



Department for  
Business, Energy  
& Industrial Strategy

# UK LULUCF Action Progress Report

Progress on actions in the Land Use, Land Use Change and Forestry (LULUCF) sector.  
Submitted to the European Commission pursuant  
to Article 10 of Decision 529/2013/EU

December 2016

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## Executive Summary

As required by Article 10(4) of Decision 529/2013/EU this report describes the United Kingdom's progress in implementation of its chosen Land Use, Land Use Change and Forestry (LULUCF) greenhouse gas (GHG) mitigation actions. This updates the information previously submitted to the European Commission in January 2015 pursuant to Articles 10(1) and 10(2), which require that Member States submit information on the most relevant current and future LULUCF actions being taken in Member States for all LULUCF categories.

The actions include those aimed at limiting or reducing GHG emissions, and maintaining or increasing GHG removals resulting from Afforestation, Reforestation and Deforestation (ARD), Forest Management (FM), Cropland Management (CM), Grazing Land Management (GM), Wetland Drainage and Rewetting (WDR), and Revegetation (RV) as defined in Articles 3(1), 3(2) and 3(3) of the Decision.

In accordance with Article 10(1), the UK submitted the LULUCF actions as an addendum to the Carbon Plan – the UK's Low Carbon Development Strategy – on 9<sup>th</sup> January 2015. The UK estimates emissions/removals from the LULUCF sector through the national inventory, reported annually under the UNFCCC and its Kyoto Protocol and the EU Monitoring Mechanism (EUMM). The Climate Change Act 2008 requires the UK to set five-year Carbon Budgets to reduce emissions by at least 80% in 2050 and the Carbon Plan

detailed how the UK will meet current and future legislated budgets. The Fifth Carbon Budget (2027 to 2032) was set in legislation in July 2016 and requires the UK to reduce emissions by at least 57% below the level in 1990. The historical inventory for LULUCF also provides a basis for projections of the LULUCF sectoral emissions in support of the UK Climate Change Act's requirement that the UK Government set Carbon Budgets.

The UK has moved from being a net source of carbon dioxide (CO<sub>2</sub>) from LULUCF activities in 1990 to a net sink for all years since 1991. The land use categories which have the greatest effect on the net LULUCF emissions/removals are Forest Land and Grassland (net sinks) and Cropland (a net source). Forest Land has become a decreasing sink since 2010 due to much of the large area of productive forest planted in the 1950s to 1980s maturing and being harvested, together with the relatively low rates of afforestation since 1990. Emissions from Cropland are estimated to have decreased while removals from Grassland have increased. Compared to CO<sub>2</sub>, emissions of methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) are relatively low in this sector.

A forest carbon accounting model, CARBINE, is used to estimate the net change in pools of carbon in living biomass, litter and soil in conifer and broadleaved forests. Research is being conducted to allow a more accurate estimation of the effects of grassland management practices and WDR on net emissions from soils.

The UK produces LULUCF emissions projections each year. The projections used here are based on data from the 2016 GHG inventory (covering the period 1990 to 2014). The projections indicate that the LULUCF sector will be a net sink of approximately 12 Mt CO<sub>2</sub>eq/year in 2020. The Forestry, Cropland, Grassland and Settlement categories dominate the trend.

Work to assess the mitigation potential in the sector has been carried out by the Forestry Commission (forest sector) and Defra (grassland and cropland soil carbon stocks). In 2014, BEIS commissioned work to investigate the possible magnitude, direction and trends in emissions and removals resulting from WDR.

The Committee on Climate Change (CCC) advises UK Government on how the UK's commitments to GHG mitigation targets can be met. The CCC has adopted a bottom-up marginal abatement cost curve (MACC) approach to help advise on setting appropriate Carbon Budgets.

An economy wide MACC was developed by Government as part of the process for setting the Fifth Carbon Budget in 2016, including both peatland restoration and afforestation.<sup>1</sup> Current work indicates that woodland creation has a relatively high mitigation potential in relation to other forestry measures. Reducing deforestation has a medium mitigation potential although in many cases abatement would be difficult to deliver due to environmental policy conflicts. Improving forest management has a relatively low mitigation potential.

The majority of the potential abatement identified in the GHG projections arises from woodland creation (Kyoto Protocol activities Afforestation and Reforestation). The nature of the woodland planted determines the level of abatement, the timeframe over which

abatement is delivered and the contribution to abatement delivered in other sectors including through providing a renewable energy feedstock. Unmanaged woodland, particularly on productive sites, will generally make the largest contribution to LULUCF removals, but will make no contribution to abatement in other sectors.

For Cropland and Grassland, recent UK research indicates that there are few measures that could be implemented to reliably achieve significant emissions reductions or increased removals without impacting production. These measures could include: increasing the land area under perennial crops (with limited possibility for the UK); increasing the use of set aside; improving grassland; and altering grassland rotation patterns. Peatland restoration (rewetting) has been identified as a measure to reduce greenhouse gas emissions, although the amount of abatement that can be achieved is still being investigated.

Since the first Action Report was submitted in 2015, the UK and its devolved administrations have made progress in a number of ways, as follows:

## United Kingdom

- Completion in 2016 of the pilot phase of the Peatland Code – a UK Voluntary Code to encourage and support private sector funding for peatland restoration projects.

## England

- Natural England's Strategic Approach to the Restoration of Blanket Bog – published in 2015.
- £100m capital funding investment in projects to support the natural environment over the next five years, including the restoration of peatlands.

<sup>1</sup> DECC (2016) Impact Assessment for the level of the Fifth Carbon Budget. [http://www.legislation.gov.uk/ukia/2016/177/pdfs/ukia\\_20160177\\_en.pdf](http://www.legislation.gov.uk/ukia/2016/177/pdfs/ukia_20160177_en.pdf)

- The forthcoming 25-Year Environment Plan, which will set out England's long term plans for environmental policy and will help to target this resource in the right places.
- Woodland Creation Planning Grant – to support the planning of woodlands larger than 30 ha to help break down the perceived barrier that the UK's regulatory framework presents in England.
- Woodland Carbon Fund – to support the planting of woodlands larger than 30 ha, with a significant productive element.

## Northern Ireland

- The Northern Ireland Rural Development Plan (RDP) was approved by the European Commission in August 2015.
- The Department of Agriculture, Environment and Rural Affairs' (DAERA) new agri-environment scheme, the Environmental Farming Scheme (EFS), is planned to open for applications in February 2017.

## Scotland

- The Scottish Government and Scottish Natural Heritage (SNH) consulted on a National Peatland Plan in 2014 and the final plan was published in August 2015.
- Through the SNH-led Peatland Action initiative 10,000 hectares of peatlands have been restored since 2013.

# Introduction

## Purpose of the UK LULUCF Action Progress Report

Pursuant to Article 10(4) of Decision 529/2013/EU<sup>2</sup> this report provides an update to the European Commission (EC) on progress on the United Kingdom's Land Use, Land Use Change, and Forestry (LULUCF) mitigation actions.

On 9th January 2015, the United Kingdom (UK) submitted an Action Report, as required under Article 10(1) of Decision 529/2013/EU to provide the EC specified information, no later than 18 months after the beginning of each accounting period, on its current and future LULUCF actions to limit or reduce emissions and maintain or increase removals resulting from LULUCF. This information was provided as an addendum to the UK National Low-Carbon Development Strategy.

## Development of the UK LULUCF Action Progress Report

The UK's LULUCF Action Report (2015) was developed by the Department of Energy and Climate Change (DECC) in close collaboration with the Devolved Administrations (DAs) – Scotland, Wales and Northern Ireland, the

Department for Environment, Food & Rural Affairs (Defra) and the Forestry Commission. Similarly, this Action Progress Report has been coordinated by the Department for Business, Energy and Industrial Strategy (BEIS), with inputs from these organisations.

## Structure of the LULUCF Action Progress Report

The UK's LULUCF Action Report (2015) was organised into 6 sections and this Action Progress Report follows the same structure:

**Chapter 1** provides a general overview of national circumstances on LULUCF with a particular focus on Afforestation, Reforestation and Deforestation (ARD), Forest Management (FM), Cropland Management (CM), Grazing Land Management (GM) and also relevant information on Wetland Drainage and Rewetting (WDR).

**Chapter 2** outlines past emissions and removals for the LULUCF sector with some emphasis on the key categories and land management types for CM, GM and FM activities.

**Chapter 3** outlines projections for the LULUCF sector and by land use category (with or without measures) up to 2020.

**Chapter 4** provides an analysis of the potential to limit or reduce emissions/removals for the LULUCF sector (an assessment of mitigation potential).

<sup>2</sup> Decision No 529/2013/EU of the European Parliament and of the Council of 21 May 2013 on accounting rules on greenhouse gas emissions and removals resulting from activities relating to land use, land-use change and forestry and on information concerning actions relating to those activities. <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013D0529&from=EN>

**Chapter 5** outlines the list of measures which could be implemented to achieve emissions reductions in the LULUCF sector under UK conditions (not limited to indicative measures specified in Annex IV of LULUCF Decision 529/2013/EU).

**Chapter 6** discusses the identification of existing policies and measures and their impacts (including semi-quantitative or qualitative description of the effects of measures on emissions/removals). It provides updated information on the range of action being undertaken in the UK's LULUCF sector.

## Strategic context

Articles 10(1) and 10(2) of Decision 529/2013/EU require that Member States submit information on the most relevant current and future LULUCF actions being taken in Member States for all LULUCF categories. The actions include those aimed at limiting or reducing GHG emissions, and maintaining or increasing GHG removals resulting from Afforestation, Reforestation and Deforestation (ARD), Forest Management (FM), Cropland Management

(CM), Grazing Land Management (GM), Wetland Drainage and Rewetting (WDR), and Revegetation (RV) (as defined in Articles 3(1), 3(2) and 3(3)). The UK opted to submit the LULUCF actions in 2015 as an addendum to the Low-Carbon Development Strategy.

In tandem with Decision 529/2013/EU, the Regulation on the mechanism for monitoring and reporting (MMR) of greenhouse gases No 525/2013/EU<sup>3</sup> also entered into force on 8 July 2013. It streamlines and enhances the legal basis for the Monitoring and Verification procedures for Member States'

<sup>3</sup> Regulation No 525/2013/EU of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change. It replaces the earlier legislative act, Decision No 280/2004/EC of the European Parliament and of the Council of 11 February 2004 concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol.

<sup>4</sup> Following Decision 2/CMP.7.

<sup>5</sup> Mandatory for those Member States which elected the activity in the first commitment period.

### Box 1: Status of LULUCF activities under the KP and the EU Decision

Activity	KP-LULUCF 1st commitment period	KP-LULUCF 2nd commitment period <sup>4</sup>	Decision 529/2013/EU	Relevant article of Decision 529/2013/EU
Afforestation/ Reforestation	Mandatory	Mandatory	Mandatory	Article 3(1)
Deforestation	Mandatory	Mandatory	Mandatory	Article 3(1)
Forest Management	Elective	Mandatory	Mandatory	Article 3(1)
Cropland Management	Elective	Elective <sup>5</sup>	Mandatory from 2021	Article 3(2)
Grazing Land Management	Elective	Elective <sup>3</sup>	Mandatory from 2021	Article 3(2)
Wetland Drainage and Rewetting	Not applicable	Elective <sup>3</sup>	Elective	Article 3(3)
Revegetation	Elective	Elective <sup>3</sup>	Elective	Article 3(3)

annual GHG inventories and for assessing efforts towards meeting emissions targets under the Kyoto Protocol (KP). The new MMR integrates requirements linked to the LULUCF reporting categories whilst building on existing common processes for gathering and publishing Member States' information on GHG projections as well as the policies and measures already in place to reduce emissions.

In addition to the Article 10 reporting requirements, there are requirements of Member States to provide updates on progress with the systems in place and estimates of GHG emissions and removals in relation to Cropland Management and Grazing Land Management under Article 3 of the Decision. Box 1 provides an overview of the main reporting and accounting requirements for all the LULUCF categories, as set out under Article 3.

During the first commitment period of the KP the UK elected FM and did not elect CM, GM and WDR. However, for the second commitment period the UK has elected to report and account for all three activities. The UK has a good basis for estimating emissions/removals from the LULUCF sector through the national inventory submitted under the UNFCCC and KP. The historical inventory for LULUCF also provides a basis for projections for the LULUCF sector up to 2050 under the UK Climate Change Act – UK Carbon Budgets. The way land is used and managed has the potential to contribute positively to climate change mitigation. However, as emissions associated with agriculture and forestry depend on many external factors such as weather, water or soil conditions, there is a high level of uncertainty in some of the emissions and removals estimates. Therefore it is often difficult to assess the potential of individual climate-related policies and measures.



# Chapter 1: A general overview of national circumstances on LULUCF

This chapter provides an overview of the UK national circumstances with regards to reporting of emissions/removals in the LULUCF sector. This builds on existing systems in place under the UNFCCC and the Kyoto Protocol and information presented here is consistent with the 6th UK National Communication submitted to the UNFCCC.

## National Circumstances

### Climate profile

The UK's climate is maritime; moist and temperate, with a moderate annual temperature range. Average annual precipitation in the UK typically ranges from approximately 600 mm to 1,400 mm. The UK climate is heavily influenced by its proximity to the Atlantic Ocean and the Gulf Stream/North Atlantic Drift which brings warm water into high northern latitudes. Prevailing winds are westerly, and so the UK regional climates vary with distance from the Atlantic as well as topography. Continental influences are most strongly seen in the southeast of the country.

The climate affects crop systems, grasslands and forestry. Crop losses and other impacts on grasslands have been identified due to flooding and coastal erosion.<sup>6</sup>

<sup>6</sup> DECC (2013). The UK's Sixth National Communication and First Biennial Report under the UNFCCC. [http://unfccc.int/files/national\\_reports/annex\\_i\\_natcom/submitted\\_natcom/application/pdf/uk\\_6nc\\_and\\_br1\\_2013\\_final\\_web-access\[1\].pdf](http://unfccc.int/files/national_reports/annex_i_natcom/submitted_natcom/application/pdf/uk_6nc_and_br1_2013_final_web-access[1].pdf)

### Forestry profile

According to forestry statistics, the area of woodland in the UK is 3.16 million hectares (ha) as of 31st March 2016. Of this total, 1.44 million ha (45%) are in Scotland, 1.31 million ha (41%) are in England, 0.31 million ha (10%) are in Wales and 0.11 million ha (4%) are in Northern Ireland. This has changed relatively little over the period 2007 to 2011. State forests account for 0.86 million ha.<sup>7</sup>

Around 1.6 million ha (51%) of the total UK woodland area is made up predominantly of conifer species, the remainder being broadleaved. The total area of new planting and restocking in the UK was 19 thousand ha in 2015-16. Restocking accounted for 71% of this total. Broadleaved species accounted for 65% of the new planting area but just 26% of the restocked area in 2015-16.<sup>8</sup>

A total of 10.8 million green tonnes of softwood was produced in the UK in 2015. UK hardwood production totalled 0.5 million green tonnes in 2015.<sup>9</sup> Softwood availability in Great Britain is projected to increase from an annual average of 16.5 million green tonnes over the

<sup>7</sup> Forestry Commission (2016) Forestry Statistics 2016. [http://www.forestry.gov.uk/pdf/Ch1\\_Woodland\\_FS2016.pdf/\\$FILE/Ch1\\_Woodland\\_FS2016.pdf](http://www.forestry.gov.uk/pdf/Ch1_Woodland_FS2016.pdf/$FILE/Ch1_Woodland_FS2016.pdf)

<sup>8</sup> Forestry Commission (2016) Forestry Statistics 2016 – Woodland area and planting. [http://www.forestry.gov.uk/pdf/Ch1\\_Woodland\\_FS2016.pdf/\\$FILE/Ch1\\_Woodland\\_FS2016.pdf](http://www.forestry.gov.uk/pdf/Ch1_Woodland_FS2016.pdf/$FILE/Ch1_Woodland_FS2016.pdf)

<sup>9</sup> Forestry Commission (2016) Forestry Statistics 2016 – Wood production. [http://www.forestry.gov.uk/pdf/Ch2\\_Timber\\_FS2016.pdf/\\$FILE/Ch2\\_Timber\\_FS2016.pdf](http://www.forestry.gov.uk/pdf/Ch2_Timber_FS2016.pdf/$FILE/Ch2_Timber_FS2016.pdf)

period 2013-2016 to 17.2 million green tonnes over the five-year period 2017 to 2021 and 18.4 million green tonnes from 2027 to 2031. Apparent consumption of wood in the UK amounted to 55.6 million m<sup>3</sup> wood raw material equivalent in 2015, made up of 10.6 million m<sup>3</sup> UK production, 49.1 million m<sup>3</sup> imports and 4.1 million m<sup>3</sup> exports.<sup>10</sup>

In the UK, 83% of forests are managed for production, 18% are managed for conservation of biodiversity and 4% are for public access.<sup>11</sup>

## Agriculture profile

The total area of agricultural land in the UK in 2014 was around 18.5 million ha.<sup>12</sup> About 4.9 million ha of this was under crops (including uncropped arable land), of which around 65% was under cereal production. 11.1 million ha is currently under grass (temporary, permanent and sole right rough grazing). The remainder was common rough grazing, other land (roads, paths, buildings, etc.) or farm woodland.

