic managed industrial SWDS were not estimated prior to 2007 owing to a lack of data.

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
		The TERT recommends that Indonesia provide a transparent explanation as to why CH_4 emissions from the anaerobic managed disposal of industrial waste were not estimated for years prior to 2007 under subcategory 5.A.1.a. The TERT encourages Indonesia to use surrogate data or extrapolation methods consistent with the splicing techniques contained in the 2006 IPCC Guidelines (vol. 1, chap. 5, section 5.3.3) to estimate emissions for years prior to 2007.
7.W.3	Specified in paragraphs 31 and 39 of the MPGs 5.A.1 Managed waste disposal sites – CH_4	Indonesia did not estimate the amount of CH_4 flared or recovered from the anaerobic managed disposal of industrial waste and reported subcategory 5.A.1.a managed waste disposal sites – anaerobic as "NE" for the entire time series, without providing an explanation as to why these values were not estimated. During the review, Indonesia clarified that the amount of CH_4 released from this type of industrial SWDS is too small to be flared or recovered (as this sludge is allowed to be used for fuel), and, as such, the activity does not occur in the country. Indonesia noted that the use of "NE" was the result of an error in transferring the information from the IPCC inventory software to the ETF GHG inventory reporting tool and that the correct notation key is "NO". The TERT recommends that Indonesia report CH_4 flared and recovered as "NO" under subcategory 5.A.1.a for the entire time series, and transparently demonstrate that this activity does not occur in the country.
7.W.4	Specified in paragraphs 31, 32, 45 and 47 of the MPGs 5.A.1 Managed waste disposal sites – CH_4	Indonesia did not report CH_4 emissions from semi-aerobic and active aeration managed SWDS and reported subcategories 5.A.1.b managed waste disposal sites – semi-aerobic and 5.A.1.c managed waste disposal sites – active-aeration as "NE" for the entire time series, without providing an explanation as to why these emissions were not estimated. During the review, Indonesia clarified that semi-aerobic and active aeration managed SWDS may or may not occur in the country, but there is a lack of data regarding this activity. The TERT recommends that Indonesia begin studies and use expert judgment on semi-aerobic and active aeration managed SWDS to confirm whether or not they occur in the country and document its conclusions. If either of these activities do not occur, the TERT recommends that Indonesia report the associated CH_4 emissions under subcategories 5.A.1.b and/or 5.A.1.c as "NO". If either of these activities do occur but the associated CH_4 emissions are considered insignificant, Indonesia may report "NE" for subcategories 5.A.1.b and/or 5.A.1.c, and the TERT encourages Indonesia to transparently justify why they are considered insignificant and provide calculations of the likely level of emissions using approximated AD. If either of these activities do occur and the CH_4 emissions are considered significant, the TERT recommends that Indonesia begin collecting data for estimating associated CH_4 emissions under subcategories 5.A.1.b and/or 5.A.1.c.
7.W.5	Specified in paragraph 39 of the MPGs 5.A.2 Unmanaged waste disposal sites – CH_4	Indonesia classified all MSW disposal sites as unmanaged deep SWDS with an MCF of 0.8 and reported the associated annual energy recovery values for 2011–2022 under category 5.A.2 unmanaged waste disposal sites. However, according to the default SWDS classification provided in the 2006 IPCC Guidelines (vol. 5, chap. 3, table 3.1), energy recovery typically takes place in managed SWDS (MCF of 1.0) rather than unmanaged deep SWDS (MCF of 0.8). During the review, Indonesia clarified that most new MSW disposal sites in the country are designed as sanitary (managed) landfills, and some are equipped with gas recovery equipment for power generation. However, owing to limited local government budgets, all these sanitary landfills operate under unmanaged deep conditions (MCF of 0.8) under the IPCC classification for SWDS. All other disposal sites in the country are designed and operated as unmanaged deep SWDS (MCF of 0.8). The TERT recommends that Indonesia transparently document the operating conditions for all types of MSW disposal sites in the country, given that this is the basis for the underlying assumption used for MCF selection, in accordance with the 2006 IPCC Guidelines.
7.W.6	Specified in paragraph 20 of the MPGs	Indonesia's FOD model, used to estimate CH_4 emissions from MSW disposal sites under category 5.A.2 unmanaged waste disposal sites, begins in 1990. However, this results in an underestimation of emissions because the IPCC FOD method requires

