Department of Energy & Climate Change

Review of UK-specific GHG Emission Factors & Update of IPCC Default Emission Factors

Final Report

Aether

January 2015

Department of Energy and Climate Change
3 Whitehall Place
London SW1A 2AW
Website: www.gov.uk/decc

Information about this publication is available from:
GHG Statistics and Inventory Team
Department of Energy and Climate Change
Area 6A, 3 Whitehall Place
London SW1A 2AW

Email: Climatechange.Statistics@decc.gsi.gov.uk

Published by the Department of Energy and Climate Change

Review of UK-specific GHG Emission Factors & Update of IPCC Default Emission Factors

Report to the Department of Energy and Climate Change

This research was commissioned and funded by DECC. The views expressed reflect the research findings and the authors' interpretation; they do not necessarily reflect DECC policy or opinions.

Table of Contents

Executive Summary 5

Introduction and Context 6

Emission Factor Analysis and Proposals for Change 7

Energy 8

Method 8

Findings 8

Industrial Processes 14

Method 14

Findings 14

Waste 15

Method 15

Findings 16

Agriculture 17

LULUCF 17

Summary of Recommendations 18

Implied Emission Factor Analysis for UK and EU Member States 18

Annex A – Proposed Updates to 2006 IPCC Default EFs 21

Annex B – UK IEF Categories Containing Outliers 32

Executive Summary

This report provides analysis on the state of compliance of emission factors (EFs) applied in the UK's 2014 greenhouse gas (GHG) inventory submission with the 2006 IPCC Guidelines for National Greenhouse Gas Inventories[1] (here on referred to as the **2006 IPCC Guidelines**).

The following summarises the current state of compliance within each inventory sector:

1. Energy: ***Mostly compliant.***
    a. Improved transparency of EF selection and justification is needed for some country-specific carbon, N_2O and CH_4 emission factors which are outliers compared to 2006 IPCC defaults and their uncertainty ranges (see below).
    b. Assessment of the continued validity of CH_4 and N_2O emission factors for a range of categories reporting emissions from the combustion of coal / coke fuels from Brain et al 1994 and Fynes et al 1994.
    c. Recommendations are made for EF updates to 2006 IPCC defaults (see Annex A).
2. Industrial Processes: ***Mostly compliant***
    a. Improved transparency needed for some country specific carbon, N_2O and CH_4 emission factors which are outliers compared to 2006 IPCC defaults and their uncertainty ranges (see below).
    b. Recommendations are made for EF updates to 2006 IPCC defaults (see Annex A).
    c. Update to Iron and Steel estimates made in 2013/2014[2] which will ensure consistency with 2006 IPCC.
    d. Update to F-Gas estimates to ensure consistency with 2006 IPCC completed in 2014[3].
3. Agriculture: ***Unconfirmed status***
    a. Beyond prioritising categories for review for Defra no other review of the agriculture sector was undertaken in this EF review project. Development work on the agricultural emissions calculation platform is ongoing with Defra. Priorities for improvement from this EF project have been highlighted to Defra who are working on updates to ensure consistency with 2006 IPCC and address comments from the 2013 UNFCCC expert review team.
4. LULUCF: ***Unconfirmed status***
    a. External to this project, there have been a number of updates to the way LULUCF emissions are estimated for the 2014 submission and to ensure consistency with 2006 IPCC. The main significant change has been the requirement to include pre-1920 forest in estimates and this has driven the switch to the use of the Forest Commission's CARBINE model in place of CEH's C-Flow model. CEH have confirmed that improvements in methods associated with use of the CARBINE model make estimates more compliant with IPCC 2006 Guidance. Due to the ongoing changes to the LULUCF estimates it has not been possible to review specific emission factors used in the UK inventory in this EF review project.
5. Waste: ***Mostly compliant.***
    a. Improved transparency needed for some country specific N_2O and CH_4 emission factors which are outliers compared to 2006 IPCC defaults and their uncertainty ranges (see below).
    b. Recommendations are made for EF updates to 2006 IPCC defaults (See Annex A).

[1] IPCC, *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 (2006). http://www.ipcc-nggip.iges.or.jp/public/2006gl/

[2] Ricardo-AEA, 2014, *Use of EU ETS Data - Iron & Steel Sector, Chemical Industry Feedstock Use*

[3] ICF Consulting Ltd, 2014, *Review of data and methodologies used in the calculation of UK emissions from F-Gases*, Acharya, B., Harris, D.,Knoell, K., Mathis, P. and Scarbrough, T.

We recommend that the UK continue to track progress on improvements and ensures that stable methods and EFs consistent with 2006 IPCC requirements are in place by September 2014 at the latest in preparation for 2015 reporting and the beginning of the fixing of assigned amounts for the second commitment period.

Introduction and Context

This project has been commissioned by the Department of Energy & Climate Change (DECC) and is designed as part of a package of projects under the GHG inventory improvements programme. The programme ensures that the UK continues to comply with its international obligations for high quality (Transparent, Complete, Consistent, Comparable and Accurate) reporting of GHG inventories to the United Nations Framework Convention on Climate Change (UNFCCC). Of most importance is that the UK GHG inventory continues to be:

- **Transparent:** by ensuring appropriate and credible documentation of data sources, methods and assumptions underpinning data used in the estimates. In particular, expert review teams (ERTs) need to be satisfied that there is suitable evidence e.g. in the National Inventory Report (NIR) for the use of country-specific EFs and assumptions when applying Intergovernmental Panel on Climate Change (IPCC) methods.

- **Complete:** Ensuring that all sources and sinks are included in the estimates as far as is possible. Of utmost importance from 2015 onwards are estimates for categories for which the 2006 IPCC Guidelines provides methods.

- **Accurate:** ensuring that estimates neither under nor over estimate emissions/removals as far as can be judged and follow agreed and suitable methods outlined in the 2006 IPCC Guidelines. Where Parties use country-specific data (e.g. fuel carbon measurements or data from measurements at industrial plant) these data must be of demonstrably higher quality (more accurate and therefore reducing uncertainty) than default data available from the 2006 IPCC Guidelines.

The UK periodically reviews the country-specific EFs used in the UK GHG inventory, giving consideration to whether values are in line with what is expected and in comparison with 2006 IPCC defaults. Where they differ, the UK ensures that these country specific emission factors are suitably and transparently justified.

In order to comply with post 2015 UNFCCC reporting requirements, the UK must ensure that it uses the most up-to-date methods and default emission factors consistent with 2006 IPCC Guidelines (where country specific emission factor parameters are not used). We note that in the UK inventory default EFs are only used in categories that have a relatively minor contribution to the UK national total emissions (non-key sources).

The default emission factors will have been sourced from the following guidelines:

- Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories[4] (here on referred to as **1996r IPCC Guidelines**);

[4] IPCC, *Revised 1996 IPCC Guidelines for National Greenhouse Inventories*. Houghton J.T., Meira Filho L.G., Lim B., Tréanton K., Mamaty I., Bonduki Y., Griggs D. J. and Callander B.A. (Eds). IPCC/OECD/IEA, Paris, France (1997) http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.html

- Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories[5] (here on referred to as **2000 IPCC Guidance**);
- Good Practice Guidance for Land Use, land-Use Change and Forestry[6] (here on referred to as the **LULUCF Guidance**).

The aims of the project are therefore:

- **To validate the UK's country-specific emissions factors (EFs)**, for example, by benchmarking them against the existing and new default emission factors of the IPCC and those of other EU Member States. *This is to ensure that, according to the most up to date evidence, they are appropriate and sufficiently justified.*

- **To update the existing IPCC default emission factors**, where used in the UK inventory database, to those required by the 2006 IPCC Guidelines. *i.e. where appropriate, update the UK's default emission factors to those presented in the 2006 IPCC Guidelines, or provide sufficient justification for retaining default values from the 1996r IPCC Guidelines or the 2000 IPCC Guidance.*

This report presents a summary of Aether's findings by inventory reporting sector, namely where analysis has highlighted queries/discrepancies that are considered to require change or further clarification.

The report also provides results from an outlier analysis of UK EFs compared to other EU Member States. This has been used to assess at a more aggregated level how the UK's implied emission factors (IEFs) compare with other EU Member States. The final section of the report draws conclusions upon the analysis and provides a list of recommendations for implementation.

Emission Factor Analysis and Proposals for Change

As far as possible a consistent method for analysis has been applied across inventory sectors. In order to best utilise allotted time, UK source categories (by sector) were initially prioritised for consideration according to a number of factors. As a general rule, country-specific EFs were given highest consideration if they met at least one of the following criteria:

a. The source category was identified in the UK inventory as a key category in the 2013 submission.
b. The source category has been identified as a review issue as part of the United Nations Framework Convention on Climate Change (UNFCCC) review process.
c. The source category contributed to >1% of the 2011 sector total emissions (as CO_2 eq.) in the 2013 submission.

This approach enabled sector reviewers to target their investigation efforts on the most important sources, however in practice a number of sectors have been reviewed at a greater detail level. This has resulted from the recognition that emission factors by fuel are often repeated across sources in the UK inventory and therefore all need to be considered for their appropriateness in order to maintain internal consistency. The Table in Annex A provides a summary of all proposed default EF updates resulting from this review.

[5] IPCC, *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories.* Penman J., Kruger D., Galbally I., Hiraishi T., Nyenzi B., Emmanuel S., Buendia L., Hoppaus R., Martinsen T., Meijer J., Miwa K., and Tanabe K. (Eds).. IPCC/OECD/IEA/IGES, Hayama, Japan (2000)
[6] IPCC, *Good Practice Guidance for Land Use, land-Use Change and Forestry*. Penman J., Gytarsky M., Hiraishi T., Krug, T., Kruger D., Pipatti R., Buendia L., Miwa K., Ngara T., Tanabe K., Wagner F.,. IPCC/IGES, Hayama, Japan (2003)

Energy

The Energy sector is of great importance in the UK inventory for GHG emissions, with notable categories such as power generation reliant upon the burning of large quantities of fossil fuels. As a result, a large number of country-specific EFs are applied, particularly for CO_2 emissions where the inventory is generally considered to be of high quality, underlined by a strong evidence base. For more minor sources of CH_4 and N_2O a number of IPCC default EFs are applied.

Method

Due to the large number of source categories within the energy sector, the analysis has been based largely around a direct comparison of UK EFs to 2006 IPCC defaults and uncertainty ranges, with the following assumptions:

- Country-specific EFs within the IPCC default ranges are likely to be justified and require no further investigation.
- Country-specific EFs outside of IPCC default ranges require a clear statement of justification in the NIR. Where no such statement has been found, this is a cause for query to the UK inventory team.
- Old default EFs (1996r and 2000 IPCC) utilised in the UK inventory can all be updated to IPCC 2006 Guidelines where values have changed unless the UK team know of specific cases where the continued use of 1996r and 2000 IPCC defaults can be fully justified.

Proposed IPCC default EF updates are listed in Annex A.

Findings

Comments raised during the 2013 UNFCCC Review identified the need for the UK to review and justify its oxidation factors for the following fuels.

