

2. Inventory estimates for the Kyoto Protocol (WP 1.2)

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2.1 Introduction

CEH produced a voluntary submission of CRF tables for activities under the Kyoto Protocol (Articles 3.3 and 3.4) for submission to the UN in April 2007. Supplementary information on these tables was included in the 2007 National Inventory Report submission (Annex 10) in accordance with Decisions 15/CP.10 (FCCC/CP/2004/10/Add.2). The UK has opted to use entire commitment period accounting (2008-2012) for activities under Article 3.3 and 3.4, reporting in 2014.

Article 3.3 of the Kyoto Protocol requires Parties to account for Afforestation, Reforestation and Deforestation (ARD) since 1990 in meeting their emissions reduction commitments using a consistent forest definition. The UK definition of forest was agreed with the Forestry Commission and has the following single minimum values:

- a minimum area of 0.1 hectares;
- a minimum width of 20 metres;
- tree crown cover of at least 20 per cent, or the potential to achieve it;
- a minimum height of 2 metres, or the potential to achieve it.

These single minimum values are used for reporting UK forestry statistics (Forestry Commission, 2006) and the UK's greenhouse gas inventory submitted under the UNFCCC.

The UK has chosen to elect Forest Management (FM) as an activity under Article 3.4. For the UK, credits from Forest Management are capped in the first commitment period at 0.37 MtC (1.36 MtCO₂) per year, or 6.78 MtCO₂ for the whole commitment period.

2.2 Consistency of Kyoto Protocol reporting with UNFCCC GHGI reporting

The areas of forest land reported for AR and FM under the Kyoto Protocol equal the area reported under 5.A.2 (Land converted to Forest Land) in the UNFCCC greenhouse gas inventory. The Afforestation/Reforestation area is land that has been converted to forested land since 1990 (inclusive), while the Forest Management area is the area converted to forest land between 1921 and 1989. In the UK Land converted to Forest Land is considered to stay in that category beyond the IPCC 20 year default period in order to take account of the long term soil carbon dynamics. Deforestation since 1990 is taken to be the land area permanently converted from forest land to either grassland or settlement (conversion to cropland is estimated to be negligible based on land use surveys). All ARD and FM definitions are consistent with those used in the UNFCCC inventory and updates to methodologies over time have been back-calculated to 1990 to ensure consistency over time.

The afforestation and reforestation datasets are provided by the Forestry Commission (the national forestry agency) and are consistent with the definition of forest given above. There is an assumption of restocking after harvesting on the national estate,

although open habitat can make up 13-20% of stand area on restocking. A felling license is required for felling outside the national forest estate; there is a legal requirement to restock under such a license unless an unconditional felling license is granted (in which case this would be formally reported as deforestation). Therefore, Afforestation and Reforestation under Article 3.3 can be considered together. Information on deforestation activities is assembled from data provided by the Forestry Commission and by the Ordnance Survey (the national cartographic agency) through the UK government. To the best of knowledge, these definitions have been applied consistently over time, although larger uncertainty is associated with deforestation as compared with afforestation.

2.3 Land-related information

2.3.1 Spatial assessment unit used

The spatial assessment units used for the voluntary submission of the Kyoto Protocol CRF tables in April 2007 are the four countries of the UK: England, Scotland, Wales and Northern Ireland. A methodology for reporting using units of 20 x 20km grid cells (Figure 2-1) is in development. In this draft method, the location of ARD and FM land will be statistically determined for the 852 grid cells covering the UK (GPG LULUCF Reporting Method 1). Each 20x20km cell has a unique identification code produced from the coordinates of the lower left corner of the cell (using the Ordnance Survey British National Grid projection and the Northern Irish grid projection for Northern Ireland cells).