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
	5.A.2 Unmanaged waste disposal sites – CH_4	data on solid waste disposal (amounts, composition and management practices) that are collected by default for at least 50 years (2006 IPCC Guidelines, vol. 5, chap. 3, section 3.2.2). During the review, Indonesia confirmed that it used historical data starting in 1990, estimated using extrapolation methods based on assumed historical population growth, for its FOD model, and constant country-specific MSW generation rates and composition values, derived from the latest national studies available, were used. The TERT recommends that Indonesia start the FOD model for MSW disposal sites in the default year of 1950 by estimating historical data on waste generation using surrogates (extrapolation with historical population data) in accordance with the methodologies set out in the 2006 IPCC Guidelines (vol. 5, chap. 3, section 3.2.2).
7.W.7	Specified in paragraphs 27 and 45 of the MPGs 5.A.2 Unmanaged waste disposal sites – CH_4	Indonesia estimated and reported the annual amount of energy recovered from MSW disposal sites for 2011–2022 and reported "NE" for 2000–2010 under category 5.A.2 unmanaged waste disposal sites without providing an explanation as to why these values were not estimated for years prior to 2011. During the review, Indonesia clarified that energy recovery at MSW disposal sites was not estimated for years prior to 2011 owing to a lack of data. The TERT recommends that Indonesia provide a transparent explanation as to why energy recovery occurring at MSW disposal sites was not estimated for years prior to 2011 under category 5.A.2. The TERT encourages Indonesia to use surrogate data or extrapolation methods consistent with the splicing techniques contained in the 2006 IPCC Guidelines (vol. 1, chap. 5, section 5.3.3) to estimate energy recovery values for years prior to 2011.
7.W.8	Specified in paragraphs 45 and 47 of the MPGs 5.B.2 Anaerobic digestion at biogas facilities – CH_4, N_2O	Indonesia did not estimate CH_4 or N_2O emissions from anaerobic digestion in MSW, reporting "NE" for the entire time series under category 5.B.2 anaerobic digestion at biogas facilities, and did not explain why these emissions were not estimated. During the review, Indonesia clarified that anaerobic digestion in MSW occurs in the country, but emissions were not estimated owing to a lack of data. The TERT recommends that Indonesia provide a transparent explanation as to why N_2O and CH_4 emissions from anaerobic digestion in MSW were not estimated under category 5.B.2. The TERT recommends that Indonesia begin collecting data on activities related to anaerobic digestion in MSW with a view to estimating associated CH_4 and N_2O emissions under category 5.B.2.
7.W.9	Specified in paragraphs 45 and 47 of the MPGs 5.C.1 Waste incineration – CO_2, CH_4, N_2O	Indonesia did not estimate CO_2, CH_4 or N_2O emissions from waste incineration, reporting "NE" for the entire time series under category 5.C.1 waste incineration, and did not provide an explanation as to why these emissions were not estimated. During the review, Indonesia clarified that waste incineration occurs in the country, but emissions were not estimated owing to a lack of data. The TERT recommends that Indonesia provide a transparent explanation as to why CO_2, N_2O and CH_4 emissions from waste incineration were not estimated under category 5.C.1. The TERT also recommends that Indonesia begin collecting data on waste incineration activities with a view to estimating associated CO_2, CH_4 and N_2O emissions under category 5.C.1.
7.W.10	Specified in paragraphs 27 and 45 of the MPGs 5.D.1 Domestic wastewater – CH_4	Indonesia estimated and reported annual energy recovery occurring at biodigesters for 2010–2022 and reported "NE" for 2000–2009 under category 5.D.1 domestic wastewater without providing an explanation as to why these values were not estimated for years prior to 2010. During the review, Indonesia clarified that energy recovery at biodigesters was not estimated for years prior to 2010 owing to a lack of data. The TERT recommends that Indonesia provide a transparent explanation as to why energy recovery occurring at biodigesters was not estimated for years prior to 2010 under category 5.D.1. The TERT encourages Indonesia to use surrogate data or extrapolation methods consistent with the splicing techniques contained in the 2006 IPCC Guidelines (vol. 1, chap. 5, section 5.3.3) to estimate energy recovery values for years prior to 2010.

