



Department for
Energy Security
& Net Zero

Planned methodology changes for UK greenhouse gas emissions statistics 1990-2022

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Contents

Introduction	4
Territorial Emissions Statistics sectors	5
Background	5
User feedback and rationale for replacing the NC sectors	5
The TES sectors	7
Impact of other methodology changes	10
Summary of individual changes	12
Non-domestic burning oil and non-road mobile machinery	12
HFC-sensitivity	12
Semiconductor F-gas use	13
Recreational N ₂ O use	13
Industrial liquid biofuels	13
Land use, land use change and forestry changes	14
Overall impact on emissions	15

Introduction

National Statistics on the UK's territorial greenhouse gas emissions for 1990-2022 will be published on 6th February 2024. The dataset of greenhouse gas emissions estimates is known as the UK's Greenhouse Gas Inventory. Every year, we apply methodological improvements to the way that emissions are estimated and revise the historical figures accordingly. This note sets out the main methodology changes that we have made this year and their estimated impact on emissions. It also describes a change we are making to the sectors we group emissions into in the statistics. The figures in this note are not an indication of the revisions to the statistics as a whole, as they only include methodology changes and do not include any annual revisions to the data sources used to estimate the UK's emitting activities, for example national fuel use. Figures presented in this report are provisional, and in addition to the UK also include emissions in the Crown Dependencies and Overseas Territories that the UK is required to report on under the United Nations Framework Convention on Climate Change (UNFCCC)¹.

The impacts of each methodology change on the 2021 totals and the 1990 baseline are given in Table 3 and the combined impact of them on each sector that we report on in Table 4. The estimated impacts are also reported as a percentage of the total emissions in last year's Greenhouse Gas Inventory. Emissions estimates are expressed in million tonnes of carbon dioxide equivalents (MtCO_{2e}), with emissions from each gas weighted based on its global warming potential². The '1990 baseline' is used for the UK's domestic greenhouse gas emission targets and is 1990 for carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O), and 1995 for fluorinated gases (F-gases).

Changes to the estimates can be prompted by the availability of new research or datasets, in response to internal or external reviews which suggest improvements, or when required by revisions to the international reporting guidelines for greenhouse gases. They can also be a result of revisions to the datasets which have been used in their compilation, for example the UK energy statistics published in the Digest of UK Energy Statistics (DUKES), although those revisions are not summarised in this document.

These changes are applied back through the time series to 1990, to ensure that the trend in emissions from 1990 to the present is based on a consistent method. It is therefore not appropriate to compare different years' inventory submissions. However, the latest inventory represents a single consistent data series going back to 1990, and this therefore allows year-on-year comparisons to be made.

¹ The Crown Dependencies are the Bailiwick of Jersey, the Bailiwick of Guernsey, and the Isle of Man. Only overseas territories that are party to the UK ratification of the UNFCCC are included in these statistics, which are the Cayman Islands, Bermuda, the Falkland Islands and Gibraltar.

² The global warming potentials (GWPs) used are from table 8.A.1 (without climate-carbon feedback) of Working Group 1 of the IPCC Fifth Assessment Report: Climate Change 2013 and summarised in a table published on the following page: <https://www.gov.uk/government/publications/uk-greenhouse-gas-emissions-explanatory-notes>.

Territorial Emissions Statistics sectors

Background

UK territorial greenhouse gas emissions statistics are based on data from the UK Greenhouse Gas Inventory. In previous iterations of the UK's official territorial emissions statistics, greenhouse gas emissions estimates were categorised into 'National Communication' (NC) sectors. However, feedback has shown that these NC sectors are misaligned with the needs of many users.

To ensure that UK territorial greenhouse gas emissions statistics best meet users' needs, the Department for Energy Security & Net Zero (DESNZ) has changed the way UK emissions sources are categorised. From February 2024, the NC sectors will be replaced by new 'Territorial Emissions Statistics' (TES) sectors.