<sup>10</sup> Forestry Commission (2016) Forestry Statistics 2016 – Trade. [http://www.forestry.gov.uk/pdf/Ch3\\_Trade\\_FS2016.pdf/\\$FILE/Ch3\\_Trade\\_FS2016.pdf](http://www.forestry.gov.uk/pdf/Ch3_Trade_FS2016.pdf/$FILE/Ch3_Trade_FS2016.pdf)

<sup>11</sup> FAO (2010). Global Forest Resources Assessment 2010 Main Report. <http://www.fao.org/docrep/013/i1757e/i1757e.pdf>

<sup>12</sup> Defra (2015). Farming Statistics: Final crop areas, yields, livestock populations and agricultural workforce. At June 2015 – United Kingdom. [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/486326/structure-jun2015final-uk-17dec15.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/486326/structure-jun2015final-uk-17dec15.pdf)

<sup>13</sup> Defra (2016). UK land areas, livestock numbers and agricultural workforce on agricultural holdings on 1 June. <https://www.gov.uk/government/statistical-data-sets/structure-of-the-agricultural-industry-in-england-and-the-uk-at-june>

Table 1-1 Total crop areas in the UK 2011-2014 (thousand hectares)<sup>14</sup>

Area of arable crops		2011	2012	2013	2014
<b>Total area of arable crops</b>		<b>4,497</b>	<b>4,576</b>	<b>4,502</b>	<b>4,559</b>
of which:	wheat	1,969	1,992	1,615	1,936
	barley	970	1,002	1,213	1,080
	oats	109	122	177	137
	rye, mixed corn & triticale	27	26	24	26
	oilseed rape	705	756	715	675
	linseed	36	29	34	15
	potatoes	146	149	139	141
	sugar beet (not for stockfeeding)	113	120	117	116
	peas for harvesting dry and field beans	155	120	147	139
	maize	164	158	194	183
<b>Total area of horticultural crops</b>		<b>175</b>	<b>172</b>	<b>163</b>	<b>164</b>
of which:	vegetables grown outdoors	129	123	116	116
	orchard fruit	24	24	23	23
	soft fruit & wine grapes	10	9	10	9
	outdoor plants and flowers	11	12	12	12
	glasshouse crops	2	3	3	3

The crop area increased by 2% between 2011 and 2014 while the area of uncropped arable land increased by 3%.

The total crop areas in the UK from 2011 to 2014 are presented in **Table 1-1**.

The production of biomass based non-food crops is increasing but is still a small percentage of overall cropland. In April 2012, the UK Bioenergy Strategy was published, which encourages the production of biomass. In August 2013, there were 11,000 ha of land approved for planting with energy crops<sup>6</sup>.

In 2014, 66% of the total agricultural area was grassland. There are three main types of grassland:

- Rotational grassland: intensively managed “grass leys” sown every few years as part of a crop rotation. This type of grassland can be used for fodder production and livestock grazing. (Equivalent to temporary grassland in the UK Survey of Agriculture.)
- Permanent pasture: grassland maintained perpetually without reseeding. In the UK this has mostly been created by draining or fertilising rough grazing land. (Equivalent to grass over 5 years old in the UK Survey of Agriculture.)
- Rough grazing: uncultivated grassland found in upland and heath areas of the UK. Used for extensive livestock grazing. (Equivalent to sole right and common rough grazing in the UK Survey of Agriculture.)

## Reporting of the LULUCF sector in the GHG inventory

The UK annually reports emissions and removals from the LULUCF sector under the UNFCCC and the Kyoto Protocol (KP). In the UK, three principal organisations are involved in estimating and reporting emissions and removals from the LULUCF sector: Ricardo Energy & Environment (Ricardo-EE), the UK

Natural Environment Research Council’s Centre for Ecology and Hydrology (CEH) and Forest Research. CEH compiles estimates of emissions and removals from the LULUCF sector, with assistance from Forest Research, using national data sources on land use and management. Ricardo-EE provides support on Quality Assurance and co-ordinates the reporting of the UK’s GHG emission inventory.

The UNFCCC basis for reporting of emissions and removals from the LULUCF sector includes all human-induced changes to land-based carbon stocks and GHG (CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O) emissions from land use and land use change. This is undertaken for six land use categories – Forest Land (5A), Cropland (5B), Grassland (5C), Wetlands (5D), Settlements (5E), Other land (5F) and Harvested Wood Products (5G).

Reporting of carbon stock changes from land use change is complete and reporting of GHG emissions and removals from non-forest land management in the LULUCF sector is approaching completion. The UK is conducting research into the effects of land management on LULUCF sector emissions and removals, and the results of this will be included in future inventories in order to move towards a more comprehensive GHG reporting and accounting system by 2020 (see **Table 1-2**).

The EU Decision requires, as a minimum, information relating to each of the activities referred to in Article 3(1), 3(2) and 3(3). The specific activities that the decision refers to are Kyoto Protocol activities: Afforestation (A), Reforestation (R), Deforestation (D), Forest Management (FM), Cropland Management (CM) and Grazing Land Management (GM). The activities of Revegetation and WDR remain voluntary and the UK has chosen to elect and report emissions/removals from WDR.

The sections below set out the accounting requirements for the LULUCF sector emissions and removals under the KP, and the reporting requirements under the UNFCCC.

Table 1-2 Timetable of implementation of LULUCF inventory improvements

Inventory development projects	Estimated date of implementation
Defra project SP1113 on impact of cropland and grassland management on soil carbon	2015 (Cropland Management)
BEIS project on impact of cropland and grassland management on biomass carbon	2015-18
BEIS project on implementing the IPCC 2013 Wetlands supplement: Feasibility study on reporting of WDR	2019
Development of stock change factors for reporting of Grazing Land Management	2018
BEIS project on applying Earth Observation to assess land use change	2020
Integration of outputs from above research projects into LULUCF Inventory	2015 onwards

## KP Forestry Activities: Afforestation, Reforestation, Deforestation and Forest Management

The UK currently reports net emissions and removals from Afforestation/Reforestation, Deforestation and Forest Management under the KP in the UK National Inventory Report. The UK definition of forest is consistent between the UNFCCC reporting and the KP reporting, and the entire forest area is considered as managed rather than unmanaged land.

The areas of forest land accounted for in A/R and FM under the KP are broadly equivalent to the area reported under 4A Forest Land in the UNFCCC reporting<sup>14</sup>. Carbon stock changes are reported for above- and below-ground biomass, litter (including deadwood), mineral and organic soils and harvested wood products. Greenhouse gas sources are

reported for N<sub>2</sub>O from forest fertilisation, N<sub>2</sub>O emissions from drained forest soils and N mineralisation following land use change, and CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions from biomass burning in wildfires. Carbon stock changes dominate net emissions from the A/R and FM activities.

The area accounted for under Deforestation is the land area converted from forests to cropland, grassland and settlements since 1990. Carbon stock changes are reported for above- and below-ground biomass, litter (including deadwood) and soils. Harvested wood products are assumed to be instantaneously oxidised following deforestation. Greenhouse gas sources are reported for N<sub>2</sub>O emissions from N mineralisation following land use change and CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions from controlled biomass burning during deforestation and a small area of wildfires on previously deforested land. Carbon stock changes and biomass burning are the main source of net emissions from this activity.

Emissions and removals from forestry are modelled using the Tier 3 CARBINE forest carbon accounting model (Forest Research). The model uses area/age-class information from the UK's National Forest Inventory and

<sup>14</sup> DECC (2016). UK Greenhouse Gas Inventory, 1990 to 2014, Brown P, Broomfield M, , Buys G, Cardenas L, Kilroy E, MacCarthy J, Murrells T, Pang Y, Passant N, Ramirez Garcia J, Thistlethwaite G, Webb N. [https://uk-air.defra.gov.uk/assets/documents/reports/cat07/1605241007\\_ukghgi-90-14\\_Issue2.pdf](https://uk-air.defra.gov.uk/assets/documents/reports/cat07/1605241007_ukghgi-90-14_Issue2.pdf)

Forestry Commission planting statistics.<sup>15</sup> This is combined with forest stand-level yield tables on stand structure and growth. CARBINE can be used to estimate historical, current and future forest carbon stocks under different forest area and management scenarios. The CARBINE model is described in the 1990-2014 National Inventory Report (NIR). CARBINE takes account of losses of Forest Land converted to other categories and the associated carbon stock changes and emissions and removals are then estimated and reported under the category concerned.

Activity data on Deforestation are compiled from Forestry Commission felling licence data, historical estimates of land use change from forestry and estimates of forest conversion from the National Forest Inventory<sup>16</sup> (see the NIR for further details). The activity data for the GHG sources are the same as those used in the CARBINE model, with a Tier 1 methodology applied to estimate emissions.

The strength of the carbon sink in forests is determined by the afforestation rate in earlier decades and the effect this has on the age structure and average growth rates of existing forests (with forest management typically operating over rotations of 40-120 years). Forest land is currently a decreasing sink due to much of the large productive area planted in the 1950s to 1980s maturing and being harvested, together with low rates of afforestation since the 1990s.<sup>6</sup>

Nitrogen fertilisers (relevant to emissions of N<sub>2</sub>O) are only applied to forests when it is absolutely necessary. This would occur during the first rotation on 'poor' soils, such as reclaimed slag heaps, impoverished brown field sites and upland organic soils. In terms of the inventory, this means that nitrogen fertilisation is assumed for areas of Settlements converted to Forest Land and Grassland converted to Forest Land on organic soils. Nitrogen fertilisers are not generally applied to native woodlands, mature forests or re-planted forests in the UK. No lime (relevant to emissions of CO<sub>2</sub>) is applied to established or newly planted forests in the UK. In England, lime may be applied to land deforested to cropland.

Drainage of forest land occurs in UK forests planted on certain soils types. Controlled burning of forest land (for example for habitat management) does not take place in the UK. Wildfires do occur, but to a limited extent on account of the generally moderate to high rainfall in the northern and western UK, and it is assumed that land use change does not occur following wildfire.

### KP Agricultural Activities: Cropland Management

Cropland Management (CM) is defined as a system of practices on land on which agricultural crops are grown, and on land that is set-aside or temporarily not being used for crop production. CM includes all lands under annual and perennial crops, and all fallow lands set at rest for one or several years before being cultivated again<sup>17</sup>. The UK has elected to report this activity for the second commitment period of the Kyoto Protocol.

Carbon stock changes for above-ground biomass and soils, and GHG emissions from wildfires and N mineralisation due to carbon losses associated with land-use conversions and management change are reported for

<sup>15</sup> Forestry Commission (2016) Forestry Statistics 2016 – Woodland area and planting. <http://www.forestry.gov.uk/website/forstats2016.nsf/LUContentsTop?openview&RestrictToCategory=1>

<sup>16</sup> Forestry Commission (2016) Preliminary estimates of the changes in canopy cover in British woodlands between 2006 and 2015. [http://www.forestry.gov.uk/pdf/Preliminary\\_estimates\\_of\\_the\\_changes\\_in\\_canopy\\_cover\\_in\\_British\\_woodlands\\_between\\_2006\\_and\\_2015.pdf/\\$FILE/Preliminary\\_estimates\\_of\\_the\\_changes\\_in\\_canopy\\_cover\\_in\\_British\\_woodlands\\_between\\_2006\\_and\\_2015.pdf](http://www.forestry.gov.uk/pdf/Preliminary_estimates_of_the_changes_in_canopy_cover_in_British_woodlands_between_2006_and_2015.pdf/$FILE/Preliminary_estimates_of_the_changes_in_canopy_cover_in_British_woodlands_between_2006_and_2015.pdf)

<sup>17</sup> FCCC/CP/2001/13/Add.1. 21 January 2002. Page 58. <http://unfccc.int/resource/docs/cop7/13a01.pdf>

KP Cropland Management. These can result from both land use change and cropland management activities and are estimated using the same methods for reporting of UNFCCC category 4B Cropland. The area of KP Cropland Management is estimated by combining annual agricultural census data and information from the land use change matrices (derived from the Countryside Survey). Additional activity data on different cropland management practices come from fertiliser and farm practice surveys<sup>18</sup>.

Carbon stock changes due to land use change are estimated using the Tier 3 land use change matrix-soil carbon model for the UK and GHG emissions from wildfires and N mineralisation are estimated using Tier 1 methods (see Annex 3.4 in the 1990-2014 NIR). Change in soil carbon stocks due to Cropland Management is estimated using the Tier 2 methodology developed in Defra project SP1113<sup>19</sup> which reviewed UK relevant literature on the effects of cropland management practices on soil carbon stocks and attempted to model UK specific emission factors. Change in cropland biomass carbon stocks was assessed based on agricultural census data on the areas under

different crop types and UK-specific biomass stock factors. Biomass carbon stock change was assumed to occur in the year in which the change in crop type was reported. Cropland biomass stock changes resulting from land use change to or from Cropland were subtracted from the changes due to change in cropland management. The methodology is also used for the UNFCCC inventory reporting and is described fully in the 1990-2014 NIR.

### KP Agricultural Activities: Grazing Land Management

Grazing Land Management (GM) is the system of practices on land used for livestock production aimed at manipulating the amount and type of vegetation and livestock produced<sup>20</sup>. The UK has elected this activity for the second commitment period of the Kyoto Protocol.

Carbon stock changes due to land use change are estimated using the Tier 3 land use change matrix-soil carbon model for the UK and GHG emissions from wildfires and N mineralisation are estimated using Tier 1 methods (see Annex 3.4 in the 1990-2014 NIR). Only biomass stock changes due to grassland management activities are included for KP Grazing Land Management, as it has not been possible to develop appropriate emission factors for UK soils. Defra project SP1113 suggested that Tier 1 emission factors for emissions and removals as a result of changing soil carbon stocks due to management activities on Grazing Land may not be appropriate for high carbon organo-mineral soils which are present under large areas of rough grazing land in the UK, and further research has been commissioned by BEIS to identify suitable emission factors and activity data for these systems. As a result, soil carbon stock changes for Article 3.4 Grazing Land Management are not yet reported fully but work is being done to address this.

<sup>18</sup> British Survey of Fertiliser Practice 2014 [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/419275/fertiliseruse-statsnotice-01apr15.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/419275/fertiliseruse-statsnotice-01apr15.pdf); Farm Practice Survey (England) 2010 <http://webarchive.nationalarchives.gov.uk/20130315143000/http://www.defra.gov.uk/statistics/files/FPS2010.pdf>; Scottish Survey of Agricultural Production Methods 2010 <http://www.gov.scot/Publications/2012/10/7669>; Scottish Survey of Farm Structure and Methods 2013 <http://www.gov.scot/Publications/2013/11/7625/5>

<sup>19</sup> Moxley, J., Anthony, S., Begum, K., Bhogal, A., Buckingham, S., Christie, P., Datta, A., Ulrike Dragosits, U., Fitton, N., Higgins, A., Myrriotis, V., Kuhnert, M., Laidlaw, S., Malcolm, H., Rees, B., Smith, P., Tomlinson, S., Topp, K., Watterson, J., Webb, J., Yeluripati, J. (2014) Capturing Cropland and Grassland Management Impacts on Soil Carbon in the UK LULUCF Inventory Contract Report prepared for the Department for Environment, Food and Rural Affairs Project SP1113.

