

The United Kingdom's Initial Report under the Second Commitment Period of the Kyoto Protocol

Pursuant to the modalities for the accounting of assigned amounts under Article 7(4) of the Kyoto Protocol to the United Nations Framework Convention on Climate Change

UK Department for Business, Energy and Industrial Strategy

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Executive Summary

The UK's Initial Report under the second commitment period of the Kyoto Protocol shows how the UK has implemented the requirements under the Kyoto Protocol to '*facilitate the calculation of its assigned amount and demonstrate its capacity to account for its emissions and assigned amount*'. The report conforms with the requirements of the Modalities for the accounting of assigned amounts under Article 7(4) of the Kyoto Protocol, as specified in Decision 13/CMP.1 of the first Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol, and the requirements of decision 2/CMP.8, concerning reports to facilitate the calculation of assigned amounts for the second commitment period of the Kyoto Protocol.

In particular, this Initial Report contains the calculation of the UK's assigned amount, once agreed by the UNFCCC, which represents the baseline of emissions against which the UK's commitments will be assessed at the end of the second commitment period under the Kyoto Protocol.

The main elements of this report are:

- A **complete inventory** of anthropogenic emissions by source and removals by sinks of greenhouse gases not controlled by the Montreal Protocol for 1990-2014.
- Identification of **1995** as the UK's selected base year for nitrogen trifluoride.
- Calculation of the UK's **assigned amount** as:
2,744,937,332 tonnes of carbon dioxide equivalent (or assigned amount units).
- Calculation of the UK's **commitment period reserve** as:
2,470,443,599 tonnes of carbon dioxide equivalent (or assigned amount units).
- The UK's decision to elect **Cropland Management, Grazing Land Management, and Wetland Drainage and Rewetting** as activities under Article 3(4) during the second commitment period.
- Identification of the UK's forest management reference level under Article 3(4) during the second commitment period, originally as **-3.442 Mt CO₂ eq/yr**, or when applying first order decay function for harvested wood products as **-8.268 Mt CO₂ eq/yr**, with a Technical Correction of **-9.275 Mt CO₂ eq/yr**, or **-5.658 Mt CO₂ eq/yr** when applying first order decay function for harvested wood products.

- The UK's intention to use **entire commitment period accounting** for all activities elected under Article 3(3) and (4) for the second commitment period.
- The UK's decision to use the provision to **exclude emissions from natural disturbances with respect to Article 3(3) Afforestation and Reforestation and Article 3(4) Forest Management**, should significant disturbance events occur during the second Commitment period that meet the requirements for exclusion.

1. Introduction

The United Kingdom of Great Britain and Northern Ireland hereby submits its **Initial Report under the second commitment period of the Kyoto Protocol** to the United Nations Framework Convention on Climate Change (UNFCCC) pursuant to the modalities for the accounting of assigned amounts for the second commitment period under Article 7(4) of the Kyoto Protocol.

The Initial Report submitted in June 2016 was delayed from its intended submission date of 15th April 2015 due to problems with the functionality of the Common Reporting Format (CRF) used by the UNFCCC for reporting. Decision 13/CP.20, paragraph 13, noted “... *that version 5.0.0 of the CRF Reporter is not functioning in order to enable Annex I Parties to submit their common reporting format tables for the year 2015;*”. Continuing problems prevented the UK from submitting a GHG Inventory for this deadline under Article 7 of the Kyoto Protocol, and therefore delayed submission of the Initial Report.

This version of the Initial Report - Version 3 - is resubmitted following resolution of the UK's territorial coverage, which has necessitated the reconfirmation of the assigned amount and commitment period reserve. This issue is explained further below in Section 1.4.

1.1 UK commitments

The UK is one of 28 Member States of the European Union (EU) with a legally binding emission reduction commitment under the Kyoto Protocol. The EU has a collective target to reduce its emissions by 20 per cent relative to base year levels over the period 2013-2020. Under the EU burden sharing agreement¹, the EU's target was distributed between Member States to reflect their national circumstances, requirements for economic growth and scope for further emissions reductions. Within this arrangement the UK has undertaken to reduce its basket of greenhouse gas emissions to be equal to the sum of the annual emission allocations for 2013 to 2020 determined pursuant to Decision No. 406/2009/EC of the European Parliament and of the Council². This was based on global warming potential values from the Fourth Assessment Report of the Intergovernmental Panel on Climate

¹ The EU and the Member States will be fulfilling their commitments jointly with Iceland. There is a further agreement between the EU, the Member States and Iceland concerning this arrangement.

² Decision No. 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020 (OJ L 140, 5.6.2009, p. 136).

Change and was determined under Annex II to Commission Decision 2013/162/EU³ and adjusted by Commission Decision 2013/634/EU⁴.

1.2 Contents and structure of the initial report

The contents of this report are prepared in accordance with decision 2/CMP.8, which states: 'that each Party with a quantified emission limitation and reduction commitment inscribed in the third column of Annex B to the Kyoto Protocol, as contained in annex I to decision 1/CMP.8, shall submit to the secretariat, by 15 April 2015, a report to facilitate the calculation of its assigned amount pursuant to Article 3(7bis), (8) and (8bis), of the Kyoto Protocol for the second commitment period and to demonstrate its capacity to account for its emissions and assigned amount'.

Annex I to decision 2/CMP.8 describes the information the report must contain and the present report is structured according to the information required by these paragraphs for Parties included in Annex I which did have a quantified emissions limitation and reduction target in the first commitment period. The table in Annex A maps the requirements of the decision text with the sources of information supplied by the UK.

1.3 UK greenhouse gas inventory

The UK submitted its greenhouse gas inventory under the UN Framework Convention on Climate Change, comprising the National Inventory Report (NIR) and Common Reporting Format (CRF) tables on time to the UNFCCC on 15 April 2016. However, the submission under the Kyoto Protocol was delayed due to problems with the CRF software.

A summary of the inventory submissions that were made to the UNFCCC in 2016 is provided in Annex B.

1.4 Territorial coverage

The territorial coverage of the UK greenhouse gas (GHG) inventory as reported each year to the UNFCCC is consistent with the definition of the 'economic territory of the United Kingdom' used by the Department of Business, Innovation and Skills, the UK Office for National Statistics and the European System of Accounts.