User feedback and rationale for replacing the NC sectors

Alongside their role in meeting the UK's international reporting requirements, territorial emissions estimates have a variety of other uses. Central government departments, devolved administrations and local authorities use territorial greenhouse gas emissions estimates to develop policies to reduce emissions, set targets, and serve a variety of users including policymakers, academics, companies, and the public.

To ensure that UK territorial greenhouse gas emissions statistics best meet users' needs, DESNZ sought feedback from key stakeholders ahead of proposed adjustments to the sector categorisation of UK emissions sources³. Both internal stakeholder feedback and public feedback found that the NC sectors were not best suited for users; they misaligned with policy responsibilities and limited users' ability to identify key emissions sources such as heating buildings, producing energy from waste, non-road mobile machinery, and upstream oil and gas production. It was also found that the coverage of the NC sectors was sometimes misunderstood, in particular the 'business' sector given that many of the emissions in other sectors were the result of activities of businesses, while some sectors did not include certain emissions that some users would have expected them to, such as emissions from public transport not being included in the 'public' sector and emissions from industrial combustion not being in the 'industrial processes' sector.

In response to these limitations, internal and external users of these statistics have developed alternative sector categorisations. For instance, DESNZ and the Devolved Administrations (DAs) use separate sectors for decarbonisation strategies⁴, whilst the Climate Change

³ National Communication sector replacement proposal:

<https://assets.publishing.service.gov.uk/media/63e145ac8fa8f50e805a3e52/national-communication-sector-replacement-proposal-user-feedback.pdf>

⁴ Net Zero Strategy: <https://www.gov.uk/government/publications/net-zero-strategy>

Committee (CCC) has developed its own sector categorisation for reporting advice to Parliament⁴.

Building on this feedback, we have developed the TES sectors to ensure it easier for users to understand what the main emissions sources in the UK are and to be better aligned with policy responsibilities within government. We have also introduced subsectors to provide a slightly more detailed breakdown within every TES sector, as only some NC sectors had them before, and made some revisions to the categories presented in the statistics within each sector.

⁴ 2023 Progress Report to Parliament: <https://www.theccc.org.uk/publication/2023-progress-report-to-parliament/>

The TES sectors

Table 1 describes the emissions associated with each TES sector.

