CONSEIL NATIONAL CLIMAT

Gabon's modified BUR REDD+ Technical Annex

Results achieved by Gabon for REDD+ Results-Based Payments

Gabonese Republic

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Table of Contents

1 Introduction

Gabon welcomes the opportunity to submit a Technical Annex to its Biennial Update Report (BUR) in the context of Results-Based Payments (RBPs) for reducing emissions from deforestation and forest degradation, conservation of forest carbon stocks, sustainable management of forests, and enhancement of forest carbon stocks in developing countries (REDD+), under the United Nations Framework on Climate Change (UNFCCC).

Gabon notes that the submission of this Technical Annex with REDD+ results is voluntary and exclusively for the purpose of obtaining and receiving RBPs for its REDD+ actions, pursuant to decisions 13/CP.19, paragraph 2 (UNFCCC COP19 – Warsaw, 2013a), and 14/CP.19, paragraphs 7 and 8 (UNFCCC COP19 – Warsaw, 2013b).

This submission, therefore, does not modify, revise or adjust in any way the Nationally Appropriate Mitigation Actions (NAMA) voluntarily submitted by Gabon under the Bali Action Plan (FCCC/AWGLCA/2011/INF.1), nor does it interfere with its Nationally Determined Contribution (NDC) under the Paris Agreement under the UNFCCC.

This submission was developed by the Gabonese government and presents the national results achieved during the 2010-2018 period in reducing emissions from deforestation, reducing emissions from forest degradation, conservation of forest carbon stocks, sustainable management of forests and enhancement of forest carbon stocks, which are the five activities included in decision 1/CP.16, paragraph 70 (UNFCCC COP16 – Cancun, 2010).

2 Summary of Information from the assessed FRL

Gabon´s national Forest Reference Level (FRL) for REDD+ RBPs under the UNFCCC from 2010 to 2018, was submitted on a voluntary basis for a technical assessment in the context of RBPs and covers the five REDD+ activities as included in paragraph 70 of decision 1/CP.16 (UNFCCC COP16 – Cancun, 2010).

Gabon submitted its FRL on 8 February 2021 in accordance with decisions 12/CP.17 (UNFCCC COP17 – Durban, 2011) and 13/CP.19 (UNFCCC COP19 – Warsaw, 2013a). The remote technical assessment took place from 19 to 23 April 2021. As a result of the facilitative interactions with the Assessment Team (AT), Gabon provided a modified version of its submission on 6 October 2021, which took into consideration the technical inputs of the AT. Finally, the technical assessment report was published on 31 October 2021.

For its submission, Gabon developed a national FRL. The modified FRL presented by Gabon in its submission to the UNFCCC is for the historical period 2000–2009 and includes all five REDD+ activities. Gabon applied the 2006 IPCC Guidelines and used the 2019 Refinement to the 2006 IPCC Guidelines solely for guidance purposes, where necessary.

The Report on the technical assessment of the proposed forest reference level of Gabon submitted in 2021 is available here and the modified submission on the proposed reference level is available here. This BUR REDD+ Technical Annex contains information taken directly from Gabon's modified FRL submission as well as from the UNFCCC technical assessment report.

2.1 Information on forest definition, forest subdivisions and land tenure classes

Gabon's definition of forests is: "Tree formation covering at least 30% of the soil over more than 1 ha and more than 20 m wide with trees at least 5 m high at maturity, but not subject to any agricultural practice. It does not include land that is predominantly under agricultural or urban land-use". All forest land in Gabon is considered managed, under the Forestry Code of 2001.

Gabon's forests are categorized as "tropical rainforest" and subdivided at the national level into dense forest, secondary forest, flooded forest and mangrove forest. Gabon's modified FRL provides the definitions of each subcategory, as well as the definitions of further subcategories in order to better align the forest types with the most appropriate country-specific Emission Factors and Removal Factors. The further subcategories are old growth forest, old secondary forest (20 to 100 years old), young secondary forest (less than 20 years old), older logged forest (more than 25 years old), logged forest (subdivided into logged forest between 1 and 10 years old (LF10); and logged forest between 11 and 25 years old (LF25)), mangrove forest, colonizing forest and degraded forest. Dense forest comprises old growth forest, old secondary forest, older logged forest and logged forest (LF25); and secondary forest includes young secondary forest, logged forest (LF10), colonizing forest and degraded forest. Flooded forest and mangrove forest do not include any further subcategories.

Gabon's land is subdivided into the following land tenure classes: logging concessions, protected areas, rural areas, agricultural areas, community forests and conservation set-aside zones. Any land that does not fall into one of these six land tenure classes is labelled as unallocated land. Gabon combined conservation set-aside zones, agricultural areas and unallocated land into a single category referred to as other land tenure, and combined community forests with logging concessions. Gabon acknowledged in its submission an allocation error of 200,000 ha of land under logging concessions to unallocated land between 2015 and 2018 and indicated that this error will be corrected in the next submission as it is part of Gabon's FRL improvement plan[1]. The land tenure classes were used to identify the REDD+ activities for which emissions and removals are reported for the purposes of the FRL.

2.2 Estimation of area changes and carbon stock changes

Activity Data were obtained to estimate biomass carbon losses and gains in forest land converted to other land uses (deforestation) and forest land remaining forest land (forest degradation) and for logging in forest land remaining forest land. For both deforestation and forest degradation, the Activity Data were extracted from remotely sensed data and volume production estimates for logging. Activity Data were provided for each land tenure class, IPCC land-use category, REDD+ activity and forest type.

Emission Factors (including Emission Factors for carbon losses and Removal Factors for carbon gains) were obtained separately for the different forest types and land tenure classes to improve accuracy. Gabon used primarily country-specific data derived from the national resource inventory, as well as measurements obtained from logging concessions and other national data (collected as part of the AfriTRON network). As no observations were available to estimate carbon gains in mangrove forest and young secondary forest, IPCC default values were used instead.

[1] Based on preliminary calculations, Gabon estimates that correcting the allocation error will not have a significant impact on the REDD+ results as it only concerns 1.6 ha of deforestation between 2015-2018. This would increase REDD+ results by a maximum of 402 tCO_2eq per year between 2016-2018, i.e. a maximum increase of 0.02% - 0.03% per year for 2016-2018).

2.3 Construction of FRL

Individual FRLs were constructed for each of the five REDD+ activities and CO_2 emissions and removals were estimated for each IPCC land-use category, land tenure class and forest type. Gabon provided a 10-year historical reference period centred around 2005 (2000–2009), which includes the net CO_2 removals from the five REDD+ activities. The national FRL is presented in the context of RBPs for 2010–2018.

The total average annual net removals from Deforestation, Forest Degradation, Sustainable Management of Forests, Conservation of Forest Carbon Stocks and Enhancement of Forest Carbon stocks is 107,186,873 tonnes of carbon dioxide equivalent per year (tCO_2eq/year) (Table 1, which can be found in Gabon's FRL (Table 30) and FRL accompanying Workbook (Table W10.3)).

Table 1 Summary of the average historical gross and net removals for Gabon (2000-2009) by REDD+ activity (FRL accompanying Workbook Table W10.3).

REDD+ Activity	Biomass Losses (Emissions)		Biomass Gains (Removals)		Gains- Losses (Net Removals)	
	Mean	U	Mean	U	Mean	U
	tCO_2eq/yr	%	tCO_2eq/yr	%	tCO_2eq/yr	%
Deforestation	5,242,334	7.4%	0	0.0%	-5,242,334	7.4%
Degradation	349,169	26.4%	43,845,150	5.3%	43,495,981	5.3%
SFM	29,480,629	6.2%	87,959,162	4.1%	58,478,533	6.8%
Conservation	0	0.0%	10,349,239	6.0%	10,349,239	6.0%
Enhancement	0	0.0%	105,454	8.7%	105,454	8.7%
Total	**35,072,131**	**1.6%**	**142,259,005**	**3.02%**	**107,186,873**	**4.4%**

Gabon applied an adjustment of 10% to the annual average net removals for 2000–2009 by including the maximum allowed adjustment as per the Green Climate Fund (GCF) REDD+ RBPs methodology for countries with High Forest cover and Low Deforestation (HFLD). The justification of the inclusion of the 10% adjustment is provided in Section 3.3. and Annex 1, and reflects the strong policy measures taken by Gabon to protect the natural environment in the 2000s that led to drastic emission reductions in the forestry sector from 2007 onward.

The proposed national adjusted FRL, including the 10% adjustment therefore corresponds to –96,468,186 tCO_2eq/year (Figure 1).

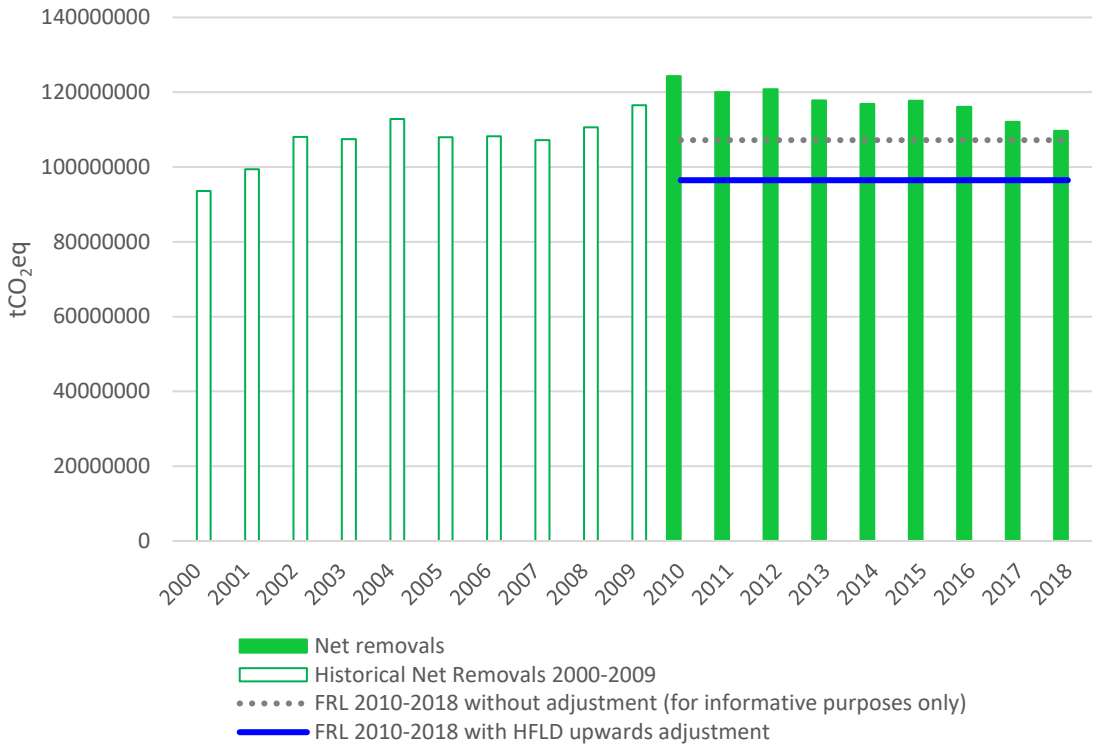

Figure 1 Gabon's proposed FRL for increased net removals (solid blue line). The FRL indicates the average historical net removals for 2000-2009 with a 10% upwards adjustment which is applied to the results period 2010-2018 (FRL accompanying Workbook Figure W11.1).