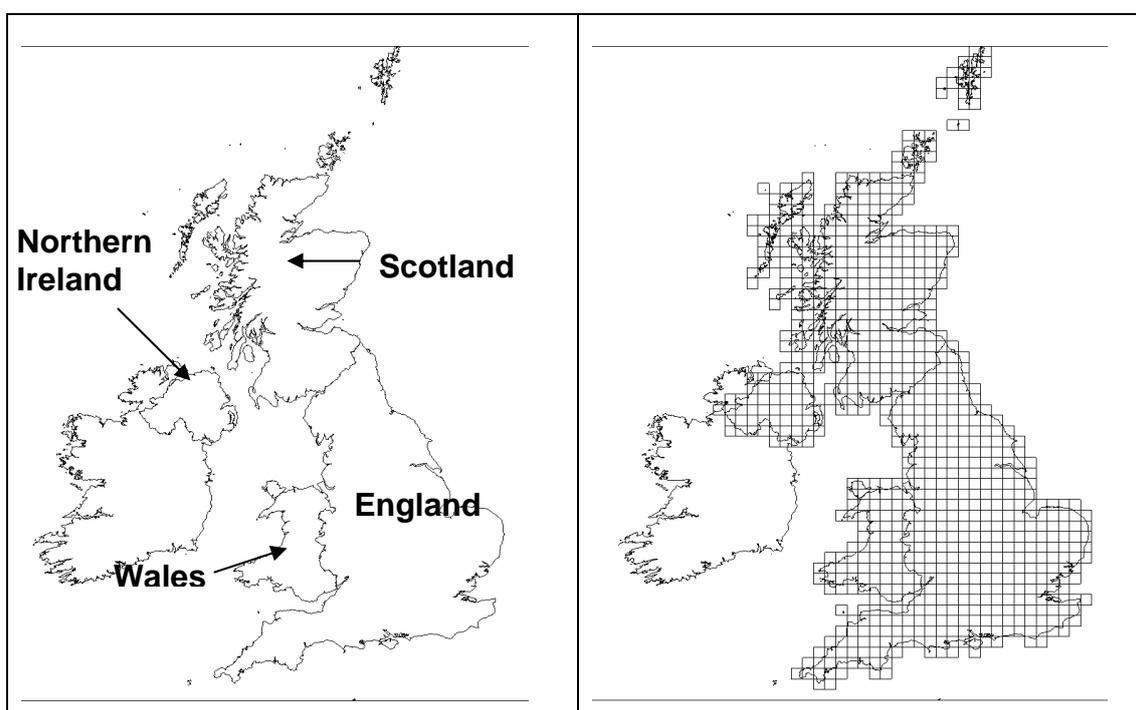


Figure 2-1: Spatial units used for reporting Kyoto protocol LULUCF activities: (left) the four countries of the UK, (right) 20 x 20km grid cells covering the UK.

2.3.2 Methodology used to develop the land transition matrix

Several datasets are either available, or will become available, for the assessment of ARD and FM activities in the UK (Table 2-3). The UK GHGI currently uses the

national planting statistics from 1921 to the present, which are provided by the Forestry Commission and the Northern Ireland Forest Service for each of the countries in the UK. This data is used for the estimation of AR and FM in the LULUCF tables. Estimates of Deforestation are made using the Unconditional Felling Licences and the Land Use Change Statistics (LUCS), a survey of land converted to developed use.

The relationship between the currently used datasets and the land transition matrix is shown in Table 2-1. With current methods it is not possible to assess the split in the Deforestation area between areas under Afforestation/ Reforestation and Forest Management although it is reasonable to assume that there will be little Deforestation on areas afforested since 1990. The relationship between data sources and the proposed land transition matrix at the 20km grid scale is shown in Table2 -2.

Table 2-1: Land transition matrix using national datasets

From \ To	Article 3.3		Article 3.4
	Afforestation/ Reforestation	Deforestation	Forest Management
Afforestation/ Reforestation	New planting since 1990 (national planting statistics).	Not estimated at present.	
Deforestation		Unconditional felling licences/LUCS	
Forest Management		Unconditional felling licences/LUCS	Forest planted 1921-1989 (national planting statistics) and NIWT.