<sup>20</sup> FCCC/CP/2001/13/Add.1. 21 January 2002. Page 58. <http://unfccc.int/resource/docs/cop7/13a01.pdf>

The area of Grazing Land Management reported under Article 3.4 is estimated from Countryside Survey data using the assumption that all grassland in the UK is subject to grazing and management to some degree.

### KP Activities: Wetland Drainage and Rewetting

Wetland Drainage and Rewetting (WDR) is a system of practices for draining and rewetting on land with organic soil. The activity applies to all lands that have been drained since 1990 and to all lands that have been rewetted since 1990 and that are not accounted for under any other KP activity.

This activity was only introduced for the second commitment period. The UK has decided to elect this activity. Work is being undertaken to establish systems for reporting and accounting for WDR in the LULUCF inventory and WDR will be reported in future LULUCF inventories in preparation for the submission of WDR accounts for the period 2013-2020 under both EU and KP.

### KP Activities: Revegetation

Revegetation (RV) is a direct human-induced activity to increase carbon stocks on sites through the establishment of vegetation that covers a minimum area of 0.05 hectares and does not meet the definitions of AR. Revegetation activities are not known to occur in the UK and the UK has not elected this activity.

## Differences in the UNFCCC categories and KP accounting

### Forestry related

The UK estimates and reports emissions and removals from land transitions to forest land and from forest management activities. Full methodological details are provided in the UK NIR. As stated above, the area of forest land accounted for in Afforestation and Forest Management are broadly equivalent

to the area reported under category 4A in the UNFCCC inventory. The UK's LULUCF inventory allows the estimation of land use type following deforestation.

### Mapping of KP activities to UNFCCC categories (KP Supplement 2013)

UNFCCC Land use categories	Kyoto Protocol activities
Cropland converted to Forest Land	
Grassland converted to Forest Land	3.3. Afforestation and Reforestation
Wetlands, Settlements and Other land converted to Forest Land	
Forest Land converted to Cropland, Grassland, Wetlands, Settlements and Other land	3.3. Deforestation
Forest Land remaining Forest Land	3.4 Forest Management

### UNFCCC Cropland category and KP Cropland Management activity

Under UNFCCC reporting, the 4B Cropland category includes estimates of carbon stock change as a result of land conversion to cropland and emissions from historical land use change in the cropland remaining cropland category.<sup>21</sup> Soil and biomass carbon stock changes from cropland management are also reported. GHG emissions from drainage of organic soils, N<sub>2</sub>O emissions from N mineralisation following land use change and emissions from biomass burning during deforestation and non-CO<sub>2</sub> emissions from wildfires on cropland are included. CO<sub>2</sub>

<sup>21</sup> IPCC (2006) 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan. Volume 4: Agriculture, Forestry and Other Land Use. Section 5.6. <http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html>

emissions from wildfires on cropland are assumed to be recaptured within a year by new plant growth.

Definitions of cropland are shared between the UNFCCC Cropland and the KP Cropland Management categories. The main differences arise due to the hierarchical nature of KP reporting: land that has been deforested to cropland will remain in the Deforestation activity and land that has been converted from cropland to other land uses (not to forest land, or to grassland) remains in the KP Cropland Management activity.

### Mapping of KP activities to UNFCCC categories (KP Supplement 2013)

UNFCCC Land use categories	Kyoto Protocol activities
Cropland remaining Cropland	
Grassland converted to Cropland	
Wetlands, Settlements and Other land converted to Cropland	3.4 Cropland Management
Cropland converted to other land use (Wetlands, Settlements and Other land)	

### UNFCCC Grassland category and KP Grazing Land Management activity

Under UNFCCC reporting, the 4C Grassland category includes estimates of carbon stock change as a result of land conversion to grassland and emissions from historical land use change in the grassland remaining grassland category. Biomass carbon stock changes from grassland management are reported and the potential for reporting soil carbon stock changes from grassland management has been assessed, but there are currently insufficient UK-specific data to allow reporting. GHG emissions from drainage of organic soils, N<sub>2</sub>O emissions from

N mineralisation following land use change and emissions from biomass burning during deforestation and non-CO<sub>2</sub> emissions from wildfires on grassland are included. CO<sub>2</sub> emissions from wildfires on grassland are assumed to be recaptured within a year by new plant growth.

The definition of the area that falls under KP Grazing Land Management mostly matches with the UNFCCC inventory definition of grassland. Similarly to KP Cropland Management, land that has been deforested to grazing land will remain in the Deforestation activity and land that has been converted from grazing land to other land uses (not to forest land, or to cropland) remains in the KP Grazing Land Management activity.

### Mapping of KP activities to UNFCCC categories (KP Supplement 2013)

UNFCCC Land use categories	Kyoto Protocol activities
Grassland remaining Grassland	
Cropland converted to Grassland	
Wetlands, Settlements and Other land converted to Grassland	3.4 Grazing Land Management
Grassland converted to other land use (Wetlands, Settlements and Other land)	

### UNFCCC Wetlands category and KP Wetland Drainage and Rewetting activity

In the UNFCCC Wetlands category the UK reports on-site and off-site emissions from peat extraction and loss of biomass carbon on conversion to flooded land. Emissions of CO<sub>2</sub> and N<sub>2</sub>O from peat extraction account for <0.1% of total UK emissions of greenhouse gases. Work is on-going to allow the UK to develop a framework for reporting and accounting of emissions/removals from WDR



based on the methodology in the IPCC 2013 Wetlands Supplement.<sup>22</sup>

WDR was not included in the first commitment period of the KP. WDR is not comparable to the Wetlands category in the UNFCCC inventory. The KP WDR activity can include areas of organic soils under agriculture and forestry (reported under the Cropland, Grassland and Forest Land UNFCCC categories). The WDR definition clearly states that this activity is at the bottom of the KP activity hierarchy and can only apply to areas not accounted for under other KP land-use activities. Once the UK's WDR development programme is complete (in 2017) we will have a clearer understanding of the comparability of the UNFCCC and KP wetland activities.

## Key Carbon pools and Carbon sources in the various KP LULUCF categories (ARD and FM) and for CM and GM

In the UK KP GHG inventory, five categories are considered to be key in the 1990-2014 inventory (from the LULUCF Key Category Analysis):

- Article 3.3 Afforestation and Reforestation (CO<sub>2</sub>)
- Article 3.3 Deforestation (CO<sub>2</sub>)
- Article 3.4 Forest Management (CO<sub>2</sub>)
- Article 3.4 Cropland Management (CO<sub>2</sub>), and
- Article 3.4 Grazing Land Management (CO<sub>2</sub>).

These have been determined according to the IPCC 2013 Kyoto Protocol Supplement section 2.3.6. The net emissions from these activities have been compared with the main key category analysis for the latest reported year of the UK inventory (2014) based on level of emissions (including LULUCF).

Article 3.3 Afforestation and Reforestation (CO<sub>2</sub>): The associated UNFCCC category 4A (-17.37 Mt CO<sub>2</sub>) is a key category and the AR component (forest planted since 1990) is key on its own (i.e. its category contribution (-3.36 Mt CO<sub>2</sub>) is greater than the smallest UNFCCC key category (4G Harvested Wood Products). Removals from this category are also predicted to increase over time as a result of tree planting schemes partially focussed on climate change mitigation.

Article 3.3 Deforestation (CO<sub>2</sub>): The associated UNFCCC categories (4B, 4C and 4E) are key categories (11.86, -9.31 and 5.92 Mt CO<sub>2</sub> respectively), however the Deforestation category contribution (0.89 Mt CO<sub>2</sub>) to these UNFCCC categories is smaller than the smallest UNFCCC key category (4G Harvested Wood Products). The data used in the calculation of deforestation emissions are the most uncertain of the data sources in the KP-LULUCF inventory but improvements have been made in reporting.

Article 3.4 Forest Management (CO<sub>2</sub>): The associated UNFCCC category 4A is a key category (-17.37 Mt CO<sub>2</sub>). The Forest Management category contribution (-17.10 Mt CO<sub>2</sub>) is also greater than other categories in the UNFCCC key category analysis.

Article 3.4 Cropland Management (CO<sub>2</sub>): The associated UNFCCC category 4B is a key category (11.86 Mt CO<sub>2</sub>). The Cropland Management category contribution (7.27 Mt CO<sub>2</sub>) is also greater than the smallest UNFCCC key category (4G Harvested Wood Products).

<sup>22</sup> IPCC (2014) 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands, Hiraishi, T., Krug, T., Tanabe, K., Srivastava, N., Baasansuren, J., Fukuda, M. and Troxler, T.G. (eds). Published: IPCC, Switzerland <http://www.ipcc-nggip.iges.or.jp/public/wetlands/>

Article 3.4 Grazing Land Management (CO<sub>2</sub>): The associated UNFCCC category 4C is a key category (-9.31 Mt CO<sub>2</sub>). The Grazing Land Management category contribution (-2.89 Mt CO<sub>2</sub>) is also greater than the smallest UNFCCC key category (4G Harvested Wood Products)

There is insufficient information available on the emissions and removals from the WDR category to allow an assessment of whether this will also be a key category.

Estimates of the carbon contents of all Forest Land carbon pools have been published in Forestry Statistics.<sup>23</sup> Data from the National Forest Inventory, including from *Carbon in live woodland trees in Britain*,<sup>24</sup> have been used to update these estimates.

## Key sources of non-CO<sub>2</sub> emissions

No sources of non-CO<sub>2</sub> emissions under current KP reporting are considered to be key categories. Emissions of N<sub>2</sub>O are reported from fertilization of forest land (A/R), from disturbance associated with land-use change (Deforestation, Cropland Management and Grazing Land Management), and drainage of soils under forest management (FM). N<sub>2</sub>O and CH<sub>4</sub> emissions from biomass burning are reported for all relevant categories.

<sup>23</sup> Forestry Commission (2016) Forestry Statistics 2016 – UK forests and climate change. [http://www.forestry.gov.uk/pdf/Ch4\\_Climate-Change\\_FS2016.pdf/\\$FILE/Ch4\\_Climate-Change\\_FS2016.pdf](http://www.forestry.gov.uk/pdf/Ch4_Climate-Change_FS2016.pdf/$FILE/Ch4_Climate-Change_FS2016.pdf); <http://www.forestry.gov.uk/website/forstats2016.nsf/LUContentsTop?openview&RestrictToCategory=1>

<sup>24</sup> Forestry Commission (2014) 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)

## Chapter 2: Past emissions and removals from the LULUCF sector

### Overview of historical emissions and removals for the LULUCF sector

Both emissions and removals occur in this sector; Forest Land and Grassland are typically net sinks while the Cropland area is a net source.

The UK has moved from being a net source of GHG emissions from LULUCF activities in 1990 to a net sink for all years after 1991; see **Figure 2-1**.

As the LULUCF sector comprises both emissions and removals of greenhouse gases, it is inappropriate to express the change since 1990 on a percentage basis. Total estimated direct emissions/removals of greenhouse gases from the LULUCF sector fell from a source of 0.27 Mt CO<sub>2</sub>e per year in 1990 to a sink of 8.96 Mt CO<sub>2</sub>e per year in 2014. The land use categories which have the greatest effect on the net LULUCF emissions/removals are Forest Land and Grassland (net sinks) and Cropland and Settlement (net sources).

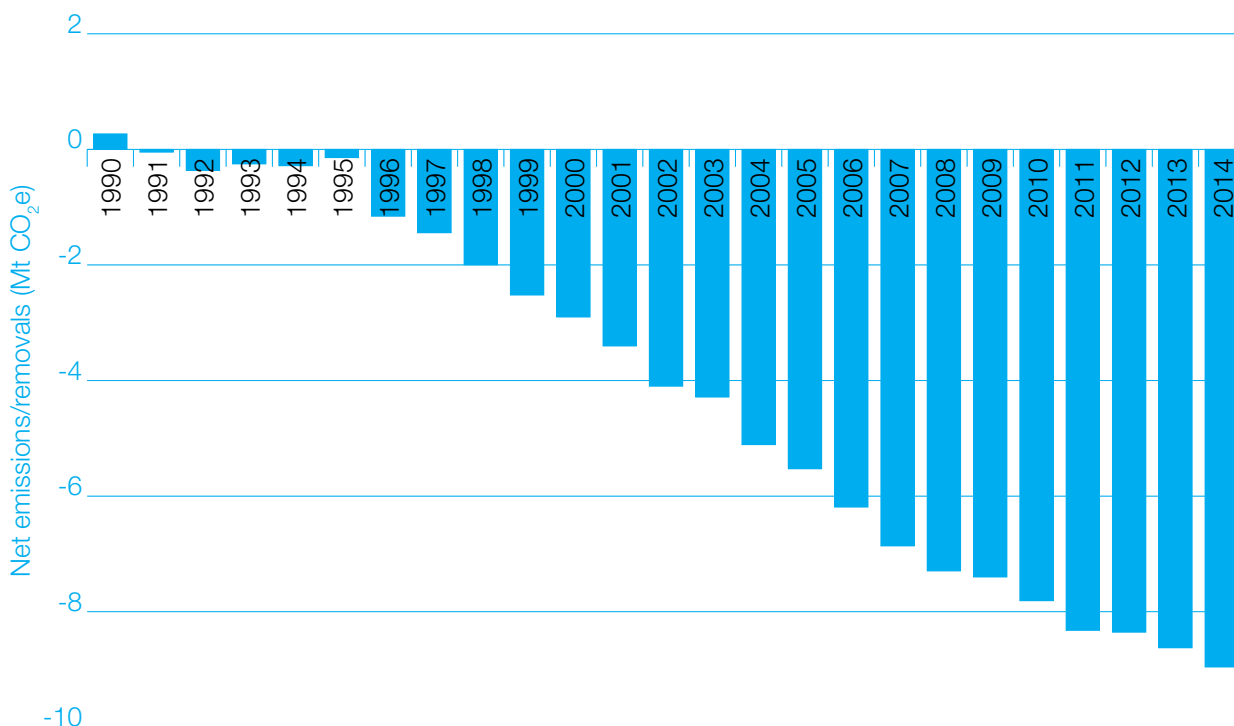


Figure 2-1 Time series of net GHG emissions and removals from the LULUCF sector, 1990-2014 (Mt CO<sub>2</sub>e)

## UNFCCC basis: historical emissions and removals from all LULUCF categories

This section provides an overview of the emissions and removals in the LULUCF sector, according to UNFCCC category.

The LULUCF sector (Sector 4 in the national GHG inventory) is divided into six land use types for reporting of emissions/removals: 4A Forest Land, 4B Cropland, 4C Grassland, 4D Wetlands, 4E Settlements, 4F Other Land. Net carbon stock changes from Harvested Wood Products are reported in 4G.

Carbon uptake associated with UK forests is calculated using CARBINE, as mentioned above under KP-LULUCF reporting.

For Cropland, Grassland and Settlements, changes in biomass and soil carbon due to land use change are estimated using a land use change matrix approach. Fluxes arising from land use change in the 20 years before the inventory year are reported under the *Land converted to* categories. Fluxes from historical land use change (more than 20 years before the inventory year) are reported under the *Land remaining Land* categories. A dynamic model of carbon stock change is used with the land use change matrices to estimate soil carbon stock changes due to land use change.

Emissions from wetlands due to peat harvesting have been developed using a Tier 1 methodology.

The time series of emissions and removals for UNFCCC categories are presented in **Figure 2-2**.

