



Report on the technical assessment of the proposed forest reference emission level and forest reference level of Chile submitted in 2023

Summary

This report covers the technical assessment of the voluntary submission of Chile on its proposed forest reference emission level (FREL) and forest reference level (FRL) in accordance with decision 13/CP.19 and in the context of results-based payments. The FREL and FRL proposed by Chile cover the activities reducing emissions from deforestation, reducing emissions from forest degradation, conservation of forest carbon stocks, and enhancement of forest carbon stocks, which are among the activities included in decision 1/CP.16, paragraph 70.

For its submission, Chile developed a national FREL and FRL. The FREL and FRL presented in the original submission, for the reference periods 2001–2013 and 2001–2010 respectively, correspond to 17,592,398 tonnes of carbon dioxide equivalent per year. As a result of the facilitative process during the technical assessment, the FREL and FRL were modified to 18,052,357.14 tonnes of carbon dioxide equivalent per year.

The assessment team notes that the data and information used by Chile in constructing its FREL and FRL are transparent, complete and in overall accordance with the guidelines contained in decision 12/CP.17, annex. This report contains the assessed FREL and FRL and a few areas identified by the assessment team for future technical improvement in accordance with the provisions on the scope of the technical assessment contained in decision 13/CP.19, annex.



Abbreviations and acronyms

2006 IPCC Guidelines	<i>2006 IPCC Guidelines for National Greenhouse Gas Inventories</i>
AD	activity data
AT	assessment team
BEF	biomass expansion factor
BUR	biennial update report
CH ₄	methane
CO ₂	carbon dioxide
CO ₂ eq	carbon dioxide equivalent
CONAF	National Forest Corporation of Chile
COP	Conference of the Parties
EF	emission factor
FREL	forest reference emission level
FRL	forest reference level
GHG	greenhouse gas
INFOR	Forestry Institute of Chile
IPCC	Intergovernmental Panel on Climate Change
LULUCF	land use, land-use change and forestry
N ₂ O	nitrous oxide
NFI	national forest inventory
REDD+	reducing emissions from deforestation; reducing emissions from forest degradation; conservation of forest carbon stocks; sustainable management of forests; and enhancement of forest carbon stocks (decision 1/CP.16, para. 70)
SOC	soil organic carbon
TA	technical assessment

I. Introduction and summary

A. Overview

1. This report covers the TA of the voluntary submission of Chile on its proposed FREL and FRL,¹ submitted on 16 January 2023, in accordance with decisions 12/CP.17 and 13/CP.19. The TA took place from 20 to 24 March 2023 and was coordinated by the secretariat.² The TA was conducted by two LULUCF experts from the UNFCCC roster of experts³ (hereinafter referred to as the AT): Marcela Itzel Olguin-Alvarez (Mexico) and Craig Wayson (United States of America). In addition, Komlan Edou, an expert from the Consultative Group of Experts, participated as an observer⁴ during the session. The TA was coordinated by Jenny Wong (secretariat).

2. In response to the invitation of the COP and in accordance with the provisions of decision 12/CP.17, paragraphs 7–15 and annex, Chile submitted its proposed FREL and FRL on a voluntary basis. The proposed FREL and FRL are one of the elements⁵ to be developed in implementing the activities referred to in decision 1/CP.16, paragraph 70. Pursuant to decision 13/CP.19, paragraphs 1–2, and decision 14/CP.19, paragraphs 7–8, the COP decided that each submission of a proposed FREL or FRL, as referred to in decision 12/CP.17, paragraph 13, shall be subject to a TA in the context of results-based payments.

3. Chile provided its submission in Spanish. Chile supported its submission by providing the AT with additional technical clarifications and background information that covered digital image processing, data spreadsheets used for the estimation of AD and EFs, and uncertainty simulation, which enhance the transparency of the FREL and FRL. The additional information and documentation were shared with the AT only.

4. The objective of the TA is to assess the degree to which the information provided by Chile is in accordance with the guidelines for submissions of information on reference levels⁶ and to offer a facilitative, non-intrusive, technical exchange of information on the construction of the FREL and FRL with a view to supporting the capacity of Chile to construct and improve its FREL and FRL in the future, as appropriate.⁷

5. The TA of the FREL and FRL submitted by Chile was undertaken in accordance with the guidelines and procedures for the TA of submissions from Parties on proposed FRELS and/or FRLs.⁸ This report on the TA was prepared by the AT following the same guidelines and procedures.

6. Following the process set out in those guidelines and procedures, a draft version of this report was communicated to the Government of Chile. The facilitative exchange during the TA allowed Chile to provide clarifications and additional information, which were considered by the AT in the preparation of this report.⁹ As a result of the facilitative interactions with the AT during the TA, Chile provided a modified version of its submission on 29 May 2023 (in English and Spanish), which took into consideration the technical input of the AT. The modifications improved the clarity and transparency of the submitted FREL and FRL without needing to alter the approach used to construct it. This TA report was prepared in the context of the modified FREL and FRL submission.

¹ The submission of Chile is available at <https://redd.unfccc.int/submissions.html?country=chl>.

² As per decision 13/CP.19, annex, para. 7.

³ As per decision 13/CP.19, annex, paras. 7 and 9.

⁴ As per decision 13/CP.19, annex, para. 9.

⁵ See decision 1/CP.16, para. 71(b).

⁶ Decision 12/CP.17, annex.

⁷ Decision 13/CP.19, annex, para. 1(a–b).

⁸ Decision 13/CP.19, annex.