Table2 -2: Proposed land transition matrix with the 20km grid for end of commitment period accounting

From \ To	Article 3.3		Article 3.4
	Afforestation/ Reforestation	Deforestation	Forest Management
Afforestation/ Reforestation	1990-1995: national planting statistics, spatially distributed in proportion to NIWT data on planting in 1990s. 1995-2012: FC management database and grant-aided woodland database.	Comparison between NIWT and NIWT2 forest cover map. Unconditional felling licences.	
Deforestation		NIWT vs. NIWT2 forest cover map.	
Forest Management		NIWT vs. NIWT2 forest cover map. Unconditional felling licences	Use NIWT and NIWT2.

Table 2-3: Data sources on ARD and FM activities (additional data sources may become available in the future)

Activity	Dataset	Available scale	Time period	Details
AR & FM	Annual planting statistics	Country (England, Scotland, Wales, Northern Ireland)	1921-present	New planting on previously non-forested land. Updated annually. Categorized into conifer and broadleaved woodland.
AR	Grant-aided woodland database	Local administrative unit/NI counties	1995-present	Private woodland planted with grant aid since 1995. Categorized into conifer and broadleaved planting.
AR & FM	Forestry Commission management database	20km grid cells	1995-present	Database of state woodland planting since 1995, indicating the rotation (1st rotation will be Afforestation, 2nd or greater rotations are restocking). Categorized by species.
AR & FM	National Inventory of Woodland and Trees (NIWT)	20km grid cells (sample statistics)	1995	Grid cell database includes the area and planting decade of each species within the grid cell. A digital map of woodland over 2ha is also available.
ARD, FM	NIWT2	20km grid cells (sample statistics)	Planned for 2009-2017	Update of the 1995 NIWT. A partial repeat of the grid cell analysis should be available by 2013. An update of the digital map will be available, initially from 2009, which can be used to assess deforestation since NIWT1.
D	Forestry Commission Unconditional Felling Licence data	England only (data from other countries should become available)	1990-2002	Unconditional Felling Licences are issued for felling without restocking. Used to estimate deforestation in rural areas (primarily for heathland restoration). English data is extrapolated to GB scale and to current reporting year. Omits felling for development purposes, e.g. construction of wind turbines.
D	Land Use Change Statistics (survey of land converted to developed uses)	England only (data from other countries should become available)	1990-2003 (updated in 2007)	Estimates of the conversion of forest to urban/developed land use. Based on Ordnance Survey map updates, identifying changes through aerial surveys and other reporting, expected to capture most changes within five years. English data is extrapolated to GB scale and to current reporting year.

2.4 Activity-specific information

Carbon uptake by UK forests is estimated by the carbon accounting model, C-Flow, as described in the Forest Land section in Chapter 1. The model estimates the net change in pools of carbon in standing trees, litter and soil in conifer and broadleaf forests and in harvested wood products. All pools and fluxes are included although the below-ground biomass and dead wood carbon pools are currently not reported separately but included in the soil and litter carbon pools respectively. It should be possible to modify the C-Flow model so that it produces estimates for these carbon pools for future reporting.

The area included in Forest Management only includes those areas of forest that were newly planted between 1921 and 1990 (1394 kha or c.50% of the UK forest area). The area of forest established before 1920 (c. 820 kha) is reported in the CRF for the national greenhouse gas inventory but is assumed to be in carbon balance, i.e. zero flux. Uncertainty as to the management and date of first establishment of pre-1921 woodlands (which are predominantly broadleaf) makes it difficult to estimate appropriate model parameters. The omission of pre-1920 forests will have no effect on the number of credits that the UK can claim under Article 3.4, as these are capped for the first commitment period.