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
7.W.11	Specified in paragraphs 27 and 45 of the MPGs 5.D.2 Industrial wastewater – CH_4	Indonesia estimated and reported annual energy recovery from industrial wastewater treatment for 2012–2022 and reported "NE" for 2000–2011 under category 5.D.2 industrial wastewater without providing an explanation as to why these values were not estimated for years prior to 2012. During the review, Indonesia clarified that energy recovery from industrial wastewater treatment was not estimated for years prior to 2012 owing to a lack of data. The TERT recommends that Indonesia provide a transparent explanation as to why energy recovery from industrial wastewater treatment was not estimated for years prior to 2012 under category 5.D.2. The TERT encourages Indonesia to use surrogate data or extrapolation methods consistent with the splicing techniques contained in the 2006 IPCC Guidelines (vol. 1, chap. 5, section 5.3.3) to estimate energy recovery values for years prior to 2012.
7.W.12	Specified in paragraphs 20, 39, 40 and 47 of the MPGs 5.E Other (waste) – CH_4, N_2O	Indonesia estimated and reported CH_4 and N_2O emissions from the incineration of empty fruit bunches under category 5.E other for 2000–2009 (the period in which this activity occurred in the country) without providing a rationale for estimating these emissions under a country-specific category or information on the methods, parameters, data and assumptions used in the estimations. This allocation is inconsistent with vol. 5, chap. 5 of the 2006 IPCC Guidelines, which allocates the incineration of waste under category 5.C.1. During the review, Indonesia confirmed that empty fruit bunches were incinerated in furnaces with chimneys, describing them as in poor condition, but not falling under open burning, until 2009, when the activity was banned. Furthermore, Indonesia clarified that it used the IPCC methods and EFs corresponding to open burning of MSW, rather than those for incineration of MSW. The TERT recommends that, for 2000–2009, Indonesia report CH_4 and N_2O emissions from the incineration of empty fruit bunches under subcategory 5.C.1.a.ii.5 (waste incineration – biogenic – other – empty fruit bunches) rather than under category 5.E in accordance with the 2006 IPCC Guidelines on allocation of emissions sources. The TERT also recommends that Indonesia use the default CH_4 and N_2O EFs for incineration of MSW reported in the 2006 IPCC Guidelines (vol. 5, chap. 5, tables 5.3 and 5.6 respectively) instead of those for open burning of MSW to more accurately reflect the incineration technology used in furnaces with chimneys. The TERT further recommends that Indonesia transparently document the methods, assumptions, AD, parameters and EFs used in the estimation of CH_4 and N_2O emissions from the incineration of empty fruit bunches.
7.W.13	Specified in paragraphs 20, 22, 39, 40 and 47 of the MPGs 5.E Other (waste) – CH_4	Indonesia estimated and reported CH_4 emissions from the stockpiling of empty fruit bunches under category 5.E other for 2010–2015 (the period in which this activity occurred in the country). However, the NID does not describe the conditions of the stockpiles or the rationale for estimating these emissions under a country-specific category, or include information on the methods, parameters, data and assumptions used in the estimations. During the review, Indonesia clarified that, after the 2009 ban on empty fruit bunch incineration, stockpiles were formed in 2010 under open dump operating conditions and were gradually 'mined' until they were fully emptied in 2015. Indonesia explained that it used a national methodology based on a modified version of the IPCC FOD model which reflects the 'mining' of the empty fruit bunch stockpiles and their disappearance by 2015. The TERT recognized that this approach is nationally appropriate, best reflects national circumstances and is consistent with the 2006 IPCC Guidelines. Indonesia also clarified that, owing to the fact that the characteristics of the empty fruit bunches differ significantly from those of industrial waste or MSW, and to the particular 'mining' conditions of the stockpiles, it considers that the most appropriate approach is to report the associated CH_4 emissions separately from those associated with industrial SWDS (reported under category 5.A.1) and MSW disposal sites (reported under category 5.A.2). The TERT recommends that Indonesia classify its empty fruit bunch stockpiles as uncategorized SWDS and apply the corresponding MCF from the 2006 IPCC Guidelines (vol. 5, chap. 3, table 3.1) to estimate CH_4 emissions from empty fruit bunch stockpiling and report them under category 5.A.3 instead of category 5.E over the entire time series, starting in 2010, in accordance with the 2006 IPCC Guidelines