⁹ As per decision 13/CP.19, annex, paras. 1(b), 13 and 14.

B. Proposed forest reference emission level and forest reference level

7. In decision 1/CP.16, paragraph 70, the COP encouraged developing country Parties to contribute to mitigation actions in the forest sector by undertaking several activities, as deemed appropriate by each Party and in accordance with their respective capabilities and national circumstances, in the context of providing adequate and predictable support. The FREL and FRL proposed by Chile, on a voluntary basis for a TA in the context of results-based payments, cover the activities reducing emissions from deforestation, reducing emissions from forest degradation, conservation of forest carbon stocks, and enhancement of forest carbon stocks, which are four of the five activities referred to in that paragraph. Owing to a lack of spatially explicit information for the activity sustainable management of forests, emissions and removals from this activity were reported on an aggregated basis under the activity reducing emissions from forest degradation or enhancement of forest carbon stocks. Pursuant to decision 1/CP.16, paragraph 71(b), Chile developed a national FREL and FRL that cover its entire territory. For its submission, Chile applied a stepwise approach to developing its FREL and FRL in accordance with decision 12/CP.17, paragraph 10. The stepwise approach enables Parties to improve their FREL or FRL by incorporating better data, improved methodologies and, where appropriate, additional pools.

8. In its submission, Chile proposed a FREL for those activities that include a land-use change, namely deforestation and enhancement of forest carbon stocks, and a FRL for those activities that do not include a land-use change (i.e. in which forest land remains forest land). For the FREL, the reference period is 2001–2013, whereas for the FRL it is 2001–2010. In the original submission, the total combined value of the FREL and FRL corresponds to 17,592,398 t CO₂ eq/year. In the modified submission, this value increased on the basis of revised estimates for emissions from forest degradation. The FREL and FRL presented in the modified submission, with the aim of accessing results-based payments for REDD+ activities for the aforementioned reference periods, correspond to net emissions of 18,052,357.14 t CO₂ eq/year,¹⁰ including emissions of 5,398,892.18 and 24,549,002.58 t CO₂ eq/year from deforestation and forest degradation respectively and removals of 20,166,878.02 t CO₂ eq/year from enhancement of forest carbon stocks. Conservation of forest carbon stocks, as defined by Chile, resulted in emissions of 8,271,340.40 t CO₂ eq/year. In constructing its FREL and FRL, Chile considered native forests only and excluded forest plantations with exotic species. For estimating the AD, Chile considered the land-use maps developed as part of the project Cadastre and Evaluation of Vegetation Resources in Chile. The information used to develop the EFs was derived from the NFI. In its modified submission, Chile reported that it used IPCC tier 2 methods for estimating EFs for all activities except forest degradation caused by forest fires, for which it used a tier 1 EF from the 2006 IPCC Guidelines (see table 15 of the modified submission).

9. The proposed FREL and FRL include the pools above-ground biomass, below-ground biomass and deadwood. Regarding GHGs, the submission includes CO₂ emissions for all four reported activities and CH₄ and N₂O emissions due to burning of above-ground biomass and deadwood for the activity reducing emissions from forest degradation.

10. The FREL and FRL proposed by Chile are its second FREL and FRL submitted in the context of applying the stepwise approach in accordance with decision 12/CP.17, paragraph 10. Its previous subnational FRELs and FRLs were submitted on 4 January 2016 and were subject to a TA in March 2016;¹¹ they covered the activities reducing emissions from deforestation, reducing emissions from forest degradation, conservation of forest carbon stocks, and enhancement of forest carbon stocks for the reference periods 2001–2013 (FRELs, for those activities that included land-use change) and 2001–2010 (FRLs, for those activities that did not include land-use change). The previous assessed FRELs and FRLs

¹⁰ In its original submission, Chile proposed a national FREL and FRL of 17,592,398 t CO₂ eq/year for 2001–2013 (FREL) and 2001–2010 (FRL). The difference between the original and the modified submissions is due mostly to the adjustment of the EF for estimating emissions from forest degradation in some regions due to an earlier miscalculation. See chap. 7 of the modified submission for the individual reference level values for each of the four selected REDD+ activities.

¹¹ See document FCCC/TAR/2016/CHL.

corresponded to 159,826 t CO₂ eq/year¹² and were therefore lower than the FREL and FRL proposed in the current submission. The previous FRELS and FRLs covered five administrative regions of the country (i.e. Maule, Biobío, La Araucanía, Los Ríos and Los Lagos), which are part of the central temperate zone containing 11 of the 12 forest types found in the country. The updated FREL and FRL proposed in the current submission expanded the geographical scope of coverage to 12 administrative regions, ranging from the northernmost Coquimbo region, which is semi-arid and arid, to the southern regions of Aysén and Magallanes, which are humid, cold humid, oceanic and sub-Antarctic. The coverage of forest lands containing native forests in the country thus increased from 41 per cent in the previous FRELS and FRLs to 99.3 per cent in the FREL and FRL proposed in the current submission.

11. Along with its submission, Chile provided spreadsheets containing calculations, forest-change maps, uncertainty analyses and the procedures followed to create the maps, which improved the transparency of the submission.

II. Data, methodologies and procedures used in constructing the proposed forest reference emission level and forest reference level

A. How each element in decision 12/CP.17, annex, was taken into account in constructing the forest reference emission level and forest reference level

1. Information used by the Party in constructing its forest reference emission level and forest reference level

12. For constructing its FREL and FRL, Chile followed the guidance and used the methodologies provided in the 2006 IPCC Guidelines as a basis for estimating annual changes in forest carbon stocks and non-CO₂ emissions from the four selected REDD+ activities.