3 Results in tonnes of CO_2 per year, consistent with the assessed forest reference emission level

3.1 Gabon's national differentiation of REDD+ results

Gabon considers its annual net removals of CO_2 to be its overall contribution to **the fight against climate change.** Moving beyond Glasgow, Gabon will submit a revised FRL in order to claim net removals ITMOs (Internationally Transferred Mitigation Outcomes).

Gabon distinguishes two categories of potential historic REDD+ results:

1. "Classic" REDD+ results linked to reductions in deforestation and degradation and enhancement in sequestration as a result of forest management, expressed as "**increased net removals**" (but which can also be expressed as reduced emissions) against a 2000-2009 baseline (centred on 2005, the year against which Gabon's climate commitments have been made). These REDD+ results consist of **90,636,103** tCO_2eq for the period 2010-2018;
2. "**HFLD Adjusted increased net removals**" REDD+ results, which are calculated by applying an adjustment of 10% to the annual average net removals for 2000–2009, equivalent to the maximum allowed adjustment as per the GCF REDD+ RBPs methodology for HFLD countries. These results would allow Gabon to claim a total of **187,104,289** tCO_2eq of credits – an additional **96,468,186** tCO_2eq of credits in recognition of Gabon's extreme HFLD status and the fact that during the 2010-18 crediting period Gabon actually absorbed **1,055,317,962** tCO_2eq of CO_2 net in its forest sector.

Gabon would expect the 90,636,103 tCO_2eq of "classic" REDD+ credits to be traded whilst the remaining 96,468,186 tonnes would be more appropriate for non-market mechanisms and national offsetting.

Post Glasgow (post 2020), Gabon plans to claim REDD+ results corresponding to **"net carbon removals",** resulting from sound management and conservation practices which result in the enhancement of carbon stocks in secondary and logged forests through the process of carbon sequestration. However, in accordance with its second NDC, in which Gabon committed unconditionally to remain carbon neutral, Gabon will adjust its post-2020 claims for REDD+ ITMO credits downwards by an amount equivalent to carbon emissions from all sectors other than the forest (which have already been deducted), as reported in its second NDC, 3rd National Communication, and first BUR. Gabon believes that these net carbon removals REDD+ results could be used as ITMOs, given the recent agreement (December 2021) of the UNFCCC Glasgow Pact.

3.2 Results against the assessed FRL

Decision 14/ CP.19, paragraph 3, "decides that the data and information used by Parties in the estimation of anthropogenic forest-related emissions by sources and removals by sinks, forest carbon stocks, and forest carbon stock and forest-area changes, as appropriate to the activities referred to in decision 1/CP.16, paragraph 70, undertaken by Parties, should be transparent, and consistent over time and with the established forest reference emission levels and/or forest reference levels in accordance with decision 1/CP.16, paragraph 71(b) and (c) and section II of decision 12/CP.17" (UNFCCC COP19 – Warsaw, 2013b).

As indicated in Table 34 of the modified FRL submitted to the UNFCCC, and Table W13.3 of the FRL accompanying workbook, Gabon already presented its results against various possible crediting levels in the FRL submission. The relevant part of this table is reproduced here (Table 2), showing Gabon's results

as net sequestration and against its modified FRL with and without the 10% upwards adjustment (note the FRL without the 10% adjustment is shown here for indicative purposes only). Gabon's REDD+ results for 2010-2018 against its adjusted FRL total 187,104,289 tCO_2eq.

Table 2 Gabon's FRL (with HFLD adjustment) and results for 2010-2018 (third column), shown alongside Gabon's unadjusted FRL and absolute net removals for indicative purposes only.

Crediting Level	Gabon's FRL without HFLD adjustment [for indicative purposes only]	Gabon's FRL with HFLD adjustment	Net removals (absolute values) [for indicative purposes only]
Baseline for calculation	2000-2009	2000-2009 (historical average with 10% HFLD adjustment included)	No baseline
Crediting level value (tCO_2eq)	107,186,873	96,468,186	Not applicable
Accounting type	Increased net removals (tCO_2eq)	Increased net removals (tCO_2eq)	Net removals(tCO_2eq)
2010	17,089,570	27,808,257	124,276,443
2011	12,882,393	23,601,080	120,069,266
2012	13,575,172	24,293,859	120,762,045
2013	10,622,107	21,340,794	117,808,980
2014	9,698,020	20,416,707	116,884,893
2015	10,543,516	21,262,203	117,730,389
2016	8,871,535	19,590,223	116,058,408
2017	4,866,160	15,584,848	112,053,033
2018	2,487,631	13,206,318	109,674,504
Total	**90,636,103**	**187,104,289**	**1,055,317,962**

As observed in Table 2, net removals during the results period generally shows a decreasing trend. This trend is explained as a result of the implementation of three key policy decisions brought in by Gabon (National Parks Law, Sustainable management plans, raw timber export ban), which led to a 59% decrease in timber harvest volume (and therefore surface area being logged) between 2007 and 2012. As a result, the percentage of the logged area considered 'recently logged' in any given year (i.e. logged within 10 years) gradually declined leading to reduced sequestration across logged forests – and across Gabon as a whole.

3.3 Further justification for the 10% adjustment

In the FRL technical assessment report, the assessment team was of the view that an adjustment, if applied, should be based on projected changes in net removals due to national circumstances during the crediting period, in accordance with decision 13/CP.19, annex, paragraph 2(h) (UNFCCC COP19 – Warsaw, 2013a). The assessment team also noted that the simple application of the maximum allowed adjustment following the GCF REDD+ RBP methodology was not *per se* a justification for the use of that level of adjustment and identified the justification of the percentage applied in the adjustment and the need to adjust future removals by taking into consideration Gabon's national circumstances as an area for technical improvement.

Following the view of the assessment team, Gabon has further improved the calculations of total projected net removals presented in the FRL (section 17 of the modified FRL). These improved projections are presented in Gabon's second NDC and in Gabon's BUR, and for the forest sector only, are reproduced here (Figure 2). The solid green line in Figure 2 shows that during the historical reference period (2000-2009), a number of key policy decisions adopted by Gabon (2001 forestry law, 2007 national parks law, 2009 raw timber export ban) coincided with a dramatic decrease in gross emissions, increasing Gabon's overall net removals. During the crediting period (2010-2018), further policy decisions (such as the 2014 sustainable development law, the 2018 announcement by President Bongo Ondimba that all concessions would be FSC certified by 2022) as well as massive investment in parks management helped Gabon to maintain low emissions at levels well below those observed in the 1990s.

The Business as Usual (BAU) scenario (dotted red line, Figure 2), projects historical and future net removals under a theoretical scenario in which Gabon had not implemented those key policy decisions from 2006 onwards (Annex 1, Section 8.1). The calculated total projected net removals under the BAU scenario during both the historical reference period and crediting period are 1,938,006,738 tCO_2eq, compared to 2,127,196,694 tCO_2eq for the measured historical net removals; a difference of 189,179,956 tCO_2eq, which represents a 10% increase in net removals. By 2030, projected net removals are expected to be 56% higher under managed conditions with strong policy actions (as outlined in Gabon's second NDC), compared to a BAU scenario.

As can be seen from the calculations, Gabon used the amount of avoided net emissions in relation to the BAU in order to inform the FRL adjustment. More detailed discussion and explanation of the rationale for choosing the FRL adjustment based on the BAU projections are described in Annex 1, Sections 8.2- 8.3.

Furthermore, the net sequestration in the forest sector during the crediting period was 1,055,317,962 tCO_2eq (Gabon modified FRL page 128), whilst total emissions across all other sectors (transport, industry, agriculture, cities, etc.) are under 10 million tCO_2eq per year – so net sequestration across all sectors was over 950 million tCO_2eq. In applying the maximum adjustment Gabon is only claiming 20% of its net sequestration across all sectors as REDD+ credits.

As Gabon's national circumstances evolve, the measurements will of course change. Nonetheless, the upwards adjustment will be calculated using the same methodological approach as for the FRL to ensure consistency. Over time, it would be expected that the data informing the measured emissions will become more robust as will the modelling approaches used for the BAU scenario.

Gabon believes that the additional net sequestrations should be rewarded, including through non market mechanisms – and will re-assess its reference level in the post 2020 period in line with the Paris agreement when creating ITMOs.

Therefore, Gabon applies the maximum allowed adjustment based on its national circumstances, data and expert judgement and is also in line with the HFLD adjustment allowed under the GCF RBP pilot programme, however Gabon presents both the unadjusted and unadjusted results for the record.