Table 1: Territorial Emissions Statistics sectors

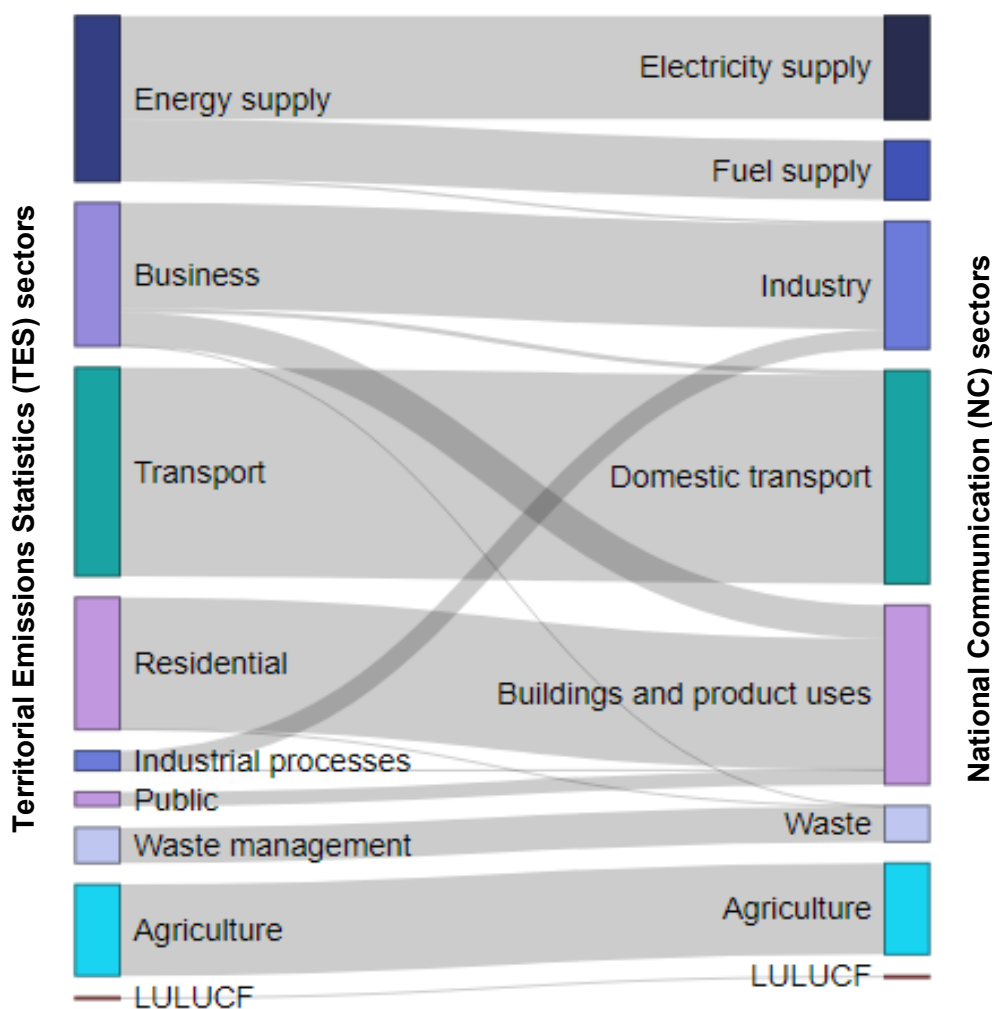
Electricity Supply	Emissions from power stations for electricity generation, including incinerators generating energy from waste. Excludes emissions from organisations generating their own electricity (autogeneration) even when exported to the electricity grid. These emissions are instead included in the sector in which they occur.
Fuel Supply	Emissions from the supply of fuels, e.g. oil, gas and coal. Includes activities such as extraction, production, venting, flaring, processing (e.g. oil refining) and distribution. Excludes emissions from coke production which are instead included in the <i>Industry</i> sector as coke is primarily used in the iron and steel industry.
Domestic Transport	Emissions from road vehicles, domestic aviation and shipping (including military), fishing vessels, and railways. Also includes emissions from transport related mobile machinery (e.g. at airports and ports) and F-gases from mobile air conditioning and refrigeration. International aviation and shipping emissions are not included in the national total, though are reported separately.
Buildings and Product Uses	Emissions from fuel combustion in residential, public, and commercial buildings, largely for heating. Also includes emissions from house and garden mobile machinery, anaesthetics, F-gases from air conditioning, refrigeration, heat pumps, aerosols as well as other product uses. Excludes emissions from industrial buildings which are instead included in the <i>Industry</i> sector.
Industry	Emissions from fuel combustion in the manufacturing and construction industries, industrial processes, and F-gases from industrial refrigeration. Emissions from coke production are included in this sector as coke is primarily used in the iron and steel industry. Includes emissions from organisations generating their own electricity and heat (autogeneration) even when exported to the electricity grid or used in heat networks.
Agriculture	Emissions from agricultural machinery and fuel combustion, livestock (enteric fermentation and manure management) and agricultural soils (excluding carbon stock changes which are included in the <i>LULUCF</i> sector).
Waste	Emissions from the treatment and disposal of waste, such as landfill, composting, incineration without energy recovery and wastewater handling. Excludes emissions from incinerators generating energy from waste as these are reported in the <i>Electricity Supply</i> sector.
Land Use, Land Use Change and Forestry (LULUCF)	Includes emissions and removals of CO ₂ from changes in the carbon stock in forestland, cropland, grassland, wetlands, settlements and harvested wood products, and emissions of other greenhouse gases from drainage (excl. croplands and intensive grasslands) and rewetting of soils, nitrogen mineralisation associated with loss and gain of soil organic matter, and fires. As impacts of carbon stock changes are included in this sector, CO ₂ emissions of biogenic origin (e.g. burning biomass for energy) are excluded from other sectors to avoid double counting.