13. Chile used the gain–loss method for estimating emissions from activities that resulted in a land-use change (e.g. deforestation) and the stock-change approach for estimating emissions from activities that did not result in a land-use change (i.e. forest land remaining forest land). For constructing the FREL and FRL, information from the NFI (e.g. diameter at breast height, basal area) was combined with parameters derived from national research (e.g. BEFs, root-to-shoot ratios, wood density) and INFOR data sets (e.g. mean annual increment). Estimates of emissions and removals for the FREL and FRL were derived using IPCC approach 3 (requiring geographically explicit land-use data) and the tier 2 methodology, except where estimating non-CO₂ emissions from forest fires, for which IPCC approach 2 and the tier 1 methodology were used owing to a lack of data.

14. Chile's FREL and FRL include the same four REDD+ activities and historical reference period reported as the previous FRELS and FRLs. Emissions and removals from REDD+ activities and subactivities that resulted in a land-use change (deforestation, substitution,¹³ enhancement of forest carbon stocks and restitution¹⁴) were reported for 2001–2013, while emissions and removals from those activities that occurred in permanent forests

¹² The FRELS and the FRLs presented for the four activities in the modified previous submission corresponded to emissions of 3,452,885 t CO₂ eq/year from deforestation, emissions of 9,149,392 t CO₂ eq/year from forest degradation, removals of 2,430,439 t CO₂ eq/year from conservation of forest carbon stocks and removals of 10,012,012 t CO₂ eq/year from enhancement of forest carbon stocks. See FCCC/TAR/2016/CHL, para. 10.

¹³ Substitution corresponds with the activity forest degradation. It refers to the conversion of native forest to forest plantation, which is considered a sub-land-use change.

¹⁴ Restitution corresponds with the activity enhancement of forest carbon stocks. It refers to the conversion of forest plantation to native forest, which is considered a sub-land-use change.

(conservation of forest carbon stocks, forest degradation¹⁵ and recovery of degraded forests¹⁶) were reported for 2001–2010. Chile identified the conservation of forest carbon stocks as the second largest source of emissions in its FREL and FRL, after forest degradation, because of how forest conservation is defined. The activity covers areas where native forests are subject to formal conservation processes and areas that are part of the National System of Protected Wilderness Areas and private forest conservation initiatives, and takes into account the net flux of carbon between areas of forest that are degrading and areas of forest that are recovering.

15. Information on the AD used in constructing the FREL and FRL was extracted from the historical time series of land use developed as part of the project Cadastre and Evaluation of Vegetation Resources in Chile. This project, which is under the purview of CONAF and has been conducted since 1997, consists of a database of spatial information that is periodically updated. The cadastre provides elaborate information on land use, especially in relation to native forests, forest plantations and grassland, and serves as a basis for land-cover mapping in the country. For constructing the FREL and FRL, Chile used a methodology known as the Land Use Chart (Etienne and Prado, 1982), which is based on the application of a multi-index method that detects spectral changes in vegetation, allowing the preparation of land-use maps, which can be overlaid to determine changes for all regions for the reference period 2001–2013, and spatially explicit maps of land-use changes for the regions covered by the FREL and FRL.

16. The information used for developing the EFs was obtained from Chile's NFI. Since 2001, INFOR has maintained an inventory of forest ecosystems in the country. Additional EFs were developed on the basis of data obtained from national research by INFOR and the Universidad Austral de Chile. For all REDD+ activities (except for forest degradation caused by fires), the EFs used were country-specific. For example, for above-ground biomass, Chile used national EFs derived from INFOR estimates of net annual increment by forest type, and for BEFs and basic density of wood, a single value for all forest types for both parameters was applied (Gayoso, 2002; Ministry of Environment of Chile, 2021). To estimate below-ground biomass, country-specific root-to-shoot ratios were developed on the basis of national research (Gayoso, 2002; Ministry of Environment of Chile, 2021). For deadwood, the EFs used were country-specific and were derived from data collected by the NFI by forest type.

17. For the harvested wood products pool, Chile assumed carbon stocks of zero owing to a lack of reliable national data sources that would enable differentiation between harvested wood products from deforestation and those from forest degradation.

2. Transparency, completeness, consistency and accuracy of the information used in constructing the forest reference emission level and forest reference level

(a) Methodological information, including description of data sets, approaches and methods

18. In table 15 of its original submission, Chile reported that it had used IPCC tier 2 and 3 methods and equations from the 2006 IPCC Guidelines for estimating forest carbon stocks and changes in forest carbon stocks for the different REDD+ activities. During the TA, Chile clarified that it had estimated emissions and removals from above-ground biomass and dead organic matter in accordance with IPCC tier 3 methods, deriving measurements for biomass data from NFI plots. These measurements are updated periodically in line with the remeasurement cycles of the NFI; however, there is no annual or biennial monitoring of biomass or dead organic matter stocks. According to the 2006 IPCC Guidelines (vol. 4, chap. 4), when the inventory year and the reporting year do not coincide, estimates of net annual biomass increments using tier 3 methods can be derived by interpolation or extrapolation, as well as from models that are capable of simulating forest dynamics. In addition, the 2006 IPCC Guidelines state that tier 3 methods ensure conservation of carbon (mass) by annually

¹⁵ Emissions from degradation of permanent forests are due to the impact of forest fires, timber harvesting and the extraction of non-timber products.