Emissions from fertilization and liming of forest land are not currently estimated. Applications of fertilizer and lime since 1990 are estimated by the Forestry Commission to be negligible due to economic factors. A methodology for estimating emissions of N₂O from the spreading of sewage sludge on forest land is under consideration (see Chapter 6). Emissions of N₂O from areas in Forest Management due to the drainage of soils are not currently estimated, although a methodology is under development (also in Chapter 6).

At present, emissions of greenhouse gases due to biomass burning are only estimated for Deforestation. Hopefully, biomass burning will diminish as the use of woodfuel as a source of bioenergy becomes more commonplace. Damage to existing forests by accidental fires (fire resulting from natural causes is very rare) is not a serious problem in the UK (Forestry Commission, 2002). Data on the occurrence of fires are available for state-owned woodland to 2004, but not for privately-owned woodland. The Forestry Commission is apparently investigating the possibility of enhanced reporting of woodland fires from 2007-2008 as one of its indicators of sustainable forestry. It can be assumed that wildfires will not result in permanent deforestation. This area will be kept under review, and a methodology for emission estimation will be developed once improved data becomes available.

2.5 Article 3.3

Under the current methodology, the Forestry Commission and the Forest Service of Northern Ireland provide annual data on new planting (on land that has not previously been forested). This information is provided for each country in the UK and the time series extends back before 1990. Data are provided for both state and private woodlands: the private woodland planting is divided between grant-aided and non-grant-aided. Estimates of non-grant-aided woodland planting and restocking are reported annually, for inclusion in planting statistics, although the Forestry Commission have doubts about their completeness and accuracy. Their assessment is that non-grant-aided new woodland has arisen by natural regeneration and is all broadleaved. This assumption can be verified against the NIWT2 at a later date. Only state and grant-aided woodland areas are currently included in the assessment of Article 3.3 activities as these are directly human-induced.

Under the proposed method, the grant-aided woodland database and the Forestry Commission management database will be used to estimate areas of Article 3.3 activities. These data have

currently been provided for 1995 to the latest year available (2006) and will be updated annually. Preliminary comparisons have shown good agreement between these data sources and the national planting statistics. It may be possible to extend the FC management database back to 1990 but the grant-aided database is incomplete before 1995. The time-series gap between 1990 and 1995 will be filled by taking the national planting statistics and distributing them between the 20km grid cells in proportion with the distribution of post-1990 planting age woodland in the NIWT (this work has been done – see Chapter 7).

The data sources used for estimating Deforestation do not allow for confusion between harvesting or forest disturbance and deforestation. The unconditional felling licences used for the estimation of rural deforestation are only given when no restocking will occur, and the survey of land converted to developed use describes the conversion of forest land to the settlement category, which precludes re-establishment. The NIWT2, which will be partially completed by the end of the first commitment period, will be used to verify deforestation estimates made using these data sources.

Restocking is assumed for forest areas that have lost forest cover through harvesting or forest disturbance, unless there is deforestation as described above. As such, information on the size and location of forest areas that have lost forest cover is not explicitly collected. However, it should be possible to assess such areas through the comparison of the NIWT and NIWT2 at the end of the first commitment period.

Projections of emissions/removals associated with ARD since 1990 have been using the scenarios described in Chapter 4. These projections are presented for Mid, Low and High emission scenarios for the UK, England, Scotland, Wales and Northern Ireland in Appendix 4 and in Figure 2-2.

2.6 Article 3.4

Countries could elect to use net sinks within Forest Management, Cropland Management, Grassland Management and/or Revegetation to offset emissions within the first commitment period (2008-2012). The UK elected to use only Forest Management in January 2006, as the uncertainties associated with estimating emissions and removals due to Cropland and Grassland Management were considered to be too large for the purposes of achieving acceptable emission reductions under the Protocol (Revegetation is not relevant in the UK context).

All managed forests (planted between 1921 and 1989) are included in the Forest Management category. The C-Flow model is used to calculate emissions from this forest area after 1990 that have arisen from thinning, harvesting and restocking. A current research project is examining the impact of management upon carbon stock changes in UK forests in more detail (Work Package 2.3). The removals of carbon dioxide by land under Forest Management predicted to 2020 for the Mid scenario are shown in Figure 2-3. Removals exceed the cap for all years except 2020.