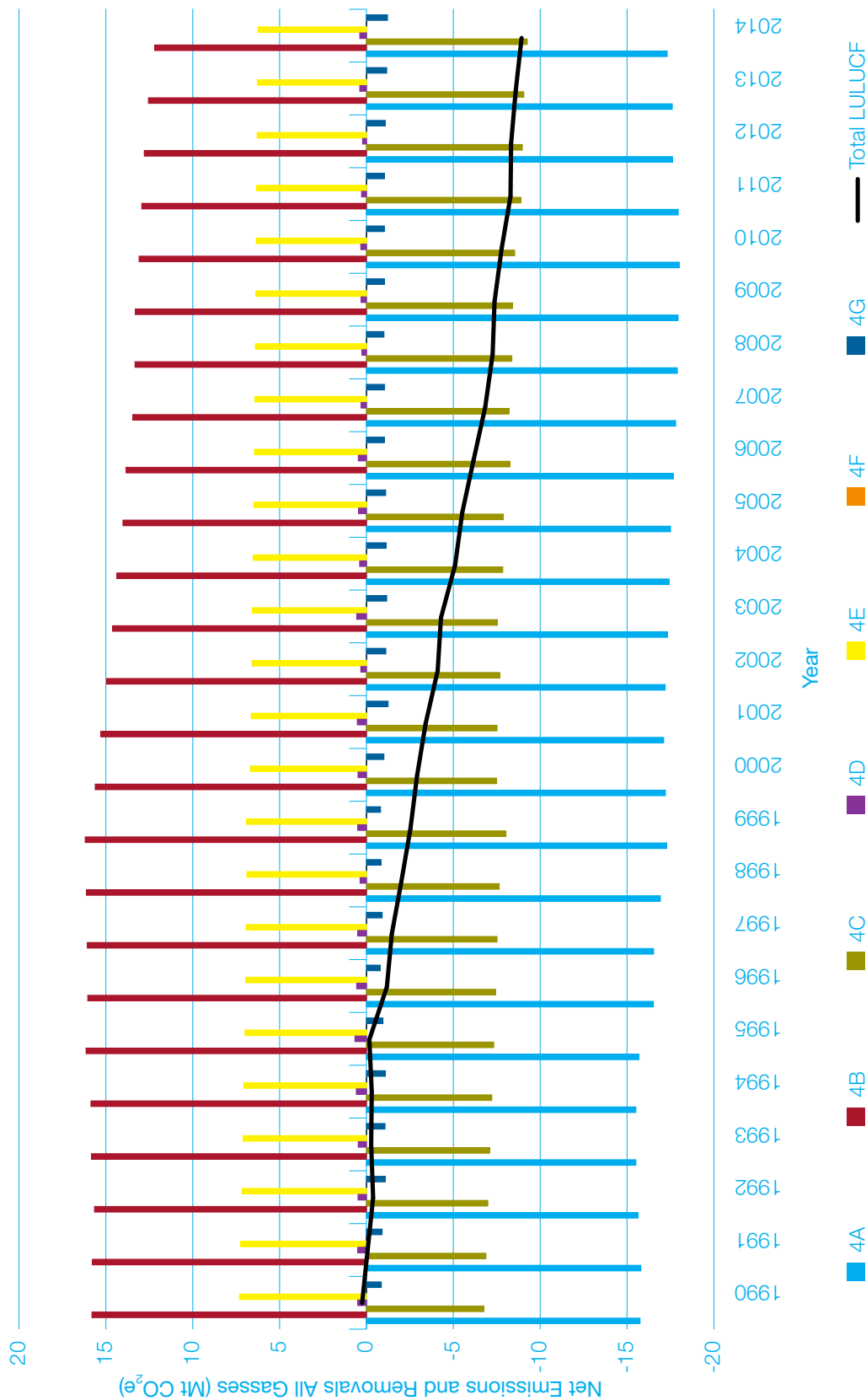


Figure 2-2 LULUCF emissions and removals from the UK 1990-2014 by category (Mt CO<sub>2</sub>e)

The land use categories which have the greatest effect on net LULUCF emissions/removals are Forest Land and Grassland (net sinks) and Cropland and Settlement (net sources). Forest Land is currently a decreasing sink due to much of the large productive area planted in the 1950s to 1980s maturing and being harvested, together with the relatively low rates of afforestation since 1990.

Emissions from Cropland and emissions from Settlement have decreased by 22% and 15% respectively since 1990. Cropland is a shrinking net source as rates of land use change have reduced since before 1990. Net removals by Grassland have increased by 37% since 1990.

Compared to CO<sub>2</sub>, emissions of CH<sub>4</sub> and N<sub>2</sub>O are relatively low in this sector. Methane emissions from the Forest Land, Cropland, Grassland and Settlements categories have increased by 74% since 1990 although emissions of methane are highly variable

because wildfires are one of the main LULUCF sources. Emissions of nitrous oxide have decreased by 33% since 1990.

In 2014, the Forest Land, Grassland and Harvested Wood Products categories represented a net sink while Cropland, Wetlands and Settlements represented a net source in the UK; see **Figure 2-3**. The emission from Settlements arises mainly from the assumption that all soil carbon is lost from half of the area of land converted to Settlement which may over-estimate emissions, but more realistic estimates of soil carbon stocks under buildings are difficult to obtain.

In 2014, CO<sub>2</sub> represented a net removal of -9.71 Mt CO<sub>2</sub>e while CH<sub>4</sub> and N<sub>2</sub>O represented the main sources with emissions of 0.03 Mt CO<sub>2</sub>e and 0.72 Mt CO<sub>2</sub>e respectively; see **Figure 2-4**.

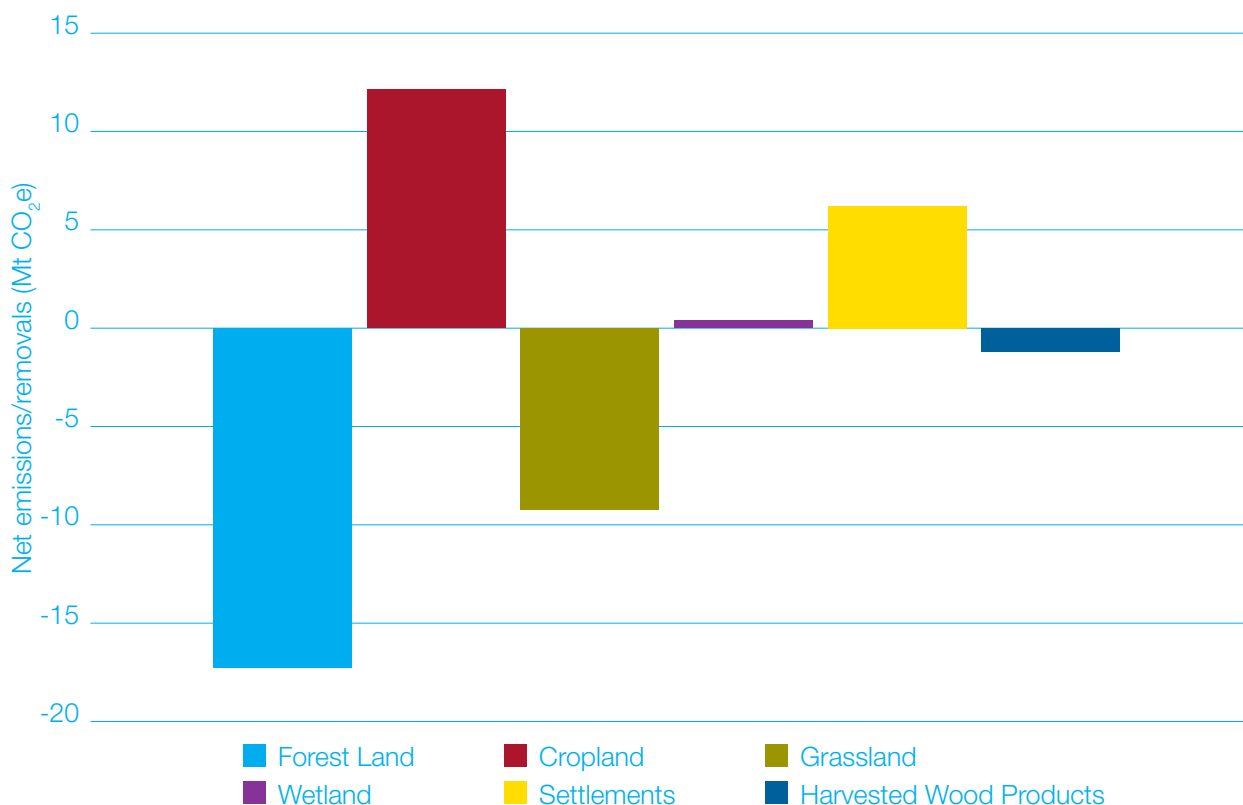


Figure 2-3 Net LULUCF emissions by source, 2014 (Mt CO<sub>2</sub>e)

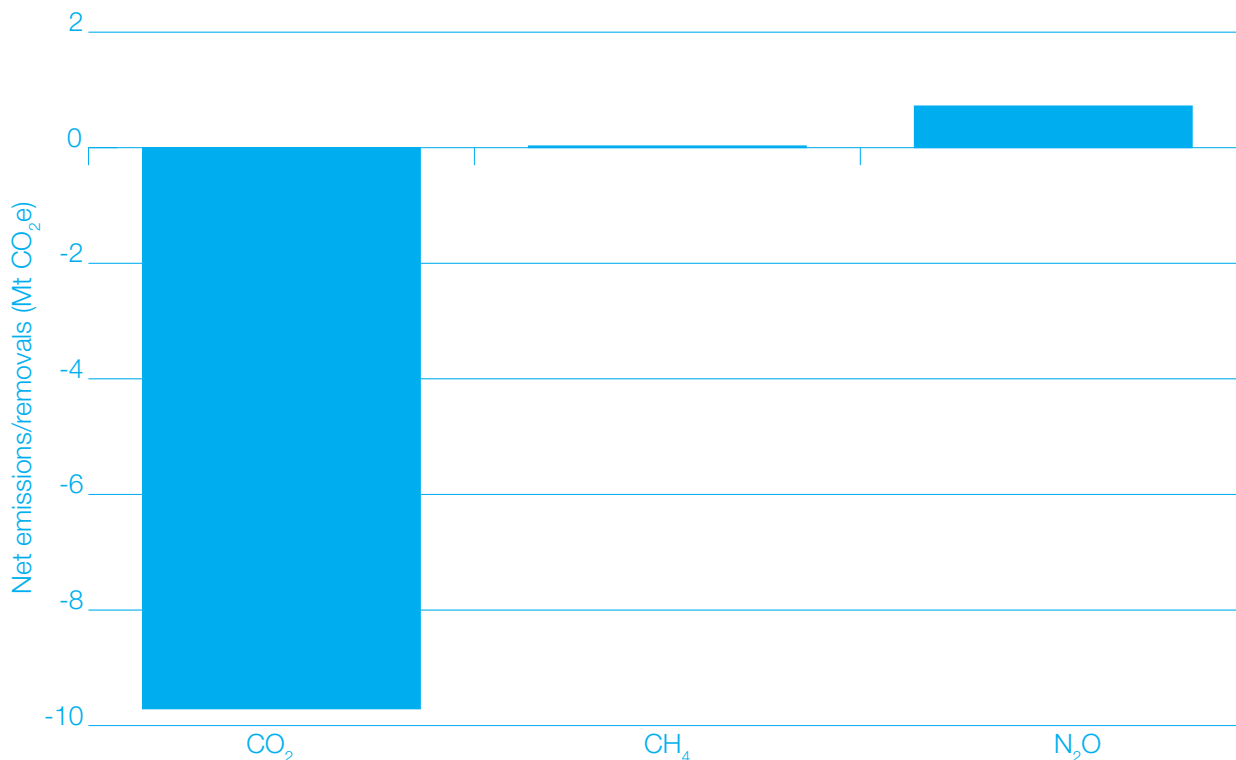


Figure 2-4 Net LULUCF emissions by gas, 2014 (Mt CO<sub>2</sub>e)

## KP Activities: historical emissions and removals – Forestry

This section provides an overview of the forestry-related emissions and removals currently reported for each KP activity.

**Table 2-1** provides a time series of emissions and removals according to KP activity from 1990 to 2014 (NIR 2016).

Methods for estimating carbon stock changes in forests for Article 3.3 Afforestation/Reforestation and Article 3.4 Forest Management are the same as those used for the UNFCCC GHG inventory. Estimates for carbon stock changes as a result of Article 3.3 Deforestation are based on the same methods as the UNFCCC GHG inventory.

The carbon uptake by UK forests is calculated using CARBINE. Overall carbon uptake is calculated as the net change in the pools of carbon in standing trees, litter, soil and

harvested wood products, for conifer and broadleaf forests. The model is able to represent all of the introduced and native plantation and naturally-occurring species relevant to the UK, the different growth rates of forests and four broad classes of forest management (clear-fell with thinnings, clear-fell without thinnings, thinned but not clear-felled and no timber production). The forest carbon sub-model is further compartmentalised to represent fractions associated with tree stems, branches, foliage, and roots. The method can be described as Tier 3, as defined in the IPCC's Good Practice Guidance for LULUCF<sup>22</sup>. The CARBINE model produces separate gains and losses for carbon stock change in living biomass, from which the net change is calculated.

Other GHG emissions, including from forest fertilisation, wildfires and N<sub>2</sub>O emissions from forest drainage, are estimated using IPCC Tier 1 or Tier 2 approaches.

**Figure 2-5** shows the net emissions and removals of GHGs from Afforestation, Reforestation and Deforestation (Article 3.3).

**Figure 2-6** shows the net emissions and removals of GHGs from Forest Management activities (Article 3.4). The UK's Forest Management Reference Level (FMRL) during the second commitment period is -9.275 Mt CO<sub>2</sub>e/yr, or -5.658 Mt CO<sub>2</sub>e/yr when including harvested wood products. This FMRL takes account of the technical correction in the 1990-2014 NIR.

The main driver of the emissions and removals trends for the reported KP-LULUCF activities before application of the forest management cap is the degree of forest planting achieved between the 1950s and the 1980s, followed by a period of reduced planting rates. As these forest stands have reached maturity and are now being harvested, the net removal of carbon dioxide from forest management (excluding HWP) has started to fall. For Article 3.3 activities, the expansion of forest area at an average of 13.9 kha per year since 1990 has produced a net removal from afforestation and reforestation that is currently about three times the emission from deforestation. Deforestation emissions have however increased since 1990, primarily due to the restoration of open-ground habitats from forests and for the development of wind-farms, involving the felling of mature trees.