¹⁶ Recovery of degraded permanent forests corresponds with the activity enhancement of forest carbon stocks.

tracking “the proportion of biomass (and all other carbon pools) that is transferred to other carbon pools, released to the atmosphere, or transferred to harvested wood products”. The AT therefore deduced that Chile had employed IPCC tier 1 and 2 methods as defined in the 2006 IPCC Guidelines. The Party confirmed that the methods applied were more closely aligned with IPCC tier 2. The AT commends Chile on revising table 15 in its modified submission to more accurately define the tiers used to estimate emissions and/or removals from the selected activities. The information provided now more accurately reflects the approach described in the 2006 IPCC Guidelines.

19. The historical reference periods for the FREL and FRL proposed in the current submission, and in the previous submission, were 13 years (2001–2013) and 10 years (2001–2010) respectively. The AT noted that the satellite information used to estimate land-use changes did not cover 1 January to 31 December of any year of these reference periods. The AT therefore concluded that it might be appropriate to use more conservative reference periods of 12 years for the FREL and 9 years for the FRL. The AT noted that the combined use of a 13-year reference period for the FREL and a 10-year reference period for the FRL made it difficult to interpret the final total value (i.e. to clarify which years were covered by the FREL and FRL as a whole) and could also lead to an underestimation of emissions. In response, Chile clarified that, according to the search window for cloud-free pixels from satellite imagery that could be used for estimating the AD, the minimum number of years that could be applied was 12 years and 6 months, while the maximum number of years was 13 years and 6 months, in particular when information between October 2000 and March 2014 was considered. For the proposed reference periods, Chile used the average of 13 and 10 years for the FREL and FRL respectively, in accordance with the search window for cloud-free pixels from satellite imagery. In line with this clarification, Chile did not amend the reference periods in its modified submission. The AT reiterates the suggestion of the previous AT that future FRELs and FRLs could be based on a single common reference period for all selected activities.¹⁷ The AT notes that Chile may wish to consider this suggestion as an area for technical improvement in future submissions.

20. For estimating emissions from deforestation and forest degradation due to substitution and forest fire events, Chile used EFs that included emissions from the dead organic matter pool. However, the AT noted that whereas Chile used the term dead organic matter, the EFs included values for only deadwood, and not for litter. During the TA, Chile clarified that the values applied only to deadwood, and included this clarification in the modified submission. In addition, a typographical error in the EF for deadwood in the original submission was corrected in the modified submission, resulting in an increase in the emission estimates and thus the overall FREL/FRL value.

21. In order to estimate increases in carbon stocks for the above-ground biomass pool, the EFs and associated parameters used (net annual biomass increment, BEFs, root-to-shoot ratios and wood densities) were derived from Chile’s NFI. During the TA, the AT noted that all existing forest inventory data for 2001–2021 were used to generate EFs for the years of the reference periods for both the FREL and the FRL. As an area for future technical improvement, Chile may wish to use only data for the years closest to the historical reference period, or otherwise provide a justification for using sample data from all years of the NFI (e.g. to maintain consistency with the technical information reported in the national GHG inventory).

22. The AT noted that in the estimation of emissions from forest degradation, the key variables used for estimating the volume of wood in degraded lands were basal area and the number of trees, which were obtained for all years of the NFI. As an area for technical improvement, Chile may wish to use data for the NFI years closest to the historical reference period, which would improve the accuracy of the estimates, or otherwise provide a justification for using sample data from all years of the NFI, which would improve transparency.

23. In estimating emissions from above-ground biomass, Chile used a single wood density value (0.4961 t/m³) for all forest types from Gayoso (2002) and a BEF of 1.75 (dimensionless) as published in its 2020 GHG inventory (Ministry of Environment of Chile,

¹⁷ See FCCC/TAR/2016/CHL, para. 9.

2021), to convert wood volume to above-ground biomass. During the TA, Chile clarified that for the FREL and FRL it had used a wood density value corresponding to the average value for those native species for which there is documented information, in keeping with its 2020 GHG inventory. In addition, the Party clarified that it currently applies degradation thresholds according to forest type with the aim of improving the accuracy of the forest carbon densities applied, which represents a methodological change made for the purpose of this submission. Given that there are 12 forest types in the country, Chile may wish to consider, as an area for future technical improvement, assigning specific values according to forest type for the conversion of wood volume to biomass, which would enhance the accuracy of the estimated emissions from deforestation and forest degradation. At the same time, the AT recognizes that such improvements can only be made with adequate financial support, particularly for research and development, and over the long term.

24. To calculate carbon densities for use in developing the EFs, Chile excluded subplots that did not contain trees or were inaccessible even if they were classified as forest land. As an area for future improvement, the Party may wish to summarize carbon density at the plot level and not the subplot level. The exclusion of subplots with zero trees in forest land may lead to the overestimation of carbon densities for the overall forest strata. Therefore, the AT notes that subplots with zero trees should be included in measurements to avoid such overestimation. In addition, inaccessible plots should be included in calculating the variance in carbon densities.

25. During the TA, Chile clarified that deforestation and forest degradation often occur in areas under legal conservation, resulting in emissions instead of removals. Chile explained that the definition of conservation had been discussed at length by relevant government entities and approved at the national level, with the overriding goal of conserving natural resources in protected and forest conservation areas, so it could not be adjusted for the purposes of developing REDD+ reference levels. The AT notes that, for the purposes of monitoring emissions and removals from REDD+ activities, Chile may wish to consider defining areas under conservation in accordance with clear and specific criteria rather than solely on the basis of administrative decisions. It might also wish to track emissions and removals from deforestation, forest degradation and forest carbon stock enhancement separately for areas with protected status and areas without protected status, to facilitate differentiation between these areas.

