

Annex XVII: Technical Annex – Recalculations of FREL and Results

The UNFCCC technically assessed FREL submitted by Indonesia for the historical reference period 1990–2012 was based on an average of CO₂ emissions associated with deforestation and forest degradation occurring in the areas that were natural forest in 1990, while emissions from soil organic carbon from peat decomposition is based on projection of future emissions.

For calculating average deforestation emissions and degradation emissions in the aboveground biomass pool, an arithmetic mean was used across all available periods. As described in Indonesia's National Forest Reference Emissions Level for REDD+, in Chapter 4.2. Methodology and Procedure, the land cover maps during the period of 1990-2000 were produced only twice for epochal data of 1990 and 1996; for 2000-2009 were produced every three years, and since 2011 the maps were generated annually. For the FREL submission, therefore, data sets for 1990, 1996, 2000, 2003, 2006, 2009, 2011 and 2012 were available and used to capture historical land-cover data.

Therefore, emission calculations from deforestation, forest degradation and peat decomposition were based on these time periods: 1990 – 1996; 1996-2000; 2000-2003; 2003-2006; 2006-2009; 2009-2011; 2011-2012. For each interval, deforestation and forest degradation polygons were generated, multiplied by the associated emission factors, in order to calculate the average emissions from deforestation and forest degradation for each interval period. The historical averages for annual emissions from deforestation and forest degradation for the entire reference period was calculated based on an overall average of the average emissions for each of these interval periods, in order to yield the FREL values for each REDD+ activity, respectively.

In the case of deforestation and forest degradation over peatlands, emissions from soil organic carbon are also included in the technically assessed FREL. The UNFCCC reference level emissions calculation for peat decomposition is based on the projection of future emissions, estimated using a linear regression of historical emissions during 1990-2012. This approach yields an accumulating estimate over time, given the inherited emissions being reflected. These accumulating emissions are the reason that the national FREL submitted by Indonesia increases annually over the results period.

The FREL values for deforestation, forest degradation and SOC emissions from deforestation and forest degradation over peatlands were then added to yield the total FREL values in the table below.

The corresponding REDD+ results, which were estimated against this UNFCCC technically assessed FREL are found below, as reported in the BUR REDD+ Technical Annex.

UNFCCC FREL period: 1990-2012

	Total FREL	Total Actual	Total Emission Reductions
2013	568,859,881	550,911,089	17,948,792
2014	572,355,503	369,384,991	202,970,512
2015	575,851,125	574,438,172	1,412,953
2016	579,346,747	618,151,083	-38,804,337
2017	582,842,369	521,478,153	61,364,215
TOTAL RESULTS			244,892,135

Table 1: REDD+ Results in BUR REDD+ Technical Annex (tCO₂e)

Taking note, however, it was recognized that the reference period applied for the UNFCCC exceeds the maximum of 20 years for the GCF REDD+ RBP pilot, as indicated in the GCF REDD+ RBP scorecard, in 2a(xiii). Following the guidance contained in footnote 22 of row 2a(xiii) of the scorecard, Indonesia has, therefore, recalculated its reference level based on a period of 20 years.

The 20-year reference period being applied for this proposal is 1993 – 2012.

The same annualized estimates of emissions, based on the methodological approach described above (and further detailed in Indonesia's UNFCCC technically assessed FREL, Chapter 4.2), including all underlying activity data and emission factors and assumptions, has been applied when calculating the historic emissions from deforestation and forest degradation for the recalculated FREL.

The UNFCCC report on the technical assessment of the proposed forest reference emission level of Indonesia (submitted in 2016) , states that the methods used by Indonesia for the construction of the FREL, as described above, were deemed consistent with the Intergovernmental Panel on Climate Change (IPCC) Good Practice Guidance for Land Use, Land-Use Change and Forestry (hereinafter referred to as the IPCC good practice guidance for LULUCF) and the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (hereinafter referred to as the 2006 IPCC Guidelines). For the estimation of emissions from peat decomposition the 2013 Supplement to the 2006 Guidelines for National Greenhouse Gas Inventories: Wetlands, or the Wetlands Supplement, was used.

The historical average used for Indonesia's UNFCCC FREL was altered, however, in the context of recalculating the FREL presented in this funding proposal, in order to comply with the ToRs for the GCF REDD+ pilot. In addition to the shorter FREL period, starting in 1993 instead of 1990, a simple annual

average approach, versus averaging across average deforestation and forest degradation emission calculations for each interval period, was applied. The recalculated FREL period still draws on data for all interval periods, as indicated above, which were analysed for the technical assessed FREL starting in 1990. However the resulting annual average across the reference level period is calculated as seen below in Table 2.