Territorial coverage has been extended to include complete coverage of emissions for the UK's Crown Dependencies. These are Guernsey, Jersey and the Isle of Man.

³ Commission Decision 2013/162/EU of 26 March 2013 on determining Member States' annual emission allocations for the period 2013 to 2020 pursuant to Decision No 406/2009/EC of the European Parliament and of the Council, OJ L 90/106, 28.3.2013.

⁴ Commission Implementing Decision 2013/634/EU of 31 October 2013 on the adjustments to Member States' annual emission allocations for the period from 2013 to 2020 pursuant to Decision No 406/2009/EC of the European Parliament and of the Council, OJ L 292/19, 1.11.2013.

Territorial coverage also includes those UK Overseas Territories that have joined the UK's ratification of the UNFCCC and intend to join the UK's ratification of the Kyoto Protocol during its second commitment period. These Overseas Territories are the Cayman Islands, Falkland Islands and Gibraltar. Bermuda is the only territory included in the first commitment period that is not included in the UK's coverage for the second commitment period.

2. Calculation of UK's assigned amount

2.1 Key points

The UK's base year estimate of the Kyoto basket of greenhouse gases for the second commitment period is **803.2 million tonnes** of carbon dioxide (CO₂) equivalent.

The UK's greenhouse gas emissions are estimated to have fallen by **35 per cent** between the Kyoto base year and 2014.

The UK's assigned amount covering the 8 years of the second commitment period is calculated at full precision to be **2,744,937,332** tonnes of CO₂ equivalent (or assigned amount units).

2.2 UK greenhouse gas emissions, 1990 to 2014

Table 2.1 below provides the full time series of greenhouse gas (GHG) emissions for the period 1990 to 2014 for the UK. As stated in Section 1.4 above, the UK GHG inventory presented here includes emissions from the UK's Crown Dependencies of Guernsey, Jersey and Isle of Man, and from the UK's Overseas Territories of Cayman Islands, Falkland Islands and Gibraltar, who intend to join the UK's instruments of ratification to the Kyoto Protocol during its second commitment period. The revision of Table 2.1 from the Initial Report submitted in June 2016 accounts for the removal of Bermuda, who declined to have ratification of the second commitment period of the Kyoto Protocol extended to them.

Carbon dioxide emissions exclude all emissions and removals associated with land use, land use change and forestry (LULUCF) in accordance with the Article 7(4) modalities for the accounting of assigned amounts. LULUCF emissions and removals enter the table only through rows labelled Article 3(3), Article 3(4) and Article 3(7):

- Article 3(3) represents the net emissions or removals of Afforestation plus Reforestation minus Deforestation (ARD) since 1990;
- Article 3(4) represents the capped net flux due to forest management since 1990 (the UK elected forest management as an activity under Article 3(4) in the first commitment period— see Section 4 of this report);

- Article 3(7) represents emissions in 1990 from deforestation (the 'D' estimate), added to the base year for Kyoto reporting (only applicable to countries with a net LULUCF emission in 1990, which is the case for the UK).

Historical emissions values in the time series presented in Table 2.1 below have changed since the UK's Initial Report for the 1st Commitment Period. This is as a result of methodological improvements made to the UK's emissions estimates, which were then applied back to 1990 in order to ensure that emissions are based on consistent estimation methodologies throughout the time series. This is in accordance with the 2006 IPCC Reporting Guidelines for National Greenhouse Gas Inventories. The improvements implemented are prompted by the internal reviews of the inventory, the publication of new sources of data which are more robust or comprehensive and the findings of UNFCCC-led expert reviews. Before being implemented, the technical outputs of these improvements are reviewed by a small scientific steering group set up to oversee the work, and then by the National Inventory Steering Committee who oversee changes to the inventory as a whole. Changes are then placed under scrutiny by the following UNFCCC-led expert review.

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Table 2.1: UK GHG emissions 1990 – 2014 (Mt CO₂e)

Table 2.1	Mt CO ₂ Equivalent															
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
CO ₂ (Inc. net LULUCF)	594.84	602.80	587.18	572.75	567.41	559.24	579.80	554.38	557.47	549.53	556.60	565.53	548.38	559.40	559.77	556.53
CO ₂ (Exc. net LULUCF)	595.69	603.97	588.65	574.10	568.79	560.51	582.06	556.94	560.57	553.14	560.58	569.98	553.49	564.72	565.82	562.99
CH ₄ (Inc. net LULUCF)	137.54	138.13	137.56	135.71	128.66	130.89	130.19	127.76	124.52	119.64	114.94	109.98	107.76	102.64	97.85	92.49
CH ₄ (Exc. net LULUCF)	137.53	138.11	137.54	135.69	128.65	130.86	130.17	127.74	124.50	119.63	114.90	109.95	107.73	102.58	97.82	92.45
N ₂ O (Inc. net LULUCF)	49.86	50.04	45.60	41.50	41.77	40.44	40.14	40.28	40.30	30.39	30.06	28.48	26.66	26.43	27.02	26.02
N ₂ O (Exc. net LULUCF)	48.77	48.96	44.52	40.43	40.70	39.37	39.08	39.22	39.25	29.35	29.04	27.50	25.71	25.47	26.13	25.14
HFCs	14.39	14.99	15.60	16.51	17.59	19.09	20.25	23.10	20.07	11.46	9.88	10.88	11.38	12.82	11.93	13.16
PFCs	1.65	1.39	0.69	0.60	0.61	0.60	0.60	0.50	0.49	0.47	0.60	0.49	0.41	0.36	0.43	0.39
SF ₆	1.28	1.32	1.36	1.18	1.22	1.26	1.31	1.28	1.33	1.50	1.82	1.45	1.50	1.32	1.12	1.06
NF ₃	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total (Inc. net LULUCF)	799.56	808.67	787.98	768.24	757.27	751.53	772.29	747.31	744.19	713.00	713.89	716.82	696.08	702.96	698.13	689.64
Total (Exc. net LULUCF)	799.31	808.73	788.37	768.51	757.57	751.70	773.47	748.78	746.21	715.54	716.81	720.24	700.20	707.26	703.25	695.18
												% change				
	2006	2007	2008	2009	2010	2011	2012	2013	2014		1990-2014					
CO ₂ (Inc. net LULUCF)	554.14	545.01	530.91	479.96	498.14	454.97	474.49	465.75	424.37		-29%					
CO ₂ (Exc. net LULUCF)	561.22	552.76	539.04	488.18	506.75	464.08	483.68	475.13	434.09		-27%					
CH ₄ (Inc. net LULUCF)	88.58	84.54	78.54	72.12	66.69	63.73	60.98	56.19	53.89		-61%					
CH ₄ (Exc. net LULUCF)	88.54	84.50	78.51	72.09	66.66	63.70	60.93	56.16	53.86		-61%					
N ₂ O (Inc. net LULUCF)	25.12	24.89	24.29	22.61	22.95	21.85	21.73	21.79	22.36		-55%					
N ₂ O (Exc. net LULUCF)	24.27	24.06	23.49	21.82	22.18	21.10	20.95	21.06	21.64		-56%					
HFCs	14.08	14.54	15.04	15.77	16.69	15.21	15.77	16.15	16.40		14%					
PFCs	0.39	0.29	0.27	0.20	0.29	0.42	0.26	0.32	0.28		-83%					
SF ₆	0.88	0.84	0.68	0.59	0.69	0.61	0.58	0.48	0.47		-63%					
NF ₃	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		-4%					
Total (Inc. net LULUCF)	683.19	670.11	649.74	591.25	605.44	556.79	573.81	560.68	517.77		-35%					
Total (Exc. net LULUCF)	689.38	676.98	657.03	598.65	613.25	565.12	582.17	569.31	526.73		-34%					