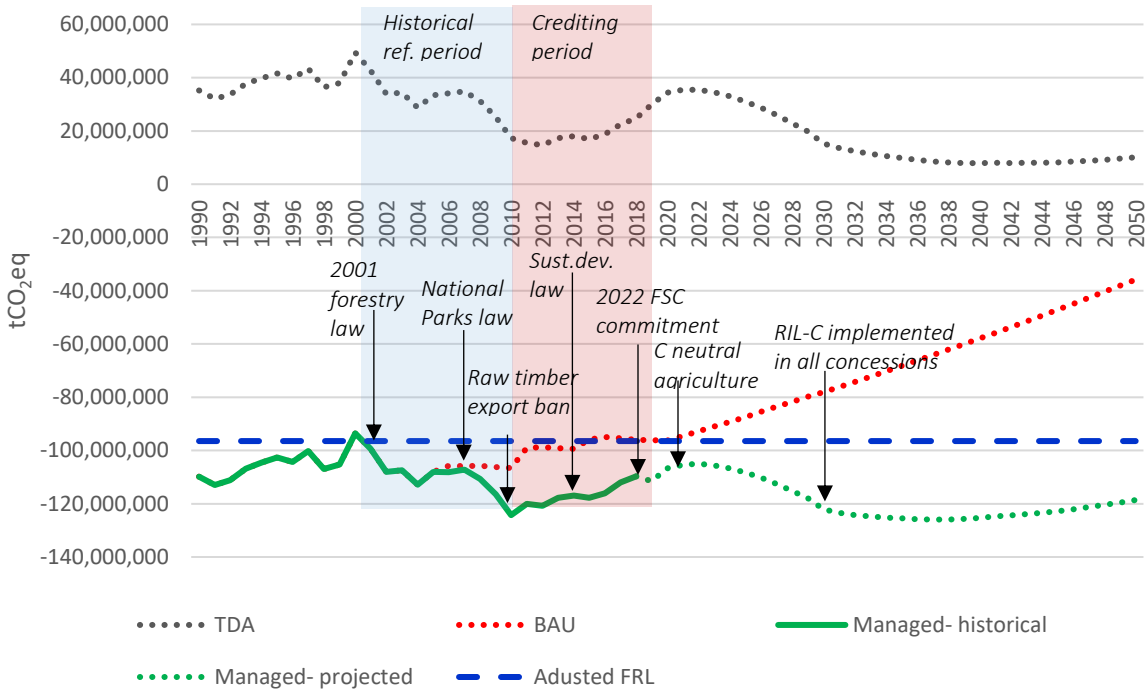

Figure 2 Historical and projected net removals with mitigation due to policy actions ("managed" scenario), and projected net emissions under a Business As Usual (BAU) scenario, 1990-2050, for the forest (FAT) sector (reproduced from Gabon's BUR and second NDC). For information purposes, Figure 2 also shows the projected net emissions scenario (Tropical Deforestation Average, TDA) where the average annual deforestation rate of 0.49% (from Achard et al., (2014)) for tropical countries is applied to Gabon.

3.4 Results for which results-based payments have already been received by Gabon

On 27 June 2017 the GoG and the Central African Forest Initiative (CAFI) signed a Letter of Intent (LoI) to establish a partnership to implement the National Investment Framework of Gabon.

In 2019, Gabon and CAFI signed a 150 million US dollars agreement (2019 addendum to the 2017 LoI). Through this, Gabon is rewarded a 10-year deal for both reducing its greenhouse gas emissions from deforestation and degradation, and increasing absorptions of carbon dioxide by natural forests.

The Partnership aims to reward Gabon, a High Forest Low Deforestation (HFLD) country, for maintaining a high forest cover and low deforestation rate, recognising the ecosystem services provided for by natural forests and the real and additional efforts needed to maintain a low deforestation rate. The Parties seek to

do this in a way that ensures the highest environmental and social integrity and that can set a model for other countries.

Under the Addendum to the CAFI LoI, the Norwegian government agreed to a first payment of USD 16.9 million which was made in June 2021 for a reduction in emissions in results years 2016 and 2017 compared to a ten-year historical baseline (Table 3), following submission of a National Results Report to the Norwegian Government, which underwent a third party independent verification. Gabon's National Results Report for RBPs presented national results in gross emissions reductions and removals for 2016 and 2017.

Based on the Addendum to the CAFI LoI and further negotiations, Gabon and Norway agreed to terms to treat statistical uncertainty, reversal risk, and possibly other risk factors, i.e. deductions. The following deductions were applied to determine the maximum number of emission reductions for Gabon under the current agreement:

a) Uncertainty: a deduction of 20% was applied to reflect the risk of uncertainty in estimates for the reported emission reduction,
b) Leakage: CAFI and Norway agreed to not apply any deduction on leakage as Gabon presented emission reduction and removal results at the national level. The national accounting approach was consistent with the GoG's draft FRL, second NDC and BUR,
c) On an exceptional basis, a 15% buffer was added to account for the novelty of the approach during this period. This figure is expected to be adjusted in subsequent years to accurately reflect the risk of uncertainty and reversal.

The awarded RBPs after deductions are presented in Table 3. These amount to emissions reductions of 3,382,204 tCO_2eq totalling USD 16,911,021, which Gabon received in June 2021.

These 2016 and 2017 results will be entered into Gabon's REDD+ register once the UNFCCC has recognised Gabon's REDD+ credits and then retired, in line with our agreement with the Government of Norway.

Table 3 Summary of results and RBPs awarded under the Addendum to the CAFI LoI, after agreed deductions.

Finance Mechanism		**Gabon-CAFI Partnership (Norwegian government)**				
Date RBPs awarded		**June 2021**				
Accounting type		**Gross Emissions**				
Historical Reference Period		**2006-2015**				
Crediting Level (historical average)		**27,368,740 tCO_2eq**				
Results Year	**Emissions (tCO_2eq)**	**Emissions Reductions (tCO_2eq)**	**35% deduction (tCO_2eq)**	**Eligible results (tCO_2eq)**	**Price/tonne (USD)**	**Total awarded (USD)**
2016	23,143,458	4,225,282	1,478,849	2,746,434	$5.00	$13,732,168
2017	26,390,631	978,109	342,338	635,771	$5.00	$3,178,853
Total		**5,203,391**	**1,821,187**	**3,382,204**	**$5.00**	**$16,911,021**

It is important to note that the National Results Report for the RBPs described above (only gross emissions) was based on Gabon's proposed FRL, submitted in February 2021, prior to the UNFCCC Technical Assessment (TA). As a result of the technical exchange between Gabon and the UNFCCC assessment team

conducted in 2021, Gabon submitted a modified version of its proposed FRL in October 2021, in which gross emissions and net removals differed slightly to those from its initial submission. This was mainly due to the inclusion, in the modified version of the FRL based on the exchanges with the UNFCCC FRL Technical Assessment team, of post-disturbance carbon stocks for above- and below-ground biomass for conversions to cropland and grassland, and dead organic matter (litter and deadwood) applying a tier 1 approach.

The average gross emissions in the National Results Report (NRR) under the CAFI LoI Addendum and the average gross emissions in the modified FRL are summarised in Table 4.

Table 4 Average gross emissions (tCO_2eq) from Gabon's National Results Report under the CAFI-LoI Addendum (NRR) and from Gabon's modified FRL, presented for the FRL historical reference period 2000-2009 and the crediting period 2010-2018.

Period	NRR (tCO_2eq)	Modified FRL (tCO_2eq)
2000-2009	34,247,229	35,072,131
2010-2018	24,011,032	25,539,917

3.5 Remaining results against the assessed FRL to avoid double counting

To avoid double counting, the emissions reductions for which RBPs were awarded under the Gabon-CAFI partnership (3,382,204 tCO_2eq, Table 3) will be clearly listed in the Lima REDD+ Information Hub and indicating the Government of Norway as the entity paying for the results as shown below in Table 5.

Table 5 Deduction of results for which RBPs have already been awarded, for years 2016 and 2017 to avoid double counting.

Results Year	Eligible results awarded under Gabon-CAFI LoI (tCO_2eq)	Amended Results (without HFLD adjustment)- for indicative purposes only	Amended Results (with HFLD adjustment)
2016	2,746,434	6,125,102	16,843,789
2017	635,771	4,230,390	14,949,077
Total	**3,382,204**	**10,355,491**	**31,792,866**

Gabon's remaining adjusted results (to avoid double counting) excluding the already awarded results under the CAFI LoI addendum are presented in Column C of Table 6.

Table 6 Gabon's FRL with the HFLD adjustment and remaining results for 2010-2018 (column C). For clarity, column (C) are Gabon's REDD+ results hereby presented to the UNFCCC. Values in red refer to the results for years 2016 and 2017 with RBPs already awarded deducted to indicate remaining results (see Table 5). Remaining results without the HFLD adjustment (column A) and net removals (column D) are also presented for indicative purposes only.

Results type	Remaining results without HFLD adjustment (A)	Additional results with HFLD adjustment (B)	Remaining results with HFLD adjustment (C=A+B)	Net removals (absolute values) [for indicative purposes only] (D)
Baseline for calculation	2000-2009 (historical average)	2000-2009 (historical average with 10% HFLD adjustment included)	2000-2009 (historical average with 10% HFLD adjustment included)	No baseline
Crediting level value (tCO_2eq)	107,186,873	96,468,186	96,468,186	Not applicable
Accounting type	Increased net removals	Increased net removals	Increased net removals	Net removals
2010	17,089,570	10,718,687	27,808,257	124,276,443
2011	12,882,393	10,718,687	23,601,080	120,069,266
2012	13,575,172	10,718,687	24,293,859	120,762,045
2013	10,622,107	10,718,687	21,340,794	117,808,980
2014	9,698,020	10,718,687	20,416,707	116,884,893
2015	10,543,516	10,718,687	21,262,203	117,730,389
2016	**6,125,102**	10,718,687	**16,843,789**	116,058,408
2017	**4,230,390**	10,718,687	**14,949,077**	112,053,033
2018	2,487,631	10,718,687	13,206,318	109,674,504
Total	**87,253,899**	**96,468,186**	**183,722,085**	**1,055,317,962**

It is important to note that in terms of REDD+ RBP market mechanisms, Gabon expects to use the adjusted results primarily for non-market mechanisms, while it will target the unadjusted results for market mechanisms.

4 Demonstration that the methodologies used to produce the results are consistent with those used to establish the assessed forest reference emission level

4.1 Activity Data

Gabon used three types of Activity Data in the FRL, which were used to calculate the results: (i) Activity Data based on remote sensing, (ii) Activity Data derived from volume estimates for logging, and (iii) Activity Data for biomass gains. These three different types of Activity Data are described in detail in the FRL.

The Activity Data for all forest cover change – with the exception of logging activities (see below) - were derived from remote sensing products. The semi-random sampling method described by (Sannier et al., 2014) was used (Box 1).