- Coal – other (0.97)
- Coal – domestic (0.94)
- Coke – power (0.97)
- Coke – other (0.97)
- Anthracite – domestic (0.947)

We note that the default for 2006 IPCC is for an oxidation factor of 1. **We recommend, as indicated above that the UK team provide further justification for its use of country specific oxidation factors, or amend to the IPCC 2006 default values in lack of such evidence.**

We have identified some issues of transparency for CO_2 where country-specific EFs are outside the 2006 IPCC default ranges. It is recommended that these should be resolved. See below for specific comment on EFs applied for Municipal Solid Waste (MSW), Sour Gas, Colliery Methane, Scrap tyres, Naphtha, Natural Gas for Upstream Oil & Gas Production and Domestic Anthracite.

There are some large **differences between 2006 IPCC defaults and EFs used for methane and nitrous oxide** across a number of categories reporting emissions from the combustion of coal / coke fuels that need further investigation and clarification or replacement with 2006 IPCC defaults (see below).

2006 IPCC default EFs have been identified for some minor source/pollutant categories that appear not to be included in the 2014 UK GHG inventory submission. **It is recommended to include these new sources, which are included in Annex A of this report.**

The units used by the UK for its EFs and AD are different to those used by 2006 IPCC Guidelines which has made comparison more difficult. We note that this has also been raised by the UNFCCC Expert Review Teams (e.g. 2012 ARR Paragraphs 30a, 43a and 47a) as an issue of transparency and comparability. The UK energy statistics are presented in various units (e.g. mass units, thermal units).

Although these units in some cases can easily be converted into each other, for some other cases (country specific) properties of the various fuels are needed. The 2006 IPCC Guidelines encourage estimates to be derived using SI energy units for fuel quantities (Net Calorific Values (NCV) expressed in MJ, GJ, TJ, PJ). The simple reason for this is that this minimizes the effect of ashes and similar non-energy carrying components of the commercial fuels and increases transparency of, and comparability between national estimates. NCV is used to represent the amount of heat that is actually available from the combustion process taking into account the moisture content as opposed to the total energy in a fuel irrespective of the moisture content (GCV). NCV is used in preference of Gross Calorific Value (GCV) in order to remove the contribution from water content to the latent heat component of the fuel combustion process. All IPCC default values for energy are expressed on the basis of SI energy units.

Where UK energy data is available in SI units we encourage the UK inventory team to derive the UK estimates using NCV values, expressed in Joules to estimate activity data. All (country specific) emission factors then could directly be compared with the IPCC default ones. Furthermore the UNFCCC review process uses IEA and EUROSTAT energy statistics data, also expressed in $TJ_{(NCV)}$ and having the UK GHG inventory and background data in comparable units improves transparency. We do realize that the UK traditionally reports energy statistics in Gross Calorific Values (GCV), as do a few other (mainly English speaking) Parties (US, Australia, Canada, New Zealand and Japan). Since all other EU MSs and EUROSTAT use NCV values, it would improve transparency and comparability for the UK to also use NCV.

CO_2

Due to the large number of EFs applied in the Energy Sector within the UK GHG inventory, a sector wide analysis was performed to compare all UK EFs against the matching IPCC 2006 Default EFs and their uncertainty ranges. For this analysis the uncertainty information in the 2006 Guidelines is converted into a lognormal distribution for each separate CO_2 emission factor in the introductory chapter of the Energy volume of the 2006 IPCC Guidelines. Figure 1 below shows the frequency of occurrences of UK EF deviation from the default value, normalized to the standard deviation. The 2006 IPCC Guidelines provide 95% confidence intervals, corresponding to 1.96 standard deviations. All occurrences between a normalized deviation of -2 and +2 can be regarded as acceptable and within the 95 % confidence interval given by the IPCC. It is clear that the vast majority of the UK EFs are within the 95 % confidence intervals. The key outliers which are beyond the +-2 standard deviations include Sour Gas (+10), Colliery Methane (+10), waste solvents (-10), scrap tyres (-7.5) and MSW (-6.5)). These fuels are discussed further below.

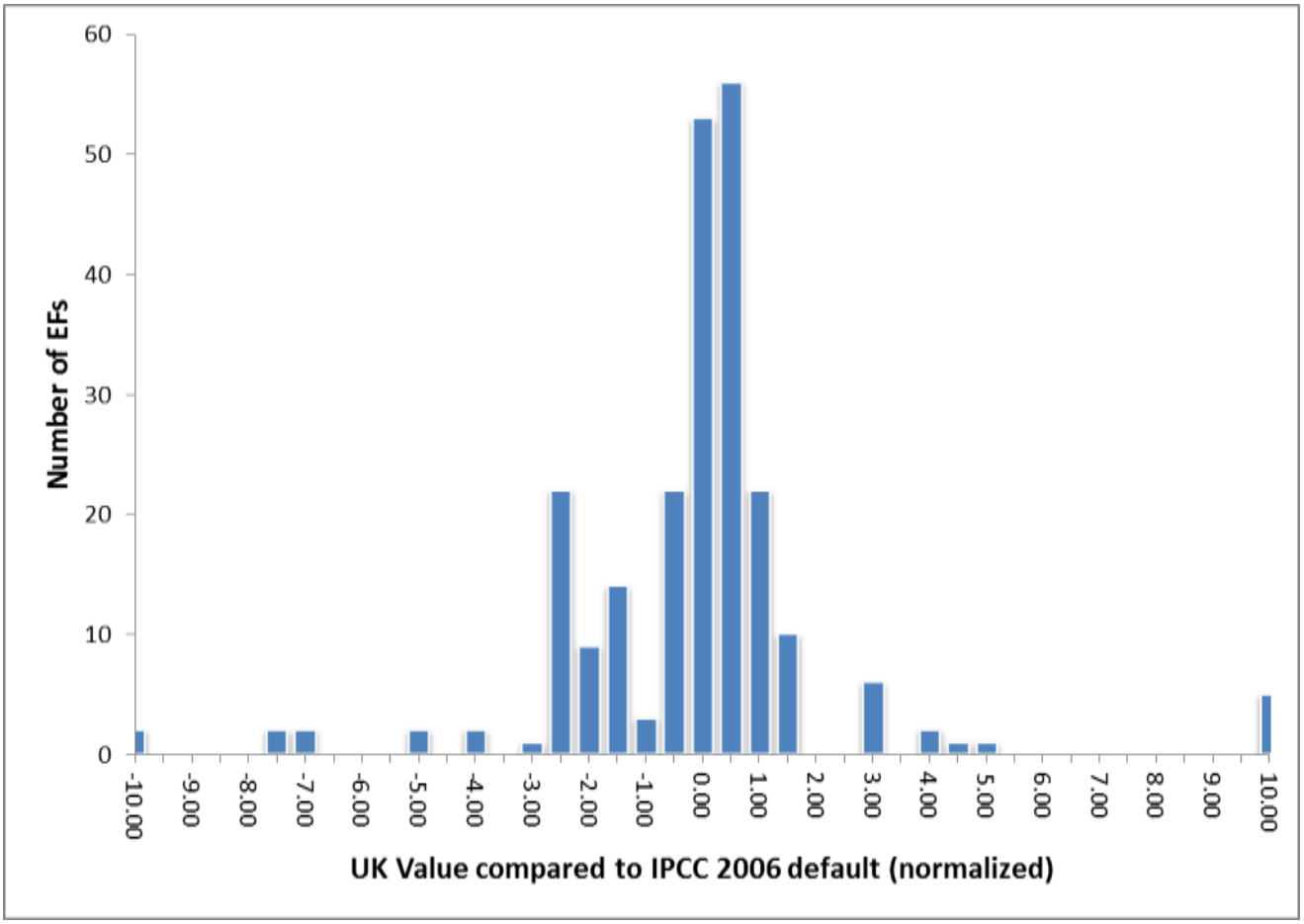


Figure 1: Frequency distribution of all UK Energy CO_2 EFs compared to IPCC 2006 defaults. The horizontal axis is expressed as standard deviations. Any value within the -2 to +2 range is within the 95 percent uncertainty range

Generally UK's country specific CO_2 EFs can be fully justified and we do not recommend changing any methods or assumptions assuming full transparency can be provided. For a number of relatively minor fuels/categories we have some recommendations on transparency.

- **Municipal Solid Waste (MSW) (Combustion of):** The UK refers to UK-specific waste composition data as a reference for the carbon emission factor for MSW in chapter 3 (Energy) of the NIR. In chapter 8 (Waste) this reference is given as "Estimates of waste composition and quantities have been taken from different sources – prior to 1995 they are from Brown et al. (1999), prior to 2000 they are based on the LQM (2003) study and from 1995 they are based on new information compiled by Eunomia (Eunomia, 2011)." (NIR page 432). We assume that these references provide the biomass carbon content fractions that are used to correct the CO_2 EF from the MSW stream for the amount of biomass in it. The NIR however does not provide the information needed to check this. Annex A3 table A.3.2.5 provides a number and references "ah" *(Carbon EF based on carbon content of waste)*. **We recommend including the biomass content data explicitly in the annex 3 of the NIR to increase transparency**.
- **Sour Gas (Combustion of):** on page 116 of the NIR the following is stated: "*In particular, for sector 1A1a, the carbon factors for gas are higher in some years than might be expected because sour gas has been used in the UK ESI sector from 1992 onwards, and sour gas has a higher carbon factor than natural gas. The large increase in the CO_2 IEF between 1991 and 1992 is explained by the start-up of Peterhead power station in Scotland. This station burned large volumes of sour gas at that time, but after the mid-1990s, the quantities rapidly decreased again and the impact of sour gas on the UK IEF for gas should be small for the later part of the time-series*." It is not clear why sour gas has a

higher carbon factor. From the additional information submitted with the 2013 submission we derive an IPCC comparable EF for sour gas used of 74 560 kg/TJ, which is in the range of lighter oil products and significantly above the natural gas value. We could not find sufficient documentation to support this value in the NIR. Annex A3 does not provide a number or a reference. **We recommend to include this information in the Annex 3 to the NIR and clearly explain the causes why the UK value is this high**.

- **Colliery Methane (Combustion of):** the emission factor used by the UK is 70 917 kg/TJ. A comparison with the EF for natural gas (also mainly methane) shows that the UKs Colliery Methane value is significantly higher. We did not find an explanation for this in the NIR. The Annex A3 refers to "EU ETS data", but does not explain why this number is this high. **We recommend including this information to increase transparency**.
- **Scrap tyres (Combustion of):** the Annex A3 of the NIR marks the emission factors for scrap tyres as Confidential. Emission factors for this fuel however are presented in the additional information, submitted with the 2013 inventory. **We recommend including these factors and including a reference to their origin, in annex A3 of the NIR to increase transparency**.
- **Naphtha (Combustion of):** the EF used in the UK is low compared to the IPCC 2006 Guidelines defaults and uncertainty ranges and is without sufficient justification for the emission factors used. **We recommend the UK to provide an explanation in annex A3 of the NIR as justification for why the UK emission factor is lower than the IPCC 2006 Default EF**.
- **Natural Gas (Combustion of) for Upstream Oil & Gas Production:** the additional information submitted in 2013 lists "natural gas" use for upstream oil and gas production with an EF that we calculate to be considerably higher (about 61 000 kg/TJ) than the one used for natural gas in all other source categories (about 56 700 kg/TJ).We could not find an explanation for this in the NIR or its annexes. **We recommend that the UK look at this issue and assess whether this fuel is natural gas or another fuel**. If natural gas, an explanation why the CO_2 EF is so high should be included in annex A3 of the NIR.
- **Domestic Anthracite (Combustion of):** the EF used in the UK is significantly below the 95% confidence interval as provided by the 2006 IPCC guidelines. Annex A.3 of the NIR explains that this value is a "*Ricardo-AEA estimate based on carbon factors review*". **The value needs a better explanation and we recommend including this in annex A3 of the NIR**.