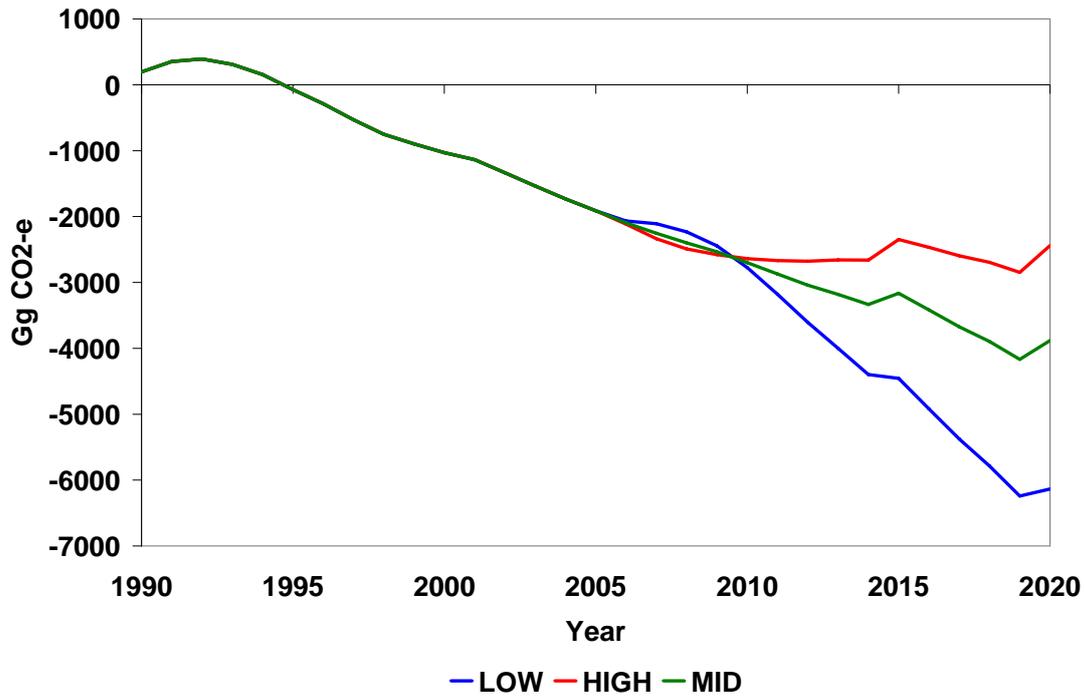


Figure 2-2: Kyoto Protocol Article 3.3: Net flux associated with post-1990 ARD for the Mid, Low and High emission scenarios