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(Excluding LULUCF)	Base year (2016 inventory)	2013	2014	Base Year - 2014
CO2	595.7	475.1	434.1	-27%
CH4	137.5	56.2	53.9	-61%
N2O	48.8	21.1	21.6	-56%
HFCs	19.1	16.2	16.4	-14%
PFCs	0.6	0.3	0.3	-53%
SF6	1.3	0.5	0.5	-63%
NF3	0.0	0.0	0.0	-52%
Grand Total	802.9	569.3	526.7	-34%
Article 3.3		-2.1	-2.4	
Article 3.4 Forest Management removals and HWP compared to FMRL (capped)		-3.8	-3.5	
Article 3.7	0.209			
Kyoto Protocol Total	803.2	563.4	520.9	-35%

2.3 Selected base year for NF₃

The UK has selected 1995 as the base year for nitrogen trifluoride in accordance with the choice under Article 3(8bis) of the Doha Amendment to the Kyoto Protocol.

2.4 Agreement under Article 4

The UK has agreed to fulfil its commitments under Article 3 of the Kyoto Protocol jointly as part of the European Union. The legal basis for this agreement is Decision 2015/1339/EC concerning the conclusion, on behalf of the European Community, of the Doha Amendment to the Kyoto Protocol to the United Nations Framework Convention on Climate Change and the joint fulfilment of commitments thereunder. The monitoring and implementation arrangements are set out in Regulations (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change.

2.5 Calculation of UK's assigned amount

As set out in the EU Council Decision (2015/1339/EC) on the conclusion of the Doha Amendment to the Kyoto Protocol to the United Nations Framework Convention on Climate Change and the joint fulfilment of commitments thereunder, the emission level of the UK (before application of Article 3(7bis)) in terms of tonnes of carbon dioxide equivalent for the second commitment period under the Kyoto Protocol is 2,743,362,625 tonnes CO₂ eq.

This figure corresponds to the sum of the annual emission allocations for the UK for 2013 to 2020 determined pursuant to Decision No. 406/2009/EC of the European Parliament and of the Council⁵. This amount, based on global warming potential values from the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, was determined under Annex II to Commission Decision 2013/162/EU⁶ and adjusted by Commission Decision 2013/634/EU⁷.

However, given that land-use change and forestry constituted a net source of greenhouse gas emissions in our 1990 base year, we must add the aggregate anthropogenic carbon dioxide equivalent emissions by sources minus removals by

⁵ Decision No. 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020 (OJ L 140, 5.6.2009, p. 136).

⁶ Commission Decision 2013/162/EU of 26 March 2013 on determining Member States' annual emission allocations for the period 2013 to 2020 pursuant to Decision No 406/2009/EC of the European Parliament and of the Council, OJ L 90/106, 28.3.2013.

⁷ Commission Implementing Decision 2013/634/EU of 31 October 2013 on the adjustments to Member States' annual emission allocations for the period from 2013 to 2020 pursuant to Decision No 406/2009/EC of the European Parliament and of the Council, OJ L 292/19, 1.11.2013.

sinks in 1990 from land-use change (deforestation)⁸ in the UK to this figure to calculate our total assigned amount for the second commitment period of the Kyoto Protocol. This aggregate value for the UK in 1990 is calculated to be 246,048 tonnes CO₂eq. This figure is unchanged with the confirmation of the UK's final territorial scope for the second commitment period as there is a lack of suitable activity data in the LULUCF sector in the base year for Bermuda.

UK Assigned Emissions Level	+	(UK Aggregate Land-use Change Emissions in 1990	x	EU second commitment period emissions reduction target (-20%)	x	Total years of the second commitment period
2,743,362,625	+	(246,048 tonnes CO ₂ eq	x	0.80)	x	8
= 2,744,937,332 tonnes CO ₂ eq.						

Since 1 tonne of CO₂ equivalent equals one assigned amount unit, the UK's assigned amount for the second commitment period is calculated to be:

= 2,744,937,332 assigned amount units (AAUs)

The calculation pursuant to Article 3(7ter) of the Kyoto Protocol shall apply to the joint assigned amount of the second commitment period for EU Member States determined in accordance with Article 3 (7bis), (8) and (8bis) of the Kyoto Protocol and the sum of the average annual emissions of EU Member States for the first three years of the first commitment period multiplied by eight. This figure can be found in the Initial Report submitted by the European Commission.