Non CO_2 gases

Figure 2 below shows for N_2O and CH_4, the frequency of occurrences of deviation from the default value, normalized to the standard deviation. IPCC provides 95% confidence intervals, corresponding to 1.96 standard deviations. All occurrences between a normalized deviation of -2 and +2 can be regarded as within the 95 % confidence interval given by the IPCC.

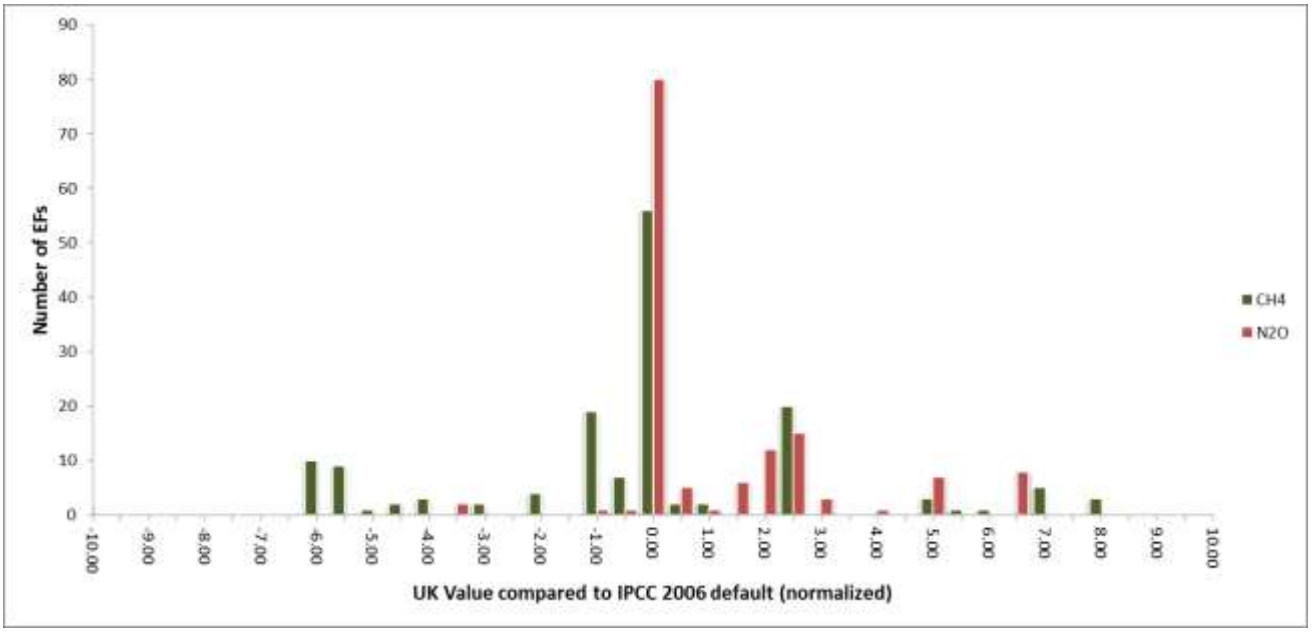


Figure 2: Frequency distribution of UK CH_4 and N_2O EFs compared to IPCC 2006 defaults. The horizontal axis is expressed as standard deviations. Any value within the -2 to +2 range is within the 95 percent uncertainty range

We note that in a number of cases (illustrated in Figure 2 above and Tables 1a and 1b below) the UK's country specific values are outside the IPCC 95 percent confidence range. A number of these relate to the UK country specific EFs derived from Brain et al 1994 and Fynes et al 1994, which cover a number of reporting categories within the UK inventory for the combustion of coal/coke fuels. We noted that in a number of cases the CH_4 emission factor is actually more in line with the 2006 IPCC default range for N_2O and similarly the N_2O EF is more in line with the 2006 IPCC default range for CH_4.

The UK inventory team has been consulted, and has confirmed that the CH_4 and N_2O EFs have been referenced correctly. Generally, the emissions of these pollutants are largely dependent upon the technology used in the fuel combustion, rather than the fuel itself (as is the case for CO_2). In the UK, technologies for the combustion of coke / coal have changed relatively little over the timeseries meaning that the original country-specific EFs remain valid.

The UK inventory team have therefore confirmed that they still regard these CS EFs to be more appropriate than using 2006 IPCC defaults, particularly for the early years of the timeseries (1990 – 2000). However, we are aware that this may be raised as an issue of concern by an Expert Review Team, but that replacing the UK CS EFs with 2006 IPCC defaults to avoid the ERT raising issues may degrade the quality of the UK GHG inventory. We therefore suggest that:

- the UK continue to use the CS EFs for the submission in 2015 as it still believes that these are the most representative of the UK categories as they are based on UK measurements.
- the UK further clarifies, in the energy annex of the NIR with references to this text from elsewhere in the NIR, its reasons for using the CS EFs and why the 2006 IPCC defaults would be less appropriate (including highlighting that using 2006 IPCC defaults for the later years would introduce inconsistencies in the timeseries).
- the UK consider resolving the issue by bringing this to the attention of the 2015 ERT and implementing any resulting recommendations (e.g. to use defaults or continue to use CS EFs).

Table 1a: Listing all UK CH_4 EFs that are 4 standard deviations below the IPCC 2006 default values

IPCC	Source Name	Activity Name	Current UK EF	Reference	IPCC Default	2.5-Percentile	IPCC Reference
1A2a_Manufacturing_Industry&Construction:I&S	Iron and steel - combustion plant	Coal	0.38	Brain et al (1994)	10.0	3.0	V2, Table 2.3
1A2a_Manufacturing_Industry&Construction:I&S	Iron and steel - combustion plant	Coke	0.39	Fynes et al (1994)	10.0	3.0	V2, Table 2.3
1A2b_Non-Ferrous_Metals	Non-Ferrous Metal (combustion)	Coal	0.42	Brain et al (1994)	10.0	3.0	V2, Table 2.3
1A2b_Non-Ferrous_Metals	Non-Ferrous Metal (combustion)	Coke	0.39	Fynes et al (1994)	10.0	3.0	V2, Table 2.3
1A2c_Chemicals	Chemicals (combustion)	Coal	0.42	Brain et al (1994)	10.0	3.0	V2, Table 2.3
1A2d_Pulp_Paper_Print	Pulp, Paper and Print (combustion)	Coal	0.42	Brain et al (1994)	10.0	3.0	V2, Table 2.3
1A2e_Food_drink_tobacco	Food & drink, tobacco (combustion)	Coal	0.42	Brain et al (1994)	10.0	3.0	V2, Table 2.3
1A2f_Manufacturing_Industry&Construction:Other	Autogeneration - exported to grid	Coal	0.76	Brain et al (1994)	10.0	3.0	V2, Table 2.3
1A2f_Manufacturing_Industry&Construction:Other	Autogenerators	Coal	0.76	Brain et al (1994)	10.0	3.0	V2, Table 2.3
1A2f_Manufacturing_Industry&Construction:Other	Cement production - combustion	Waste oils	2.11	Unknown	30.0	10.0	V2, Table 2.3
1A2f_Manufacturing_Industry&Construction:Other	Lime production - non decarbonising	Coal	0.42	Fynes et al (1994)	10.0	3.0	V2, Table 2.3
1A2f_Manufacturing_Industry&Construction:Other	Lime production - non decarbonising	Coke	0.39	Fynes et al (1994)	10.0	3.0	V2, Table 2.3
1A2f_Manufacturing_Industry&Construction:Other	Other industrial combustion	Coal	0.42	Brain et al (1994)	10.0	3.0	V2, Table 2.3
1A2f_Manufacturing_Industry&Construction:Other	Other industrial combustion	Coke	0.39	Brain et al (1994)	10.0	3.0	V2, Table 2.3
1A2f_Manufacturing_Industry&Construction:Other	Other industrial combustion	SSF	0.36	Brain et al (1994)	10.0	3.0	V2, Table 2.3
1A4a_Commercial/Institutional	Miscellaneous industrial/commercial combustion	Coal	0.45	Brain et al (1994)	10.0	3.0	V2, Table 2.3
1A4a_Commercial/Institutional	Miscellaneous industrial/commercial combustion	Coke	0.39	Brain et al (1994)	10.0	3.0	V2, Table 2.3
1A4a_Commercial/Institutional	Miscellaneous industrial/commercial combustion	SSF	0.36	Brain et al (1994)	10.0	3.0	V2, Table 2.3
1A4a_Commercial/Institutional	Public sector combustion	Coal	0.45	Brain et al (1994)	10.0	3.0	V2, Table 2.4
1A4a_Commercial/Institutional	Public sector combustion	Coke	0.39	Brain et al (1994)	10.0	3.0	V2, Table 2.4
1A4a_Commercial/Institutional	Railways - stationary combustion	Coal	0.45	Brain et al (1994)	10.0	3.0	V2, Table 2.4
1A4a_Commercial/Institutional	Railways - stationary combustion	Coke	0.39	Brain et al (1994)	10.0	3.0	V2, Table 2.4
1A4ci_Agriculture/Forestry/Fishing:Stationary	Agriculture - stationary combustion	Coal	0.41	Brain et al (1994)	300.0	100.0	V2, Table 2.5
1A4ci_Agriculture/Forestry/Fishing:Stationary	Agriculture - stationary combustion	Coke	0.39	Brain et al (1994)	300.0	100.0	V2, Table 2.5

Table 2b: Listing all UK N_2O EFs that are 4 standard deviations above the IPCC 2006 default values