Years	Emissions from Deforestation (tCO ₂ e)	Emission from Forest Degradation (tCO ₂ e)
1993	198,912,693	7,676,560
1994	198,912,693	7,676,560
1995	198,912,693	7,676,560
1996	198,912,693	7,676,560
1997	737,006,187	162,396,173
1998	737,006,187	162,396,173
1999	737,006,187	162,396,173
2000	737,006,187	162,396,173
2001	142,951,619	73,690,805
2002	142,951,619	73,690,805
2003	142,951,619	73,690,805
2004	264,363,082	78,596,482
2005	264,363,082	78,596,482
2006	264,363,082	78,596,482
2007	286,400,629	59,226,954
2008	286,400,629	59,226,954
2009	286,400,629	59,226,954
2010	173,891,040	18,511,560
2011	173,891,040	18,511,560
2012	248,937,119	5,920,802
Annual Average	321,077,036	67,888,879

Table 2. Annualized Emissions and historical annual averages for deforestation and degradation (1993-2012)

As seen in Table 2, the resulting annual averages for 1993-2012 are 321,077,036 tCO₂e for deforestation and 67,888,879 tCO₂e for forest degradation.

As described above, following IPCC 2013 Supplement to the 2006 Guidelines, a linear regression was applied for inclusion of SOC emissions for deforestation and forest degradation over peatlands in Indonesia's technically assessed FREL.

For the purpose of estimating soil carbon emissions from deforestation and forest degradation over peatlands, an annual average was generated and applied to the shorter period. The exclusive purpose for this application of an annual average is the GCF pilot and to ensure alignment with its ToRs.

The annual average is based on the annual estimates calculated according to a linear projection approach. This is a simplified approach. For Indonesia, from a technical perspective, inherited historical emissions should be excluded if a historical average approach is to be applied. If the inherited emissions are included, it is not fully in accordance with the characteristics of the historical data.

See Table 3 below for the linear regression results as compared to the annual average.

Reference Period 1993-2012			
	Projected Peat Decomposition Emissions		
1993	151,712,921		151,712,921
1994	151,712,921		151,712,921
1995	151,712,921		151,712,921
1996	151,712,921		151,712,921
1997	164,773,548		164,773,548
1998	164,773,548		164,773,548
1999	164,773,548		164,773,548
2000	164,773,548		164,773,548
2001	174,711,277		174,711,277
2002	174,711,277		174,711,277
2003	174,711,277		174,711,277
2004	184,188,644		184,188,644
2005	184,188,644		184,188,644
2006	184,188,644		184,188,644
2007	200,067,598		200,067,598
2008	200,067,598		200,067,598
2009	200,067,598		200,067,598
2010	215,742,080		215,742,080
2011	215,742,080		215,742,080
2012	226,109,789		226,109,789
2013	219,956,686	Linear equation applied: $Y = 3803292,20x - 7436070512,47$	Annual Average: 180,022,119
2014	223,759,978		
2015	227,563,271		
2016	231,366,563		

2017	235,169,855		
2018	238,973,147		
2019	242,776,439		
2020	246,579,732		

Table 3: Projected Peat Decomposition Reference Level Estimates for 1993 -2012 FREL Period (in tCO₂e)

The average emissions from peat decomposition for the eligible GCF results years (in bold) were then added to the recalculated FREL values for deforestation and degradation, to give the total recalculated FREL estimate for each year of the period 2014-16, for which results being offered to the GCF (see tables 3 and 4 below).

Years	Deforestation		Degradation		Peat Decomposition	
	Reference level	Actual	Reference level	Actual	Reference Level	Actual
2014	321,077,036	118,747,501	67,888,879	9,824,101	180,022,119	240,813,389
2015	321,077,036	239,501,493	67,888,879	85,971,152	180,022,119	248,965,527
2016	321,077,036	283,794,741	67,888,879	78,649,415	180,022,119	255,706,927
Total:						

Table 4: Input Data for 1993-2012 Recalculated FREL and Corresponding Results (tCO₂e)

	Total FREL	Total Actual Emissions	Total Emission Reductions
2014	568,988,034	369,384,991	199,603,043
2015	568,988,034	574,438,172	(5,450,138)
2016	568,988,034	618,151,083	(49,163,049)
TOTAL			144,989,856
Average results for 2014 - 2016			48,329,952

Table 5: Recalculated 1993-2012 FREL and Corresponding Results (tCO₂e)