3. Calculation of the UK's commitment period reserve

In accordance with decision 11/CMP.1, paragraph 6, and decision 1/CMP.8, paragraph 18, 'each Party included in Annex I shall maintain, in its national registry, a commitment period reserve which should not drop below 90 per cent of the Party's assigned amount calculated pursuant to Article 3(7) and (8) of the Kyoto Protocol, or 100 per cent of eight times its most recently reviewed inventory, **whichever is lowest**.

Therefore the UK's commitment period reserve is calculated as:

Either

UK's Adjusted Assigned Amount	x	90%
2,744,937,332	x	0.90
= 2,470,443,599 assigned amount units		

Or

⁸ Decisions adopted by the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol. FCCC/KP/CMP/2015/8/Add.1. (Annex 1, Section I, Part B, p. 10).

2014 Total Emissions	x	Total years of the second commitment period
520,869,455	x	8
= 4,166,955,640 assigned amount units		

The lower of the two numbers is that calculated as 90 per cent of the UK's assigned amount.

The UK's Commitment Period Reserve is therefore **2,470,443,599 tonnes of CO₂ equivalent (or assigned amount units)**.

4. Land use, land use change and forestry

4.1 Election of activities under Article 3(4)

Article 3(4) of the Kyoto Protocol, as elaborated by decision 2/CMP.7, now allows Parties flexibility to choose Cropland Management, Grazing Land Management, Wetland Drainage and Rewetting, and Revegetation towards meeting commitments. All Parties must account for any activity elected in the first commitment period (in the UK's case, forest management), but otherwise electing new activities is not mandatory. For the second commitment period of the Kyoto Protocol the UK elects Cropland Management, Grazing Land Management, and Wetland Drainage and Rewetting, as activities under Article 3.4. The UK does not elect Revegetation. The eligible land area for Revegetation within the UK is estimated to be very small, and therefore the associated potential sink will be very small also. The accounting of Forest Management (formerly elective) has become mandatory for the second commitment period under the Kyoto Protocol.

The UK supports a move to full accounting for greenhouse gas emissions and removals; expanding the scope of covered sectors improves transparency, encourages a wider range of mitigation activities and creates economic efficiencies. In the land sector, expanding coverage encourages better management of greenhouse gases in peatland ecosystems and agricultural lands.

4.2 Accounting choice under Article 3(3) and (4)

The UK intends to account for Article 3(3) and 3(4) LULUCF activities, as elaborated by decision 2/CMP.7, for the entire commitment period, rather than annually. This is because the periodic nature of forest and land cover means that a more detailed and accurate assessment, based on the best possible data, will be possible at the end of the second commitment period. There is also current and planned research and methodological development for the newly elected Article 3(4) activities, which will enable complete accounting at the end of the commitment period.

4.3 Forest management reference level under Article 3(4)

Article 3(4) of the Kyoto Protocol, as elaborated by decision 2/CMP.7 and decision 2/CMP.8, makes Forest Management a mandatory activity for the second commitment period.

The original Forest Management Reference Level (FMRL) to be applied by the UK, as set out in the appendix to the annex to decision 2/CMP.7, was -3.442 Mt CO₂ eq/yr, or when applying first order decay function for harvested wood products is -8.268 Mt CO₂ eq/yr. The projections that the FMRL was based upon were constructed using inventory data, age class structure and current management practice in accordance with the UK forestry standard and its supporting guidelines. These can be accessed via www.forestry.gov.uk. The projections for the FMRL were methodologically consistent with those published in the UK's 4th and 5th National Communications, and with the Submission by Belgium and the European Commission on behalf of the European Union and its Member States to the UNFCCC dated 23 July 2010. No additional allowance was made for projected additional use of bioenergy.

As part of the UK's 2016 National Inventory Report the UK has calculated a technical correction (TC) to the FMRL (see Annex E), which is -9.275 Mt CO₂ eq/yr, or -5.658 Mt CO₂ eq/yr when applying first order decay function for harvested wood products. Removals from Forest Management above this FMRL can be accounted for, up to a limit of 3.5 % of UK base year emissions excluding LULUCF.

4.4 Calculation of harvested wood product emissions under Article 3(3) and (4)

A description of the methodology is given in the UK's FMRL submission (2011), attached as Annex C to this report. The UK has used the approach required by Decision 2/CMP.7 for the 2nd Commitment Period and the Technical Correction to the Forest Management Reference level referred to in Section 4.3 above.

4.5 Application of natural disturbances provisions under Article 3(3) and (4)

In accordance with decision 2/CMP.7, paragraph 33 the UK hereby indicates that it will use the provision to exclude emissions from natural disturbances with respect to Article 3(3) (Afforestation and Reforestation) and Article 3(4) (Forest Management), should significant disturbance events occur during the second Commitment period that meet the requirements for exclusion.

Information on the background level of emissions associated with natural disturbance events, and included implicitly within the reference level for Forest Management, is given below and summarised in Table 4.2 and Table 4.3. The

disturbance events given include those that are thought to pose the greatest potential risks to UK forest carbon stocks. Past disturbance events have been reviewed in the context of a changing climate⁹, while the potential risks from geological disturbance are also considered¹⁰.

Country-specific information on the background level of emissions associated with annual natural disturbances

Forest management in the UK has evolved to cope with disturbance events, notably windstorms, wildfires and extreme weather events with guidance and decision support systems in place.

Wildfire: Although the climate of the UK does not generally expose forests to excessive wildfire risk, wildfire is included on the National Risk Register and significant area of forest (up to the low thousands of hectares) can be lost to wildfire in extreme years.

Insect pest and disease infestation: The UK has been subject to an increasing number of pest and disease introductions over the past two decades. In most cases, the impacts have been characterised by reduced growth rates and low levels of mortality within stands. However, two current disease outbreaks *Chalara fraxinea* on ash and *Phytophthora ramorum* on larch could lead to significant stand mortality and the need for phyto-sanitary felling.

Extreme weather – Windstorm: Forest management in the UK has evolved to reflect the stormy nature of its climate due to the UK's location on the seaboard of the Atlantic Ocean, with the rotation length of upland forestry determined by stand height and the ability to withstand windstorms. Windstorm events are generally characterised by the loss of individual trees and groups of trees within stands, rather than the catastrophic loss of whole stands. However, there have been exceptions to this historically, though outside of the calibration period. Most recently, an estimated 3.9 million cubic metres of timber was damaged in a storm across southern England in 1987. Previous storms in 1953 (north-east Scotland), 1968 (west Highlands and the central belt of Scotland) and 1976 (Wales, the Midlands and East Anglia) resulted in an estimated loss of 4.1 million cubic metres of timber.