26. The AT was able to reconstruct the FREL and FRL values on the basis of the data provided in the spreadsheets, including the ancillary data shared by Chile, and considers the values to be complete and transparent. In its submission, Chile noted the improvements and corrections made in developing its FREL and FRL and extending their scope to the entire country, with a view to improving consistency and technical alignment with the national GHG inventory. The same criteria and assumptions were employed in both reports. Chile's national FREL and FRL cover 99.3 per cent of the country's native forest areas, excluding the minimal area of native forests in the Arica y Parinacota and Atacama regions, while the national GHG inventory covers forest land in all 16 regions of the country. As noted in paragraph 13 above, the IPCC stock-change method for determining carbon stock changes was used to construct the FREL and FRL, while the national GHG inventory employed the gain-loss method. The AT commends Chile for its efforts to maintain consistency between its FREL and FRL and national GHG inventory, in line with decision 12/CP.17, paragraph 8.

27. To estimate uncertainties for AD, errors related to land-use change were calculated in accordance with the good practices described in Olofsson et al. (2014) and using the complex area estimator from Cochran (1977). Uncertainties for EFs were based on published uncertainties (e.g. Gayoso, 2002, 2006; Ministry of Environment of Chile, 2021) and the sample variance from the NFI plot values. To combine uncertainties, Chile used the Monte Carlo approach, performing 10,000 simulations for all data used to calculate estimates of emissions and removals from the selected REDD+ activities. The AT takes note of Chile's uncertainty assessment of the parameters used in constructing its FREL and FRL.

28. In its most recent FREL and FRL submission, Chile described the following changes from previously submitted information in accordance with decision 12/CP.17, annex, paragraph (b):

- (a) Additional regions that have natural forest cover were included to extend the scope of REDD+ activities to the entire country;
- (b) The EFs applied were updated with the most recent data available from the NFI;
- (c) Regional EFs were replaced with EFs specific to forest type based on data from the NFI, which better represent forest carbon densities;
- (d) More specific forest degradation models (i.e. stock charts) were applied, resulting in improved AD for estimating emissions from forest degradation;
- (e) Annual spatially explicit data for the historical reference period were included;
- (f) A cloud-free spatial data set was created using multi-pixel mosaics consisting of the most cloud-free pixels available for dates as close as possible to the start and end dates of the historical reference period;
- (g) Arborescent shrubland was excluded from the FREL and FRL as it was no longer included in the forest definition;
- (h) The k-nearest neighbour algorithm for estimating emissions from forest degradation was improved;
- (i) The multi-index integrated change analysis methodology (Jin et al., 2013) was applied to improve land-use change detection;
- (j) Accuracy was prioritized in the identification of forest carbon pools by REDD+ activity to avoid misreporting (e.g. in the case of deadwood in the previous submission);
- (k) A more up-to-date carbon fraction value of 0.47 was applied;
- (l) A transition was made from the use of simple spreadsheets for the calculation of estimates to a more robust relational database;
- (m) Uncertainty and error propagation were estimated using approach 2 (Monte Carlo analysis) from the 2006 IPCC Guidelines.

29. The AT takes note of the differences between the current FREL and FRL submission and the previous submission. In addition, the AT acknowledges that these changes were made in response to the areas for technical improvement identified during the TA in 2016 and taking into consideration lessons learned while constructing the FREL and FRL. The AT commends the Party for these efforts to increase the transparency and accuracy of the FREL and FRL.

(b) Description of relevant policies and plans, as appropriate

30. In its submission, Chile provided detailed information on its national circumstances regarding institutional arrangements and national legislation for the monitoring and conservation of forest resources relevant to REDD+. Chief among these are the Forest Law and decree law 701 on forestry promotion. Together, these laws highlight the importance of forest resources by setting out a range of norms for the forestry sector that regulate the use of fire, the conservation of water resources, the banning of logging activities near springs or on high slopes, among other activities, as well as policies that incentivize activities such as afforestation and forest protection. In addition, Chile briefly described its nationally determined contribution and the National Strategy on Climate Change and Vegetation Resources, including the role of the forestry sector in mitigating climate change and enabling Chile to reach carbon neutrality by 2050.

31. The AT commends Chile for providing a comprehensive description of the main national policies and plans for the forestry sector in the country.

3. Pools, gases and activities included in constructing the forest reference emission level and forest reference level

32. According to decision 12/CP.17, annex, paragraph (c), reasons for omitting a pool or activity in constructing the FREL and FRL should be provided, noting that significant pools and activities should not be excluded.

33. The pools included in the Party's FREL and FRL varied according to REDD+ activity. For the activities reducing emissions from deforestation and reducing emissions from forest degradation, Chile included above-ground and below-ground biomass and deadwood. For the activities conservation of forest carbon stocks and enhancement of forest carbon stocks, the pools included were above-ground and below-ground biomass. Emissions of CH₄ and N₂O from forest fires were estimated for the above-ground biomass and deadwood pools and included under the activity reducing emissions from forest degradation.