IPCC	Source Name	Activity Name	Current UK EF	Reference	IPCC Default	2.5-Percentile	IPCC Reference
1A1b_Petroleum_Refining	Refineries - combustion	Petroleum coke	8.28	Unknown	0.6	0.2	V2, Table 2.2
1A1ci_Manufacture_of_Solid_Fuels-coke	Coke production	Blast furnace gas	2.00	EMEP/CORINAIR (2003)	0.1	0.0	V2, Table 2.2
1A1ci_Manufacture_of_Solid_Fuels-coke	Coke production	Coke oven gas	2.22	IPCC (1997c)	0.1	0.0	V2, Table 2.2
1A1cii_Other_Energy_Industries	Upstream Gas Production - fuel combustion	Natural gas	5.02	EF derived from annual data provided by UKOOA.	0.1	0.0	V2, Table 2.2
1A1cii_Other_Energy_Industries	Upstream oil and gas production - combustion at gas separation plant	LPG	4.71	EF derived from annual data provided by UKOOA.	0.1	0.0	V2, Table 2.2
1A1cii_Other_Energy_Industries	Upstream oil and gas production - combustion at gas separation plant	OPG	4.71	EF derived from annual data provided by UKOOA.	0.1	0.0	V2, Table 2.2
1A1cii_Other_Energy_Industries	Upstream Oil Production - fuel combustion	Natural gas	4.82	EF derived from annual data provided by UKOOA.	0.1	0.0	V2, Table 2.2
1A2a_Manufacturing_Industry&Construction:I&S	Blast furnaces	Blast furnace gas	2.00	EMEP/CORINAIR (2003)	0.1	0.0	V2, Table 2.2
1A2a_Manufacturing_Industry&Construction:I&S	Blast furnaces	Coke oven gas	2.22	EMEP/CORINAIR (2003)	0.1	0.0	V2, Table 2.2
1A2a_Manufacturing_Industry&Construction:I&S	Iron and steel - combustion plant	Blast furnace gas	2.00	EMEP/CORINAIR (2003)	0.1	0.0	V2, Table 2.3
1A2a_Manufacturing_Industry&Construction:I&S	Iron and steel - combustion plant	Coke oven gas	2.22	EMEP/CORINAIR (2003)	0.1	0.0	V2, Table 2.3
1A2f_Manufacturing_Industry&Construction:Other	Other industrial combustion	Coke oven gas	2.22	Confidential Company Reported Data	0.1	0.0	V2, Table 2.3
1A2fii_Manufacturing_Industry&Construction:Off-road	Industrial off-road mobile machinery	DERV	29.64	Netcen	0.6	0.2	V2, Table 2.3
1A2fii_Manufacturing_Industry&Construction:Off-road	Industrial off-road mobile machinery	Gas oil	29.64	IPCC (1997c)	0.6	0.2	V2, Table 2.3
1A4bii_Residential:Off-road	House and garden machinery	DERV	30.12	Netcen	0.6	0.2	V2, Table 2.5
1A4cii_Agriculture/Forestry/Fishing:Off-road	Agriculture - mobile machinery	Gas oil	30.66	IPCC (1997c)	0.6	0.2	V2, Table 2.5

Industrial Processes

The majority of emission factors in the Industrial Processes sector are country-specific or based on stoichiometric[7] calculations, which are simply defined by the chemical processes taking place in the industrial process. There was only a small number of default EFs taken from the 1996r IPCC Guidelines. This meant that the focus for this sector was on the verification of country-specific EFs.

A number of improvement programme studies have been or are being undertaken recently including:

- "Review of data and methodologies used in the calculation of UK emissions from F-Gases" (ICF International, draft report, 2013) which has developed a set of estimates consistent for 2006 IPCC requirements for F-Gases.
- Assessment of the iron and steel sector which has updated the methodology so that it is transparent, uses relevant country specific parameters, and follows a carbon balance approach in accordance with 2006 IPCC requirements.
- Analysis of carbon used in feedstocks and carbon stored in products

To ensure there was no duplication of effort, this project focussed on those sectors outside of the scope of these projects above.

Method

Analysis of the Industrial Processes sector was conducted using two approaches:

- For the country-specific EFs, comparison was made against 2006 IPCC default EFs and their associated uncertainty ranges (where available). Where outliers existed the NIR was consulted for suitable explanation and justification.
- Old default EFs (1996r IPCC Guidelines and 2000 IPCC Guidance) utilised in the UK inventory can all be updated to 2006 IPCC Guidelines where values have changed unless the UK team know of specific cases where the continued use of 1996r and 2000 IPCC defaults can be fully justified. To date for this analysis none of these cases have been identified.

Proposed IPCC default EF updates are listed in Annex A.

Findings

The emission factors used within the Industrial Processes sector are generally up-to-date and in line with the 2006 IPCC Guidelines. **There is one change to the default emission factors that needs to be implemented for the 2015 submission, which is for 2.B.2: Nitric Acid Production (see Annex A for details) and the corresponding reference in the NIR should be updated** (see NIR sections 4.10.2 and 4.10.3 of the 2014 submission)

In addition, we highlight and reiterate a comment raised during the 2013 UNFCCC Review that the UK clarify which methodology/protocol/measurement system is used by plant operators in estimating emissions for data that is used in the estimates.

There are a number of areas in the NIR where the reporting and documentation of the EFs used in the inventory could be improved. These are detailed below:

a. 2.B.1 Ammonia production, use of natural gas as feedstock – the UK country-specific EF is considerably lower than the 2006 IPCC default value and the EFs from other EU countries (see Figure 4). Comments raised during the 2013 UNFCCC Review have indicated that the transparency of the NIR should be improved by including "*clear explanations of the distribution of*

[7] This describes a quantitative relationship, usually expressed as the ratio between two or more chemical substances undergoing a physical or chemical change.

natural gas consumption for non-energy use by ammonia production plants". The NIR states that there are no CO_2 emissions from the Hull plant, and provides a transparent comparison of the CO_2 IEF with and without the Hull plant data (Table 4-10). When this EF is compared to other EU country EFs, the UK value is low but is not an outlier. The 2006 IPCC default value includes emissions from the combustion of fuel, and therefore is not directly comparable to the UK EF. **The UK inventory team could consider updating the NIR to provide more transparent information regarding the comparability of this EF. This could be achieved by updating Table 4-9 and including an additional column outlining the method used to estimate emissions for each plant along with the implied EF to clearly identify the reason for the low IEF compared to other EU countries. We also suggest that the UK consider including text on the plant-specific QA/QC procedures that are carried out to verify the accuracy of the data.**

b. 2.B.2 Nitric acid production – Table 4-13 of the NIR shows the sharp decrease in the EF from 2010 to 2011, providing an EF lower than any stated in the 2006 IPCC Guidelines. The text explains this is because: *"The larger of the two remaining UK plants fitted control equipment to reduce N_2O emissions in early 2011"*. **Because this EF is considerably lower than 2006 IPCC default values, the inventory team may consider providing additional text in the sector-specific QA/QC section highlighting specific procedures that were performed to verify these data.**

c. 2.B.2 Nitric acid production – the NIR states that the following is one of the approaches used to estimate N_2O emissions from nitric acid production: *"A default emission factor of 6 kt N_2O /Mt 100% acid produced in cases where no emissions data are available for the site (some sites in England, Scotland, 1990-1993). This default factor is the average of the range quoted in IPCC Guidelines (IPCC, 1997) for medium pressure plant".* The inventory team should consider updating these default emission factors to be in line with the 2006 IPCC Guidelines (see Annex A).

d. 2.B.5 Other chemical production, carbon in detergents; 2.B.5 Other chemical production, energy recovery – there are no 2006 IPCC default emission factors available for these sub-sectors. These EFs were assessed because they met the contribution criteria set for this project analysis. The NIR does not provide any information on the methods used for these estimates, but provides a reference to an external paper: "Passant, Watterson and Jackson, 2007", which is easily available from the NAEI website. This reference provides the methodology used for data up to 2004, so **further details regarding the extrapolation techniques / data collection applied for the following eight years would improve the transparency of these values. If any verification checks have been applied against international references used (US EPA for detergents and EA PI data for energy recovery) then a brief description of these in the NIR would improve transparency.**

Waste

For the Waste sector there are only a limited number of direct EFs utilised in the UK submission, most of which are for the incineration (without energy recovery) of various waste streams. These generally contribute to a small percentage of the total Waste sector emissions and IPCC 2006 default EFs are applied widely. The largest contribution to Waste sector emissions comes from landfill of waste (CH_4) and wastewater treatment (N_2O and CH_4). Emission factors for these sources generally consist of a number of country-specific parameters and assumptions, which should be detailed in the NIR.

Method

Evaluation of Waste sector EFs has generally been conducted using two approaches:

- For the country-specific EFs, comparison has been made against 2006 IPCC default ranges where possible, with greater emphasis given to the transparency of documentation for EF parameters for more complex sources.
- Old default EFs (1996r and 2000 IPCC) utilised in the UK inventory can all be updated to IPCC 2006 where values have changed unless the UK team know of specific cases where the continued use of 1996r and 2000 IPCC defaults can be fully justified.

Proposed IPCC default EF updates are listed in Annex A.

Findings
Comments raised during the 2013 UNFCCC Review recommended that the UK:

- Revise its calculations for methane recovery at landfill sites.
- Improve the transparency of parameters used to estimate methane emissions from sewage sludge.

6A – Solid Waste Disposal on Land
As highlighted, CH_4 emissions from landfill are a major source category for the Waste sector. The UK has its own model (MELMod), which has been regularly updated and has also been peer-reviewed as recently as 2010. Along with this, a 2008 report[8] reviewed the UK model with reference to both the first-order decay (FOD) method outlined in the 1996 IPCC Guidelines / 2000 Good Practice Guidance (GPG), and the 2006 IPCC Guidelines. The review found the UK model to be appropriate to adhere to the 2006 IPCC Guidance in terms of method and parameters / EFs. The NIR is considered to be transparent and contain detailed information on how these parameters for the model are derived. However, it is noted that the NIR refers largely to the model's applicability to IPCC 1996 and the 2000 GPG. **It is recommended that the NIR is reviewed and updated for the 2015 submission to highlight compliance with the 2006 Guidance.**

6B – Wastewater Handling
The UK inventory applies the IPCC default EF for CH_4 emissions from industrial waste water. This has been revised in the 2006 IPCC Guidelines and therefore it is **proposed to update the EF to the new default value** (see Annex A).

CH_4 EFs for emissions from domestic / commercial wastewater treatment are described and shown in detail in Section A3.7.2 of the NIR. A country-specific method is applied using UK water industry emissions data reported to the inventory agency. These have been assessed and are considered to be in line with good-practice as outlined the 2006 IPCC Guidelines (V5, 6.2.2.2).

N_2O parameters for domestic / commercial wastewater treatment are based upon the 1996 default methodology. These parameters are outlined in the NIR and the approach remains valid, however the default EF for N_2O emissions from sewage sludge decomposition ("kg sewage-N produced", Section 8.3.2.1 of NIR) has been updated from 0.01 to 0.005 in the 2006 Guidelines and would be better stated as "kg N_2O-N/kg sewage-N produced". **It is recommended that this new default EF is applied in the UK inventory. There are no other fundamental changes between 1996 and 2006 methods for this category that need to be taken into account.**

The remaining EFs reviewed are for sources under 6C – Waste Incineration. In the UK all MSW incineration facilities have recovered energy since 1997, so for the recent timeseries all of these emissions are reported in the Energy sector. Remaining EFs applied to incineration of other specified waste streams have been reviewed against 2006 IPCC default ranges and **a number of updates are proposed and outlined in Annex A, along with the proposed EF changes for sources under categories 6B described above.** Where no changes are proposed in the Table it can be assumed that existing EFs and references remain valid.

The UK inventory does not currently estimate CH_4 emissions from chemical waste incineration. **Despite this being a minor source, an appropriate 2006 IPCC is considered to be available and it is recommended to add this source to the UK inventory.**

[8] Brown & Leech, Revision of UK model for predicting methane emissions from landfills, 2008

Agriculture

Development work on the agricultural emissions calculation platform is ongoing with a series of significant Defra projects. These projects are looking to improve the country-specific emission factors and understanding of nitrogen and carbon balances in agricultural processes. Beyond prioritising categories for review for Defra no other detailed review of the agriculture sector was undertaken in this EF review project. However, some Categories such as Category 5.D have been identified as having Implied Emission Factors that appear outliers compared to other EU Member States (see following Section).