Box 1 Further information on the use of different remote sensing products to generate Activity Data.

To estimate Activity Data from remote sensing, both Landsat and Sentinel images were used (Sentinel 2 images from 2015 onwards). Sentinel 2 and Landsat images were compared to ensure that there was a consistency in the analysis before and after the availability of Sentinel 2. A double-assessment was therefore made between Landsat and Sentinel 2 to ensure consistency (using Collect Earth and Google Earth Engine imagery). In the long-term Sentinel 2 data will be increasingly used in terms of spatial and temporal resolution.

The double assessment was conducted through augmented visual interpretation using Collect Earth and Google Earth Engine imagery. Furthermore, Landsat and Sentinel-2 data were used jointly to calibrate the visual interpretation process ensuring that the forest definition thresholds were respected through a structured visual interpretation process to avoid any significant bias. The double assessment was only made qualitatively to ensure that the Sentinel 2 interpretation could be detected on Landsat imagery; however, no quantitative comparison were made.

Furthermore, Fichet et al. (2014) demonstrated (using the same method used in Sannier et al. (2014)) that the analysis performed with Landsat did not provide any statistically different results to that based on higher resolution data of a resolution similar or better than that of Sentinel 2.

Gabon therefore believes that the use of Sentinel-2 data has not created a bias and that this has not affected the accuracy of the REDD+ results.

The Sannier et al. (2014) direct expansion method as applied in Gabon is based on large primary sampling units (2 by 2 km). One of the advantages of this method is that it is independent from the resolution of the input data, as it considers that the proportion of forest change is extracted as proportion from each sample unit.

Gabon is currently undertaking a re-analysis of the 2015-18 period using the 2021 data. Gabon does not expect this to have a significant impact on REDD+ results as any change will only affect the relative allocation of emissions due to permanent versus temporary forest cover losses which are each measured using the same emissions factors.

The Activity Data for logging emissions were derived from national timber production statistics, which were analysed and validated at a national level to identify and remove error sources and ensure the highest level of accuracy for use in the FRL. Gabon conducted a study to produce a corrected time series after comparing multiple available sources of declared timber production volumes with exported volumes and identifying any unregistered or undeclared timber in the production volume data (Box 2). Gabon did not specifically

measure emissions from charcoal production[2]. All logging emissions were measured using the volume-based approach with national timber production data, and Gabon did not attempt to measure illegal logging and logging inside community forests separately or using a different method (Box 2).

Box 2 Further information on the volume-based approach.

To increase transparency and ensure the highest confidence in the timber volume activity data, Gabon commissioned a detailed study whereby nationally validated declared production data were compared against national export data that were converted to equivalent production volumes using specific equations and assumptions based on expert knowledge of Gabon's timber industry. The equations and analysis are explained in detail in the report by FRM Ingénierie (2020) which is provided, along with the raw data, in the accompanying FRL Supplementary information folder :

https://www.dropbox.com/sh/0bk6j8zhhnf1go1/AABtfmpJpjwHfAHzhHc---cFa?dl=0.

To summarise the approach taken, for 3 recognised product types (logs, plywood and sawn wood) and for each year, the conversion equations considered the proportion of Okoumé (the principle species exploited), the proportion of air-dried sawn timber, the proportion of plywood and peeling sheets, the density of Okoumé, the density of other timber species and yield per product. The results indicated that the export data were similar to the declared production data, and that the inter-annual variations could be explained by domestic sales which are known to be low in Gabon. Gabon therefore believes that the export data represents a robust approach for validating the nationally compiled timber production data.

The Activity Data for carbon biomass gains was derived from a combination of the Activity Data for remote sensing data as well as the Activity Data derived from volume estimates of logging and ensuing emissions. This approach was taken to enable the estimation and inclusion of the area of Logged Forest.

4.2 Emissions and Removals Factors

Emissions Factors for all forest types except logged forests were primarily derived from Gabon's National Resource Inventory, supplemented with national data from other sources, as well as IPCC default values where national data were unavailable. Emissions Factors for logged forests were based on measurements obtained from logging concessions. Gabon included post-disturbance carbon stocks for above- and below-ground biomass for conversions to cropland and grassland; here, data from the national literature was used in conjunction with IPCC default values. Post-disturbance carbon stocks for other land categories were assumed to be zero.

[2] While some historical data on fuelwood production exist in Gabon there is a lack of long-term data necessary to establish a reliable annual time series and examine dynamics and trends across the results period. Available reports indicate that fuelwood is declared as part of the total national timber production figures (Schure et al., 2012). Most of the charcoal production in Gabon is from waste wood in the Nkok special economic zone and is exported in the form of activated charcoal. Gabon is only now starting to record these exports and the waste wood would previously have been assumed to have been burnt. Most households in Gabon's cities cook on gas, with charcoal used as a luxury (for home barbeques and in some restaurants). Rural fuel wood is almost exclusively gathered as dry, dead wood which would have decayed naturally (note also that of Gabon's 2.2 million inhabitants, almost 90% live in urban areas). Therefore Gabon considers rural fuelwood production to be a very minor source of emissions and would expect it to have little or no impact on national emissions calculations and therefore results.

Removals Factors for all forest types were derived from national studies, supplemented with regional data from Central Africa and IPCC default values where national data were unavailable. While there is a general paucity of data in Central Africa on sequestration rates in different forest types and carbon pools, Gabon used the most complete and recent data available to determine its removals factors. National data - supported by a second study in the region- demonstrate higher sequestration rates in logged forests than unlogged forests.

Above-ground carbon gains and losses were estimated through measurement of trees with a diameter at breast height greater than 10 cm using a pantropical model (Chave et al., 2014) and wood densities derived from the Global Wood Density database (Zanne et al., 2009). Below-ground biomass was estimated using root-to-shoot ratios for tropical moist forest (Mokany et al., 2006) and biomass estimates were converted to carbon using a wood carbon concentration for tropical forest taken from Martin et al. (2018).

Box 3 Further information on illegal logging and community forests.

In Gabon illegal logging can be recognised in different ways including practices that might affect activity data (e.g. logging above the authorised threshold, logging without the right paperwork, logging cutting blocks in the wrong order) or logging emissions (e.g. logging more intensively, logging smaller diameter trees). Following the raw timber export ban in 2009, illegal forestry in Gabon increased steadily from 2010 to 2017, when a major law enforcement exercise was undertaken in coordination with the EIA investigation that produced the report entitled "Toxic Trade" (Environmental Investigation Agency, 2019). It was this report, and subsequent decisions taken by President Bongo Ondimba that resulted in improved forestry monitoring and major national efforts to reduce illegal forestry activities (it should be noted that the National Action Plan to Combat Illegal Logging in 2013 went largely unnoticed).

Data from Gabon indicates that most of the illegal logging was in fact undertaken by legally declared companies that supplemented their production by logging outside the annual cutting areas within their own permits, or outside their permits. Recent, unpublished national studies (conducted by law enforcement departments) indicate that about 30% Gabon's exploitation was illegal. However, the wood was declared as if legally harvested and was then transformed locally and exported 'legally' through Gabonese ports, thus being declared at customs. Therefore, the vast majority of illegally harvested timber in Gabon is captured by the activity data in the volume-based system of calculating carbon emissions.

Legislation for community forests came into force in 2008 and the first community forests (covering only 1,247ha) were not created until 2013, increasing to 141,000 ha by 2018 and representing less than 1% of the entire forestry estate. A small amount of community forest logging therefore occurred between 2013 and 2018 (during the results period), but community forestry was suspended in 2019 as a result of significant illegality observed within the community forest logging operations. Almost all of this logging was undertaken by small and medium sized companies who sold on to sawmills and larger forestry operators, or by large forestry companies with a nearby permit. The production was followed in the same way as timber harvested in commercial permits – as such, the volumes harvested in community forests were captured in national production statistics, although not necessarily with the correct origin. The wood was then transformed and, as for other illegal timber, laundered into the legal timber market. As such, the volumes from illegal (and legal) logging in community forests are accounted for in the volume-based method.

For these reasons, and given limited detailed data on logging practices and associated emissions in Gabon, Gabon did not attempt to measure illegal logging separately to legal logging and did not stratify logging emissions estimates by concession type. It also chose to measure logging emissions in community forests in the same way as for other logging concessions.

Gabon applied a national average logging emissions factor to the national data which was derived from national studies conducted in 12 different concessions. Of these concessions, four were FSC -certified, four had sustainable management plans and four did not. One was a community forest (without a sustainable management plan) and

two (both of which had sustainable management plans) were subsequently revealed by law enforcement departments to have participated in significant illegal logging activity. These two latter concessions both had total logging emissions factors (TEF) at the higher end of the range of measured values, with high Logging Infrastructure factors (LIF) but variable Logging Damage factors (LDF). In contrast, the community forest had the lowest LIF of the 12 concessions, but a high LDF with total logging emissions lower than the national average. Given the considerable inter-concession variability in logging practices and limited national data on illegal logging, Gabon did not consider it a scientifically robust approach to apply separate emissions factors for each concession type or to stratify by 'illegal' and 'legal' logging. Gabon applied instead the national average logging emissions factor that encompasses all kinds of logging practices, including FSC-certified, sustainably managed, legal, illegal and community forests. Gabon has already included the best available data and information on illegal timber logging and its impacts in the modified FRL and the BUR REDD+ Technical Annex.

Gabon is implementing a new robust traceability system that will be applied to forestry concessions and community forests in the same way, in its commitment to stamp out illegal logging. At the same time Gabon is collecting more detailed data on logging emissions in a larger sample of different concession types. Both these initiatives evidence Gabon's efforts to improve its national data as part of the FRL step-wise improvements.

4.3 Carbon pools

Above-ground live biomass (AGB), below-ground live biomass (BGB) and Dead Organic Matter (DOM, dead wood and litter) are included in the FRL. As data from national studies focussed on above-ground biomass, Gabon applied a standard root-shoot scaling factor to derive below-ground woody biomass carbon stocks and sequestration. Carbon stocks for Soil Organic Carbon (SOC) are not included, as Gabon considers that changes in soil organic carbon are currently insignificant. As a consequence, for soil organic carbon in forest land remaining forest land, Gabon applied the IPCC default assumption that mineral soil carbon stocks on land that has been forest for at least 20 years are in equilibrium and do not change. For forest land converted to other land-use categories, Gabon provides detailed rationale in its FRL to justify their exclusion at this time.