34. In its submission, Chile cited a lack of national information on the rate of change in carbon stocks for the SOC pool as justification for excluding this pool in all four activities. The AT notes that changes in SOC could be significant where forest land is converted to other land uses (e.g. deforestation). However, since carbon stocks are not expected to decrease in the enhancement of forest carbon stocks, the exclusion of the SOC pool could be justified in this case. The AT commends Chile for its efforts to obtain better information on SOC with the aim of including this pool as part of a stepwise approach in future submissions, or excluding it if there is evidence that changes are not significant on a national scale. Furthermore, the AT notes that the 2006 IPCC Guidelines document a method for estimating changes in carbon stock in the SOC pool using default EFs. The AT considers the treatment of the omitted emissions from SOC as an area for future technical improvement of the FREL and FRL. During the TA, Chile stated that it is making efforts to develop country-specific EFs that correspond with SOC fluxes in order to include this pool in future submissions. The AT commends Chile for these continuing efforts.

35. Chile stated in its submission that it assumes no net change in the deadwood pool for the conservation of forest carbon stocks. However, the AT noted that since conservation is a net emitter owing to loss of biomass, it is likely that the deadwood pool is also a net emitter. In addition, the deadwood estimates for some forest types with high carbon density were based on small sample sizes (e.g. three to six plots), which could result in the underestimation of emissions from this pool. As an area for future technical improvement, the inclusion of additional plots for forest areas with small sample sizes would help to increase the representativeness of the sample plots for improving the EFs for deadwood.

36. With regard to emissions from litter, the AT requested clarification on the reasons for omitting the pool. In response, Chile explained that the pool was not included owing to the unavailability of reliable national data. The AT notes that the 2006 IPCC Guidelines provide a method for estimating carbon stock changes in litter and the corresponding default EF. In addition, the AT notes that Chile could review available scientific literature relating to emissions from litter for similar forest types and, on the basis of such peer-reviewed findings, provide a justification for the omission of this pool until reliable national data become available. The AT considers the treatment of emissions from litter (i.e. either including the pool or providing more information to justify its omission) as an area for future technical improvement of the FREL and FRL.

37. Regarding emissions from forest fires, Chile clarified that currently there is no way to obtain information relating to the typology of fires (e.g. crown fires or surface fires). Forest fire reports by CONAF are limited to information on the causes of fires. According to Chile, forest fires are often associated with normal anthropogenic activities such as the transit of people, vehicles or aircraft through forest areas and recreational use of forest areas. For a large percentage of forest fires the causes remain unconfirmed or unidentified. The Party noted that, as part of the continuous improvement of forest fire management by CONAF and relevant public institutions, 32 per cent of the forest fires were investigated during the 2022–2023 fire season, including the identification of causes. The Party also undertakes fire severity analyses for fires occurring in forest areas greater than 200 ha with the purpose of quantifying the damage to forest vegetation. The AT notes that Chile is already reporting non-CO₂ emissions from forest fires by region as a separate category. In addition, it may wish

to include these emissions by fire typology for all forest types and selected activities with a view to enhancing the transparency of reporting on these emissions.

38. The AT acknowledges that Chile included in its FREL and FRL the most significant activities, that is, reducing emissions from deforestation, reducing emissions from forest degradation, conservation of forest carbon stocks, and enhancement of forest carbon stocks, which are among the five activities identified in decision 1/CP.16, paragraph 70, in accordance with its national capabilities and circumstances. The AT notes that the activity sustainable management of forests could also be significant. During the TA, Chile explained that, although currently not enough information is available to include sustainable management of forests, it plans to include this activity in a future submission. The AT acknowledges the Party's intention to improve future FREL and FRL submissions when new and adequate data and better information become available as part of the stepwise approach.

4. Definition of forest

39. Chile provided in its submission the definition of forest used in constructing its FREL and FRL. According to Chile, the Law on Native Forest Recovery and Forest Promotion (2008) defines forest as a site that is populated with plant formations in which trees predominate and that occupies an area of at least 5,000 m², with a minimum width of 40 m, with tree crown coverage that exceeds 10 per cent of the total area in arid and semi-arid conditions and 25 per cent in more favourable conditions. Native forest is defined as forest formed by autochthonous species, resulting from natural generation, natural regeneration or plantation under canopy with the same species existing in the original distribution area, which may have an accidental presence of randomly distributed exotic species.

40. All lands defined as native forest under current legislation were considered in constructing the FREL and FRL. Forest plantations consisting mainly of monoculture species have been excluded from the FREL and FRL. In addition, since the adoption of the legal definition of forest in 2008, which allowed for the update of the native forest cadastre, those lands classified as arborescent scrub do not constitute native forests. Hence, arborescent scrubs were excluded from the FREL and FRL.

41. In its fourth BUR and national GHG inventory (2021), Chile applied the national forest definition but also included forest plantations in the GHG estimates.

III. Conclusions

42. The information used by Chile in constructing its FREL and FRL for the activities reducing emissions from deforestation, reducing emissions from forest degradation, conservation of forest carbon stocks, and enhancement of forest carbon stocks is transparent, complete and in overall accordance with the guidelines for submissions of information on reference levels.

43. The FREL and FRL presented in the submission are Chile's second FREL and FRL. The previous FRELS and FRLs were submitted on 4 January 2016 and were subject to a TA in 2016. The FRELS covered the activities reducing emissions from deforestation and enhancement of forest carbon stocks for the reference period 2001–2013, while the FRLs covered the activities reducing emissions from forest degradation and conservation of forest carbon stocks for the reference period 2001–2010.