Priorities for improvement identified in this EF review project, including the analysis of current implied emission factor outliers have been highlighted to Defra who are working to ensure consistency with 2006 IPCC and address comments from the 2013 UNFCCC expert review team. **We recommend that the UK continue to track progress on improvements and ensures that stable methods and EFs consistent with 2006 IPCC requirements are in place by September 2014 at the latest in preparation for 2015 reporting and the beginning of the fixing of assigned amounts for the second commitment period.**

LULUCF

Aether has been in contact with the LULUCF inventory compilers at CEH, as there have been a number of updates to the way LULUCF emissions are estimated in the past year. The main significant change has been the requirement to include pre-1920 forest in estimates and this has driven the switch to the use of the Forest Commission's CARBINE model in place of CEH's C-Flow model. CEH have confirmed that improvements in methods associated with use of the CARBINE model make estimates more compliant with IPCC 2006 Guidance. These include:

- C-Flow is based on growth data for two tree species (sitka spruce and beech typifying conifers and broadleaf trees) obtained from a small number of sites. CARBINE includes a more comprehensive set of tree species and uses Forest Research data on tree growth which comes from a larger number of sites across GB. This gives better UK-specific Tier 3 emission factors relating to carbon stored in trees.
- C-Flow assumes that all commercial Forest is felled a set number of years after planting. CARBINE allows of a wider range of management regimes, and uses Forestry Commission data on timber production to correct felling rates. This gives a smoother and more realistic felling regime which is a better reflection of the market for timber (which is fairly steady) rather than mirroring the peaks and troughs of the planting pattern.
- Because of its improved modelling of tree species and harvesting patterns CARBINE can incorporate pre-1920 forest much more fully than C-Flow.
- C-Flow takes an average lifetime for carbon stored in Harvested Wood Products. CARBINE includes separate estimates of lifetime for long-lived and short-lived sawn timber, particle board and paper e.g. carbon stored in paper is released more quickly than carbon stored in sawn timber.

CEH have noted that one area where C-Flow does perform better than CARBINE is modelling soil carbon stocks under forestry. The C-Flow soil carbon model has been scrutinised in peer reviewed journals, whereas the basis of the CARBINE soil carbon model has not been as thoroughly reviewed. Therefore after some discussion amongst an expert group of LULUCF inventory compliers it was decided that for the 2012 inventory the C-Flow input parameters would be used for modelling soil carbon stocks. This may change in future as the CARBINE soil carbon model is refined and subjected to peer review.

The explanations provided are considered to be valid, however due to these changes it has not been possible to review specific emission factors used in the UK inventory. This would become possible once the 2014 GHG inventory (and NIR) has been published and is a potential follow up action to this report. **We recommend that there is an additional more in-depth review of 2006 IPCC compliance once methods and assumptions in the 2014 LULUCF estimates have stabilised.**

Summary of Recommendations

Energy

- It is recommended to update defaults to 2006 IPCC Guidelines (see Annex A).
- We recommend that the UK team provide further justification for its use of country specific oxidation factors, or amend to the IPCC 2006 default values in lack of such evidence.
- Where UK energy data is available in SI units we encourage the UK inventory team to derive the UK estimates using NCV values, expressed in Joules to estimate activity data.
- It is recommend to include new sources in the UK inventory where 2006 IPCC default EFs have been sourced (included in Annex A).
- We recommend including the following information / evidence in Annex A3 of the NIR:
  - Inclusion of MSW biomass carbon content data
  - justification for high sour gas carbon factor
  - justification for high colliery methane carbon factor
  - justification for high gas works gas carbon factor
  - inclusion of scrap tyre carbon factors
  - justification for low naphtha carbon factor
  - justification of different natural gas carbon factor applied to Upstream Oil & Gas Production
  - Improved justification for low anthracite carbon factor
- We recommend that the UK inventory team investigate outliers for CH_4 and N_2O EFs (coal/coke fuels) and provide additional justification for their use of country-specific EFs over 2006 IPCC defaults.

Industrial Processes

- It is recommended to update defaults to 2006 IPCC Guidelines (see Annex A).
- The UK inventory team could consider updating NIR Table 4-9 and including an additional column outlining the method used to estimate non-energy use emissions from ammonia production plant along with the implied EF to clearly identify the reason for the low IEF compared to the 2006 IPCC default value and other EU countries.
- We also suggest that the UK consider including text on the ammonia production plant-specific QA/QC procedures that are carried out to verify the accuracy of the data.
- We recommend providing additional text in the NIR on nitric acid production highlighting specific procedures that were performed to verify plant data.
- We recommend providing additional text in the NIR on methodology for making whole timeseries estimates from specific source categories under 2.B.5 Other chemical production.

Waste

- It is recommended to update defaults to 2006 IPCC Guidelines (see Annex A).
- It is recommended that the NIR is reviewed and updated for the 2015 submission to highlight the compliance of MELMod with the 2006 Guidance.
- It is recommended to estimate CH_4 emissions from chemical waste incineration and include this as a new inventory source.

Implied Emission Factor Analysis for UK and EU Member States

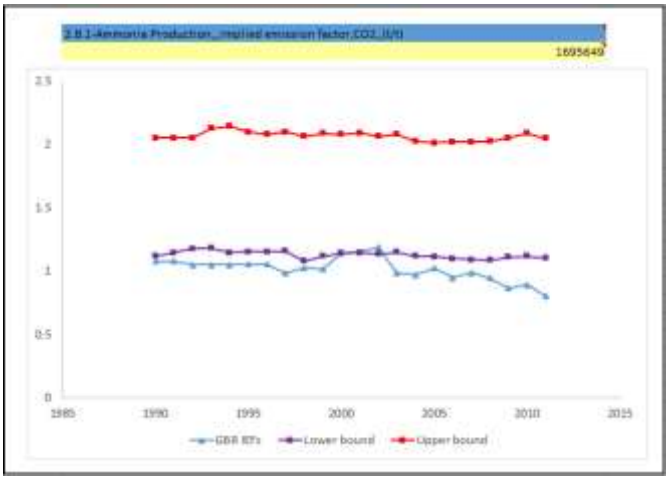
As a method of secondary verification, a study has been completed comparing UK Implied Emission Factors (IEFs) against those from other EU member states sourced from publically available Common Reporting Format (CRF) tables. We have compiled a database for countries' IEFs for the 2013 submission, by sector and for all years available (1990-2011 usually). We compared the UK's IEF from the same datasets with an average and standard deviation of IEFs for all other EU member states. This non UK IEF data was used to create upper and lower bounds, plus or minus one standard deviation from the mean. This range represented 68% of average MS IEFs.

Where UK IEFs were greater than the upper bound, they were labelled 'upper outliers' and where they were smaller than the lower bound, they were labelled 'lower outliers'.

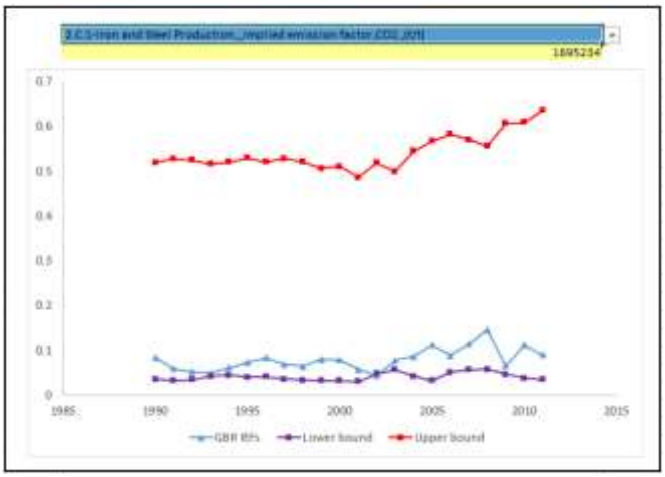
Figure 3 provides a high level overview of the findings showing the number of individual outliers in the UK IEF dataset. The categories which contain these upper and lower outliers can be found in Annex B. The categories referred to in the graphs are IPCC sectors split by fuel type (solid, gas, liquid, biomass fuels) and gas (N_2O, CO, CH_4).

Figure 3: Overview of UK IEFs which are outliers

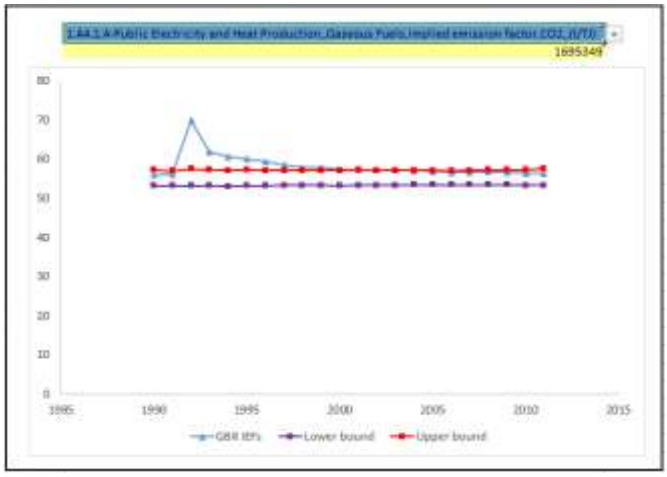
Of the UK IPCC emission factors which are implied, 17.5% are upper outliers, and 10.0% are lower outliers. Lower outliers suggest an under-estimation of emissions may be occurring, if the IEFs cannot be justified. For perspective, 12.8% of all UK IPCC emission factors are implied. Figure 4 provides examples of the detailed analysis by category and gas available in the analysis. These examples illustrate how each category and gas can be analysed and compared against other EU MS to assess whether it is justifiable.



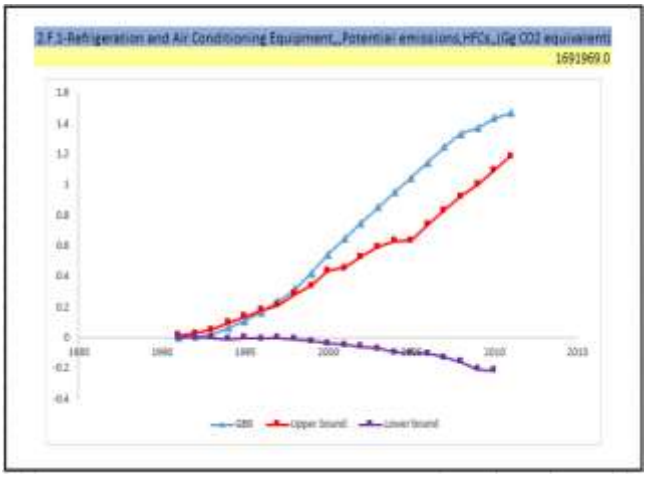
2.B.1 Ammonia Production: Showing that UK ammonia production has amongst the lowest IEF compared to EU Member States and is generally below the lower bound for all EU MS. This could indicate a requirement for clear justification of estimates.



2.C.1: Iron and Steel Production: Showing UK Iron and Steel production IEF is within the range of other MS IEFs but low. Les strong requirement for justification of estimates.



1.A.1.a Power Stations Gaseous Fuel: Showing a upper spike in Public Power gaseous fuel IEFs in early years and a reduction to within the MS upper and lower bounds in later years.



2.F.1 Air-conditioning and Refrigeration. Example showing UK per capita emissions compared to range of other member states. Indicates UK is an outlier for years from 1998.