Extreme weather – drought: In the UK, the choice of forestry species for planting takes the ability to withstand drought episodes into account and experience suggests that the level of mortality associated with a single summer drought event is limited. The main impacts are generally early senescence and reduced growth in the year of the drought and, often, subsequent years. Even in the best documented 'drought

⁹ Forestry Commission (2002). Climate Change: Impacts on UK Forests. Bulletin 125. Forestry Commission, Edinburgh.

¹⁰ Defra (2005). The threat posed by tsunami to the UK.

<http://archive.defra.gov.uk/environment/flooding/documents/risk/tsunami05.pdf>

years' (1976 and 1995), stand level mortality was not observed and GHG emissions are likely to have been limited.

Extreme weather – flood: It is considered highly unlikely that due to the relatively small-scale of UK catchments and their floodplains that flood events would be of such extent or ferocity to lead to widespread forest mortality and associated emissions.

Extreme weather – heavy, wet snow/ice: Significant ice-storm events have not been recorded in the UK. Likewise, the impact of heavy, wet, snowfall events is not considered significant as experience in the UK indicates that they damage forest crowns rather than causing widespread mortality.

Geological disturbance: The UK is not subject to volcanic eruptions and earthquakes are rare and of very low magnitude. It's location on the Atlantic seaboard means that there is a risk of a low frequency high impact flood event (tsunami).

Information on how the background levels have been estimated, and on how to avoid the expectation of net credits or net debits during the commitment period, including through the use of a margin, where a margin is needed

As disturbance events are generally considered to be part of the forest management cycle in the UK, monitoring mechanisms have not yet been established to provide comprehensive, geo-referenced, data on disturbance events. However, a number of data-sets have been accessed which, together with expert judgement, have allowed background levels and margins for Forest Management and Afforestation and Reforestation to be established, following the methodology set out in Chapter 2 of the 2013 Kyoto Protocol Supplement of the 2006 IPCC Guidelines.

The timeframes covered by the individual data-sets do not overlap in all cases, with the longest continuous data-set being 2000 to 2013 (for windstorms), which is taken as the calibration period. Where data are not available for individual disturbance categories, data-filling has used the mean over their individual calibration periods. Assumptions concerning salvage logging (see details under individual disturbance categories, below) has allowed emissions associated with salvage-logging to be excluded from the background emissions.

The avoidance of net credits/debits during the accounting period has been achieved through establishing a margin of twice the standard deviation of the sum of emissions resulting from each of the disturbance categories over the calibration period, both for Forest Management and Afforestation and Reforestation, separately. Monitoring of disturbance events in the future will also be more robust than the data-sets over calibration period, ensuring that all disturbances are geo-referenced and excluded from Forest Management, Afforestation or Reforestation activities for the duration of the Commitment Period, if the disturbance provision is enacted.

Emissions resulting from disturbance events (after the exclusion of emissions from salvage-logging) have been estimated on the basis of instantaneous oxidation.

Assumptions: For Forest Management, carbon stocks and thus emissions (per hectare) are estimated on the basis of mean carbon stocks for conifers (295 tCO₂e/ha) and broadleaves (298 tCO₂e/ha), respectively, reported by the National Forest Inventory¹¹. With the exception of wildfire events (see below) carbon stocks associated with Afforested and Reforested land are assumed to be 20% of those of Forest Managed land, reflecting their younger growth phase.

Background disturbance emissions and margin: The background emissions estimated for disturbance events over the calibration period for Forest Management and Afforestation and Reforestation are set out below:

Table 4.1: The background emissions estimated for disturbance events over the calibration period for Forest Management and Afforestation and Reforestation

	Background Level (ktCO ₂ e/yr)	Margin (ktCO ₂ e/yr)	Disturbance provision threshold (ktCO ₂ e/yr)
Forest Management	270	112	382
Afforestation and Reforestation	34.9	18.8	54
Forestland	307	132	440

Wildfire: Annual emissions from wildfire on Forest Management and Afforestation and Reforestation land are reported explicitly in the UK's LULUCF GHG inventory. These data have been used for the calibration period. 45% of biomass is assumed to be burned, with no distinction made between total carbon stocks on Forest Management and Afforestation and Reforestation land. Wildfire is apportioned to Forest Management and Afforestation and Reforestation on the basis of the ratio between the two forest categories. Salvage-logging is not assumed to occur on land affected by wildfire.

More detailed data are currently recorded by the UK Fire and Rescue Services and reported in Forestry Statistics. This data-set would be used if the disturbance provision was implemented during the second commitment period.

Plant health: Statutory Plant Health Notices (SPHNs) are issued for some regulated¹² pest and disease infestations, requiring felling and, in some cases, imposing movement restrictions on the timber. Data are available for the period 2010-2014 in Forestry Statistics¹³. Restocking is not required following issuance of

¹¹ Forestry Commission (2014a). Carbon in live woodland trees in Britain. National Forest Inventory Report. [http://www.forestry.gov.uk/pdf/fcnfi113.pdf/\\$FILE/fcnfi113.pdf](http://www.forestry.gov.uk/pdf/fcnfi113.pdf/$FILE/fcnfi113.pdf)

¹² Plant Health (Forestry) Order (2005). <http://www.legislation.gov.uk/uksi/2005/2517/contents/made>

¹³ Forestry Commission (2014d). Forestry Statistics 2014.

an SPHN; however it is strongly encouraged, supported by grant-aid and experience to date indicates that more than 99% of the area has been restocked either by planting or natural regeneration. 80% of the SPHN area is allocated to Forest Management and 20% to Afforestation and Reforestation (expert judgement), with 80% salvage-logging assumed for Forest Management land and 20% for Afforestation and Reforestation land.

Other monitoring and surveillance is used to report on the presence of specific pests and diseases (see <http://www.forestry.gov.uk/pestsanddiseases>). However, the area affected and the level of mortality are not reported. Further surveillance is provided through the field survey associated with the National Forest Inventory across approximately 3,000 one hectare sample squares per annum.