44. The FREL and FRL presented in the current modified submission, for the reference periods 2001–2013 and 2001–2010 respectively, correspond to net emissions of 18,052,357.14 t CO₂ eq/year.

45. The AT acknowledges that Chile included in its FREL and FRL the most significant activities and the most important forest types in terms of emissions from forests. The AT considers that, in doing so, Chile followed decision 1/CP.16, paragraph 70, on activities undertaken, and decision 12/CP.17, paragraph 10, on applying the stepwise approach.

46. As a result of the facilitative interactions with the AT during the TA, Chile provided a modified submission that took into consideration the technical input of the AT. The AT

notes that the transparency and completeness of the information provided were improved in the modified FREL and FRL submission and commends Chile on its efforts. The new information provided in the modified submission, including the data made available during the TA and the examples of how estimates of CO₂ emissions from all four activities were calculated, increased the reproducibility of the FREL and FRL calculations.

47. The AT notes that, overall, Chile maintained consistency, in terms of sources of AD and EFs used for its FREL and FRL, with those used for the GHG inventory included in its fourth BUR.¹⁸ Where consistency was not maintained, Chile explained the reasons for the differences in the CO₂ emission estimates in its FREL and FRL submission.¹⁹

48. Pursuant to decision 13/CP.19, annex, paragraph 3, the AT identified the following areas for future technical improvement:

(a) Considering using reference periods of 12 years for the FREL and nine years for the FRL to facilitate the interpretation of the final total value of the FREL and FRL (see para. 19 above);

(b) Considering applying a single common reference period for all selected REDD+ activities in future FRELs and FRLs (see para. 19 above);

(c) Using data from the NFI years closest to the chosen historical reference period in generating EFs for above-ground biomass, or otherwise providing a justification for using sample data from all years of the NFI (see para. 21 above);

(d) Using data from the NFI years closest to the chosen historical reference period to calculate emissions from forest degradation to improve the accuracy of the estimates, or otherwise providing a justification for using sample data from all years of the NFI (see para. 22 above);

(e) Assigning specific values according to forest type for the conversion of wood volume to biomass, which would enhance the accuracy of the estimates (see para. 23 above);

(f) Summarizing carbon density at the plot level and including subplots with zero trees to avoid the overestimation of carbon density for the overall forest strata, as well as including inaccessible plots in calculating the variance in carbon densities (see para. 24 above);

(g) Considering defining areas under conservation in accordance with clear and specific criteria rather than solely on the basis of administrative decisions (see para. 25 above);

(h) Tracking emissions and removals from deforestation, forest degradation and enhancement of forest carbon stocks separately for areas with protected status and areas without protected status, to facilitate differentiation between these areas (see para. 25 above).

49. Pursuant to decision 13/CP.19, annex, paragraph 2(f), the AT also identified the following additional areas for future technical improvement for pools and gases included or excluded from the FREL and FRL:

(a) Treatment of omitted emissions from SOC for both the FREL and FRL (see para. 34 above);

(b) Including additional plots for forest areas with small sample sizes to increase the representativeness of the sample plots for improving the EFs for deadwood (see para. 35 above);

(c) Treatment of emissions from litter (i.e. either including the pool or providing more information to justify its omission) (see para. 36 above);

(d) Reporting non-CO₂ emissions from forest fires by fire typology for all forest types and selected activities (see para. 37 above).

50. The AT acknowledges and welcomes the Party's intention to:

¹⁸ In reference to the scope of the TA, as per decision 13/CP.19, annex, para. 2(a).

¹⁹ See chap. 9 of the modified submission.

- (a) Include sustainable management of forests as a future REDD+ activity, as emissions or removals from this activity are likely to be significant;
- (b) Collect information on SOC for the inclusion of this pool in future submissions;
- (c) Include more accurate estimates of emissions from forest fires in future submissions, based on the collection of more accurate information since 2015.

51. Chile provided information on its plans to evaluate tools for measuring degradation in the Araucaria and Alerce forest types and to develop stocking tables for additional forest subtypes in order to more accurately represent the behaviour of Chilean forests. It also provided information on its intention to make improvements to the system for tracking AD through the use of higher-resolution imagery and to include radar imagery in areas with high cloud cover. Chile also described its plans to include sustainable management of forests as a future activity. It noted that including all five REDD+ activities would call for the standardization of management plans. In addition, Chile noted that it planned to include a more recent reference period in a future FREL and FRL submission, with the same years for all activities. The AT acknowledges and welcomes the Party's intention to undertake all these improvements in future FREL and FRL submissions.

52. In conclusion, the AT commends Chile for showing strong commitment to continuously improving its FREL and FRL estimates in line with the stepwise approach. A number of areas for the future technical improvement of Chile's FREL and FRL have been identified in this report. At the same time, the AT acknowledges that such improvements are subject to national capabilities and policies, and notes the importance of providing adequate and predictable support.²⁰ The AT also acknowledges that the TA was an opportunity for a rich, open, facilitative and constructive technical exchange of information with Chile.

53. The table contained in annex I summarizes the main features of Chile's proposed FREL and FRL.

²⁰ As per decisions 13/CP.19, annex, para. 1(b); and 12/CP.17, para. 10.