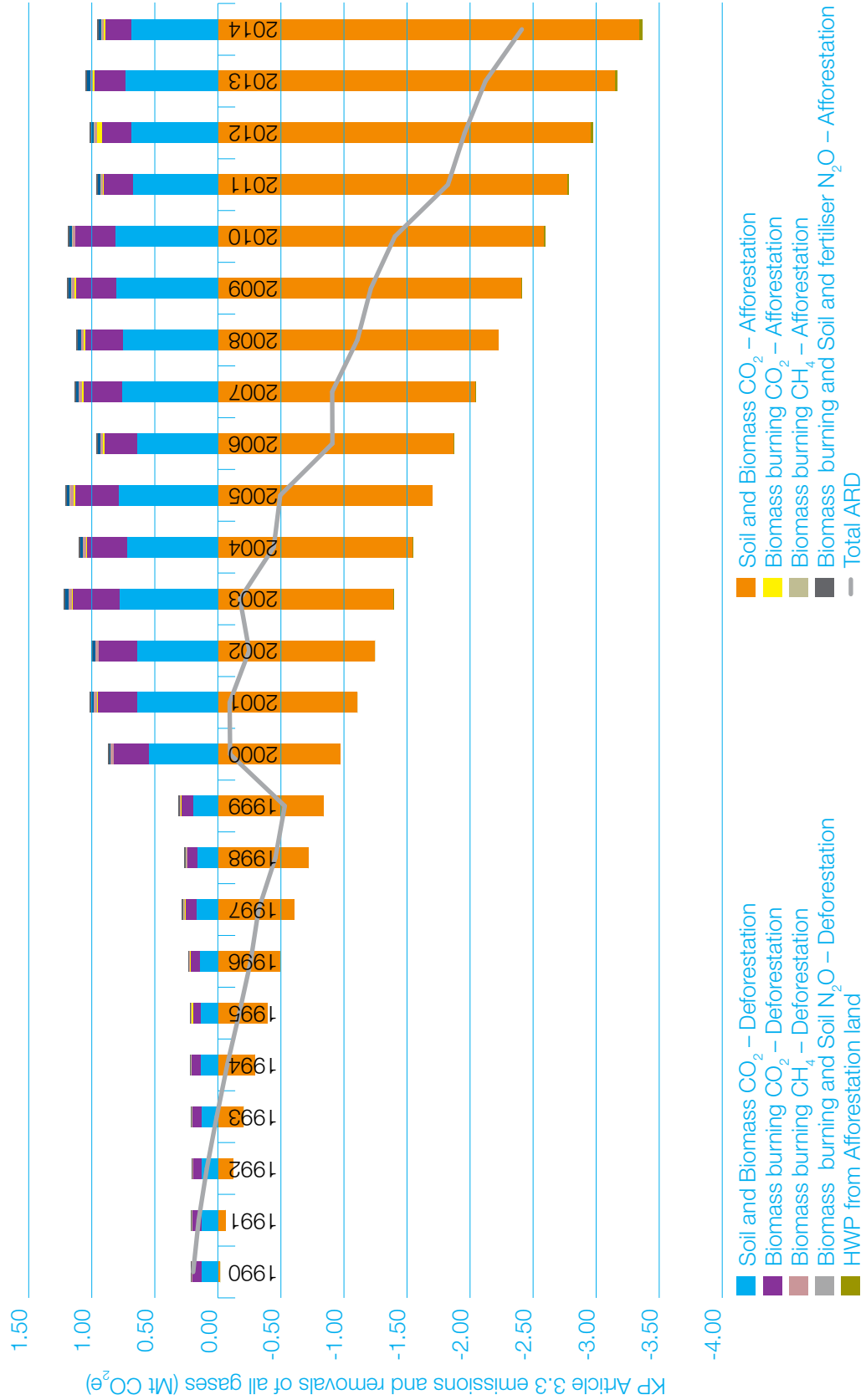


Figure 2-5 Article 3.3 Afforestation, Reforestation and Deforestation activities, emissions and removals by gas (Mt CO<sub>2</sub>e)

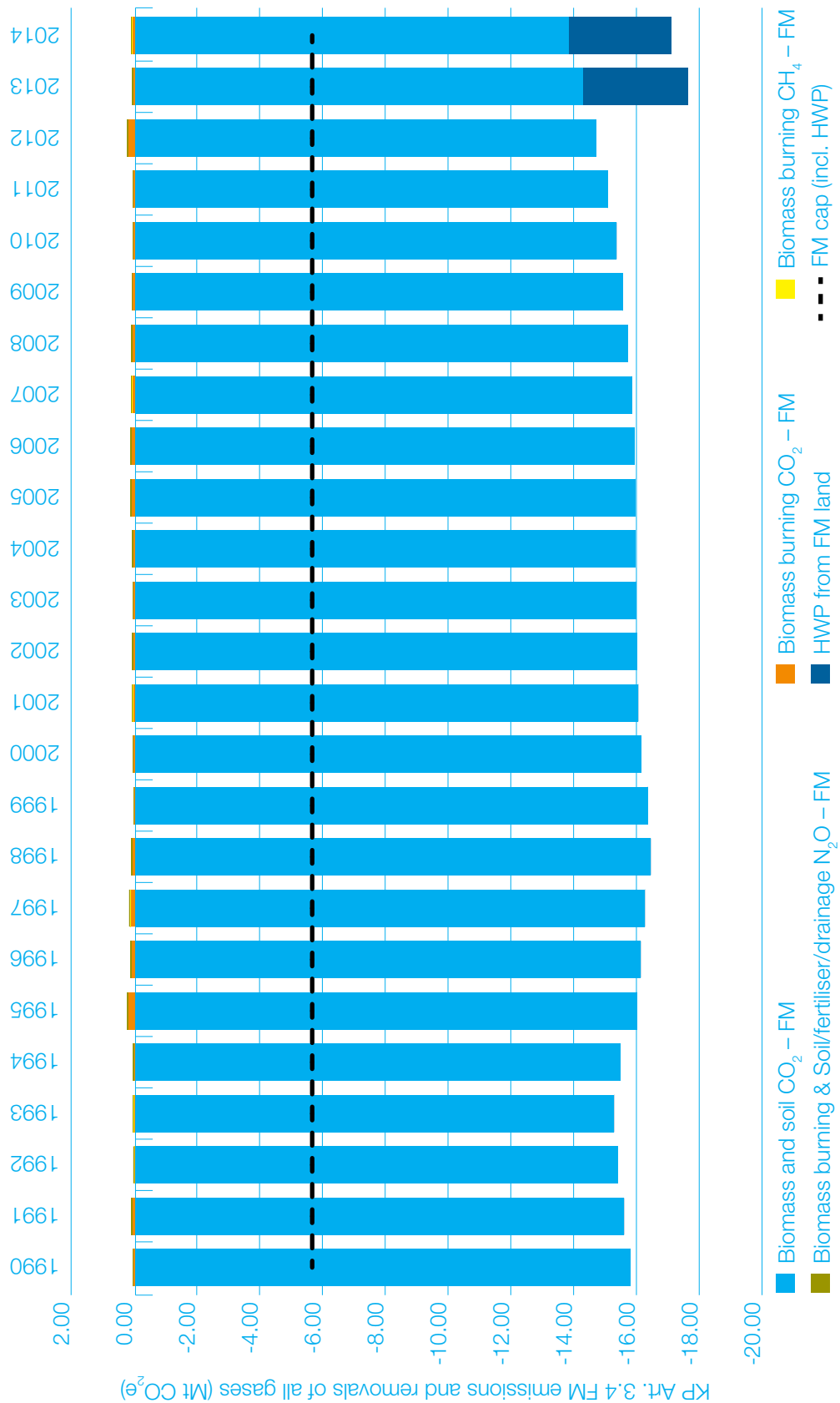


Figure 2-6 Article 3.4 Forest Management emissions and removals, by gas (Mt CO<sub>2</sub>e)

## KP Activities: historical emissions and removals – Cropland Management and Grazing Land Management

This section provides an overview of the agricultural land-related emissions and removals currently reported for each KP activity.

Methods for estimating carbon stock changes and LULUCF GHG emissions on Article 3.4 Cropland Management and Grazing Land Management are the same as those used for the UNFCCC greenhouse gas inventory. These are described in the KP Agricultural Activities section in Chapter 1.

**Table 2-1** provides a time series of emissions and removals according to KP activity from 1990 to 2014 (NIR 2016).

**Figure 2-7** shows the net emissions and removals by gas from Article 3.4 Cropland Management. **Figure 2-8** shows the net emissions and removals by gas from Article 3.4 Grazing Land Management.

KP Cropland Management is an increasing source over time, based on the 1990-2014 inventory. This trend is driven by land use changes to cropland, which produce soil carbon losses over long time periods. KP Grazing Land Management is a small net source of emissions in 1990, but becomes an increasing net sink in 1997. This trend is also driven by land use change, in this case, because change to grazing land typically leads to soil carbon stock gains over time.

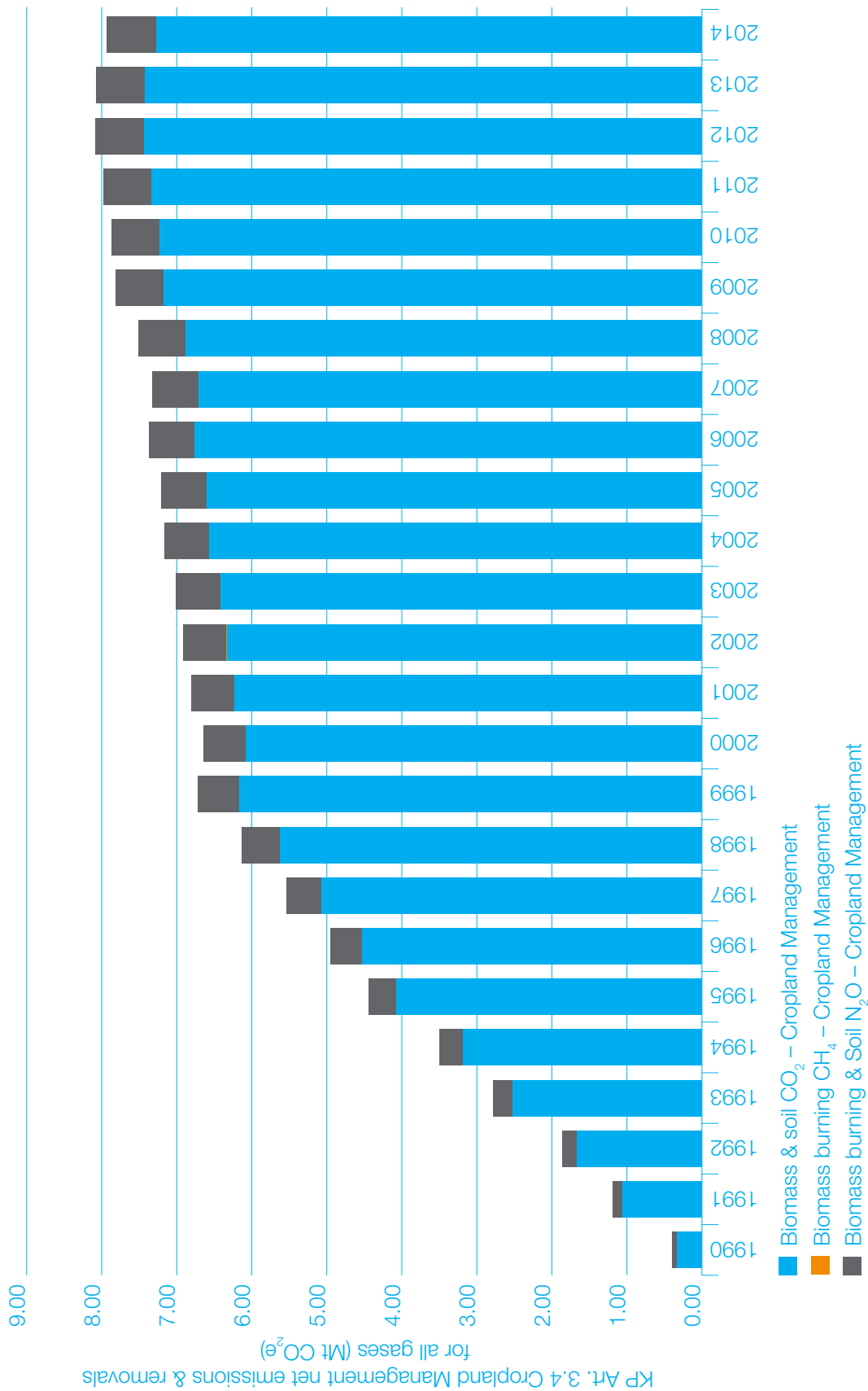


Figure 2-7 Article 3.4 emissions and removals from Cropland Management, by gas (Mt CO<sub>2</sub>e)

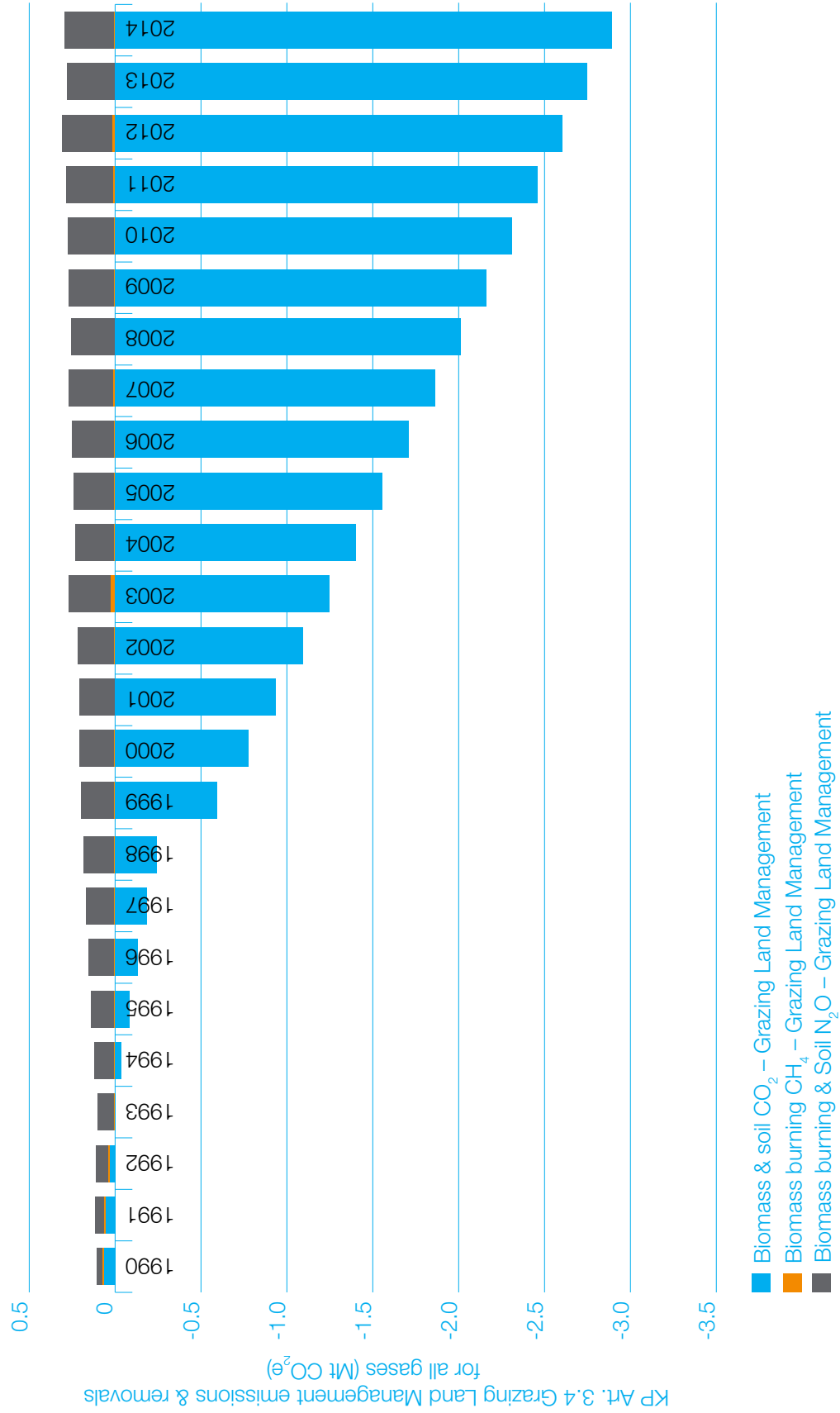


Figure 2-8 Article 3.4 emissions and removals from Grazing Land Management, by gas (Mt CO<sub>2</sub>e)

## Chapter 3: UK Projections for the LULUCF sector

### Approach to creating projections in the LULUCF sector

LULUCF emissions projections are produced by CEH, Forest Research and Ricardo-EE under contract to BEIS. The projections take account of the dynamics of carbon stocks in the relevant pools and GHG emissions produced by LULUCF activities. The assumptions underlying the projections were developed by a group of representatives from BEIS, Defra, the Forestry Commission, CEH and the Devolved Administrations. Five projection scenarios have been developed, which take account of current land use policies and/or aspirations and meet various policy needs. Land management activities are now represented in the projections and development work is ongoing to improve their coverage.

### Scenarios

LULUCF emissions and removals are projected to 2050, which is the target date for 80% emissions reductions below the 1990 baseline in the UK Climate Change Act. Projections are made for carbon stock changes and CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions arising from LULUCF activities reported in the latest UK Greenhouse Gas Inventory 1990-2014.<sup>15</sup>

The projection scenarios were revised in 2016 in order to align them more closely with policy needs. These needs are:

- The projections must be aligned with international commitments including the

EU requirement for biennial reporting of projections with and without policy measures, and with additional measures.