Regarding DOM, Gabon adopts the IPCC Tier 1 assumption that DOM is in equilibrium in land remaining in the same land-use category (i.e. Forest Land remaining Forest Land (IPCC, 2006a). Therefore, CO_2 gains and losses from DOM are not reported in Forest Land remaining Forest Land. However, changes in DOM carbon biomass are reported from Forest Land converted to non-Forest Land-use categories and non-Forest Land-use categories converted to Forest Land following IPCC Guidelines (IPCC, 2006b).

An Approach 1 key category analysis was conducted on the different carbon pools; this indicated that at least 95% net removals are contributed by AGB and BGB; based on this, Gabon considers that DOM and SOC are not significant carbon pools.

For the above reasons, Gabon would like to recall paragraph 10, of decision 12/CP.17 (UNFCCC COP17 – Durban, 2011) enabling countries to undertake the gradual improvement of their data and methods, including additional pools as appropriate. Through the establishment of its national network of permanent forest plots (National Resources Assessment), Gabon is currently collecting this data as part of its step-wise approach to improvements.

4.4 REDD+ activities

The REDD+ activities included in the FRL are:

- Deforestation,
- Forest Degradation,
- Sustainable Management of Forests (SMF),
- Conservation of Forest Carbon Stocks,
- Enhancement of Forest Carbon Stocks.

Gross emissions (from forest cover losses and logging) are accounted for separately under REDD+ Activities Deforestation, Forest Degradation, SMF and Conservation of forest carbon stocks. Gross removals are accounted for under REDD+ Activities Forest Degradation, Sustainable Management of Forests, Conservation of forest carbon stocks and Enhancement of forest carbon stocks.

The complex and comprehensive nature of Gabon's submission presented a unique challenge to finding the most optimal configuration of data organisation for REDD+ reporting. Following extensive discussions with UNFCCC experts it was decided that, given activity data were available for both Deforestation and Degradation, that losses and gains in some land-use categories should be treated separately under REDD+ activities Deforestation and Forest Degradation. This was considered an optimal approach as such a separation would provide information on the scale of each REDD+ activity separately and a better understanding of their relative importance.

4.5 Uncertainties

Gabon applied the error propagation methods from the 2006 IPCC Guidelines (vol. 1, equations. 3.1 and 3.2), as well as the 2019 Refinement to the 2006 IPCC Guidelines (vol. 1, equations 3.1 and 3.2) to calculate uncertainty associated with the AD, EFs and RFs. The accuracy and uncertainty of the wall-to-wall forest-cover maps produced for 1990, 2000, 2010 and 2015 were assessed using samples following the semi-random sampling method in Sannier et al.(2014), based on 95% confidence limits. Reported uncertainty was based on one standard error rather than on the commonly applied two standard errors. The overall uncertainty for net removals is 7.4% for 2000-2009 and 6.76% for 2010-2018 (Gabon’s modified FRL, page 122).

5 Description of the National Forest Monitoring System (NFMS) and the institutional roles and responsibilities for Measuring, Reporting and Verifying the results (MRV)

In 2011, Gabon initiated the establishment of the National Observation System of Natural Resources and Forests (SNORNF) to effectively monitor, evaluate and adapt Gabon's low emissions development activities in the Agriculture, Forestry and Other Land Use (AFOLU) sector, including sustainable forestry, management of protected areas and buffer zones, agricultural expansion, and land-use planning. The SNORNF will ensure effective implementation of national land-use activities and achievement of emission reductions, including increasing forest carbon sequestration potential through the expansion of its protected area network and avoiding or minimizing future emissions from the agricultural sector while meeting the country's food consumption needs through land-use optimization. It uses satellite image analysis, field inventories and modelling in order to evaluate, monitor and report on the National Land-Use Plan (PNAT – interactive platform) (République Gabonaise, 2015).

The PNAT is cross-ministerial and is Gabon's primary tool for the implementation of the country's sustainable development policy and for optimizing management of its national territory that promotes development while protecting Gabon's natural heritage and contributing to international commitments to prevent climate change.

Two presidential agencies also work in close alignment with MINEF and are key to the implementation of Green Gabon. Gabon's National Parks Agency (ANPN – soon to be restructured as the Nature Preservation Agency) manages Gabon's protected areas, including the network of 13 National Parks and buffer zones. Gabon's Space Agency (AGEOS) runs a national programme of spatial observation and analysis for strategic land-use and environmental planning. Both ANPN and AGEOS are responsible for implementing the SNORNF and are closely tied to the PNAT. The relevant institutional arrangements for data collection and reporting to the UNFCCC in relation to forests are presented in Figure 3.

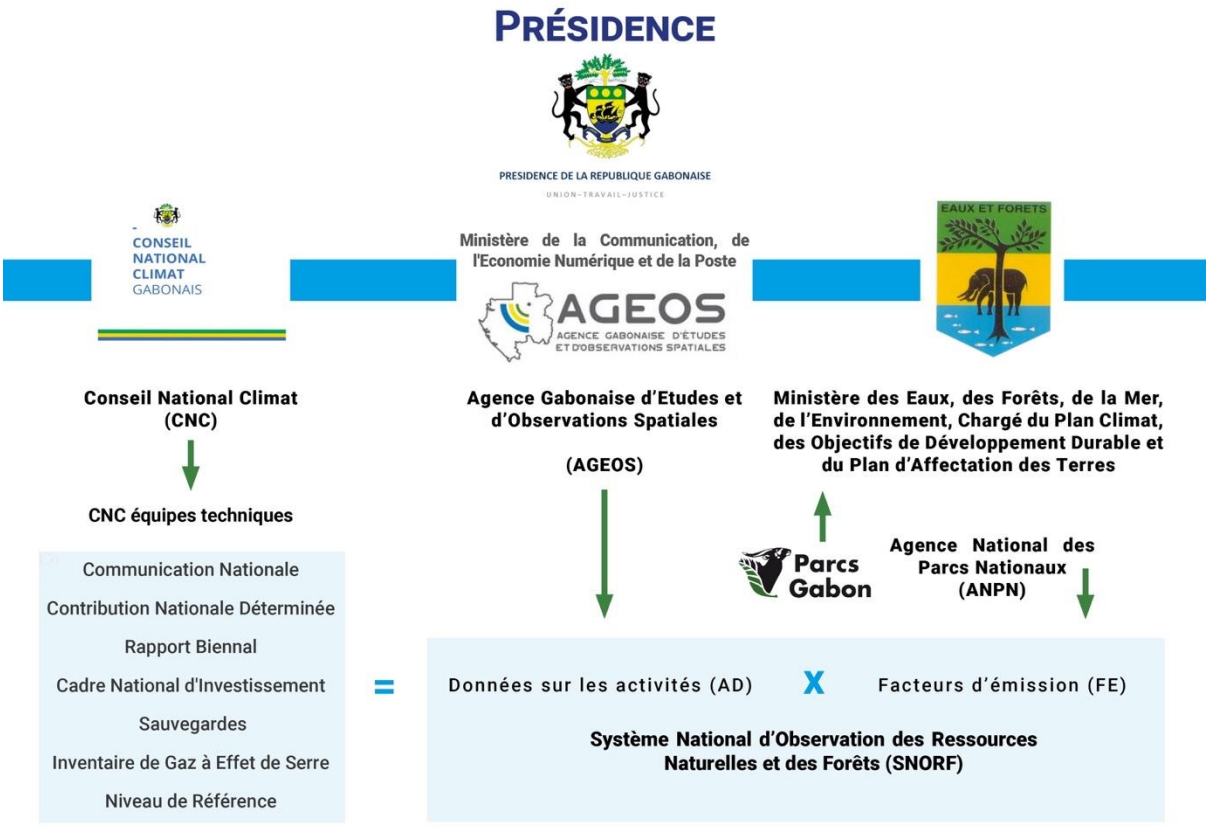

Figure 3 Institutional arrangements for data collection for the FRL and reporting to the UNFCCC.

Gabon's National Forest Monitoring System (NFMS) is a subset of the SNORF (Figure 4). ANPN is responsible for the collection and analysis of field data through Gabon's National Resource Inventory (NRI), while AGEOS is responsible for the collection and analysis of the remote sensing data. It is supported by SIRS (Systèmes d'Information à Réfèrence Spatiale) which has a long-term partnership agreement with AGEOS to provide technical assistance and transfer of capacity. Information on reduced impact logging to support sustainable forest management practices is being gathered by ANPN with support from The Nature Conservancy. MINEF is responsible for the reporting and data management systems of timber production.

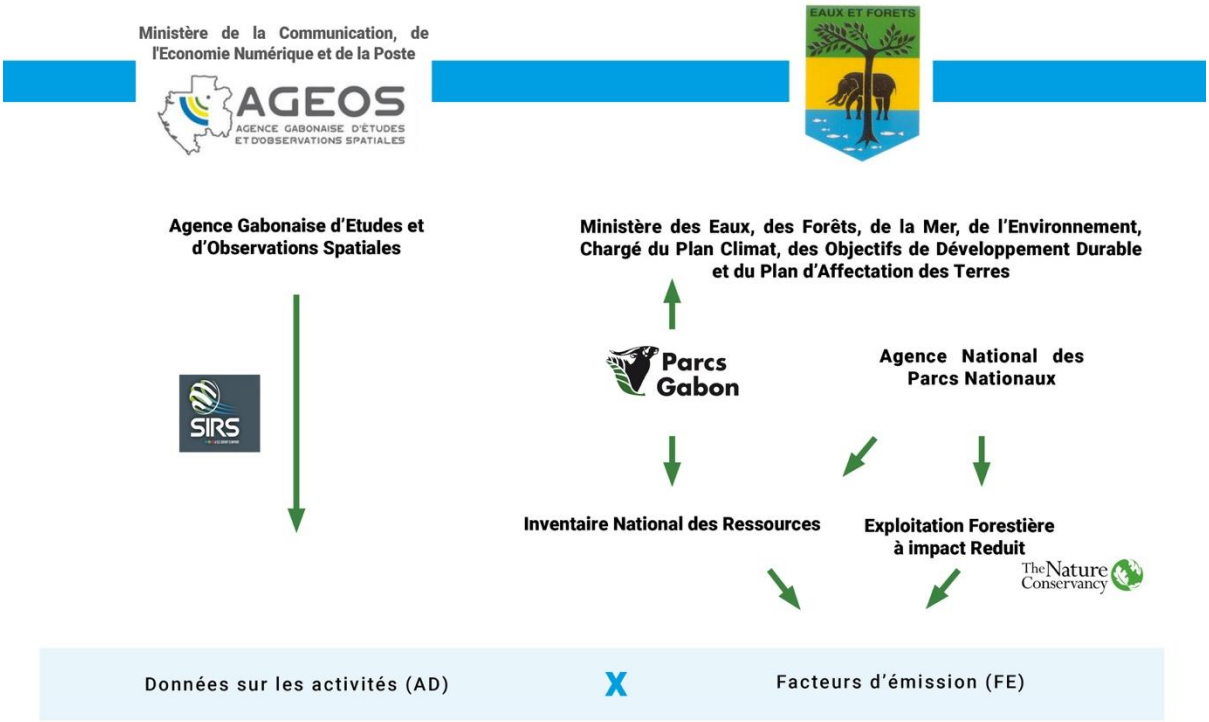

Figure 4 Institutional arrangements for Gabon's NFMS.