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
		on allocating emissions sources. The TERT also recommends that Indonesia transparently describe the modified IPCC FOD model applied, which incorporates waste 'mining', and report information on the associated assumptions, AD, parameters and EFs used.
7.W.14	Specified in paragraphs 20, 39, 40 and 47 of the MPGs 5.E Other (waste) – CH_4	Indonesia estimated CH_4 emissions from retention ponds for paper industry wastewater treatment plant sludge and reported them under category 5.E other, starting in 2015 when the activity began in the country. However, Indonesia did not provide a rationale for estimating these emissions under a country-specific category, or provide information on the methods, parameters, data and assumptions used in the estimations. The Party's allocation is inconsistent with the 2006 IPCC Guidelines, according to which industrial wastewater treatment and discharge should be allocated under category 5.D.2 industrial wastewater. During the review, Indonesia clarified that it used the methods and EFs corresponding to industrial wastewater treatment laid out in the 2006 IPCC Guidelines (vol. 5, chap. 6) to estimate CH_4 emissions from retention ponds for paper industry wastewater treatment plant sludge. The Party recognized that these emissions should be estimated under category 5.D.2. The TERT recommends that Indonesia estimate and report CH_4 emissions from retention ponds for paper industry wastewater treatment plant sludge under category 5.D.2 instead of under category 5.E in accordance with the 2006 IPCC Guidelines on allocating emissions sources, and transparently document the methods, assumptions, AD, parameters and EFs used in the estimation of these emissions.
7.W.15	Specified in paragraphs 20, 39, 40 and 47 of the MPGs 5.E Other (waste) – CO_2	Indonesia estimated CO_2 emissions from the process for preparing biomass fuel from paper industry wastewater treatment plant sludge and reported them under category 5.E, starting in 2010 when this activity began in the country. However, Indonesia did not provide a rationale for estimating these emissions under a country-specific category, or provide information on the methods, parameters, data and assumptions used in the estimations. During the review, Indonesia clarified that these CO_2 emissions correspond to the combustion of fossil fuel as the energy source needed for the drying process involved in preparing the sludge for biomass fuel production. The TERT explained to Indonesia that CO_2 emissions from wastewater treatment plant sludge are biogenic in origin and are not to be reported in national totals. The TERT also clarified that fossil fuel combustion for powering the drying process should be reported under the energy sector in accordance with the 2006 IPCC Guidelines on allocating emissions. The TERT recommends that Indonesia report under the energy sector CO_2 emissions from the combustion of fuel for the drying process involved in preparing paper industry wastewater treatment plant sludge for biomass fuel production in accordance with the 2006 IPCC Guidelines on allocating emissions, and transparently document the methods, assumptions, AD, parameters and EFs used in the estimation of these emissions.