The sectors described in Table 1 categorise emissions by source, meaning emissions are typically attributed to the sector that emits them directly, as opposed to where the end-user activity occurred. When presented on an end-user basis, emissions from the electricity supply

and fuel supply sectors (as well as some industry sector emissions from coke production and autogeneration) are instead assigned to the sectors in which the electricity and fuels are used, or to the *end use outside UK* sector when exported overseas.

Figure 1 illustrates the scale of emissions being reallocated between the NC and TES sectors. Whilst there have adjustments to the category names within the agriculture and LULUCF sectors, the overall emissions estimates for these sectors remains unchanged.

Figure 1: Greenhouse gas emissions by sector, UK 2021



Source: Table 1, NC to TES mapping Excel data table
 2021 UK greenhouse gas emissions: final figures – dataset of emissions by source
 Note: LULUCF is land use, land use change and forestry.

Table 2 provides a more detailed breakdown of how emissions sources have been reallocated across the new TES sectors. Like the hierarchical NC sectors, the TES sectors provide a breakdown of emissions at three levels.

For complete information on how each emissions source in the UK 1990-2021 GHG Inventory maps between NC and TES sectors see the supplementary mapping document published alongside this document. Note there have been substantial changes to the structure of the emissions sources and activities reported against the LULUCF sector in the UK 1990-2022 Greenhouse Gas Inventory so the mapping for LULUCF is based on the UK 1990-2022 Greenhouse Gas Inventory.

Table 2: Comparison of National Communication and Territorial Emissions Statistics sectors

TES sector	Emissions sources in scope according to their NC sector allocation
Electricity Supply	Energy Supply – Includes emissions from power stations previously allocated to the <i>Energy Supply</i> sector.
Fuel Supply	Energy Supply – Includes emissions from fuel production and fuel supply activities such as mining, refining, manufacturing and distributing fuels previously allocated to the <i>Energy Supply</i> sector.
Domestic Transport	Transport – Includes all emissions previously allocated to the <i>Transport</i> sector. Business – Includes F-gas emissions from mobile air conditioning and transport refrigeration previously categorised as part of the <i>Business</i> sector.
Buildings and Product Uses	Business – Includes emissions from combustion on commercial sites previously allocated to the <i>Business</i> sector. Also includes emissions from product uses in <i>Business</i> such as nitrous oxide (N ₂ O) use as an anaesthetic, or stationary refrigeration and air conditioning. Public – Includes all emissions previously allocated to the <i>Public</i> sector. Residential – Includes emissions from residential fuel combustion and product uses such as recreational N ₂ O use, aerosols, and metered dose inhalers previously allocated to the <i>Residential</i> sector. Industrial Processes – Includes emissions from the use of N ₂ O in industry previously allocated to the <i>Industrial Processes</i> sector.
Industry	Business – Most <i>Industry</i> sector emissions carry over from the <i>Business</i> sector. These comprise of emissions from manufacturing and construction, as well as industrial refrigeration and air conditioning. Industrial Processes – Most emissions previously categorised as part of the <i>Industrial processes</i> sector have been reallocated to the <i>Industry</i> sector. Energy Supply – Emissions from coke production previously categorised as part of the <i>Energy Supply</i> sector are now included in the <i>Industry</i> sector as energy from coke production is primarily used in the iron and steel industry.
Waste	Waste Management – Includes all emissions previous allocated to the <i>Waste Management</i> sector. Business – Includes emissions from accidental fires previously allocated to the <i>Business</i> sector. Residential – Includes emissions from household composting, small-scale waste burning, and accidental fires previously allocated to the <i>Residential</i> sector.
Agriculture	Agriculture – The coverage of the <i>Agriculture</i> sector is unchanged. However, there have been some changes to the categories within the <i>Agriculture</i> sector.
Land Use, Land Use Change and Forestry (LULUCF)	Land Use, Land Use Change and Forestry (LULUCF) – The coverage of the <i>LULUCF</i> sector is unchanged. However, there have been some substantial changes to the categories within the <i>LULUCF</i> sector to align better with land use policy. Key changes include the separation of forestry and peatlands related emissions into their own sub-sectors, as well as the creation of new categories within forestry and peatlands that better describe the emissions and removals.