Annex I

Summary of the main features of the proposed forest reference emission level and forest reference level based on information provided by Chile

	<i>Main features of the FREL and FRL</i>	<i>Remarks</i>
Proposed FREL/FRL	18 052 357.14 t CO ₂ eq/year	5 398 892.18 t CO ₂ eq/year (deforestation), 24 549 002.58 t CO ₂ eq/year (forest degradation), -20 166 878.02 t CO ₂ eq/year (enhancement of forest carbon stocks) and 8 271 340.40 t CO ₂ eq/year (conservation of forest carbon stocks) (see para. 8 of this document)
Type and reference period of FREL/FRL	FREL = average of historical emissions from activities that have a land-use change in 2001–2013. FRL = average of historical emissions and removals from activities that occur in forest land remaining forest land in 2001–2010	Chile proposed a total FREL/FRL value, combining estimates for activities with a land-use change and activities occurring on forest land remaining forest land. It also provided reference level values for each selected REDD+ activity (see para. 8 of this document)
Application of adjustment for national circumstances	No	
National/subnational	National	For 12 administrative regions (out of 16), covering 65.5 per cent of the national territory and 99.3 per cent of national native forest (see para. 10 of this document)
Activities included	Reducing emissions from deforestation Reducing emissions from forest degradation Conservation of forest carbon stocks Enhancement of forest carbon stocks	See paragraphs 7 and 38 of this document
Pools included	Above-ground biomass Below-ground biomass Deadwood	Above- and below-ground biomass were included for all four REDD+ activities, while estimates of emissions from deadwood were included for the activities reducing emissions from deforestation and reducing emissions from forest degradation only. The SOC and litter pools were excluded for all four activities owing to a lack of national information (see paras. 9, 33, 34 and 36 of this document)
Gases included	CO ₂ , CH ₄ , N ₂ O	Chile reported CO ₂ emissions from all REDD+ activities and CH ₄ and N ₂ O emissions from forest degradation due to fire events (see paras. 9 and 37 of this document)
Forest definition	Included	Based on Chile's Forest Law; refers to all lands covered by native forest (see paras. 39–40 of this document)
Consistency with latest GHG inventory	Methods used for estimating the FREL/FRL are consistent with those	Consistency is maintained between the sources of AD and EFs used for the FREL/FRL and

<i>Main features of the FREL and FRL</i>		<i>Remarks</i>
	used for the latest GHG inventory (2021)	those used for the GHG inventory (2021) (see paras. 26 and 47 of this document)
Description of relevant policies and plans	Included	See paragraph 30 of this document
Description of assumptions on future changes to domestic policy, if included in constructing the FREL/FRL	Not applicable	
Description of changes to previous FREL/FRL	Included	See paragraph 28 of this document
Identification of future technical improvements	Included	Several areas for future technical improvement have been identified (see paras. 48–49 of this document)

Annex II

Reference documents

A. Reports of the Intergovernmental Panel on Climate Change

IPCC. 2006. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. S Eggleston, L Buendia, K Miwa, et al. (eds.). Hayama, Japan: Institute for Global Environmental Strategies. Available at <http://www.ipcc-nggip.iges.or.jp/public/2006gl>.

B. UNFCCC documents

First and second FREL and FRL submissions of Chile and the modified submissions. Available at <https://redd.unfccc.int/submissions.html?country=chl>.

Fourth BUR and national inventory report of Chile (in Spanish) submitted in 2021. Available at <https://unfccc.int/BURs>.

“Guidelines and procedures for the technical assessment of submissions from Parties on proposed forest reference emission levels and/or forest reference levels”. Decision 13/CP.19, annex. Available at <https://unfccc.int/sites/default/files/resource/docs/2013/cop19/eng/10a01.pdf#page=36>.

“Guidelines for submissions of information on reference levels”. Decision 12/CP.17, annex. Available at <https://unfccc.int/sites/default/files/resource/docs/2011/cop17/eng/09a02.pdf#page=19>.

Report on the TA of the proposed FREL and FRL of Chile submitted in 2016. FCCC/TAR/2016/CHL. Available at <https://redd.unfccc.int/submissions.html?country=chl>.

C. Other documents

The following references may not conform to UNFCCC editorial style as some have been reproduced as received or as cited in the submission:

Cochran, WG. 1977. *Sampling Techniques (3rd Edition)*. New York: John Wiley & Sons. ISBN 0-471-16240-X.

Etienne MG and Prado CC. 1982. *Descripción de la Vegetación Mediante la Cartografía de Ocupación de Tierras: Conceptos y Manual de Uso Práctico*. Santiago, Chile: Universidad de Chile.

Gayoso J. 2002. *Medición de la Capacidad de Captura de Carbono en Bosques de Chile y Promoción en el Mercado Mundial*. Informe Técnico. Valdivia: Universidad Austral de Chile.

Gayoso, J. 2006. *Inventario de carbono en praderas y matorrales para el estudio de línea de base*. Proyecto SIF Sociedad Inversora Forestal S.A. Regiones VII Y VIII.

Jin S, Yang L, Danielson P, Homer C, et al. 2013. A comprehensive change detection method for updating the National Land Cover Database to circa 2011. *Remote Sensing of Environment*. 132: 159–175. <https://doi.org/10.1016/j.rse.2013.01.012>

Ministry of Environment of Chile. 2021. *Informe del Inventario Nacional de Chile 2020: Inventario Nacional de Gases de Efecto Invernadero y Otros Contaminantes Climáticos, 1990–2018*. Santiago, Chile: Oficina de Cambio Climático.

Olofsson P, Foody G, Herold M, Stehman S, et al. 2014. Good practices for estimating area and assessing accuracy of land change. *Remote Sensing of Environment*, 148:42–57. <https://doi.org/10.1016/j.rse.2014.02.015>