Extreme weather – windstorm: The Forestry Commission maintains detailed records of land cover and use across the 250,000 ha of land it manages in England. The area of forest reported as entering the ‘windblown category’ each year between 2000 and 2013, separately for conifer and broadleaf woodland, has been used as the source data for the calibration period. These data have been extrapolated to all UK woodland, on a proportion basis. It is assumed that Afforestation and Reforestation land is not affected by windstorm due the young age of the forest, with all emissions from Forest Management land. 80% salvage-logging is assumed to have occurred in conifer woodland and 50% in broadleaf woodland, based on experience from the 1987 windstorm¹⁴.

Remote sensing is being deployed more extensively to monitor woodlands in the UK as part of the National Forest Inventory. If the disturbance provision was enacted to cover a major windstorm event, these data would be used to provide robust coverage, including geo-referencing across public and private woodlands, similar to analysis undertaken for a single windstorm event in 2013¹⁵.

Extreme weather – drought: Data on forest damage due to drought are not available, and it is assumed that emissions resulting from drought are included in the growth and yield models that underpin the LULUCF GHG inventory. A background level of zero has therefore been set over the calibration period. If a significant drought event occurred during the commitment period requiring that the disturbance provision was enacted, a bespoke report providing robust geo-referenced data would be elaborated.

Geological disturbance: No significant geological disturbances have occurred during the calibration period. Background emissions have therefore been set at zero.

[http://www.forestry.gov.uk/pdf/ForestryStatistics2014.pdf/\\$FILE/ForestryStatistics2014.pdf](http://www.forestry.gov.uk/pdf/ForestryStatistics2014.pdf/$FILE/ForestryStatistics2014.pdf)

¹⁴Forestry Commission (1996). Water storage of timber: Experience in Britain. Bulletin 117.

¹⁵Forestry Commission (2014e). Survey of the impact of the 2013 St. Jude's day storm on woodland in Southern England. [http://www.forestry.gov.uk/pdf/NFI_St-Judes-day-storm-damage-survey-report.pdf/\\$file/NFI_St-Judes-day-storm-damage-survey-report.pdf](http://www.forestry.gov.uk/pdf/NFI_St-Judes-day-storm-damage-survey-report.pdf/$file/NFI_St-Judes-day-storm-damage-survey-report.pdf)

Table 4.2.Background emissions for disturbance events for the calibration period 2000-2013 for Forest Management.

TOTAL AND AREA SPECIFIC EMISSIONS FROM DISTURBANCES FOR THE CALIBRATION PERIOD FOR FOREST MANAGEMENT														
Disturbance type	Inventory year during the calibration period													
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
	Total annual emissions (Gg CO ₂ e)													
Wildfires	48	65	54	46	59	110	108	95	88	77	45	52	233	54
Insect/disease	126*	126*	126*	126*	126*	126*	126*	126*	126*	126*	110	57	109	228
Windstorm	68	164	103	87	124	30	41	32	57	8	54	51	19	49
Drought**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Geological	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sum	242	355	283	259	309	266	275	253	271	211	209	160	361	326
For all land under Forest Management	Total Area (Kha)													
	2364	2360	2357	2353	2349	2345	2343	2340	2337	2333	2330	2328	2326	2324
	Area specific emissions (Mg CO ₂ e / ha)													
	0.102	0.150	0.120	0.110	0.131	0.113	0.117	0.108	0.116	0.090	0.089	0.069	0.155	0.140

*Mean disturbance specific emissions used for data filling. **Background data not available.

Table 4.3.Background emissions for disturbance events for the calibration period 2000-2013 for Afforestation and Reforestation.

TOTAL AND AREA SPECIFIC EMISSIONS FROM DISTURBANCES FOR THE CALIBRATION PERIOD FOR AFFORESTATION AND REFORESTATION														
Disturbance type	Inventory year during the calibration period													
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
	Total annual emissions (GgCO ₂ e)													
Wildfires	4	7	7	5	8	15	14	14	13	11	2	10	51	13
Insect/disease	25*	25*	25*	25*	25*	25*	25*	25*	25*	25*	22	11	22	46
Windstorm	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Drought**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Geological	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sum	29	32	32	30	33	40	39	39	38	36	24	21	73***	59
For all land under Afforestation and Reforestation	Total Area (Kha)													
	202	218	231	244	256	266	276	284	291	297	304	316	327	340
	Area specific emissions (Mg CO ₂ e / ha)													
	0.145	0.149	0.138	0.124	0.130	0.150	0.142	0.137	0.130	0.122	0.078	0.067	0.222	0.175

*Mean disturbance specific emissions used for data filling. **Background data not available. ***Excluded as outlier.

Annex A: Cross-referencing Decision 13/CMP.1 with UK information sources

Annex to Decision 2/CMP.8	Decision Text	Sources of UK information
Para 1(a)	Complete inventories of anthropogenic emissions by sources and removals by sinks of greenhouse gases (GHGs) not controlled by the Montreal Protocol, recalculated in accordance with decision 4/CMP.7 for all years from 1990, or another approved base year or period under Article 3(5), of the Kyoto Protocol, to the most recent year available, and prepared in accordance with Article 5(2), of the Kyoto Protocol, and any relevant decisions of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP) and the Conference of the Parties (COP). If the report is submitted at the same time as the submission of the Party's annual GHG inventories, only one inventory submission should be provided and both reports should be submitted in conjunction;	<p>UK NIR (1990-2014) submitted to UNFCCC under the Convention on 15 April 2016 UK CRF submitted to UNFCCC under the Convention on 15 April 2016.</p> <p>UK NIR (1990-2014) submitted to UNFCCC under the Kyoto Protocol on 15 June 2016. UK CRF (1990-2014) submitted to UNFCCC under the Kyoto Protocol on 15 June 2016.</p>
Para 1(b)	The identification of its selected base year for hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride in accordance with Article 3(8) of the Kyoto Protocol, if the Party included in Annex I did not have a quantified emission limitation and reduction target in the first commitment period, and the identification of its selected base year for nitrogen trifluoride in accordance with Article 3(8bis), of the Kyoto Protocol, for all Parties included in Annex I with a quantified emission limitation and reduction target for the second commitment period;	<p>UK's 2006 Initial Report, Part One, Section 2 and UK's 2017 revised Initial Report, Section 2</p>
Para 1(c)	The agreement under Article 4 of the Kyoto Protocol for the second commitment period, where the Party has reached such an agreement to fulfil its commitments under Article 3 of the Kyoto Protocol jointly with other Parties;	<p>Council Decision 2015/1339/EC on the conclusion, on behalf of the European Union, of the Doha Amendment to the Kyoto</p>