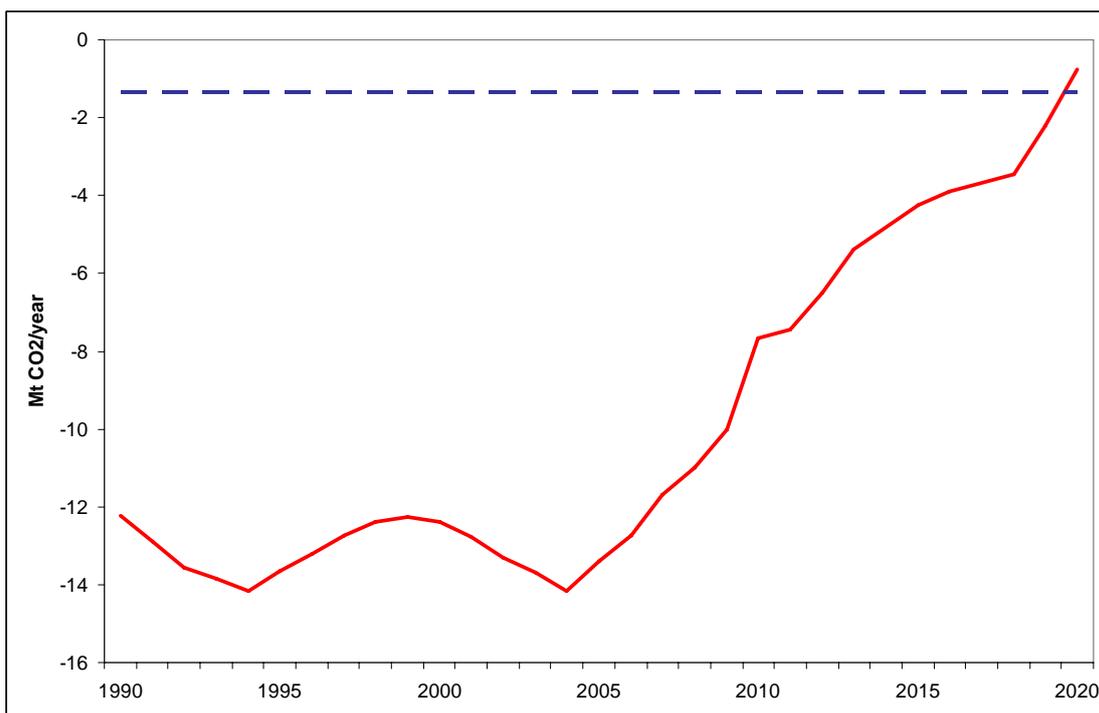


Figure 2-3: Kyoto Protocol Article 3.4: Removals and emissions associated with Forest Management for the MID scenario. The UK cap of -0.37 MtC/year (-1.36 Mt CO₂ eq.) is shown by the broken line.

Forest Management under the Protocol is defined as a system of practices for stewardship and use of forest aimed at fulfilling relevant ecological, economic and social functions of the forest in a sustainable manner. The UK has a system of certification for sustainable woodland management under the Forest Stewardship Council (FSC). Forest statistics published in 2006 by the Forestry Commission record that 73% of softwood removals in 2005 were from certified sources. Such removals will almost entirely come from post-1920 conifer woodland reported under Forest Management. The management practices in certified woodlands are

reviewed annually. All state-owned forests are certified and an increasing proportion of non-state-owned woodlands are becoming certified. The total certified area in March 2006 was 1233 kha (Forestry Commission, 2006). This does not include all woodland that is managed in a sustainable manner, such as smaller or non-timber producing woodlands where certification is not considered worthwhile. In particular, it may omit many broadleaved woodlands even though they are managed for their social and environmental benefits (Forestry Commission, 2002). In the UK's country report to the Global Forest Resource Assessment 2005 (FAO, 2005) 83% of UK forests are managed for production, 18% are managed for conservation of biodiversity (these have protected status) and 55% have a social service function (public access).

2.7 Article 3.7

Under Kyoto Protocol Article 3.7 countries with a net emission in 1990 from the LULUCF Sector must count that part of the emission due to deforestation for estimating "Base Year Emissions". These "Base Year Emissions" then become the basis for the emission allowance for that country during the first commitment period (2008-2012). In 1990 the UK LULUCF Sector is estimated to have been a net emitter, therefore Article 3.7 applies. The deforestation emission in 1990 has been taken to be that associated with all deforestation prior to and including 1990. For 1990 the immediate emissions due to biomass removal and burning are relevant but there will also be delayed soil carbon stock change resulting from deforestation in earlier years. The estimate of deforestation emissions in 1990 in the 2004 GHG Inventory (the estimate used in the Assigned Amount) was 366 Gg CO₂-equivalent (including CH₄ and N₂O emissions). The estimate of 1990 deforestation emissions in the 2005 inventory is 332 Gg CO₂-equivalent, as revisions in the deforestation activity data have affected estimates of emissions. However, this change will not affect the UK's Assigned Amount which is fixed to the 2004 inventory estimate.