- Second, and linked to both domestic and international commitments, BEIS produces annually updated Energy and Emissions Projections (EEP) which help to both set and track progress towards Government climate targets, including the recently set Fifth Carbon Budget (CB5, 2027 to 2032) which requires the UK to reduce emissions by at least 57% below 1990.
- The projections are used to support the development of the Emissions Reduction Plan (ERP), which will succeed the 2011 Carbon Plan, a statutory requirement of the UK's Climate Change Act. The ERP will lay out the strategy to be taken to achieve CB5.
- Projections are also required to monitor progress towards targets under the Climate Change (Scotland) Act, the Well-being of Future Generations (Wales) Act, the Environment (Wales) Act and for the UN Framework Convention on Climate Change (UNFCCC).

Three policy scenarios (*Central*, *Low* and *Stretch*) have been constructed along with two *Baseline* scenarios which continue existing trends with no new policy interventions.

The *Baseline 1* scenario is based on climate change-related and forestry policies extant in July 2009 (required for reporting the Forest Management Reference Level used in the second commitment period of the Kyoto

Protocol).<sup>25</sup> The projections continue 2009 (forestry) or 2000-2009 (non-forestry) average activity rates out to 2050. The *Baseline 2* scenario is similar to *Baseline 1* except that forest planting rates drop to a low level after 2015 to project the time-limited nature of Common Agricultural Policy (CAP) supported grant-aided planting, and other activities are projected to continue at 2000-2009 average rates until 2050. This is used as the EEP 'baseline' scenario.

The *Central* scenario is based on current policies and funding (as extant in 2014) continuing at the same rate into the future (this is the EEP 'reference' scenario). It continues 2014 rates to 2050 for non-forest activities. The *Low* scenario assumes that climate change mitigation policy aspirations for each of the Devolved Administrations are projected forward beyond 2021. Finally, the *Stretch* scenario assumes an ambitious climate change mitigation programme exceeding current policy aspirations or funding.

The latest forestry projections differ from the forestry numbers published in the 1990-2014 inventory because the input data to the forest carbon accounting model were based on the National Forest Inventory dataset (2011-2015)<sup>26</sup>

<sup>25</sup> Submission of information on forest management reference levels by United Kingdom of Great Britain and Northern Ireland in accordance with Decision 2/CMP.6. [http://unfccc.int/files/meetings/ad\\_hoc\\_working\\_groups/kp/application/pdf/uk\\_frml.pdf](http://unfccc.int/files/meetings/ad_hoc_working_groups/kp/application/pdf/uk_frml.pdf)

<sup>26</sup> National Forest Inventory. <http://www.forestry.gov.uk/inventory>

rather than the previous National Inventory of Woodland and Trees (1995-99).<sup>27</sup> This had the effect of increasing the forest area of the UK, and hence carbon stocks. In addition, there was a methodological revision to ensure that forest carbon stock changes were attributed to the correct reporting year (this affected Forest Land and Harvested Wood Products net emissions).

## Trends in UK sources and sinks in the LULUCF sector

The main trends in UK sources and sinks from the LULUCF sector are presented in the 2016 GHG inventory (covering the period 1990 to 2014), and the latest Central projections produced by CEH are shown in **Table 3-1**. CO<sub>2</sub> is the main greenhouse gas associated with LULUCF, although emissions derived from N<sub>2</sub>O also make a significant contribution.

The net CO<sub>2</sub> equivalent emissions / removals from all parts of the LULUCF sector combine to produce an increasing net carbon sink (decreasing emissions) between 1990 and 2014. This trend continues until the 2020s, when the trend reverses, driven by the decreasing sink in the Forest Land category. The different scenarios start to diverge at 2020.

Forestry is projected to be a net sink under all scenarios. It is relatively stable between 1990 and 2020, but then shows a net decrease

<sup>27</sup> National Inventory of Woodland and Trees. <http://www.forestry.gov.uk/fr/hcou-54pg9u>

Table 3-1 GHG emissions and removals from LULUCF for the UK in Mt CO<sub>2</sub>e equivalents for 1990-2014 and 2020 (Central scenario)

Mt CO <sub>2</sub> e	1990-2014 Inventory						Central scenario projection
	1990	1995	2000	2005	2010	2014	2020
Carbon dioxide (CO <sub>2</sub> )	-3.743	-5.278	-7.850	-10.368	-12.050	-12.602	-13.478
Methane (CH <sub>4</sub> )	0.021	0.041	0.043	0.053	0.043	0.039	0.039
Nitrous oxide (N <sub>2</sub> O)	1.674	1.652	1.578	1.349	1.179	1.109	1.073
<b>Total GHG emissions</b>	<b>-2.048</b>	<b>-3.585</b>	<b>-6.229</b>	<b>-8.965</b>	<b>-10.828</b>	<b>-11.453</b>	<b>-12.365</b>



in sink strength under all scenarios. The scenarios are driven by the projected planting rates and management, with the biggest projected sink beyond 2020 coming from the *Stretch* scenario with high planting rates, and the smallest sink coming from the *Baseline* and *Central* scenarios with low planting rates. The long term decrease in the sink is due to large numbers of trees being thinned or reaching maturity (some 35-50 years since planting) and hence being harvested, and a relatively low planting rate during the 1980s and 1990s.

Cropland is projected to be a slowly increasing source post-2015, mostly driven by land use change to Cropland. Grassland is projected to be a gradually increasing sink. Although the scenario assumptions for the Wetlands category have been revised in 2016, the scale of changes is small compared to the other land use categories. Emissions from (land use change to) Settlements are projected to decrease over the time period under all scenarios. Although Settlement areas are projected to increase under all scenarios, the rate of change of land to Settlement (and hence emissions from land use change) is projected to be less than historical levels. Harvested Wood Products (HWPs) are projected to be a small sink over the period 2015 to 2050 with some inter-annual variation. The trend is driven by the balance between deforestation rates, thinning and felling regimes and the expected lifetime of the HWPs. There is little difference between the scenarios as the majority of harvest originates from trees planted before the projection time period.

## Trends in the Kyoto Protocol Article 3.3 and 3.4 categories

Emissions and removals in the Kyoto Protocol Article 3.3 and 3.4 activities have been projected on the same basis (with the same underlying activity data) as the UNFCCC LULUCF sector. Summary numbers are shown in **Table 3-2** and **Table 3-3**.

Table 3-2 Article 3.3 emissions and removals of CO<sub>2</sub> equivalents (Mt CO<sub>2</sub>e) 1990-2020<sup>28</sup>

Scenario	1990	2014	2020
Baseline 1	0.275	-3.686	-5.397
Baseline 2	0.275	-3.686	-5.381
Central	0.275	-3.686	-5.412
Low	0.275	-3.686	-5.434
Stretch	0.275	-3.686	-5.471

<sup>28</sup> Buys, G., Malcolm, H., Moxley, J., Matthews, R.J. and Henshall, P. (2014). Projections of emissions and removals from the LULUCF sector to 2050. [http://uk-air.defra.gov.uk/assets/documents/reports/cat07/1407090749\\_Projections\\_of\\_emissions\\_and\\_removals\\_from\\_the\\_LULUCF\\_sector\\_to\\_2050-PUBLISHED\\_VERSION-JULY2014.pdf](http://uk-air.defra.gov.uk/assets/documents/reports/cat07/1407090749_Projections_of_emissions_and_removals_from_the_LULUCF_sector_to_2050-PUBLISHED_VERSION-JULY2014.pdf)

Table 3-3 Article 3.4 emissions and removals of CO<sub>2</sub> equivalents (Mt CO<sub>2</sub>e) 1990-2020

Activity	Scenario	1990	2014	2020
3.4 Forest Management	Baseline 1	-18.983	-14.685	-14.096
	Baseline 2	-18.983	-14.685	-14.095
	Central	-18.983	-14.685	-14.053
	Low	-18.983	-14.685	-14.055
	Stretch	-18.983	-14.685	-14.120
3.4 Cropland Management	Baseline 1	0.401	7.930	9.232
	Baseline 2	0.401	7.930	9.232
	Central	0.401	7.930	9.343
	Low	0.401	7.930	9.251
	Stretch	0.401	7.930	9.246
3.4 Grazing Land Management	Baseline 1	0.105	-2.600	-3.579
	Baseline 2	0.105	-2.600	-3.579
	Central	0.105	-2.600	-3.438
	Low	0.105	-2.600	-3.662
	Stretch	0.105	-2.600	-3.673

## Chapter 4: Analysis of the potential to limit or reduce emissions and maintain or increase removals from the LULUCF sector

One of the requirements of the EU Decision is an analysis of the potential to limit or reduce emissions and maintain or increase removals. Such an analysis allows Government to assess the mitigation potential of LULUCF activities while identifying where further measures or action is required in the continuing goal to reduce GHG emissions from this sector. Up to date information on the mitigation potential is useful in making a quantitative assessment of the measures that are already implemented or are planned in relation to this sector. This chapter provides an analysis of our understanding of the mitigation potential of LULUCF activities under the EU Decision's Article 3(1) (AR, D and FM); Article 3(2) (CM and GM); and Article 3(3) (WDR).

In the UK, the Committee on Climate Change (CCC) advises the Government on how the UK's commitments under the Climate Change Act can be met. The CCC has adopted a bottom-up marginal abatement cost curve (MACC) approach on setting appropriate carbon budgets. MACCs detail abatement potentials from a suite of technically feasible mitigation measures and define their relative cost-effectiveness. The use of a reference carbon price allows measures to be considered from a notional cost-benefit perspective and provides a threshold for defining an efficient budget (i.e. those measures delivering mitigation at a unit cost less than the chosen reference price). There are, however, some weaknesses in a MACC based approach since it can be difficult to value all policy co-benefits of abatement measures, particularly those relating to social

and environmental objectives. In addition to the advice from the CCC, the UK Government continues to develop a more comprehensive analysis for the mitigation potential of LULUCF activities in order to inform various policy initiatives, as set out in the Impact Assessment for setting the Fifth Carbon Budget (CB5)<sup>1</sup>.

### An analysis of existing data on the mitigation potential in relation to LULUCF activities

In December 2008, the CCC published the results of its commissioned project that developed MACCs for the agriculture, land use, and land use change and forestry sectors.<sup>29</sup> Following the publication of the initial MACCs, two studies reassessed the MACCs and reached differing abatement potential conclusions.<sup>30,31</sup> In addition, a significant amount of feedback was received on the work from Government and industry and further evidence was identified.

<sup>29</sup> Moran, D., Macleod, M., Wall, E., Eory, V., Pajot, G., Matthews, R., McVittie, A., Barnes, A., Rees, B., Moxey, A., Williams, A. and Smith, P. (2008). UK Marginal Abatement Cost Curves for agriculture and land use, land-use change and forestry sectors out to 2022, with qualitative analysis of options to 2050, Final Report to the Committee on Climate Change. London.

<sup>30</sup> AEA (2009) Unpublished Review of the SAC MACC Undertaken for Defra.

<sup>31</sup> Harris, D., Jones, G., Elliott, J., Williams, J., Chambers, B., Dyer, R., George, C., Salado, R., Crabtree, B. (2009) RMP/5142 Analysis of Policy Instruments for Reducing Greenhouse Gas Emissions from Agriculture, Forestry and Land Management Wolverhampton: ADAS

In 2010, the CCC commissioned a project<sup>32</sup> to review the MACCs, subsequent studies and feedback in order to explore the uncertainties through three activities: one-to-one consultation with experts on specific points; an expert meeting; and a short survey. A series of revisions were made to the original assumptions based on the findings of these activities. The MACCs were then recalculated using the revised assumptions and a new approach to interactions. However, the focus was on methane and nitrous oxide emissions and the effects on soil carbon were not thoroughly considered. Hence, most of the mitigation potential suggested by the work for the cropland and grassland activities (e.g. in relation to nutrient management) is not directly relevant to the LULUCF sector and would be realised and reported in the agriculture sector. In relation to the LULUCF sector, the MACCs have been partly superseded by recent research, for example, the extent to which emissions due to changes in soil organic carbon (SOC) stocks arising from cropland and grassland/grazing land management can be incorporated into the UK's LULUCF inventory<sup>20</sup>.

In 2012, the Forestry Commission (FC) reviewed all past studies that have produced MACCs for UK forestry.<sup>33</sup> Their literature search identified three primary studies estimating MACCs that include UK forestry measures: Radov et al. (2007),<sup>34</sup> Moran et al.

(2008)<sup>35</sup> and ADAS (2009).<sup>36</sup> The Read Report provided a synthesis of the potential of UK forestry to contribute to the UK Government's emissions reduction commitments, which included results from the last three studies<sup>37</sup>. Eighteen recommendations for developing UK MACCs covering forestry emerged from the FC's review and a new MACC for UK forestry has recently been published.<sup>38</sup> However, the new MACC is restricted to woodland creation as the sole forestry measure. The CCC has subsequently incorporated forestry in a revised MACC, as has Government in its evidence supporting the setting of the Fifth Carbon Budget.<sup>34</sup>

<sup>32</sup> MacLeod, M., Moran, D., McVittie, A., Rees, B., Jones, G., Harris, D., Antony, S., Wall, E., Eory, V., Barnes, A., Topp, K., Balla, B., Hoad, S. and Eory, L. (2010) Review and update of UK marginal abatement cost curves for agriculture. Final Report to the Committee on Climate Change. London.

<sup>33</sup> Valatin, G (2012). Marginal abatement cost curves for UK forestry. Forestry Commission, Edinburgh. [http://www.forestry.gov.uk/pdf/FCRP019.pdf/\\$FILE/FCRP019.pdf](http://www.forestry.gov.uk/pdf/FCRP019.pdf/$FILE/FCRP019.pdf)

<sup>34</sup> Radov, D., Klevnas, P., Skurray, J., Harris, D., Chambers, B., Chadwick, D., Dyer, R. and Nagler, D. (2007). Market mechanisms for reducing GHG emissions from agriculture, forestry and land management. NERA Economic Consulting, London, Defra.

<sup>35</sup> Moran, D., Macleod, M., Wall, E., Eory, V., Pajot, G., Matthews, R., McVittie, A., Barnes, A., Rees, B., Moxey, A., Williams, A. and Smith, P. (2008). UK Marginal Abatement Cost Curves for agriculture and land use, land-use change and forestry sectors out to 2022, with qualitative analysis of options to 2050, Final Report to the Committee on Climate Change. London.

<sup>36</sup> ADAS (unpublished). Analysis of policy instruments for reducing greenhouse gas emissions from agriculture, forestry and land management – forestry options. Report to Forestry Commission England, ADAS, Abingdon, Oxfordshire.

<sup>37</sup> Matthews, R.W. and Broadmeadow, M.S.J. (2009). The potential of UK forestry to contribute to government's emissions reduction commitments. In: D.J. Read, P.H. Freer-Smith, J.I.L. Morison, N. Hanley, C.C. West and P. Snowdon eds. Combating climate change – a role for UK forests – an assessment of the potential of the UK's trees and woodlands to mitigate and adapt to climate change. TSO, Edinburgh.

<sup>38</sup> CJC Consulting (2014). Assessing the cost-effectiveness of woodlands in the abatement of carbon dioxide emissions. <http://www.forestry.gov.uk/forestry/infod-8rck8m>

Table 4-1 Mitigation potentials in relation to forestry measures

Forestry measure	Scale of additional mitigation potential	Quantified mitigation potential (if known)
Woodland creation (AR)	High	1.4 to 2 Mt CO <sub>2</sub> /yr depending on assumptions <sup>42</sup>
Reduced deforestation (D)	Medium	0.9 Mt CO <sub>2</sub> /yr assuming reduced to zero <sup>42</sup>
Improved management (FM)	Low	-5 to 5 Mt CO <sub>2</sub> /yr depending on timeframe and assumptions <sup>38</sup>
Woodland enrichment (FM)	Unknown	Unknown
Enhanced resilience (FM)	Low to High	Less than zero; protects existing stocks but often at a cost to growth rate in the short term <sup>38</sup>

## Mitigation potentials in relation to forestry measures (AR, D and FM)

The forestry sector GHG inventory projections<sup>39</sup> indicate a declining trend in net removals, although 'forest land' will remain a sink at least through to the middle of the century. Additional abatement could be delivered through increasing afforestation, reducing deforestation or focusing forest management on increasing carbon stocks. The potential abatement indicated in the GHG inventory projections do not include abatement associated with other sectors, such as energy and construction, through the use of woodfuel and timber, respectively.