Impact of other methodology changes

Alongside the changes to the sectors used to group emissions estimates in our statistics publications, we have made other improvements to the methodology used to estimate greenhouse gas emissions. Unlike the changes to sector categorisation that have no impact on overall emissions estimates, other methodological improvements can lead to revisions to the historical figures. Table 3 shows the impact of methodological changes made this year on emissions estimates for the 1990 baseline and 2021.

Table 3 – Provisional effect of individual changes: UK, Crown Dependencies and Overseas Territories^{5,6,7,8}

Change	Reason for change	Change in emissions (MtCO ₂ e)		Impact on national total from previous inventory (%)	
		1990 baseline	2021	1990 baseline	2021
Non-domestic burning oil and non-road mobile machinery	Improved models allowing for allocation by machinery type and sector	0.00	0.00	0.00%	0.00%
HFC-sensitivity	Review of model parameters	-0.13	-2.66	-0.02%	-0.62%
Semiconductor F-gas use	Implementation of real industry data	0.00	~0.00	0.00%	~0.00%
Recreational N ₂ O use	Review of model assumptions	0.00	0.14	0.00%	0.03%
Industrial liquid biofuels	New data available	0.00	~0.00	0.00%	~0.00%
Sustainable aviation fuel	New data available	0.00	~0.00	0.00%	~0.00%
Land use, land use change and forestry changes (UK)	Model and data updates	-0.10	-0.16	-0.01%	-0.04%
Land use, land use change and forestry changes (Crown Dependencies and Overseas Territories)	Model and data updates	~0.00	-0.02	~0.00%	~0.00%
TOTAL⁹		-0.23	-2.69	-0.03%	-0.62%

⁵ The '1990 baseline' is used for the UK's domestic greenhouse gas emission targets and consists of emissions from 1990 for all gases except fluorinated gases, for which it uses emissions values from 1995.

⁶ ~0.00 indicates where a value is non-zero but is less than either 0.005 MtCO₂e or 0.005% in magnitude. 0.00 indicates a value that has not changed.

⁷ A positive number indicates an increase on last year's emissions estimates; a negative number indicates a decrease.

⁸ All figures have been rounded to 2 decimal places.

⁹ Totals may not sum due to rounding.

Table 4 summarises the estimated impact on emissions from the methodology changes for each sector.

Table 4 – Provisional effect of changes by sector: UK, Crown Dependencies and Overseas Territories ^{10,11,12,13}

TES sector	Change in emissions (MtCO ₂ e)		Impact on national total from the previous inventory (%)	
	1990 baseline	2021	1990 baseline	2021
Domestic Transport	0.82	-0.17	0.10%	-0.04%
Electricity Supply	0.00	0.00	0.00%	0.00%
Fuel Supply	0.00	0.00	0.00%	0.00%
Buildings and Product Uses	-0.04	-1.08	~0.00%	-0.25%
Industry	-0.91	-1.26	-0.11%	-0.29%
Agriculture	0.00	0.00	0.00%	0.00%
Waste	0.00	0.00	0.00%	0.00%
Land Use, Land Use Change and Forestry (LULUCF)	-0.10	-0.17	-0.01%	-0.04%
TOTAL ¹⁴	-0.23	-2.69	-0.03%	-0.62%

¹⁰ The '1990 baseline' is used for the UK's domestic greenhouse gas emission targets and consists of emissions from 1990 for all gases except fluorinated gases, for which it uses emissions values from 1995.