6 Necessary information that allows for the reconstruction of the results

Gabon's BUR REDD+ Technical Annex is accompanied by its own Workbook, which extracts relevant sections from the FRL accompanying Workbook in order to allow for the reconstruction of the results. The workbook is available here:

https://www.dropbox.com/sh/823zdi66bw0pa3g/AACGjYkYHF2JsfZQn_buiB-da?dl=0

6.1 Use of the most recent IPCC guidance and guidelines

The IPCC 2006 Guidelines for National Greenhouse Gas Inventories: Agriculture, Forestry and Other Land-use (IPCC, 2006c) were used as a technical framework for the formulation of the FRL. The 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2019a) was consulted as a guiding framework for the simple propagation of error uncertainty and land representation, as well as default values for perennial crops.

6.1.1 Good practice

Paragraph (b) of the annex of decision 12/CP.17 (UNFCCC COP17 – Durban, 2011) states that the information provided by countries during the FRL submission should be transparent, complete, consistent and accurate. Gabon has followed this as outlined below.

- **Transparency:** Gabon's FRL information (including the results) is openly available online at the following link: https://www.dropbox.com/sh/0bk6j8zhhnf1go1/AABtfmpJpjwHfAHzhHc---cFa?dl=0 (please copy link and paste into a new browser). The FRL document is accompanied by an Excel workbook, a user-guide and a folder of Supplementary Information containing all raw data, publications and reports used to construct the FRL. Due to its complexity, it was not possible to present all calculations and data-points in the written document to allow independent reconstruction of the FRL. Therefore, it is necessary to consult the FRL accompanying workbook in order to fully understand the FRL document. To facilitate cross-referencing of data and calculations, Tables and Figures in the FRL accompanying Workbook are referenced throughout the written document.

  Gabon is currently working on publishing relevant spatially explicit and non-spatial information through the open-access geoportal of the SNORF (currently under construction). The PNAT is accessible through this interactive platform. The data on the National Resources Inventory are published (Carlson et al., 2017; Poulsen et al., 2020; Wade et al., 2019).
- **Completeness:** as per the annex of decision 13/CP.19 (UNFCCC COP19 – Warsaw, 2013a), all data, methodologies, procedures used are presented and shared to allow for the independent reconstruction of the FRL (as described in the point above).
- **Consistency:** The methodologies and data used are consistent with the guidance provided in the relevant UNFCCC decisions. The net removals are estimated in a way that is consistent and will remain functionally consistent as Gabon implements its various national policies and measures. The FRL is established maintaining consistency with anthropogenic forest-related greenhouse gas emissions by sources and removals by sinks as will be contained in Gabon's updated greenhouse gas inventory.
- **Accuracy:** Estimates of emissions and removals are accurate and include estimates of uncertainty represented at the 95% confidence interval.

The Technical Assessment of the modified FRL found that the data and information used by Gabon in constructing its FRL are transparent, complete and in overall accordance with the guidelines contained in the annex to decision 12/CP.17 (UNFCCC COP17 – Durban, 2011).

6.1.2 Tiers and approaches

Regarding the estimation of emissions and removals from Forest Land, the IPCC has released extensive Guidance and Guidelines (IPCC, 2019, 2006c, 2003), that Gabon took into account for the development of its FRL and the calculation of the results presented here.

Gabon is mainly collecting information at Tier 2 and Tier 3 level. In terms of Emissions Factors, national data-sets include carbon stock data from Gabon's NRI which currently consists of a series of 104 permanent 1 ha plots and logging Emissions Factors collected from twelve logging concessions as part of three separate studies (Ellis et al., 2019; Medjibe et al., 2013, 2011) (see Section 10.2.4 of Gabon's modified FRL).

In terms of Removals Factors data are collated for old-growth forest from a national network of 134 permanent 'research' plots which are regularly re-measured, part of the Afritron network (www.forestplots.net) and have been widely published. Newly collected re-measures from a subset of plots from the NRI and from previously studied logging concessions are also included to provide preliminary estimates of sequestration in logged and secondary forests. Gabon intends to take steps to improve Tier 2 data by completing re-measures in all 104 NRI plots, and to increase the robustness of the NRI inventory by establishing a total of 500 plots.

In terms of Activity Data, national remote sensing data-sets collected and compiled by SIRS are used to provide information to calculate all emissions and removals with the exception of logging emissions. For logging emissions, national timber harvest production data are used, which have been nationally validated (Conseil National Climat, 2020). Other data concerning forestry management and national land tenure are sourced from national archives and government sources.

6.1.3 Consistency with the national greenhouse gas inventory

The FRL and the national greenhouse gas inventory are consistent. The data used for the development of the FRL were integrated in Gabon's national greenhouse gas inventory and second NDC.

6.2 Establish, according to national circumstances and capabilities, robust and transparent national forest monitoring system

Gabon's NFMS is a subset of the SNORF. Both the SNORF and the NFMS continue to be improved and strengthened to provide robust and transparent information for the AFOLU sector, including sustainable forestry, management of protected areas and buffer zones, agricultural expansion, land-use planning and calculations of greenhouse-gas emissions.

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8 Annex 1

8.1 Methods for constructing the BAU scenario

Gabon's Business As Usual (BAU) scenario is a retrospective one that takes account of Gabon's status as an early mover in implementing environmental policies. The BAU scenario begins in 2006 and is projected to 2050. Note that the complete method is included here for purposes of transparency, however, only data for 2000-2018 are presented in this section as relevant to the BUR REDD+ Technical Annex.

In order to establish the BAU scenario, a set of assumptions were first established for gross emissions and gross removals separately.

8.1.1 Gross Emissions

The assumptions in the BAU model for gross emissions are outlined in Box 4.

Box 4 Assumptions for Gross Emissions under the BAU scenario.

Activity	*Assumption*
Deforestation	• Industrial agriculture begins in 2011, at observed (measured) rates until 2015. From 2015 the annual rate of conversion is predicted to continue at a maximum yearly rate of 11,100 ha/year (as reported by Olam in 2015) until 2020. This then doubles by 2030, triples by 2040 and quadruples by 2050.
	• All deforestation other than industrial agriculture is predicted to continue at 2015-2018 levels from 2019-2050
	• Inside agricultural concessions, it is assumed that only Dense forest is converted (not secondary), and it is assumed that all Dense forest is converted to Cropland.
	• Outside agricultural concessions, it is assumed that the proportion of Dense and Secondary forest converted to Cropland, Grassland and other land-use categories between 2011-2050 is the same as that observed (measured) between 2001-2010 (when no deforestation was observed inside agricultural concessions).
Forest Degradation	• All forest degradation continues at 2015-2018 levels from 2019- 2050
Logging	• The area of forestry concession (C) recorded is predicted to increase from 2006 onwards at rates observed between 1990 and 2005 (by linear regression, see below). This increase continues until the maximum forestry estate of 20 million ha is reached for Gabon, then concession area remains stable at the maximum threshold of 20 Mha.
	• It is assumed no concessions have sustainable management plans ("CFADs") ; all concessions have a harvest cycle (HC) of 17 years (average harvest cycle for concessions under traditional logging regimes, without sustainable management plans).
	• Harvest intensity (HI) remains a constant value of 10 m^3/ha from 1990-2050;

	• The % exploitable area ($\mathrm{P_{exp}}$) within a forestry concession is 92%- this is a constant value from 1990-2050;
	• Timber production volume (V) is predicted to increase at rates observed between 1990-2005 from 2006-2050 (by linear regression, see below).
	• RIL-C is not introduced : The logging emissions factor without RIL-C is assumed to be 9.4 tCO_2eq/m^3 (see (Conseil National Climat, 2021).

The methodology applied to gross emissions under the BAU scenario is detailed as follows:

Deforestation

- The area of forest lost annually inside agricultural concessions under BAU was set at 11,100 ha /year from 2015-2020, 22,200 ha in 2030, 33,300 ha in 2040 and 44,400 ha in 2050. A simple interpolation was used to extrapolate the increase between years. This summed to a total of 938,071 ha agricultural concessions by 2050.
- Based on data from 2001-2010, it was observed that 58% Dense forest lost outside agricultural concessions was converted to Cropland, 6% to grassland and 36% to other land-use categories. Similarly, 75% secondary forest lost outside agricultural concessions was converted to Cropland, 5% to Grassland and 21% to other land-use categories. These proportions were assumed from 2011-2050 to determine the area of Dense and Secondary forest converted to each land-use category, outside agricultural concessions.
- The same Emissions Factors as in the FRL (Conseil National Climat, 2021) were applied to the Activity Data.

Degradation

- The same assumptions as for the Managed scenario were applied to Degradation under BAU (i.e. same rates of forest degradation observed in 2015-2018 applied to 2019-2050. The same Emissions Factors as in the FRL (Conseil National Climat, 2021) were applied to the Activity Data.