The CCC identified potential for an additional 2.4 Mt CO<sub>2</sub>/yr abatement in 2030 through afforestation and further deployment of agroforestry, which rises to up to 4.8 Mt CO<sub>2</sub>/yr under the 'maximum' scenario.<sup>40</sup> Based on consideration of all the evidence a semi-

quantitative evaluation of abatement potential in 2030 is shown in **Table 4-1**.

## Mitigation potentials in relation to Cropland Management and Grazing Land Management

A recent project (SP1113)<sup>20</sup> evaluated the extent to which emissions due to changes in SOC stocks arising from Cropland and Grassland/Grazing Land management can be incorporated into the UK's LULUCF inventory based on:

- A literature review of emissions and removals from Cropland and Grassland Management;<sup>42</sup> and
- An assessment of whether the default stock change factors for land management activities given in the 2006 IPCC guidance are appropriate for UK conditions, and

<sup>39</sup> Thomson, A., Hallsworth, S. and Malcolm, H. (2013). Projections of emissions and removals from the UK LULUCF sector to 2050. [http://uk-air.defra.gov.uk/reports/cat07/1304300925\\_Projections\\_of\\_emissions\\_and\\_removals\\_from\\_the\\_LULUCF\\_sector\\_to\\_2050\\_2011i\\_UK-FINAL-VERSION.pdf](http://uk-air.defra.gov.uk/reports/cat07/1304300925_Projections_of_emissions_and_removals_from_the_LULUCF_sector_to_2050_2011i_UK-FINAL-VERSION.pdf)

<sup>40</sup> Committee on Climate Change (2015). Sectoral Scenarios for the Fifth Carbon: Technical report. Budget <https://www.theccc.org.uk/wp-content/uploads/2015/11/Sectoral-scenarios-for-the-fifth-carbon-budget-Committee-on-Climate-Change.pdf>

<sup>41</sup> Thomson et al (Forthcoming). Projections of emissions and removals from the LULUCF sector to 2050. Report to BEIS.

<sup>42</sup> Buckingham, S; Cloy, J; Topp, K; Rees, R and Webb, J. Capturing cropland and grassland management impacts on soil carbon in the UK Land Use, Land Use Change and Forestry (LULUCF) inventory. Report for DEFRA Project SP1113 (2013). <http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18355>

attempted modelling of more appropriate stock change factors, where necessary.

The literature review concluded that:

- Tillage reduction cannot be considered a reliable management option to increase the SOC content of UK soils.
- Increasing crop residue returns and increasing inputs of manure and fertiliser could increase SOC stock although the SOC stock increases resulting from manure and fertiliser inputs could be outweighed by increases in nitrous oxide emissions and the risk of nitrate run-off.
- Increasing crop yields through increased fertilisation and improved crop rotation could increase the annual input of crop residues and root exudate to soils and hence increase SOC on low fertility soils.
- Manure additions resulted in greater C sequestration than the addition of equivalent amounts of N as mineral fertiliser and the effect lasted longer. However, increasing inputs of nitrogen from fertiliser or manure risk increasing N<sub>2</sub>O emissions which could negate any increases in SOC stock.

IPCC default stock change factors were judged by project SP1113 to be inappropriate for the UK, based on expert opinion and the literature review findings. Therefore the project used the Daily DayCent and Landscape DNDC models to estimate stock change factors for Cropland Management activities under UK conditions. Although based on a very limited dataset, outputs from the model suggested that the effect of Cropland Management activities under UK conditions might be less than implied by the IPCC stock change factors. Tillage reduction was found to have little effect on SOC stocks. Increasing manure and crop residue inputs increased SOC stocks, with manure inputs being particularly effective.

A framework for reporting SOC stock changes resulting from Cropland Management was developed in SP1113, and used to assess mitigation options. Overall the impact of Cropland Management on SOC is likely to be very small compared to other activities in the LULUCF inventory such as land use change. The most effective mitigation option was converting Cropland from annual tillage crops to perennial crops, fallow and set aside. However, given the need for food production there is limited scope for such change. Increasing manure, fertiliser and crop residue inputs gave smaller increases in SOC stocks, but practical considerations, such as the availability of manures and residues, limit the scope of these actions.

A lack of field data on the effect of Grassland Management on SOC stocks was identified as a knowledge gap by SP1113. The literature review suggested that intensification could increase SOC stocks under pasture on mineral soils. However, expert opinion suggested that this might not be the case for rough grazing on organo-mineral soils, where intensification might lead to SOC loss. This lack of data meant that it was not possible to calibrate or validate models to estimate UK specific stock change factors for Grassland. As the IPCC stock change factors were judged to be inappropriate to UK conditions, assessment of the mitigation potential of Grassland Management using these factors was not carried out to avoid presenting potentially misleading results. BEIS has commissioned work to provide SOC stock change factors for Grassland Management, which is due to complete in 2017 and will be fed into future inventories and projections.

**Table 4-2** provides a semi-quantitative synthesis of mitigation potentials of Cropland Management and Grassland Management measures based on the results of SP1113.

Project SP1113 identified practical limits on the mitigation potentials of Cropland Management (and Grassland Management). To be effective

Table 4-2 Mitigation potentials of Cropland Management and Grassland Management measures based on SP1113

CM or GM measure	Scale of additional mitigation potential
Converting Cropland from annual tillage crops to perennial crops, fallow and set aside (CM)	Low to Medium
Increasing manure, fertiliser and crop residue (CM)	Low
Intensification of pasture on mineral soils (GM)	Zero to Low (Unknown)
Intensification of rough grazing on organo-mineral soils	Less than Zero (Unknown)

in mitigating climate change increases in SOC would need to be weighed against increased nitrous oxide emissions from increased nitrogen inputs from fertiliser and manure and from compaction (and yield losses) due to the zero tillage. In addition to nitrous oxide emissions which could outweigh the carbon dioxide reduction achieved by increased SOC sequestration, there would also be an issue of availability of sufficient quantities of manure or organic waste, as UK supplies are already almost fully utilised. Increasing livestock numbers in order to increase SOC stocks under Cropland would lead to increased methane emissions from ruminants and potentially require conversion of Grassland to Cropland to provide fodder and is therefore unlikely to reduce GHG emissions, although a full life-cycle analysis to confirm this has not been carried out.

### Mitigation potentials in relation to Wetland Drainage and Rewetting

In late 2014, BEIS commissioned a study to provide an initial assessment on the possible magnitude, direction and trends in emissions and removals resulting from WDR. The study considers how emissions and removals from these activities can be estimated following the methods set out in the IPCC 2013 Wetlands Supplement. The study, which will report in 2017, will identify relevant activity data and emission factors, including an assessment of their uncertainties.

# Chapter 5: List of measures that could be implemented to achieve emissions reductions or increased removals in the LULUCF sector under UK conditions

While our knowledge base of emissions and removals estimates from this sector continues to improve, there remain significant gaps in our understanding of estimates of costs and benefits of existing measures in reducing emissions/removals in this sector.

The UK does not currently have quantitative assessments of costs and benefits of all the measures that could be implemented to achieve emission reductions. Work is on-going towards developing a more comprehensive quantitative assessment on the list of measures currently implemented. This chapter identifies the measures that could be implemented to achieve emission reductions and sets out the available evidence which at present suggests that there are limited measures with significant potential to reduce GHG emissions for both CM and GM. Work is still on-going to identify measures for WDR. The majority of UK mitigation potential appears to be in the forestry activities of the LULUCF sector.

## LULUCF measures that will lead to reduction of GHGs or avoid new GHG emissions in key LULUCF categories

### Afforestation, deforestation and forest management

The majority of the potential abatement identified in the GHG Inventory projections<sup>42</sup> arises from woodland creation (AR). The nature of the woodland planted determines the level of abatement, the timeframe over which

abatement is delivered and the contribution to abatement delivered in other sectors including through providing a renewable energy feedstock. Unmanaged woodland, particularly on productive sites, will generally make the largest contribution to LULUCF removals over the second commitment period of the Kyoto Protocol, but will make no contribution to abatement in other sectors, nor to the rural economy. Other potential abatement measures to achieve GHG emissions mitigation involving forest land are:

- Reducing deforestation (avoidance of D)
- Improved woodland management (FM), including measures aimed at increasing the resilience of forests to climate change.

Further detail on abatement options for forestry is provided in the following section.

### Increasing afforestation:

Woodland expansion is a policy objective of all four countries of the United Kingdom, in part to deliver GHG abatement through sequestration in growing biomass. GHG inventory projections indicate significant abatement potential through to 2050. If woodland creation aspirations across all four countries of the UK are to be met, significant private sector investment will be required to supplement Rural Development Programme grant-aid while the UK remains in the European Union and any successor schemes following the UK's exit. An example of a measure being taken in the UK is the Woodland Carbon Code and associated carbon registry for domestic woodland carbon schemes to encourage private sector funding for woodland creation projects.



### Reducing deforestation:

A strong regulatory framework means that rates of deforestation are relatively low, most recently reported in 2014 as 1,913 ha across the UK.

The majority of deforestation is for priority open habitat restoration, principally lowland heath and upland peat bog. In England, a 'balancing mechanism' is in place as a component of the Open Habitats Policy<sup>43</sup> to reduce the risk of net deforestation; the balancing mechanism requires compensatory planting in cases where non-priority sites are restored. A similar policy on the control of woodland removal is in place in Scotland.<sup>44</sup> Further policy measures to reduce levels of deforestation could compromise other policy objectives.

The loss of woodland to development falls outside the remit of the Forestry Act (1967) and is subject to the Town and Country Planning Act. The National Forest Inventory indicates that loss of woodland of more than 0.5 ha to development has been limited in recent years, with approximately 4,000 ha lost across Great Britain between 2006 and 2015.<sup>45</sup> There are very limited opportunities for policy intervention to deliver significant carbon savings through reduced deforestation of development land.

### Reducing harvesting/enhancing carbon stocks:

The Read Report (2009)<sup>42</sup> indicated that abatement opportunities from differing

approaches to sustainable forest management (as set out in the UK Forestry Standard) are limited, particularly when viewed in the longer term (50-100 years) and when abatement delivered in other sectors through direct and indirect fossil fuel substitution is considered.

In England, only 58% of woodlands have management plans (including those on the Public Forest Estate which all have management plans and comprise 15% of the woodland resource).<sup>46</sup> The lack of management is particularly acute in private sector broadleaf woodlands, of which less than 20% are in active management<sup>47</sup>. This lack of management has led to a well-documented decline in habitat condition and the woodland birds index. The Government's Forestry and Woodlands Policy Statement<sup>48</sup> aspires to bring 80% of the woodland resource into management in the long term, to contribute to the rural economy, renewable energy and biodiversity targets and to provide opportunities for climate change adaptation measures to be implemented.

While reducing the level of management (i.e. harvesting) would lead to GHG abatement in the short term, other Government policy objectives would not be delivered, and it is highly likely that the resilience of England's woodlands to pest and disease outbreaks and to the impacts of climate change would decline, placing their large carbon stocks at significant risk of being returned to the atmosphere.

<sup>43</sup> FC England (2010) When to convert woods and forests to open habitat in England: Government policy. [http://www.forestry.gov.uk/pdf/eng-oh-policy-march2010.pdf/\\$FILE/eng-oh-policy-march2010.pdf](http://www.forestry.gov.uk/pdf/eng-oh-policy-march2010.pdf/$FILE/eng-oh-policy-march2010.pdf)

<sup>44</sup> FC Scotland (2009) The Scottish Government's Policy on Control of Woodland Removal. [http://www.forestry.gov.uk/pdf/fcfc125.pdf/\\$FILE/fcfc125.pdf](http://www.forestry.gov.uk/pdf/fcfc125.pdf/$FILE/fcfc125.pdf)

<sup>45</sup> FC (2016) Preliminary estimates of the changes in canopy cover in British woodlands between 2006 and 2015. Forestry Commission. [http://www.forestry.gov.uk/pdf/Preliminary\\_estimatesofthechangesincanopycoverin\\_Britishwoodlandsbetween2006and2015.pdf/\\$FILE/Preliminary\\_estimatesofthechangesincanopycoverin\\_Britishwoodlandsbetween2006and2015.pdf](http://www.forestry.gov.uk/pdf/Preliminary_estimatesofthechangesincanopycoverin_Britishwoodlandsbetween2006and2015.pdf/$FILE/Preliminary_estimatesofthechangesincanopycoverin_Britishwoodlandsbetween2006and2015.pdf)

<sup>46</sup> FC England (2016) Corporate Plan Performance Indicators 2016. [http://www.forestry.gov.uk/pdf/FC-England-Indicators-Report-20163.pdf/\\$FILE/FC-England-Indicators-Report-20163.pdf](http://www.forestry.gov.uk/pdf/FC-England-Indicators-Report-20163.pdf/$FILE/FC-England-Indicators-Report-20163.pdf)

<sup>47</sup> FC (2014) 50-year forecast of hardwood timber availability. [http://www.forestry.gov.uk/pdf/50\\_YEAR\\_FORECAST\\_OF\\_HARDWOOD\\_AVAILABILITY.pdf/\\$FILE/50\\_YEAR\\_FORECAST\\_OF\\_HARDWOOD\\_AVAILABILITY.pdf](http://www.forestry.gov.uk/pdf/50_YEAR_FORECAST_OF_HARDWOOD_AVAILABILITY.pdf/$FILE/50_YEAR_FORECAST_OF_HARDWOOD_AVAILABILITY.pdf)

<sup>48</sup> Defra (2013) Government Forestry and Woodlands Policy Statement. [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/221023/pb13871-forestry-policy-statement.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/221023/pb13871-forestry-policy-statement.pdf)

### Forest enrichment:

This intervention is characterised by enrichment planting of derelict or under-stocked woodland. The area of this category of woodland is unknown at the present time, but data collected on the 15,000 sample squares of the National Forest Inventory could allow such an estimate to be derived, along with an estimate of abatement potential.

### Climate change adaptation:

Intervening to increase resilience is characterised by increasing species and genetic diversity, planting or restocking with species better able to cope with the climatic conditions represented in climate projections, converting to continuous cover systems of management and reducing other pressures such as over grazing by deer and by controlling grey squirrel populations, as set out in the National Adaptation Programme<sup>49</sup>. Adaptation measures can only be introduced if woodlands are in management. Although adaptation measures may reduce growth rates and thus abatement through sequestration in the short term, they will help to ensure that carbon stocks are not lost to the atmosphere in the future as a result of climatic unsuitability or pest/disease outbreaks.

### Cropland and grassland management

A recent Defra project<sup>50</sup> assessed management activities in relation to Cropland Management (CM) and Grassland Management (GM) in the UK that have the potential to affect soil carbon stocks. As identified in **Table 4-2** the practices which have the potential to result in increased soil

carbon stocks are converting cropland from annual tillage to perennial crops, fallow and set aside and increasing manure, fertiliser and crop residue inputs. However, there are constraints on the use of these practices and the increased emissions of N<sub>2</sub>O as a result of increased nutrient inputs needs to be considered. These issues are discussed in Chapter 4.

Peatland restoration (rewetting) has been identified as a measure to reduce GHG emissions; and the amount of abatement that can be achieved is being investigated.