C. Information necessary to track progress in implementing and achieving the nationally determined contribution under Article 4 of the Paris Agreement

Table 8
Areas of improvement of the reporting on national circumstances and institutional arrangements

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
8.1	Specified in paragraph 62 of the MPGs	In the BTR (section 2.1.2), Indonesia provided information on institutional arrangements for the planning, implementation, monitoring and evaluation of activities related to tracking progress made in implementing and achieving its NDC. The BTR does not include information on the framework used, such as legislative arrangements and enforcement procedures used by its National Registry System on Climate Change to ensure that all actors in the country, including private sector

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
		actors, provide data and information relevant to tracking progress in implementing and achieving the NDC. During the review, Indonesia indicated that it plans to improve its reporting in future, with details on this issue clearly reported in the BTR. The TERT recommends that Indonesia include information on the framework used by the Party, including with regard to any enforcement procedures for the planning, implementation, monitoring and evaluation of activities related to tracking progress of implementation and achievement of the NDC.

Table 9
Areas of improvement of the description of the nationally determined contribution under Article 4 of the Paris Agreement, including updates

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
NA	NA	No areas of improvement identified

Table 10
Areas of improvement of the reporting of the information necessary to track progress in implementing and achieving the nationally determined contribution under Article 4 of the Paris Agreement

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
10.1	Specified in paragraph 74(b) of the MPGs	In the BTR (section 2.6, pp.87–89), Indonesia provided information on key modelling parameters used for the construction of the baseline, including the implementation of a clean coal technology power plant, a natural gas power plant and energy management in power plants. The TERT was not able to identify drivers of changes in emissions (e.g. population trends, economic development, energy prices and technical and sector-specific factors) or key PaMs included in the baseline for the projection period (i.e. 2011–2030), including assumptions used to differentiate them from the WM and WAM projections as part of the projection scenarios. During the review, Indonesia noted that in the energy and waste sectors, information was only included for its WM scenario and that more information on assumptions, as well as a set of measures for the 'business as usual' WM and WAM scenarios, can be found in annex 1 to its enhanced NDC. The TERT recommends that the Party provide a clear description of its methodology for constructing the 'business as usual' scenario for its target and clearly differentiate 'business as usual' projections from the projections under the WM and WAM scenarios.
10.2	Specified in paragraph 70 of the MPGs	In the BTR (section 1.3) Indonesia reported that it has successfully achieved its unconditional and conditional emission reduction targets (corresponding to the WM and WAM scenarios) in the last three years (2020–2022); however, according to the MPGs, Parties shall provide an assessment of whether they have achieved their NDC target(s) in the first BTR that contains information on the end year or end of the period of their NDCs. During the review, Indonesia acknowledged the information provided by the TERT, which explained that the achievement of the NDC target should only be referenced in the context of the NDC target for 2030, after the end of the NDC implementation period. The TERT recommends that Indonesia report an assessment of the achievement of the target for its NDC only in the first BTR that contains information on the end year of that NDC.

Table 11
Areas of improvement of the reporting on mitigation policies and measures, actions and plans, including those with mitigation co-benefits resulting from adaptation actions and economic diversification plans, related to implementing and achieving the nationally determined contribution under Article 4 of the Paris Agreement