		Protocol to the United Nations Framework Convention on Climate Change and the joint fulfilment of commitments thereunder
Para 1(d)	The calculation of its assigned amount pursuant to Article 3(7bis), (8) and (8bis), of the Kyoto Protocol, on the basis of its inventory referred to in paragraph 1(a) above, which is due by 15 April 2016;	UK's 2017 revised Initial Report, Section 2
Para 1(e)	The calculation of its commitment period reserve in accordance with decision 11/CMP.1 or any subsequent revision thereof related to the calculation of the commitment period reserve;	UK's 2017 revised Initial Report, Section 3
Para 1(f)	The identification of its selection of single minimum values for tree crown cover, land area and tree height for use in accounting for its activities under Article 3(3) and (4), of the Kyoto Protocol, if the Party included in Annex I did not select a definition of forest for the first commitment period, together with a justification of the consistency of those values with the information that has been historically reported to the Food and Agriculture Organization of the United Nations or other international bodies, and in the case of difference, an explanation of why and how such values were chosen, in accordance with decisions 16/CMP.1 and 2/CMP.7. If the Party included in Annex I selected its forest definition for the first commitment period, the definition for the second commitment period shall be the same;	The definition used in the first commitment period can be found in the UK's 2006 Initial Report, Part One, Section 4
Para 1(g)	The identification of its election of activities under Article 3(4) of the Kyoto Protocol for inclusion in its accounting for the second commitment period, in addition to those activities under Article 3(4) of the Kyoto Protocol that were elected in the first commitment period, together with information on how its national system under Article 5(1) of the Kyoto Protocol will identify land areas associated with all additional elected activities and how the Party ensures that land that was accounted for under activities under Article 3(3) and (4) of the Kyoto Protocol in the first	UK's 2017 revised Initial Report, Section 4

	commitment period continues to be accounted for in subsequent commitment periods, in accordance with decisions 16/CMP.1 and 2/CMP.7;	
Para 1(h)	The identification of whether, for each activity under Article 3(3) and (4) of the Kyoto Protocol, it intends to account annually or for the entire commitment period;	UK's 2017 revised Initial Report, Section 4
Para 1(i)	The forest management reference level as inscribed in the appendix to the annex to decision 2/CMP.7, any technical corrections as contained in the inventory report for the first year of the second commitment period and references to those sections in the national inventory report where such information is reported consistent with the requirements of decision 2/CMP.7, annex, paragraph 14; ¹⁶	UK's 2017 revised Initial Report, Section 4
Para 1(j)	Information on how emissions from harvested wood products originating from forests prior to the start of the second commitment period have been calculated in the reference level in accordance with decision 2/CMP.7, annex, paragraph 16;	UK's 2017 revised Initial Report, Section 4
Para 1(k)	An indication of whether it intends to apply the provisions to exclude emissions from natural disturbances for the accounting for afforestation and reforestation under Article 3(3) of the Kyoto Protocol and/or forest management under Article 3(4) of the Kyoto Protocol during the second commitment period in accordance with decision 2/CMP.7, annex, paragraph 33, and any relevant supplementary methodological guidance developed by the Intergovernmental Panel on Climate Change and adopted by the CMP and the COP, including: (i) Country-specific information on the background level of emissions associated with annual natural disturbances that have been included in its forest management reference level; (ii) Information on how the background	UK's 2017 revised Initial Report, Section 4

¹⁶Parties shall include the submission pursuant to decision 2/CMP.6, paragraph 4, and the corresponding technical assessment report pursuant to decision 2/CMP.6, paragraph 5, as annexes to the report. Any technical corrections resulting from recommendations in the technical assessment report shall be reported in the inventory submission for the first year of the second commitment period.

	level(s) for afforestation and reforestation under Article 3(3) of the Kyoto Protocol and/or forest management under Article 3(4) of the Kyoto Protocol have been estimated, and information on how it avoids the expectation of net credits or net debits during the commitment period, including information on how a margin is established, if a margin is needed;	
Para 1(l)	A description of its national system in accordance with Article 5(1) of the Kyoto Protocol, reported in accordance with the "Guidelines for the preparation of the information required under Article 7 of the Kyoto Protocol", if the Party included in Annex I did not have a quantified emission limitation and reduction target in the first commitment period;	Not required for the UK in this report
Para 1(m)	A description of its national registry, reported in accordance with the "Guidelines for the preparation of the information required under Article 7 of the Kyoto Protocol", if the Party included in Annex I did not have a quantified emission limitation and reduction target in the first commitment period.	Not required for the UK in this report

Annex B: UK NIR and CRF submissions to UNFCCC in 2016

Version	Date of submission	Reason for submission
UK NIR 2016	15 April 2016	To fulfil UK GHG inventory reporting obligation to UNFCCC under the Convention
UK CRF tables 1990 to 2014	15 April 2016	To fulfil UK GHG inventory reporting obligation to UNFCCC under the Convention
UK NIR 2016	15 June 2016	To fulfil UK GHG inventory reporting obligation to UNFCCC under the Kyoto Protocol
UK CRF tables 1990 to 2014	15 June 2016	To fulfil UK GHG inventory reporting obligation to UNFCCC under the Kyoto Protocol

Annex C: Report of the technical assessment of the forest management reference level submission of the United Kingdom of Great Britain and Northern Ireland submitted in 2011

Attached

Annex D: Submission of information on forest management reference levels by United Kingdom of Great Britain and Northern Ireland in accordance with Decision 2/CMP.6

Attached

Annex E: Technical Correction of the United Kingdom's FMRL submitted with the 2016 inventory.