### Semi-quantitative ranking based on costs and benefits of measures and maximum level of potential uptake

The cost-effectiveness of carbon abatement associated with 96 forestry systems was assessed across England, Scotland and Wales.<sup>51</sup> The study concluded that woodland creation was generally a cost-effective means of reducing greenhouse gas emissions with the cost-effectiveness of conventional forestry systems in the range of £21 per tCO<sub>2</sub>e to £245 per tCO<sub>2</sub>e. Conifer systems were typically the most cost-effective with costs mainly in the range £20-40 per tCO<sub>2</sub>e. Permanent broadleaved and Continuous Cover Forestry (CCF) systems were generally in the £40-90 per tCO<sub>2</sub>e range. An alternative cost-effectiveness metric found that 72% (69 out of 96) of scenarios analysed showed that the cost of sequestering carbon dioxide was less than the value of that carbon and, hence, cost effective. The results are sensitive to timber prices, with an increase of 1% per annum resulting in the cost-effectiveness of the most efficient system improving from £21 per tCO<sub>2</sub>e to £13 per tCO<sub>2</sub>e and also highly dependent on assumptions over agricultural income foregone and future management costs.

<sup>49</sup> Defra (2013) The National Adaptation Programme: Making the country resilient to a changing climate. [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/221023/pb13871-forestry-policy-statement.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/221023/pb13871-forestry-policy-statement.pdf)

<sup>50</sup> Defra (2014). Capturing Cropland and Grassland Management Impacts on Soil Carbon in the UK LULUCF Inventory – SP1113. Retrieved from: <http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18355>

<sup>51</sup> CJC Consulting (2014). Assessing the cost-effectiveness of woodlands in the abatement of carbon dioxide emissions. <http://www.forestry.gov.uk/forestry/infd-8rck8m>

## Chapter 6: Identification of existing policies that deliver implementation of these measures and identification of their impacts

This chapter sets out existing policies that deliver implementation of the measures identified as appropriate for UK national circumstances, providing an update on the 2015 Action Report.

The UK's commitment to tackle climate change is framed by the Climate Change Act (2008). This is domestic legislation and is therefore unaffected by the result of the UK referendum on exiting the EU. Until exit occurs, the UK will remain a full member of the EU, with all of the rights and obligations this entails.

The UK's decision to exit the European Union will result in a new policy landscape for agriculture and land use. Although options are still in development at this stage, this change represents a significant opportunity to further address climate change issues in agriculture.

The UK does not currently have data on the quantitative impacts of policy instruments per policy. Furthermore, some policies are bundled together and it is difficult to separate the impacts of these different policies. This chapter also highlights the challenges of separating the impacts of policies due to data gaps.

Key policies are presented in **Table 6-1**, with updates to the 2015 Action Report in bold.

Table 6-1 The UK's implemented policies and measures relating to LULUCF presented in the 'with measures' scenario in the 6th National Communication, and supplemented with other recent mitigation measures. Updated measures are in bold.

Name of mitigation action	Objective and / or activity affected	Type of instrument	Brief description	Start year of implementation	Implementing entity(s)
<b>Forestry</b>					
<b>Woodland Creation Planning Grant</b>	Grant aid to support the planning of large-scale woodlands in support of meeting the requirements of the UK Forestry Standard	Economic/Regulatory	Grant support for the planning of woodlands larger than 30 ha to help break-down the perceived barrier that the UK's regulatory framework presents in England.	<b>2015</b>	Forestry Commission (FC)
<b>Woodland Carbon Fund</b>	Grant aid to support the planting of large-scale woodlands to help meet future carbon meetings and maximise natural capital	Economic	Grant support for the planting of woodlands larger than 30 ha, with a significant productive element.	<b>2016</b>	FC
<b>Woodland Carbon Code</b>	Increase rate of afforestation	Voluntary Agreement, Information	Voluntary Code and associated carbon registry (2013) for UK domestic woodland carbon schemes to encourage private sector funding for woodland creation projects. Recognised as component of net GHG emissions reporting for businesses in Government's Environmental Reporting Guidelines.	2011	FC
<b>Revised UK Forestry Standard</b>	Enhance removals and reduce emissions through woodland creation and sustainable forest management	Regulatory, Information	Revised national standard for sustainable forest management to include a new guideline on climate change, covering both adaptation and mitigation.	2011	FC
<b>Forestry Act Felling Licence Regulations and Environmental Impact (Forestry) regulations</b>	Regulatory framework to limit deforestation and forest degradation	Regulatory	Strong regulatory framework that controls felling, only allows deforestation for purposes of nature conservation and prevents afforestation of deep peat. Legislation updated 1999.	1999	FC

Name of mitigation action	Objective and / or activity affected	Type of instrument	Brief description	Start year of implementation	Implementing entity(s)
<b>Grown in Britain</b>	Industry led action plan with the objective of increasing woodland creation and the use of harvested wood products	Voluntary Agreement, Information, Education	Industry-led action plan announced in Government's Forestry and Woodlands Policy Statement (2013) which aspires to encourage businesses to invest in woodland creation and sustainable forest management practice.	2013	Department for Environment Food and Rural Affairs (Defra)
<b>Woodfuel Implementation Plan</b>	Strategy to increase woodfuel supply for renewable heat	Information, Education, Economic	Initiative to develop supply chains, including through support for harvesting/processing and woodland access, to increase woodfuel supply from existing woodland.	2011	FC
<b>Rural Development Programme and CAP</b>					
<b>Rural Development Programme (2007)</b>	Grant aid for afforestation	Economic	Woodland creation grants provided through EU cofinanced Rural Development Programmes in all four countries of the UK.	2007	Defra
<b>Rural Development Programme (2015)</b>	Grant aid for afforestation and measures relevant to cropland and grassland management	Economic	The RDP is intended to help farming, forestry and horticultural businesses to become more efficient at using resources and deliver environmental objectives. <b>The Northern Ireland RDP was approved by the European Commission in August 2015. DAERA's new agri-environment scheme, the Environmental Farming Scheme (EFS), is planned to open for applications in February 2017.</b>	New schemes for 2015 and <b>2017</b>	Defra/Devolved Administrations (DAs)
<b>CAP Cross Compliance</b>	Soil Management Requirements, Nutrient management (NVZ), EIA	Regulatory	<ul style="list-style-type: none"> <li>• Good Agricultural and Environmental Conditions in place to ensure minimum soil cover, to maintain soil organic matter and to minimise erosion.</li> <li>• Implementation of the Nitrates Directive</li> <li>• Retention of permanent pasture (up to 2014 – now under Greening measures)</li> </ul>	Cross-compliance rules in place from January 2005. <b>Revised rules in place from January 2015</b>	Defra/DAs

Name of mitigation action	Objective and / or activity affected	Type of instrument	Brief description	Start year of implementation	Implementing entity(s)
<b>CAP Greening</b>	Maintenance of Permanent Grassland, introduction of Ecological Focus Areas (EFA) and Crop Diversification	Regulatory	<ul style="list-style-type: none"> <li>Obtain consent before improving grassland that has not been cultivated for 15 years or more (EIA).</li> <li>Select a range of EFA measures to meet new standards: relevant actions include enhanced buffer strips, cover crops and growing N-fixing crops</li> <li>In Wales consent must be obtained to improve grassland that has less than 25% rye grass.</li> <li>In Wales under CAP Greening, farmers can select a number of relevant EFA measures including, fallow land, short rotation coppice and nitrogen fixing crops.</li> <li>In Northern Ireland, under CAP Greening, farmers can select a number of relevant EFA measures including, landscape features, fallow land, agro-forestry, short rotational coppice and nitrogen fixing crops.</li> </ul>	New rules in 2015	Defra/DA
<b>Peatlands</b>					
<b>UK Peatland Code</b>	Increase private funding of peatland restoration	Voluntary Agreement, Information, Economic	<p>A UK Voluntary Code to encourage and support private sector funding for peatland restoration projects.</p> <p>Provides standards and robust science to give business supporters confidence that their financial contribution is making a measurable and verifiable difference.</p>	<b>2013 (pilot)</b> <b>2016 (finalised)</b>	Defra/ International Union for the Conservation of Nature (IUCN) UK

Name of mitigation action	Objective and / or activity affected	Type of instrument	Brief description	Start year of implementation	Implementing entity(s)
England Natural Environment White Paper (NEWP) targets on horticultural peat	A political commitment to reduce horticultural peat use to zero by 2030	Policy	The Sustainable Growing Media Taskforce was set up to look at ways in which the barriers to the use of peat alternatives could be overcome. The Government published its response to the Task Force's report and draft roadmap in 2013 which set out where our resources will be focussed. <b>A policy review will be published in 2017 assessing the delivery of the roadmap and identifying further actions necessary to achieve a transition to sustainable growing media and reduced peat use.</b>	2011	Defra
<b>Area Designations</b>	Improvement of peatland habitats into 'favourable' condition	Regulatory	3 out of 12 Nature Improvement Areas (NIA, 2012) are focussed on peatland restoration. 47% England's wetlands are protected by (Sites of Special Scientific Interest (SSSIs).	2004 and 2012	Defra/DAs
<b>Countryside Stewardship</b>	Funding to deliver effective environmental management of land including moorland habitats	Economic	Agri-environment scheme to provide funding to farmers and other land managers in England to deliver effective environmental management on their land, potentially including options for the maintenance and restoration of moorland habitats.	New scheme for 2015	Defra
<b>Natural England's Strategic Approach to the Restoration of Blanket Bog</b>	To ensure that the blanket bog habitat is actively moved towards 'favourable' conservation status	Information	<b>Natural England published the Strategy for the Restoration of Blanket Bog in England in 2015.</b> The approach sets out the extent, nature and importance of the blanket bog resource across England and what is currently being done to conserve it, as well as setting out the required management and timeframe for delivery to achieve an improvement in site condition across the resource at a strategic level.	2015	Defra/ Natural England (NE)
<b>Northern Ireland Peat Restoration</b>	Restoration of peatlands	Voluntary Agreement	Northern Ireland (NI) will include peatland restoration measures within the new agri-environment scheme, the Environmental Farming Scheme (EFS), as part of its NI Rural Development Programme 2014-2020.	<b>The first EFS Higher Level agreements to commence in 2018</b>	Northern Ireland

Name of mitigation action	Objective and / or activity affected	Type of instrument	Brief description	Start year of implementation	Implementing entity(s)
<p>Wales</p> <p><b>Peat restoration</b></p>	<p>Wales are developing a peatland action plan and priority action map</p>	<p>Voluntary</p>	<p>Wales has undertaken a comprehensive programme to understand the status of all peatlands in Wales. Each area will be assessed for the potential multiple benefits of restoration to develop a project prioritisation map. A key delivery method is the co-ordination of the multiple funding mechanisms.</p>		<p>Wales</p>
<p>Scotland</p> <p><b>National Peatland Plan</b></p>	<p>To promote improvements in the protection and condition of peatlands</p>	<p>Information</p>	<p>Scottish Government and Scottish Natural Heritage (SNH), working with a range of stakeholders, have published a <b>National Peatland Plan</b> to highlight the importance of Scotland's peatlands. It draws attention to the poor state of large areas, and proposes building on existing initiatives to secure their sustainable use, management and restoration.</p>	<p><b>2015</b></p>	<p>Scotland</p>



## Impact of policy instruments on emissions/removals

The following discussion of the impact of policy instruments on emissions/removals is consistent with the UK 6th National Communication, supplemented by more recent information. Actual and projected CO<sub>2</sub>e savings apportioned to each policy have not been published. Updates are provided in bold.

### Sustainable forestry policy

Forestry policy is devolved in the UK. All four countries have established policies for woodland creation, co-financed through the EU Rural Development Programme. The development of the Woodland Carbon Code, including its launch on an international carbon registry is attracting private and corporate funding to complement the Rural Development Programme. A revised UK Forestry Standard (UKFS) was published in November 2011, including a new guideline on Forests and Climate Change. The requirement for climate change mitigation is that 'forest management should contribute to climate change mitigation over the long term through the net capture and storage of carbon in the forest ecosystem and in wood products'. Meeting the requirements of the UKFS is a condition of grant-aid, and also underpins both the Woodland Carbon Code and forest certification under the UK Woodland Assurance Standard. A strong regulatory framework continues to protect existing woodland from deforestation and degradation.

In England, objectives for forestry are set out in the Forestry and Woodlands Policy Statement (2013), including an aspiration to increase woodland cover from 10% to 12% by 2060. The policy statement recognises the need to make woodland planting more attractive to landowners and attract private investment to fund it, particularly through the development of payments for ecosystem services as set out by the Ecosystems Market

Task Force. The Woodland Carbon Task Force has been established to help deliver emissions reductions by the forestry sector. A policy on when to convert woods and forests to open habitats in England is in place, which includes an assessment of implications for carbon balance in the process of prioritising sites for restoration. The development of a thriving forestry sector, through an industry-led action plan (Grown in Britain), is highlighted as an essential element to achieve woodland planting aspirations and deliver emissions savings in other sectors through the sustainable use of woodfuel as a source of renewable energy and harvested wood products substituting for other materials.

In Scotland, forestry is recognised as having an important role in contributing to emissions reduction targets through carbon sequestration and climate change mitigation is a specific objective of woodland creation. Following on from the 2012 Woodland Expansion Advisory Group review, a target to create an additional 100,000 ha of new woodland by 2022 was set out in the 2013 Low Carbon Scotland Report. This level of woodland creation aims to reduce Scotland's emissions by around 4.8 Mt CO<sub>2</sub>e in the period to 2027. To complement woodland creation, a framework to better control woodland removal is also in place along with proposals to further increase emissions abatement through greater use of Scottish timber in building construction and refurbishment.

The Welsh government has also set a target to create 100,000 hectares of new woodland in Wales by 2030 which will not only mitigate the impacts of climate change by locking up carbon emissions but also achieve other multiple objectives, such as reducing run-off after heavy rain.

England, Scotland and Wales have also established Woodfuel Strategies that aim to maximise the contribution of both existing and new woodlands to renewable energy production.

An independent study (the *Read Report: combating climate change – a role for UK forestry*), commissioned by the Forestry Commission, was published in 2009 and evaluated the role of forests and harvested wood products in GHG balance.

### Rural development regulation and environmental stewardship

Rural Development Programmes for 2014-2020 are currently being implemented in Scotland, Wales, Northern Ireland and England. These include delivering agri-environment-climate schemes, and climate change will be a cross-cutting priority across each Programme.

#### Peat restoration

##### England

The UK Government is committed to ensuring that all soils in England are managed sustainably by 2030. Measures such as the **UK Peatland Code**, peatland restoration through the new **Countryside Stewardship (RDP) scheme**, conservation designations and targets for the reduction of peat use in horticulture will help to achieve this ambition for England's peatlands. £100m capital funding is being invested directly in projects to support the natural environment over the next five years, including the restoration of peatlands. The forthcoming **25-Year Environment Plan** will set out long term plans for environmental policy and will help to target this resource in the right places.

##### Wales

The Welsh Government is committed to taking action to restore peatlands in Wales. Recent ministerial statements have set out an ambition to deliver restoration in a more coordinated manner using the RDP as the main delivery mechanism. In addition, this co-ordination will be used to develop a prioritisation for restoration and action plan to achieve cost effective mitigation. Steps include, co-ordinating restoration effort across privately

owned land and the Government estate and to co-ordinate RDP funded projects with domestic and LIFE funded projects with private finance initiatives to achieve landscape scale interventions.

##### Scotland

The Scottish Government and SNH consulted on a **National Peatland Plan** in 2014 and the final plan was published in August 2015. It highlights the Scottish Government's aspirations around peatlands, both in terms of protecting and managing peatlands as well as where appropriate restoring them. As part of the **Scottish Rural Development Programme 2015-2020**, £10m has currently been identified to support peatland restoration. Through the SNH led **Peatland Action** initiative 10,000 hectares of peatlands have been restored since 2013.

##### Northern Ireland

Northern Ireland (NI) will include peatland restoration measures within its new agri-environment scheme, the Environmental Farming Scheme (EFS), as part of its NI Rural Development Programme 2014-2020. The **first EFS Higher Level agreements will commence in 2018**.

### Identified challenges with effective implementation of measures and how data gaps could be addressed

The UK has a programme of research to address data gaps to complete reporting of land management practices in the UK LULUCF inventory (see **Table 1-2**). Research to enhance the understanding of the forest GHG balance, support LULUCF inventory modelling and underpin the National Forest Inventory are components of the Science and Innovation Strategy for British Forestry, published in 2014.



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