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
11.1	Specified in paragraph 82(b), (c), (d), (e) and (h) of the MPGs	Indonesia did not include in CTF table 5 a description of the policy or measure entitled combined cycle power plant, or information on (1) the objectives of some of the reported PaMs; (2) the status of the policy or measure entitled energy conservation partnership programme; (3) the types of instrument for each policy or measure; or (4) the start year of implementation for some PaMs. Additionally, Indonesia did not clearly describe the meaning of energy efficiency in the context of the Government's target of increasing energy efficiency in certain subsectors. During the review, Indonesia provided the missing description, objectives and status information. With regard to the types of instrument, Indonesia explained that it chose to report specific acts and regulations instead of the types of instrument because these acts and regulations provide the main basis on which sectors and entities implement PaMs. With regard to the start year of implementation, Indonesia explained that most of its PaMs were implemented on the date when the related legislation was published. The Party also clarified that the energy efficiency of each subsector is defined as the level of energy saving compared with the baseline projection, and the baseline is projected with the assumption that there is no additional energy efficiency compared with the base year (2010). The TERT recommends that the Party provide a definition of energy efficiency in the context of the Government's energy efficiency target and, to the extent possible, provide in CTF table 5 for each of its PaMs (1) a description; (2) information on objectives; (3) information on status; (4) information on the type of instrument, using the definitions contained in the MPGs (regulatory, economic instrument or other); and (5) the start year of implementation. If it is not possible for the Party to report consistently with paragraph 82 of the MPGs, the TERT recommends that the Party include the reasons in the BTR.
11.2	Specified in paragraph 83 of the MPGs	Indonesia did not report information on costs, non-GHG mitigation benefits or how the mitigation actions as identified in paragraph 80 of the MPGs interact with each other. During the review, Indonesia explained that this information will be provided depending on resource availability. The TERT encourages the Party to report information on costs, non-GHG mitigation benefits and how the mitigation actions as identified in paragraph 80 of the MPGs interact with each other.
11.3	Specified in paragraph 86 of the MPGs	Indonesia provided information on achieved and expected emission reductions for its PaMs. However, it did not include a description of the methodologies and assumptions used to estimate these emission reductions. During the review, Indonesia explained how the achieved and expected emission reductions were estimated and provided a link to its emission reduction calculation methodology, which contains detailed descriptions of the methodology for estimating emission reductions in the energy sector. The TERT recommends that the Party, to the extent possible, provide a description of the methodologies and assumptions used to estimate achieved and expected emission reductions in the BTR or an annex to the BTR. If it is not possible for the Party to report consistently with paragraph 86 of the MPGs, the TERT recommends that it describe the reasons for this in the BTR.
11.4	Specified in paragraph 88 of the MPGs	Indonesia did not identify its actions and PaMs that influence GHG emissions from international transport. During the review, Indonesia explained that no actions or PaMs affect emissions from international transport. The TERT encourages the Party to include in its BTR information on actions and PaMs that affect emissions from international transport, or if no such actions are planned or implemented, to state this in the BTR.

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
11.5	Specified in paragraph 90 of the MPGs	Indonesia did not provide detailed information on the assessment of economic and social impacts of response measures, stating in its BTR that a comprehensive assessment of the economic and social impacts of mitigation actions will be conducted for key sectors, depending on resource availability. During the review, Indonesia confirmed that such information will be provided depending on resource availability. The TERT encourages the Party, to the extent possible, to provide detailed information on the assessment of economic and social impacts of response measures.

Table 12
Areas of improvement of the summary of greenhouse gas emissions and removals

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
NA	NA	No areas of improvement identified

Table 13
Areas of improvement of the projections of greenhouse gas emissions and removals

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
13.1	Specified in paragraph 95 of the MPGs	Indonesia did not report projections from the most recent year in its NIR (2022). During the review, Indonesia explained that it used flexibility in this area and will recalculate the projections starting from the most recent year of the inventory for future submissions. However, the use of flexibility for projections was not mentioned in the BTR, and the baseline projections for 2011–2030 for calculating the NDC target are not a substitute for projections of emissions from the latest inventory year. The TERT recommends that the Party develop projections beginning from the most recent inventory year until the appropriate end year, and, if it chooses to use flexibility in this area, to report in the BTR on the specific flexibility provision applied.

Table 14
Areas of improvement of other information relevant to tracking progress in implementing and achieving the nationally determined contribution under Article 4 of the Paris Agreement

ID#	*Reporting requirement*	*Description of area of improvement with recommendation or encouragement*
NA	NA	No areas of improvement identified

II. Capacity-building needs[3] identified by the Party and by the technical expert review team in consultation with the Party during the technical expert review of its first biennial transparency report

2. Table 15 presents capacity-building needs identified by the Party and by the TERT in consultation with the Party during the technical expert review of its BTR1.