¹¹ ~0.00 indicates where a value is non-zero but is less than either 0.005 MtCO₂e or 0.005% in magnitude. 0.00 indicates a value that has not changed.

¹² A positive number indicates an increase on last year's emissions estimates; a negative number indicates a decrease.

¹³ All figures have been rounded to 2 decimal places.

¹⁴ Totals may not sum due to rounding.

Summary of individual changes

Details of the methodology changes made to emissions estimates are given below. Further information on the updated methodologies will be provided in the UK's National Inventory Document (NID) when it is submitted to the UNFCCC later in 2024¹⁵.

Non-domestic burning oil and non-road mobile machinery

Following improvements to the non-road mobile machinery (NRMM) model, NRMM emissions are now better disaggregated by machinery type. Prior to this change, a large share of NRMM emissions were reported as 'industrial off-road machinery' as there was insufficient data resolution to report them against more appropriate sectors. Now, NRMM emissions can be allocated to more appropriate sectors. Emissions from refrigerated transport and seaport machinery (0.73 MtCO_{2e} in 2021) which would have previously been reported in the industry sector can now be reported in the domestic transport sector, consistent with the allocation of emissions from aircraft support vehicles.

This change has no impact on the overall estimate of UK territorial greenhouse gas emissions. Instead, improvements to the NRMM model allow for a more appropriate and detailed sector allocation of NRMM emissions.

HFC-sensitivity

Hydrofluorocarbon (HFC) emissions are estimated through bottom-up modelling of all UK equipment and products that use HFCs. Key sources of HFC emissions include refrigeration, air-conditioning, and heat pumps (RACHP), insulating foams, technical aerosols, and metered dose inhalers. To verify the HFC emissions estimates included in the UK greenhouse gas inventory, DESNZ also funds external HFC emissions modelling carried out by the UK Met Office and Bristol University. These alternative estimates are derived from atmospheric measurements of HFC concentrations. Previously, there have been significant discrepancies between the estimates obtained from the two approaches¹⁶.

To support Defra's work on the upcoming revisions of the Great Britain F-Gas Regulation, several model parameters were reviewed and updated to address the discrepancies with external model estimates. Overall, these revisions reduce total HFC emissions estimates throughout the time series. Key changes include:

- A change in the leakage deterioration factor for most RACHP equipment. This factor is applied to increase the leakage from RACHP equipment after it reaches two thirds of its

¹⁵ UNFCCC reports: <https://unfccc.int/reports>

¹⁶ Annual Report 2021: Verification of UK greenhouse gas emissions using atmospheric observations: [https://www.gov.uk/government/publications/uk-greenhouse-gas-emissions-monitoring-and-verification#:~:text=The%20atmospheric%20observations%20derive%20baseline,Atmospheric%20Gases%20Experiment%20\(AGAGE\).](https://www.gov.uk/government/publications/uk-greenhouse-gas-emissions-monitoring-and-verification#:~:text=The%20atmospheric%20observations%20derive%20baseline,Atmospheric%20Gases%20Experiment%20(AGAGE).)

life expectancy. Previously, lack of good data necessitated the use of a conservatively high factor. There have also been modifications to the in-life leakage and end-of-life emission assumptions for mobile air-conditioning, as well as retail and industrial refrigeration.

- Modifications to stock assumptions to reflect the rapid growth expected by DESNZ in the heat pump market.

Semiconductor F-gas use

The models used to estimate semiconductor F-gas use now use real data from industry. Previously, estimates of semiconductor F-gas use were based on qualitative data. Overall, the inclusion of new data from industry has minimal impacts on industry sector emissions estimates across the series.

Recreational N₂O use

There have been several updates to the assumptions included in the recreational N₂O use model in response to new research indicating that the previous assumptions used were inaccurate¹⁷. The assumption changes are:

- An increase in the mass of N₂O in a 10mL cartridge from 1.2g to 7.5g.
- An increase in the number of N₂O canisters consumed per session from 1 to 5.