Logging

- A linear regression was first applied to predict the increase in logging concession area from 2006 onwards (based on 1990-2005 trends) until the maximum threshold of 20 million ha was reached. The regression equation (y=630340.638079101x-1247691094.93166) was applied; the results indicated that the threshold of 20 million ha concession would be reached by 2012 under BAU.
- From the concession area data, the annually exploitable area $\mathrm{A_E}$ was computed as:

$$A_E = \frac{C * P_{exp}}{HC}$$

- From this, the maximum timber harvest possible (V_{max}) in any given year was computed as:

$$V_{max} = A_E * HI$$

- Using this method the maximum value of $\mathrm{V_{max}}$ was calculated to be 10.5Mm^3 under BAU.
- Timber production volume (V) was predicted to increase at rates observed between 1990-2005 from 2006-2050 under BAU, using linear regression. The regression equation

(y=122237.205882353x-241728975) was applied; the results predicted a yield of 8.9 million m^3 timber /year by 2050 (below the maximum threshold).

8.1.2 Gross Removals

The assumptions in the BAU model for gross removals are outlined in Box 5.

Box 5 Assumptions for Gross Removals under the BAU scenario.

Activity	Assumption
Afforestation	• No forest plantations are grown
Natural Regeneration and Encroachment	• The area of new forest gained each year through natural regeneration following human disturbance (young secondary) or natural encroachment of savannahs (colonising forest) is assumed to remain the same as rates observed in 2015-2018. (Note that this data is incorporated into the total (cumulative) area of colonising and young secondary forest recorded for each year)
Sequestration in standing forest	• For forest types Young Secondary, Secondary, Mangrove and Colonising, the assumption is made that the areas observed from 1990- 2018 remain the same, and the areas then remain constant at 2018 values from 2019-2050. • Logged forest is defined (as in the FRL) as logged 1-10 years previously and logged 11-25 years previously.

The methodology applied to gross removals under the BAU scenario is detailed as follows:

Forest cover

- Total forest cover from 2006-2050 was calculated as the total area of forest for the previous year (starting with the observed value for 2018), less the area deforested for that year, plus the area planted.
- The area of logged forest was derived from the annually harvested area $(\mathrm{A_H})$, as per the FRL and which was first computed as:

$$\mathrm{A_H} = \frac{\mathrm{V}}{\mathrm{HI}}$$

- Then $\mathrm{A_H}$ was then summed for the previous 1-10 or 11-25 years to provide the cumulative area of logged forest, for each subcategory.
- For forest type “Dense” (i.e. Old growth/old secondary/older logged), the area from 2006-2050 was calculated as the total area of forest cover for that year less the sum of the area of all other forest types.

Sequestration rates

- Sequestration rates assumed in the model were the same as for the FRL (Conseil National Climat, 2021).
- To account for climate change, the assumption was made from (Hubau et al., 2020) that sequestration rates are predicted to decrease in African tropical forest by 14% in 2030 from 2010-2015 values. Note, that in the paper this value is continent wide and measured for old growth forests only. However in the absence of data on the impacts of climate change on sequestration across different forest types, the assumption was made that the same decrease is observed across forest types.
- The following method was applied: data from Table 1 in (Hubau et al., 2020) were taken for years 2010-2040 (Table 7); the 2010-2020 reported value was assumed to be "100%" and the % reduction computed for subsequent decades. The data-point for 2040-2050 was predicted using the regression equation (y = -0.04x + 0.67, Figure 5). The % decrease at the end of each decade (so 100% in 2020, 6% in 2030, 13% in 2040 and 19% in 2050) was applied to the sequestration rate for each forest type for removals calculations for each of those years respectively. A simple interpolation was applied to calculate the % reduction in intervening years and applied accordingly to the removals calculation for each forest type.

Table 7 Predicted decrease in sequestration from 2020-2050, using data from Table 1, Hubau et al. (2020) for African forests for 2010-2040, and extrapolating to 2050.

X	Years	Mg C ha−1 yr−1	% decrease
1	2010-2020	0.63	100%
2	2020-2030	0.59	6%
3	2030-2040	0.55	13%
4	2040-2050 (predicted)	0.51	19%

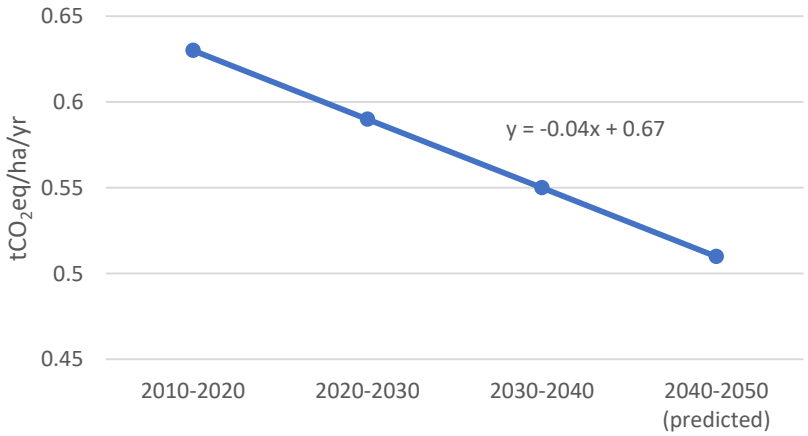

Figure 5 Sequestration rates for 2010-2040 in African Old growth forests (from Hubau et al., 2020), with regression line for predicting sequestration rate for 2040-2050.

8.2 Comparing Scenarios: 2000-2018 period

Although the BAU scenario and 'managed' conditions were projected to 2050 in Gabon's FRL, second NDC and BUR, here we focus on the period 2000-2018 only for the purposes of the BUR REDD+ Technical Annex.

- Reported gross emissions total 581 million tCO_2eq for the 2000-2018 period, compared to 864 million tCO_2eq under BAU; a 33% reduction (Figure 6).
- Reported gross removals total 2.7 billion tCO_2eq for the 2000-2018 period, compared to 2.8 billion tCO_2eq under BAU; a 3% reduction (Figure 7).
- Reported net emissions (gross emissions – gross removals) total -2.1 billion tCO_2eq for the 2000-2018 period compared to -1.9 billion tCO_2eq under BAU, a 10% reduction (Figure 8).

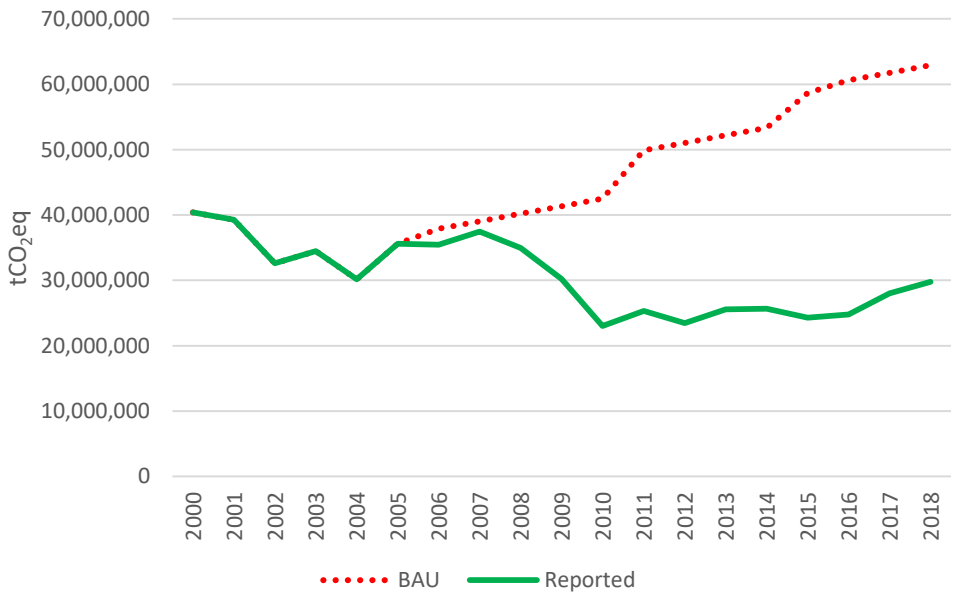

Figure 6 Comparison of Gross Emissions between the two different scenarios (Reported and Business as Usual (BAU) between 2000-2018.

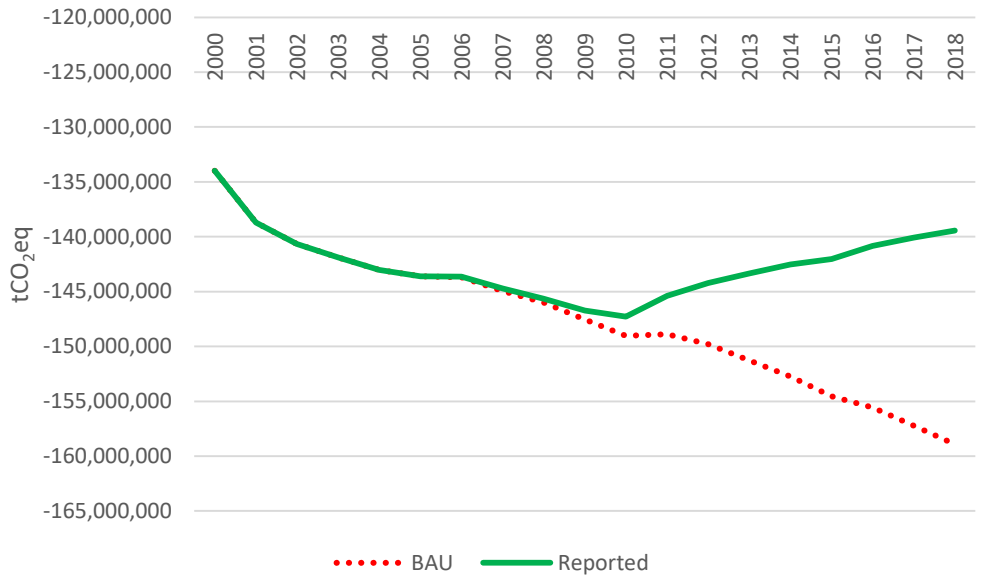

Figure 7 Comparison of Gross Removals (expressed as negative values) between the two different scenarios (Reported and Business as Usual (BAU) between 2000-2018.