Figure 4: Examples of detailed comparisons for IEFs compared to other Member States

Figure 5 shows a summary of the % of outliers for each category that are upper and lower outliers compared to the upper and lower bounds of the aggregated EU dataset.

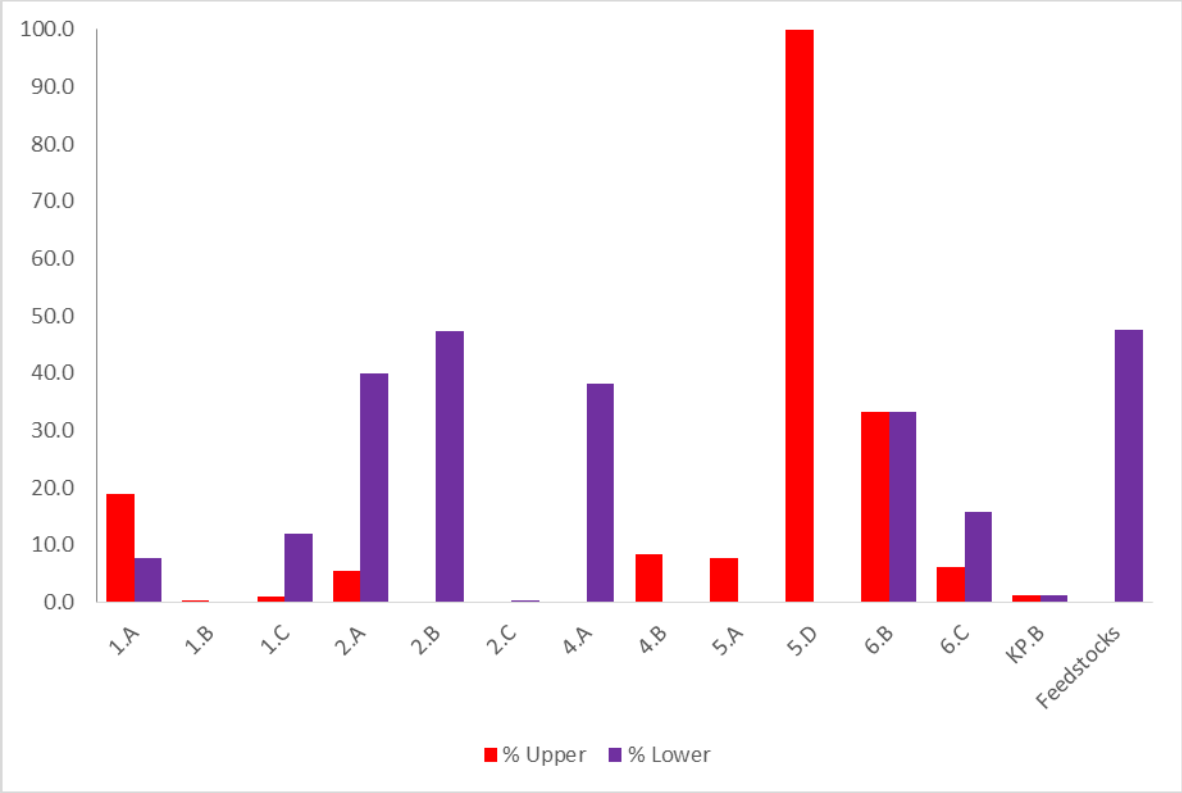


Figure 5: % of outliers by category where analysis could be completed

The upper outliers in 5.D pertain to N_2O from wetlands, containing 66 IEFs (3 categories with 22 years); whilst this sector is 100% outliers, it is the sector with the second smallest number of IEFs (Feedstocks only has 42 IEFs). As stated previously, issues identified for EFs in the agriculture sector in this review will be communicated with the team at Defra, and **it is recommended that they consider these IEF outliers and make sure the appropriate justification is in place.**

Annex A – Proposed Updates to 2006 IPCC Default EFs

Pollutant	NFR	Source	Fuel Name	Current EF (kg/Tj unless stated otherwise)	Reference	Proposed EF	Reference	Reason for change
Energy								
CO_2	1A1b_Petroleum_Refining	Refineries - combustion	Fuel oil	78372.891	EMEP/CORINAIR (1996)	77400 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1a_Public_Electricity &Heat_Production	Power stations	MSW	31.579	IPCC (1997c)	30 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1a_Public_Electricity &Heat_Production	Power stations	LPG	0.969	US EPA, 2004	1 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1a_Public_Electricity &Heat_Production	Power stations	MSW	31.579	IPCC (1997c)	30 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1a_Public_Electricity &Heat_Production	Power stations	Natural gas	1.111	IPCC (1997c)	1 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1a_Public_Electricity &Heat_Production	Power stations	OPG	1.087	IPCC, 1996	1 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1a_Public_Electricity &Heat_Production	Power stations	Petroleum coke	3.660	-	3 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1a_Public_Electricity &Heat_Production	Power stations	Scrap tyres	32.598	IPCC, 1996	30 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1a_Public_Electricity &Heat_Production	Power stations	Waste oils	3.023	-	30 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1b_Petroleum_Refining	Refineries - combustion	Burning oil	None	NA	3 kg/Tj	V2, Table 2.2	Default available
CH_4	1A1b_Petroleum_Refining	Refineries - combustion	Fuel oil	3.159	IPCC (1997c)	3 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1b_Petroleum_Refining	Refineries - combustion	Gas oil	3.172	IPCC, 1996	3 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1b_Petroleum_Refining	Refineries - combustion	LPG	0.969	US EPA, 2004	1 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1b_Petroleum_Refining	Refineries - combustion	Naphtha	2.848	Use figure for burning oil	3 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1b_Petroleum_Refining	Refineries - combustion	Natural gas	1.111	IPCC (1997c)	1 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1b_Petroleum_Refining	Refineries - combustion	OPG	1.087	IPCC (1997c)	1 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1b_Petroleum_Refining	Refineries - combustion	Petrol	3.092	Use figure for burning oil	3 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1b_Petroleum_Refining	Refineries - combustion	Refinery miscellaneous	3.158	Use figure for burning oil	3 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1ci_Manufacture_of_Solid_Fuels-coke	Coke production	Blast furnace gas	112.007	EMEP/CORINAIR (2003)	1 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1ci_Manufacture_of_Solid_Fuels-coke	Coke production	Coke oven gas	63.615	IPCC (1997c)	1 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1ci_Manufacture_of_Solid_Fuels-coke	Coke production	Colliery methane	1.111	IPCC, 1996	1 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1ci_Manufacture_of_Solid_Fuels-coke	Coke production	Natural gas	1.111	IPCC, 1996	1 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1ci_Manufacture_of_Solid_Fuels-coke	Solid smokeless fuel production	Natural gas	1.111	IPCC, 1996	1 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1cii_Other_Energy_Industries	Collieries - combustion	Coke oven gas	63.615	EMEP/CORINAIR, 2003	1 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1cii_Other_Energy_Industries	Collieries - combustion	Colliery methane	5.556	IPCC (1997c)	1 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1cii_Other_Energy_Industries	Collieries - combustion	Natural gas	1.111	IPCC, 1996	1 kg/Tj	V2, Table 2.2	Updated default available

Pollutant	NFR	Source	Fuel Name	Current EF (kg/Tj unless stated otherwise)	Reference	Proposed EF	Reference	Reason for change
CH_4	1A1cii_Other_Energy_Industries	Gas production	Colliery methane	1.111	IPCC, 1996	1 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1cii_Other_Energy_Industries	Gas production	LPG	0.969	US EPA, 2004	1 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1cii_Other_Energy_Industries	Gas production	OPG	1.087	IPCC, 1996	1 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1cii_Other_Energy_Industries	Gas production	Town gas	1.111	IPCC, 1996	1 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1cii_Other_Energy_Industries	Nuclear fuel production	Natural gas	1.111	IPCC, 1996	1 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A1cii_Other_Energy_Industries	Town gas manufacture	Burning oil	0.000	Netcen estimate based on carbon balance for town gas manufacture	3 kg/Tj	V2, Table 2.2	Zero value to be updated – default available
CH_4	1A1cii_Other_Energy_Industries	Town gas manufacture	Coal	0.000	Netcen estimate based on carbon balance for town gas manufacture	1 kg/Tj	V2, Table 2.2	Zero value to be updated – default available
CH_4	1A1cii_Other_Energy_Industries	Town gas manufacture	Coke	0.000	Netcen estimate based on carbon balance for town gas manufacture	1 kg/Tj	V2, Table 2.2	Zero value to be updated – default available
CH_4	1A1cii_Other_Energy_Industries	Town gas manufacture	Coke oven gas	0.000	Netcen estimate based on carbon balance for town gas manufacture	1 kg/Tj	V2, Table 2.2	Zero value to be updated – default available
CH_4	1A1cii_Other_Energy_Industries	Town gas manufacture	LPG	0.000	Netcen estimate based on carbon balance for town gas manufacture	1 kg/Tj	V2, Table 2.2	Zero value to be updated – default available
CH_4	1A1cii_Other_Energy_Industries	Town gas manufacture	Natural gas	0.000	Netcen estimate based on carbon balance for town gas manufacture	1 kg/Tj	V2, Table 2.2	Zero value to be updated – default available
CH_4	1A2a_Manufacturing_Industry&Construction:I&S	Blast furnaces	Blast furnace gas	112.007	EMEP/CORINAIR (2003)	1 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A2a_Manufacturing_Industry&Construction:I&S	Blast furnaces	Coke oven gas	63.615	EMEP/CORINAIR (2003)	1 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A2a_Manufacturing_Industry&Construction:I&S	Blast furnaces	Gas oil	None	NA	3 kg/Tj	V2, Table 2.2	Default available
CH_4	1A2a_Manufacturing_Industry&Construction:I&S	Blast furnaces	LPG	5.435	IPCC, 1996	1 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A2a_Manufacturing_Industry&Construction:I&S	Blast furnaces	Natural gas	5.556	IPCC (1997c)	1 kg/Tj	V2, Table 2.2	Updated default available
CH_4	1A2a_Manufacturing_Industry&Construction:I&S	Iron and steel - combustion plant	Blast furnace gas	112.007	EMEP/CORINAIR (2003)	1 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2a_Manufacturing_Industry&Construction:I&S	Iron and steel - combustion plant	Coke oven gas	63.615	EMEP/CORINAIR, 2003	1 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2a_Manufacturing_Industry&Construction:I&S	Iron and steel - combustion plant	Fuel oil	2.106	IPCC (1997c)	3 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2a_Manufacturing_Industry&Construction:I&S	Iron and steel - combustion plant	Gas oil	2.115	IPCC (1997c)	3 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2a_Manufacturing_Industry&Construction:I&	Iron and steel - combustion plant	LPG	0.969	US EPA, 2004	1 kg/Tj	V2, Table 2.3	Updated default available