These assumptions are considered more evidence-based than the previous ones and sum to an increase in N₂O emissions estimates from recreational use.

Industrial liquid biofuels

The 2023 publication of DUKES introduced data on the quantities of liquid biofuels used in unclassified industries together with autogenerators. These data have been incorporated into the greenhouse gas inventory to include estimates of emissions from these fuels for the first time, with appropriate emission factors obtained from the Intergovernmental Panel on Climate Change (IPCC) 2006 Guidelines, Volume 2.

Sustainable aviation fuel

The 2023 publication of DUKES introduced data on the quantities of aviation biofuel use. These data have been used to produce estimates of emissions from these fuels for the

¹⁷ Reassessment of N₂O model assumptions:
<https://pubs.rsc.org/en/content/articlehtml/2023/ea/d3ea00025g#cit20>

greenhouse gas inventory for the first time, calculating them using the DUKES activity data and the IPCC Tier 3 methodology for aviation.

Land use, land use change and forestry changes

There have been several methodological updates to the LULUCF sector. These include:

- Several updates to the carbon accounting models that change the estimates of Forest Land Carbon Stock Change. Notable changes include revisions to the soil model and the inclusion of urban trees across the whole time series. There are other minor changes resulting from the estimation of Northern Ireland wood production in private woodland for the first time. Combined, these changes to carbon accounting models have the largest impact to emissions estimates amongst the methodological changes to the LULUCF sector this year.
- Several updates to peatlands emissions estimates. The inclusion of new peat extraction volume data for Northern Ireland sums to the largest change to organic soils this year. Peat map revisions for England and Northern Ireland have also affected estimates of emissions and removals from the LULUCF sector. For Northern Ireland, revisions have led to a decrease in organic soil areas of 137 hectares. For England, peat map revisions have led to the inclusion of 2,674 hectares of rewetted bog. There have also been slight changes to peatland restoration areas in Scotland, including the addition of restoration areas for domestic peat extraction. Peat map revisions for have also led to minor changes in cropland areas and estimates of greenhouse gas emissions from cropland.
- New data for estimating forest, grassland, settlement, and cropland areas in the Isle of Man. The methodology for calculating these areas in the Isle of Man was updated to use the Land Cover Map (LCM) 2019 dataset that was commissioned by the Isle of Man Government in 2021. This has resulted in a larger forest area, a smaller grassland area, and a smaller settlement area. These changes have all led to lower emissions estimates in the Isle of Man across the time series in these sub-sectors. In contrast, the new data set now results in a larger cropland area, and therefore higher emissions for cropland. The overall effect of these changes is lower emissions estimates for the Isle of Man.
- Minor changes to forest land, grassland, settlement, and cropland area estimates for Guernsey resulting from consistency updates and error corrections.
- Minor LULUCF changes resulting from updated deforestation data and woodland loss estimates in England. In Scotland, updates to estimates of rewetting have impacted the split between forest to wetland and forest to grassland areas from 2000 onwards.

Table 3 distinguishes between the changes that impact UK emissions and changes that impact the emissions of Crown Dependencies and Overseas Territories.

Overall impact on emissions

In total, the changes made to the methods for the 1990-2022 greenhouse gas emissions statistics decrease emissions in the 1990 baseline by 0.23 MtCO₂e and decrease emissions in 2021 by 2.69 MtCO₂e. This compares to an increase in the 1990 baseline by 6.14 MtCO₂e and an increase in 2020 by 0.63 MtCO₂e from the methodological changes in last year's statistics.

The figures in this note are not an indication of the revisions to the statistics as a whole, as it only includes methodology changes and does not include any annual revisions to the data sources used to estimate the UK's emitting activities, for example national fuel use. It should also be noted that these figures are not yet finalised and are subject to change.

This publication is available from: www.gov.uk/government/publications/planned-methodology-changes-for-uk-greenhouse-gas-emissions

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