The FMRL submitted by the UK in 2011 was based on the 1990-2008 UK greenhouse gas inventory, since which the following data and assumptions have changed that necessitate a technical correction:

- A switch in the model used from CFlow to CARBINE – this model can represent a wider range of tree species and management practices, though the methodology of both models is consistent.
- Inclusion of the age structure of the pre-1921 forest area – the 1999 National Inventory of Woodlands and Trees is used to provide information of the age class distribution of the pre-1921 forest area.
- Change in tree growth assumptions – the information from the National Inventory of Woodlands and Trees is used to give a better indication of the mix of tree species in the UK forests and information from data on the public forest estate is used to give a better indication of the growth rate distribution by species.
- Change in the assumptions about harvesting rates – CFlow assumed all post-1921 forests were harvested according to a specific small range of rotation lengths for both broadleaves and conifers. This change in assumptions is not policy based, but based on additional information on the management practices on the public forest estate, and information about the quantity of timber harvested each year.
- Updated information on the rate of deforestation – based on administrative data on the conversion from forest as part of open habitat restoration and the building of wind farms.
- Updated approach to estimating the incidence of emissions from wildfires.

The forest management reference level for the UK was estimated using the same methodology as the UNFCCC LULUCF inventory, the Kyoto Protocol LULUCF inventory and

national projections of LULUCF emissions and removals to 2020. The methodology is described in Chapter 6 of the 2016 NIR.

The UK Greenhouse Gas Inventory approach to estimating carbon stock changes uses a carbon accounting model, CARBINE, driven by historical planting data and data on species, management practice and growth rate distributions. It is assumed that current management practices are continued into the future, and no allowance is made in the projection for changes in management practice, e.g. due to increased demand for bioenergy feedstock (which might involve shorter rotations or more intensive management of woodlands) or more widespread use application of continuous cover management (which might involve longer rotations). This also factors out the effects of post-2009 changes to policies affecting forest management.

The following pools and gases are included in the corrected FMRL: carbon stock changes in above and below ground biomass, litter, deadwood, mineral and organic soils and harvested wood products, and CO₂, CH₄ and N₂O emissions from biomass burning in wildfires.

No pools are omitted from the reference level construction and there is no double counting. The pools included in the reference level are consistent with those reported in the KP and UNFCCC LULUCF inventories. Below-ground biomass is included in the above-ground biomass pool, and deadwood is included in the litter pool.

The area under forest management between 1990 and 2020 was compiled using information of the area of forest in the National Inventory of Woodlands and Trees in 1999. This area is adjusted using information on deforestation and afforestation since 1990 and then adjusted for each year to take account of losses due to deforestation. This is the area reported under Forest Management for article 3.4 of the Kyoto Protocol.

Table 11.6 Area under forest management and emissions/removals from forest management 1990-2020

Year	Area of FM land, kha	Net CO ₂ emissions/removals from carbon stock changes, Gg CO ₂	Emissions from wildfire biomass burning, Gg CO ₂ eq	Emissions/removals from HWP, Gg CO ₂	Net emissions/removals, Gg CO ₂ eq
1990	2373	-15841	48	-851	-16644
1991	2373	-15648	83	-995	-16560
1992	2372	-15447	21	-1036	-16462
1993	2371	-15328	37	-1045	-16336
1994	2370	-15527	29	-952	-16449
1995	2369	-16065	230	-795	-16631
1996	2368	-16176	118	-837	-16896
1997	2367	-16320	155	-813	-16977
1998	2366	-16498	87	-773	-17184
1999	2363	-16403	14	-824	-17214
2000	2359	-16197	48	-1013	-17162
2001	2356	-16098	65	-989	-17022
2002	2352	-16062	54	-973	-16981
2003	2348	-16029	46	-970	-16952
2004	2344	-16008	59	-945	-16894
2005	2341	-16010	110	-923	-16824
2006	2338	-15973	108	-901	-16766
2007	2335	-15898	95	-878	-16681

2008	2331	-15762	88	-883	-16557
2009	2328	-15610	77	-886	-16420
2010	2326	-15407	45	-932	-16295
2011	2323	-15127	52	-977	-16052
2012	2320	-14752	233	-1039	-15559
2013	2317	-14325	54	-1098	-15369
2014	2315	-13872	94	-1162	-14940
2015	2312	-13521	95	-1179	-14605
2016	2309	-13076	97	-1217	-14196
2017	2307	-12606	99	-1231	-13738
2018	2304	-12114	100	-1257	-13271
2019	2301	-11680	101	-1261	-12840
2020	2298	-11284	102	-1268	-12450

Historical and projected emissions and removals from 1990 to 2020 are also shown in **Table 11.6**. These are consistent with the national GHGI, as they are based on the same activity data and use the same methods. Wildfire emissions are also shown, both historical and projected, as described in the 2016 NIR. Projections are based upon business as usual assumptions and are consistent with the approach taken in calculating the original FMRL. Projected estimates rely on the same methodology as that used for estimating historical emissions and removals.

It is assumed for the Business as Usual projection that historical management (rotation lengths and thinning regime and felling regimes) will continue in to the future, with the effect that harvesting rates are largely driven by historical planting rates. The pre-2010 policies included are the same as for the original FMRL submission. The projections used for the forest reference level are based on the methodology used for the 1990-2014 inventory. The pre-1990 woodland area is based on the National Inventory of Woodland and Trees, which assessed the state of the woodland up to 1999. This therefore excludes any policy effects from after this date. Standard management regimes are rolled forward and do not take account of any policies implemented after mid-2009.

The corrected FMRL was calculated from the average of the Business as Usual projection for the period 2013-2020 (**Table 11.6**). The Technical Correction was calculated as $FMRL_{corr} - FMRL_{orig}$ and is shown in **Table 11.7**.

Table 11.7: Forest Management Reference Levels and Technical Correction for the period 2013-2020.

	Assuming instantaneous Oxidation, Gg CO ₂ eq	With emissions/removals from HWP using first order decay functions, Gg CO ₂ eq
Submitted FMRL (FMRL_{orig})	-3442	-8268
Corrected FMRL (FMRL_{corr})	-12717	-13926
Technical Correction	-9275	-5658