Pollutant	NFR	Source	Fuel Name	Current EF (kg/Tj unless stated otherwise)	Reference	Proposed EF	Reference	Reason for change
	S							
CH_4	1A2a_Manufacturing_Industry&Construction:I&S	Iron and steel - combustion plant	Natural gas	5.556	IPCC (1997c)	1 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2a_Manufacturing_Industry&Construction:I&S	Iron and steel - combustion plant	Town gas	5.556	IPCC, 1996	1 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2a_Manufacturing_Industry&Construction:I&S	Sinter production	Coke	49.147	-	10 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2b_Non-Ferrous_Metals	Non-Ferrous Metal (combustion)	Fuel oil	2.106	IPCC, 1996	3 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2b_Non-Ferrous_Metals	Non-Ferrous Metal (combustion)	Gas oil	2.115	IPCC, 1996	3 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2b_Non-Ferrous_Metals	Non-Ferrous Metal (combustion)	Natural gas	5.556	IPCC, 1996	1 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2c_Chemicals	Ammonia production - combustion	Natural gas	5.556	IPCC, 1996	1 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2c_Chemicals	Chemicals (combustion)	Fuel oil	2.106	IPCC, 1996	3 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2c_Chemicals	Chemicals (combustion)	Gas oil	2.115	IPCC, 1996	3 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2c_Chemicals	Chemicals (combustion)	Natural gas	5.556	IPCC, 1996	1 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2d_Pulp_Paper_Print	Pulp, Paper and Print (combustion)	Fuel oil	2.106	IPCC, 1996	3 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2d_Pulp_Paper_Print	Pulp, Paper and Print (combustion)	Gas oil	2.115	IPCC, 1996	3 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2d_Pulp_Paper_Print	Pulp, Paper and Print (combustion)	Natural gas	5.556	IPCC, 1996	1 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2e_Food_drink_tobacco	Food & drink, tobacco (combustion)	Fuel oil	2.106	IPCC, 1996	3 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2e_Food_drink_tobacco	Food & drink, tobacco (combustion)	Gas oil	2.115	IPCC, 1996	3 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2e_Food_drink_tobacco	Food & drink, tobacco (combustion)	Natural gas	5.556	IPCC, 1996	1 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2f_Manufacturing_Industry&Construction:Other	Autogeneration - exported to grid	Natural gas	5.556	IPCC, 1996	1 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2f_Manufacturing_Industry&Construction:Other	Autogenerators	Natural gas	5.556	IPCC (1997c)	1 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2f_Manufacturing_Industry&Construction:Other	Other industrial combustion	Burning oil	2.107	IPCC (1997c)	3 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2f_Manufacturing_Industry&Construction:Other	Other industrial combustion	Colliery methane	5.556	IPCC (1997c)	1 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2f_Manufacturing_Industry&Construction:Other	Other industrial combustion	Fuel oil	2.106	IPCC (1997c)	3 kg/Tj	V2, Table 2.3	Updated default available

Pollutant	NFR	Source	Fuel Name	Current EF (kg/Tj unless stated otherwise)	Reference	Proposed EF	Reference	Reason for change
CH_4	1A2f_Manufacturing_Industry&Construction:Other	Other industrial combustion	Gas oil	2.115	IPCC (1997c)	3 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2f_Manufacturing_Industry&Construction:Other	Other industrial combustion	LPG	0.969	USEPA (2005)	1 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2f_Manufacturing_Industry&Construction:Other	Other industrial combustion	Lubricants	2.115	IPCC (1997c)	3 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2f_Manufacturing_Industry&Construction:Other	Other industrial combustion	Natural gas	5.556	IPCC (1997c)	1 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2f_Manufacturing_Industry&Construction:Other	Other industrial combustion	OPG	5.435	IPCC (1997c)	1 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2f_Manufacturing_Industry&Construction:Other	Other industrial combustion	Petroleum coke	3.161	-	3 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2f_Manufacturing_Industry&Construction:Other	Other industrial combustion	Town gas	5.556	IPCC, 1996	1 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A2f_Manufacturing_Industry&Construction:Other	Other industrial combustion	Waste solvent	None	NA	30 kg/Tj	V2, Table 2.3	Default available
CH_4	1A2fii_Manufacturing_Industry&Construction:Off-road	Industrial engines	Lubricants	None	NA	3 kg/Tj	V2, Table 2.3	Default available
CH_4	1A4a_Commercial/Institutional	Miscellaneous industrial/commercial combustion	Fuel oil	10.530	IPCC (1997c)	10 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A4a_Commercial/Institutional	Miscellaneous industrial/commercial combustion	Gas oil	10.573	IPCC (1997c)	10 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A4a_Commercial/Institutional	Miscellaneous industrial/commercial combustion	Natural gas	5.556	IPCC (1997c)	5 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A4a_Commercial/Institutional	Miscellaneous industrial/commercial combustion	Town gas	5.556	IPCC, 1996	5 kg/Tj	V2, Table 2.3	Updated default available
CH_4	1A4a_Commercial/Institutional	Public sector combustion	Burning oil	10.534	IPCC, 1996	10 kg/Tj	V2, Table 2.4	Updated default available
CH_4	1A4a_Commercial/Institutional	Public sector combustion	Fuel oil	10.530	IPCC (1997c)	10 kg/Tj	V2, Table 2.4	Updated default available
CH_4	1A4a_Commercial/Institutional	Public sector combustion	Gas oil	10.573	IPCC (1997c)	10 kg/Tj	V2, Table 2.4	Updated default available
CH_4	1A4a_Commercial/Institutional	Public sector combustion	Natural gas	5.556	IPCC (1997c)	5 kg/Tj	V2, Table 2.4	Updated default available
CH_4	1A4a_Commercial/Institutional	Public sector combustion	Town gas	5.556	IPCC, 1996	5 kg/Tj	V2, Table 2.4	Updated default available
CH_4	1A4a_Commercial/Institutional	Railways - stationary combustion	Burning oil	10.534	IPCC, 1996	10 kg/Tj	V2, Table 2.4	Updated default available
CH_4	1A4a_Commercial/Institutional	Railways - stationary combustion	Fuel oil	10.530	IPCC, 1996	10 kg/Tj	V2, Table 2.4	Updated default available
CH_4	1A4a_Commercial/Institutional	Railways - stationary	Natural gas	5.556	IPCC (1997c)	5 kg/Tj	V2, Table 2.4	Updated default available

Pollutant	NFR	Source	Fuel Name	Current EF (kg/Tj unless stated otherwise)	Reference	Proposed EF	Reference	Reason for change
		combustion						
CH_4	1A4bi_Residential	Domestic combustion	Burning oil	10.534	IPCC (1997c)	10 kg/Tj	V2, Table 2.5	Updated default available
CH_4	1A4bi_Residential	Domestic combustion	Fuel oil	10.530	IPCC, 1996	10 kg/Tj	V2, Table 2.5	Updated default available
CH_4	1A4bi_Residential	Domestic combustion	Gas oil	10.573	IPCC (1997c)	10 kg/Tj	V2, Table 2.5	Updated default available
CH_4	1A4bi_Residential	Domestic combustion	LPG	0.969	USEPA (2005)	5 kg/Tj	V2, Table 2.5	Updated default available
CH_4	1A4bi_Residential	Domestic combustion	Natural gas	5.556	IPCC (1997c)	5 kg/Tj	V2, Table 2.5	Updated default available
CH_4	1A4bi_Residential	Domestic combustion	Petroleum coke	None	NA	10 kg/Tj	V2, Table 2.5	Default available
CH_4	1A4bi_Residential	Domestic combustion	Town gas	5.556	IPCC, 1996	5 kg/Tj	V2, Table 2.5	Updated default available
CH_4	1A4ci_Agriculture/Forestry/Fishing:Stationary	Agriculture - stationary combustion	Fuel oil	10.530	IPCC (1997c)	10 kg/Tj	V2, Table 2.5	Updated default available
CH_4	1A4ci_Agriculture/Forestry/Fishing:Stationary	Agriculture - stationary combustion	Gas oil	10.573	-	10 kg/Tj	V2, Table 2.5	Updated default available
CH_4	1A4ci_Agriculture/Forestry/Fishing:Stationary	Agriculture - stationary combustion	Natural gas	5.556	IPCC (1997c)	5 kg/Tj	V2, Table 2.5	Updated default available
CH_4	1A4ci_Agriculture/Forestry/Fishing:Stationary	Agriculture - stationary combustion	Vaporising oil	10.573	Use figure for gas oil	10 kg/Tj	V2, Table 2.5	Updated default available
CH_4	1A4a_Commercial/Institutional	Miscellaneous industrial/commercial combustion	Burning oil	10.534	IPCC, 1996	10 kg/Tj	V2, Table 2.5	Updated default available
CH_4	1A4cii_Agriculture/Forestry/Fishing:Off-road	Agricultural engines	Lubricants	None	NA	10 kg/Tj	V2, Table 2.5	Default available
CH_4	1A4cii_Agriculture/Forestry/Fishing:Off-road	Agriculture - mobile machinery	Gas oil	3.782	IPCC (1997c)	10 kg/Tj	V2, Table 2.5	Updated default available
CH_4	1A4ciii_Fishing	Fishing vessels	Fuel oil	1.215	-	10 kg/Tj	V2, Table 2.5	Updated default available
CH_4	1A4ciii_Fishing	Fishing vessels	Gas oil	1.163	EMEP/CORINAIR (1996) for THC assuming 12% methane according to IPCC(1997c)	10 kg/Tj	V2, Table 2.5	Updated default available
N_2O	1A1a_Public_Electricity &Heat_Production	Power stations	MSW	4.211	IPCC (1997c)	4 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A1a_Public_Electricity &Heat_Production	Power stations	LPG	0.109	IPCC, 1996	0.1 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A1a_Public_Electricity &Heat_Production	Power stations	MSW	4.211	IPCC (1997c)	4 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A1a_Public_Electricity &Heat_Production	Power stations	Natural gas	0.111	IPCC (1997c)	0.1 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A1a_Public_Electricity &Heat_Production	Power stations	OPG	None	NA	0.1 kg/Tj	V2, Table 2.2	Default available
N_2O	1A1a_Public_Electricity &Heat_Production	Power stations	Petroleum coke	2.955	-	0.6 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A1a_Public_Electricity &Heat_Production	Power stations	Scrap tyres	4.346	IPCC, 1996	4 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A1a_Public_Electricity &Heat_Production	Power stations	Waste oils	0.605	-	4 kg/Tj	V2, Table 2.2	Updated default available