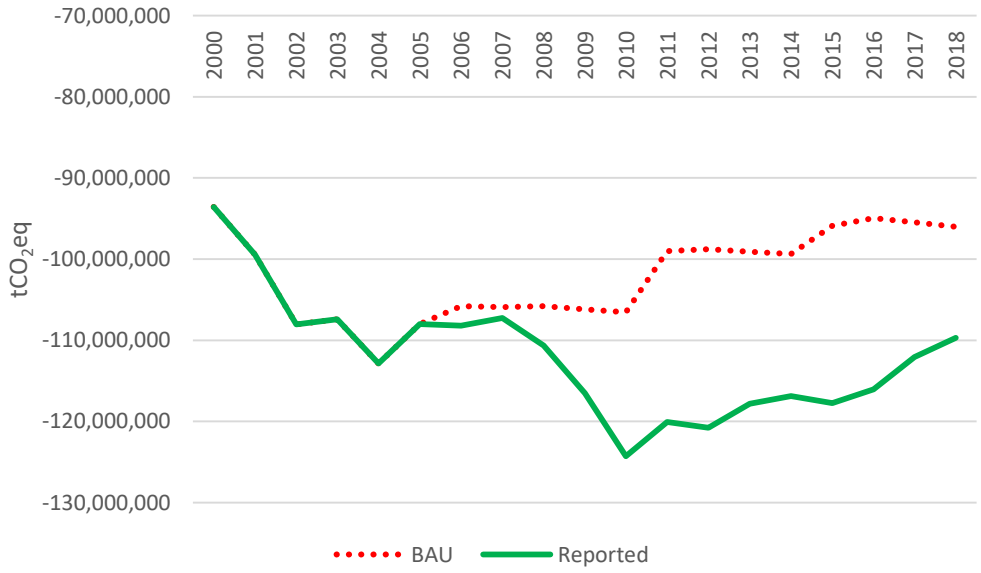

Figure 8 Comparison of overall Net Emissions (Gross Emissions – Gross Removals) between the two different scenarios (Reported and Business as Usual (BAU) between 2000-2018.

8.3 Understanding the 10% difference between measured and BAU net removals 2000-2018

The annual difference in net removals between the reported and BAU scenarios for the period 2000-2018 varies between 0 and 22 million tCO_2eq (Figure 9, expressed as positive values), and sums to a total of 189,179,956 tCO_2eq.

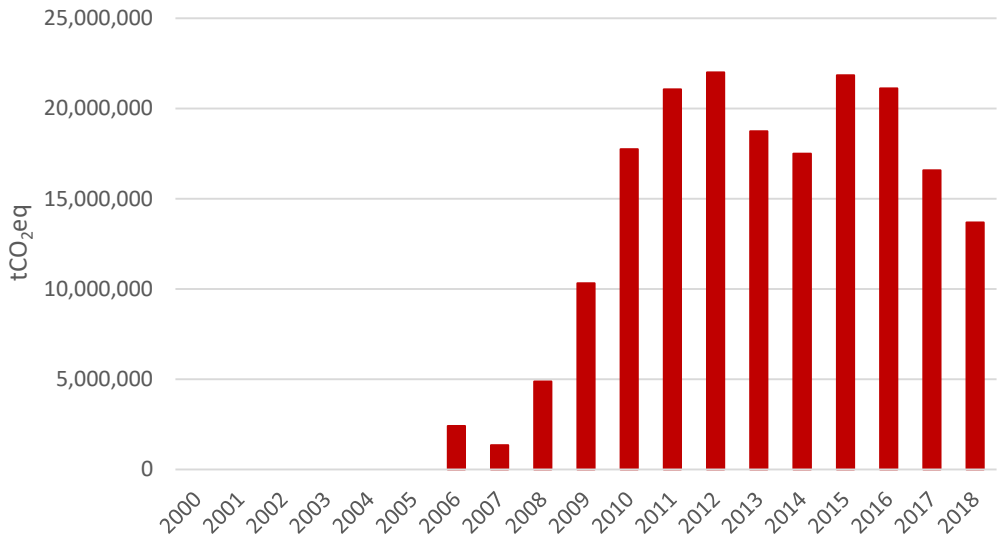

Figure 9 Annual difference in net removals between the reported and BAU scenarios, expressed as positive values.

This annual difference can be broken down into different composite categories, here, by mitigation activity under the reported (historical) scenario (with policy action), compared to a BAU scenario.

- The total annual difference in gross emissions was separated into its respective allocation to reduced (avoided) deforestation, reduced (avoided) degradation and improved logging practices.
- The total annual difference in gross removals was separated into its respective allocation to afforestation, regeneration and natural forest encroachment, foregone removals in standing forest (the amount of removals in forest that remained standing under Reported conditions that would have otherwise been deforested under BAU), and removals in all other standing forest.

The results indicate, that for gross emissions, 9% of the difference was attributed to avoided deforestation whereas 91% was attributed to improved logging practices (Figure 10). No difference in gross emissions was attributed to avoided degradation outside of logging concessions.

For gross removals, as there was no afforestation and no change predicted for regeneration or encroachment, 100% of the difference in removals was attributed to standing forest (Figure 10). Here, a small amount of the difference in removals was attributed to foregone removals as a positive gain in the reported scenario compared to BAU, however, this was offset by the overall higher removals under BAU compared to the reported scenario for all other standing forest, due largely to the higher area of logged forest (forest logged within 25 years) under BAU (average 6,217,309 ha/yr under BAU compared to an average 5,608,724 ha/year under reported conditions).

Overall, this summed to the total difference in net removals per year (Figure 10, red dotted line), which represents the total of 189,179,956 tCO_2eq, or a 10% difference between the reported and BAU scenarios.

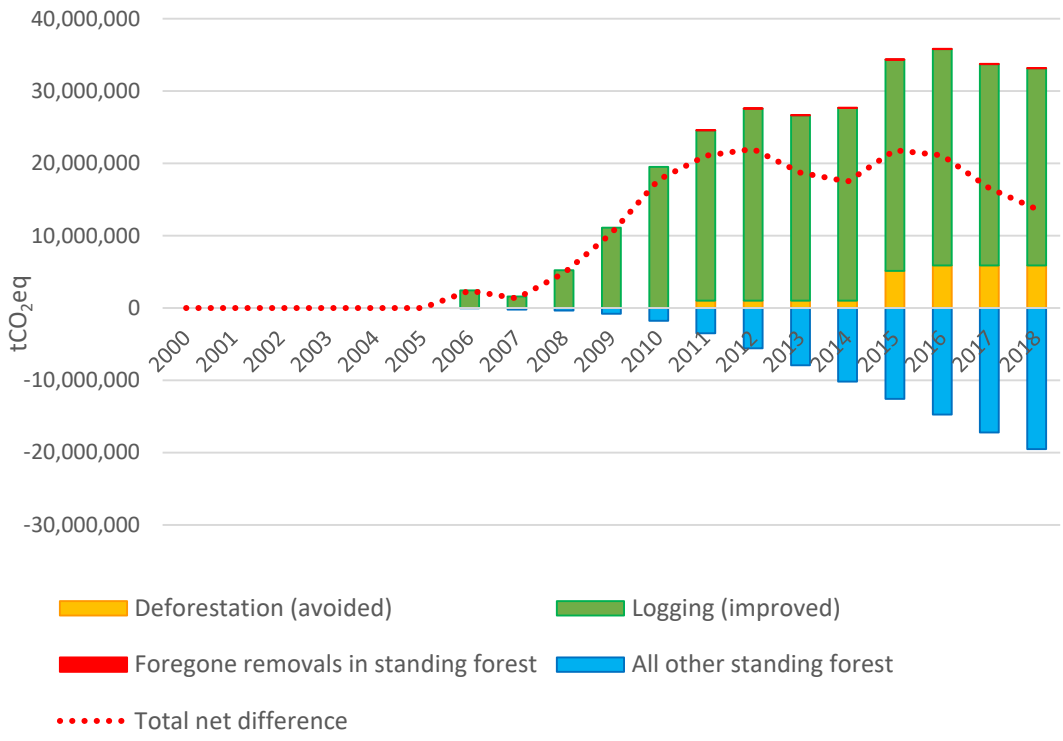

Figure 10 Allocation of the difference in net removals (reported – BAU) to each mitigation activity identified in the model, 2000-2018.

Gabon recognises that comparing the net removals between the BAU and reported (measured) scenarios for the 2010-2018 period is not the only way to compare the results. For example, the difference in average net removals between the BAU and reported scenarios for the results period only (2010-2018) is a 19.2% increase relative to the BAU, whereas the difference in average net removals between the BAU scenario for the results period (2010-2018) and reported scenario for the reference period (2000-2009) is a 9% increase relative to the BAU. Further, the difference in the average measured net removals between the results period (2010-2018) and the reference period (2000-2009) represents a 9.4% increase relative to the reference period.

Taking all this into consideration, Gabon is of the view is that the chosen value of 10% is a reasonable and justifiable adjustment representing the difference between the BAU and the observed values during the FRL period (2000-2009) and crediting period (2010-2018) and reflective of the observation that Gabon's measured performance is 10% better compared to its BAU scenario. The 10% value is also very close to other values produced by different pairwise comparisons of BAU and measured net removals (as described above).

Furthermore, Gabon's data demonstrates the enormous globally significant sequestration potential which is only possible thanks to the early mover efforts made by Gabon to actively protect and manage its forests. By applying a 10% adjustment, Gabon is only claiming 20% of its net sequestration across all sectors as

REDD+ credits. Across the crediting period Gabon net absorbed 1.05 billion tonnes of CO_2eq in its forest sector, but only claims 187 million tCO_2eq for this period. As such, for every credit claimed more than 4 additional tonnes of CO_2eq were removed from the atmosphere thanks to Gabon's active restoration and management of its entire forest estate, ensuring there is no leakage. Given Gabon's net absorber status, approximately 5 tCO_2eq are actually removed, net, from the atmosphere and fixed in the forests of Gabon, for every credit claimed. Given Gabon's low deforestation rates over the 3 decades since Rio, it is fairly safe to assume that these carbon gains are relatively secure.

No other country, no matter what their size, can claim to be as effective in removing CO_2 from the atmosphere as Gabon and as such Gabon feels that the 10% adjustment of our increased net sequestrations is fully justified.