Table 15
Capacity-building needs identified in consultation with the Party

ID#	*Reporting requirement*	*Area in which capacity-building is needed*
General reporting		

[3] As referred to in paras. 7, 8 and 162(d) of the MPGs.

ID#	*Reporting requirement*	*Area in which capacity-building is needed*
1_CBN.1[a]	Specified in paragraph 6 of the MPGs	Applying flexibilities in its reporting in the BTR as per the MPGs with regard to (1) technical capacity for monitoring and analysis of F-gases; (2) the reporting of insignificant emissions; and (3) the reporting of projections
NIR		
2_G.CBN.1[a, b]	Specified in paragraph 47 of the MPGs	Institutional strengthening aimed at establishing sustainable national energy information management systems that enable the regular production of high-quality energy statistics
2_G.CBN.2[a, b]	Specified in paragraph 29 of the MPGs	Improve the quantitative and qualitative uncertainty assessment for GHG emission and removal estimates

[a] Capacity-building need identified by the TERT in consultation with the Party relating to the flexibilities applied by it as per the MPGs.

[b] Capacity-building need identified by the Party in its BTR1.

Annex

Documents and information used during the review

A. Reference documents

BTR1 of Indonesia. Available at https://unfccc.int/first-biennial-transparency-reports.

BTR1 CTF tables of Indonesia.
Available at https://unfccc.int/first-biennial-transparency-reports.

Carbon Management, 13(1), 154–163. 2022. *Fossil fraction of CO_2 emissions of biofuels*. Sebos, I. Available at: https://doi.org/10.1080/17583004.2022.2046173.

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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/.

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"Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement". Annex to decision 18/CMA.1. FCCC/PA/CMA/2018/3/Add.2. Available at https://unfccc.int/documents/193408.

B. Additional information provided by the Party

Responses to questions during the review were received from Rizaldi Boer (MoEF of the Government of Indonesia), including additional material. The following references were provided by Indonesia and may not conform to UNFCCC editorial style as some have been reproduced as received:

Herlina, L., et al. 2025. *Indonesia's country-specific CO_2 emission factor based on gas fuels for greenhouse gas inventory in the energy sector*. Environmental Pollution 368: 125749. Available at https://doi.org/10.1016/j.envpol.2025.125749.

IPCC Inventory Software – Indonesia's BTR1 all sector database

Ministry of Energy and Mineral Resources. 2020. *Emission Reduction Calculation Methodology*. Available at https://simebtke.esdm.go.id/sinergi/page/content/1/metodologi-penghitungan-reduksi-emisi.

Ministry of Energy and Mineral Resources. 2023. Handbook of Energy and Economic Statistics of Indonesia.

Ministry of Environment and Forestry, 2023. *Recalculation of Indonesia's Land Cover in 2022. Directorate of Forest Resources Inventory and Monitoring*. Directorate General of Forestry Planning and Environmental Management. Ministry of Environment and Forestry. Jakarta

Ministry of Environment and Forestry, 2020. *Standard Operating Procedure (SOP): Accuracy and Uncertainty Calculation Land Cover Changes*. Ministry of Environment and Forestry. Jakarta

Ministry of national developing planning, 2010. *Policies scenario of reducing carbon emissions from Indonesia's peatlands*, Ministry of national developing planning. Jakarta

Indonesia submission of 2nd FRL
https://redd.unfccc.int/media/modified_2nd_frl_indonesia_20220529_clean.pdf

Widiawati, et al. 2021. Emisi Gas Rumah Kaca dari Peternakan di Indonesia dengan TIER 2 IPCC. 10.55981/brin.461. Available at:
https://www.researchgate.net/publication/361853192_Emisi_Gas_Rumah_Kaca_dari_Peternakan_di_Indonesia_dengan_TIER_2_IPCC