Pollutant	NFR	Source	Fuel Name	Current EF (kg/Tj unless stated otherwise)	Reference	Proposed EF	Reference	Reason for change
N_2O	1A1b_Petroleum_Refining	Refineries - combustion	Burning oil	None	NA	0.6 kg/Tj	V2, Table 2.2	Default available
N_2O	1A1b_Petroleum_Refining	Refineries - combustion	Fuel oil	0.632	IPCC (1997c)	0.6 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A1b_Petroleum_Refining	Refineries - combustion	Gas oil	0.634	IPCC, 1996	0.6 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A1b_Petroleum_Refining	Refineries - combustion	LPG	0.109	IPCC, 1996	0.1 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A1b_Petroleum_Refining	Refineries - combustion	Naphtha	0.570	IPCC, 1996	0.6 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A1b_Petroleum_Refining	Refineries - combustion	Natural gas	0.111	IPCC (1997c)	0.1 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A1b_Petroleum_Refining	Refineries - combustion	OPG	None	NA	0.1 kg/Tj	V2, Table 2.2	Default available
N_2O	1A1b_Petroleum_Refining	Refineries - combustion	Petrol	0.618	IPCC, 1996	0.6 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A1b_Petroleum_Refining	Refineries - combustion	Refinery miscellaneous	0.632	IPCC, 1996	0.6 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A1ci_Manufacture_of_Solid_Fuels-coke	Coke production	Blast furnace gas	2.000	EMEP/CORINAIR (2003)	0.1 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A1ci_Manufacture_of_Solid_Fuels-coke	Coke production	Coke oven gas	2.222	IPCC (1997c)	0.1 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A1ci_Manufacture_of_Solid_Fuels-coke	Coke production	Colliery methane	0.111	IPCC, 1996	0.1 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A1ci_Manufacture_of_Solid_Fuels-coke	Coke production	Natural gas	0.111	IPCC, 1996	0.1 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A1ci_Manufacture_of_Solid_Fuels-coke	Solid smokeless fuel production	Natural gas	0.111	IPCC, 1996	0.1 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A1cii_Other_Energy_Industries	Collieries - combustion	Coke oven gas	None	NA	0.1 kg/Tj	V2, Table 2.2	Default available
N_2O	1A1cii_Other_Energy_Industries	Collieries - combustion	Colliery methane	0.111	IPCC (1997c)	0.1 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A1cii_Other_Energy_Industries	Collieries - combustion	Natural gas	0.111	IPCC, 1996	0.1 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A1cii_Other_Energy_Industries	Gas production	Colliery methane	None	NA	0.1 kg/Tj	V2, Table 2.2	Default available
N_2O	1A1cii_Other_Energy_Industries	Gas production	LPG	0.109	IPCC, 1996	0.1 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A1cii_Other_Energy_Industries	Gas production	OPG	None	NA	0.1 kg/Tj	V2, Table 2.2	Default available
N_2O	1A1cii_Other_Energy_Industries	Gas production	Town gas	None	NA	0.1 kg/Tj	V2, Table 2.2	Default available
N_2O	1A1cii_Other_Energy_Industries	Nuclear fuel production	Natural gas	0.111	IPCC, 1996	0.1 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A1cii_Other_Energy_Industries	Town gas manufacture	Burning oil	None	NA	0.6 kg/Tj	V2, Table 2.2	Default available
N_2O	1A1cii_Other_Energy_Industries	Town gas manufacture	Coal	None	NA	1.5 kg/Tj	V2, Table 2.2	Default available
N_2O	1A1cii_Other_Energy_Industries	Town gas manufacture	Coke	None	NA	1.5 kg/Tj	V2, Table 2.2	Default available
N_2O	1A1cii_Other_Energy_Industries	Town gas manufacture	Coke oven gas	None	NA	0.1 kg/Tj	V2, Table 2.2	Default available
N_2O	1A1cii_Other_Energy_Industries	Town gas manufacture	LPG	None	NA	0.1 kg/Tj	V2, Table 2.2	Default available
N_2O	1A1cii_Other_Energy_Industries	Town gas manufacture	Natural gas	None	NA	0.1 kg/Tj	V2, Table 2.2	Default available

Pollutant	NFR	Source	Fuel Name	Current EF (kg/Tj unless stated otherwise)	Reference	Proposed EF	Reference	Reason for change
N_2O	1A2a_Manufacturing_Industry&Construction:I&S	Blast furnaces	Blast furnace gas	2.000	EMEP/CORINAIR (2003)	0.1 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A2a_Manufacturing_Industry&Construction:I&S	Blast furnaces	Coke oven gas	2.222	EMEP/CORINAIR (2003)	0.1 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A2a_Manufacturing_Industry&Construction:I&S	Blast furnaces	Gas oil	None	NA	0.6 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A2a_Manufacturing_Industry&Construction:I&S	Blast furnaces	LPG	0.109	IPCC, 1996	0.1 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A2a_Manufacturing_Industry&Construction:I&S	Blast furnaces	Natural gas	0.111	IPCC (1997c)	0.1 kg/Tj	V2, Table 2.2	Updated default available
N_2O	1A2a_Manufacturing_Industry&Construction:I&S	Iron and steel - combustion plant	Blast furnace gas	2.000	EMEP/CORINAIR (2003)	0.1 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2a_Manufacturing_Industry&Construction:I&S	Iron and steel - combustion plant	Coke oven gas	2.222	EMEP/CORINAIR, 2003	0.1 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2a_Manufacturing_Industry&Construction:I&S	Iron and steel - combustion plant	Fuel oil	0.632	IPCC (1997c)	0.6 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2a_Manufacturing_Industry&Construction:I&S	Iron and steel - combustion plant	Gas oil	0.634	IPCC (1997c)	0.6 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2a_Manufacturing_Industry&Construction:I&S	Iron and steel - combustion plant	LPG	0.109	IPCC, 1996	0.1 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2a_Manufacturing_Industry&Construction:I&S	Iron and steel - combustion plant	Natural gas	0.111	IPCC (1997c)	0.1 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2a_Manufacturing_Industry&Construction:I&S	Iron and steel - combustion plant	Town gas	None	NA	0.1 kg/Tj	V2, Table 2.3	Default available
N_2O	1A2b_Non-Ferrous_Metals	Non-Ferrous Metal (combustion)	Fuel oil	0.632	IPCC, 1996	0.6 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2b_Non-Ferrous_Metals	Non-Ferrous Metal (combustion)	Gas oil	0.634	IPCC, 1996	0.6 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2b_Non-Ferrous_Metals	Non-Ferrous Metal (combustion)	Natural gas	0.111	IPCC, 1996	0.1 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2c_Chemicals	Ammonia production - combustion	Natural gas	0.111	IPCC, 1996	0.1 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2c_Chemicals	Chemicals (combustion)	Fuel oil	0.632	IPCC, 1996	0.6 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2c_Chemicals	Chemicals (combustion)	Gas oil	0.634	IPCC, 1996	0.6 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2c_Chemicals	Chemicals (combustion)	Natural gas	0.111	IPCC, 1996	0.1 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2d_Pulp_Paper_Print	Pulp, Paper and Print (combustion)	Fuel oil	0.632	IPCC, 1996	0.6 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2d_Pulp_Paper_Print	Pulp, Paper and Print (combustion)	Gas oil	0.634	IPCC, 1996	0.6 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2d_Pulp_Paper_Print	Pulp, Paper and Print (combustion)	Natural gas	0.111	IPCC, 1996	0.1 kg/Tj	V2, Table 2.3	Updated default available

Pollutant	NFR	Source	Fuel Name	Current EF (kg/Tj unless stated otherwise)	Reference	Proposed EF	Reference	Reason for change
N_2O	1A2e_Food_drink_tobacco	Food & drink, tobacco (combustion)	Fuel oil	0.632	IPCC, 1996	0.6 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2e_Food_drink_tobacco	Food & drink, tobacco (combustion)	Gas oil	0.634	IPCC, 1996	0.6 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2e_Food_drink_tobacco	Food & drink, tobacco (combustion)	Natural gas	0.111	IPCC, 1996	0.1 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2f_Manufacturing_Industry&Construction:Other	Autogeneration - exported to grid	Natural gas	0.111	IPCC, 1996	0.1 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2f_Manufacturing_Industry&Construction:Other	Autogenerators	Natural gas	0.111	IPCC (1997c)	0.1 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2f_Manufacturing_Industry&Construction:Other	Other industrial combustion	Burning oil	0.632	IPCC (1997c)	0.6 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2f_Manufacturing_Industry&Construction:Other	Other industrial combustion	Colliery methane	0.111	IPCC (1997c)	0.1 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2f_Manufacturing_Industry&Construction:Other	Other industrial combustion	Fuel oil	0.632	IPCC (1997c)	0.6 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2f_Manufacturing_Industry&Construction:Other	Other industrial combustion	Gas oil	0.634	IPCC (1997c)	0.6 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2f_Manufacturing_Industry&Construction:Other	Other industrial combustion	LPG	0.109	IPCC (1997c)	0.1 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2f_Manufacturing_Industry&Construction:Other	Other industrial combustion	Lubricants	0.634	IPCC (1997c)	0.6 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2f_Manufacturing_Industry&Construction:Other	Other industrial combustion	Natural gas	0.111	IPCC (1997c)	0.1 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2f_Manufacturing_Industry&Construction:Other	Other industrial combustion	OPG	0.109	IPCC, 1996	0.1 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2f_Manufacturing_Industry&Construction:Other	Other industrial combustion	Petroleum coke	None	NA	0.6 kg/Tj	V2, Table 2.3	Default available
N_2O	1A2f_Manufacturing_Industry&Construction:Other	Other industrial combustion	Town gas	0.111	IPCC, 1996	0.1 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A2f_Manufacturing_Industry&Construction:Other	Other industrial combustion	Waste solvent	None	NA	4 kg/Tj	V2, Table 2.3	Default available
N_2O	1A2fii_Manufacturing_Industry&Construction:Off-road	Industrial engines	Lubricants	None	NA	0.6 kg/Tj	V2, Table 2.3	Default available
N_2O	1A4a_Commercial/Institutional	Miscellaneous industrial/commercial combustion	Fuel oil	0.632	EMEP/CORINAIR	0.6 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A4a_Commercial/Institutional	Miscellaneous industrial/commercial combustion	Gas oil	0.634	IPCC (1997c)	0.6 kg/Tj	V2, Table 2.3	Updated default available

Pollutant	NFR	Source	Fuel Name	Current EF (kg/Tj unless stated otherwise)	Reference	Proposed EF	Reference	Reason for change
N_2O	1A4a_Commercial/Institutional	Miscellaneous industrial/commercial combustion	Natural gas	0.111	IPCC (1997c)	0.1 kg/Tj	V2, Table 2.3	Updated default available
N_2O	1A4a_Commercial/Institutional	Miscellaneous industrial/commercial combustion	Town gas	None	NA	0.1 kg/Tj	V2, Table 2.3	Default available
N_2O	1A4a_Commercial/Institutional	Public sector combustion	Burning oil	0.632	IPCC, 1996	0.6 kg/Tj	V2, Table 2.4	Updated default available
N_2O	1A4a_Commercial/Institutional	Public sector combustion	Fuel oil	0.632	IPCC (1997c)	0.6 kg/Tj	V2, Table 2.4	Updated default available
N_2O	1A4a_Commercial/Institutional	Public sector combustion	Gas oil	0.634	IPCC (1997c)	0.6 kg/Tj	V2, Table 2.4	Updated default available
N_2O	1A4a_Commercial/Institutional	Public sector combustion	Natural gas	0.111	IPCC (1997c)	0.1 kg/Tj	V2, Table 2.4	Updated default available
N_2O	1A4a_Commercial/Institutional	Public sector combustion	Town gas	None	NA	0.1 kg/Tj	V2, Table 2.4	Default available
N_2O	1A4a_Commercial/Institutional	Railways - stationary combustion	Burning oil	0.632	IPCC, 1996	0.6 kg/Tj	V2, Table 2.4	Updated default available
N_2O	1A4a_Commercial/Institutional	Railways - stationary combustion	Fuel oil	0.632	IPCC, 1996	0.6 kg/Tj	V2, Table 2.4	Updated default available
N_2O	1A4a_Commercial/Institutional	Railways - stationary combustion	Natural gas	0.111	IPCC (1997c)	0.1 kg/Tj	V2, Table 2.4	Updated default available
N_2O	1A4bi_Residential	Domestic combustion	Burning oil	0.632	IPCC (1997c)	0.6 kg/Tj	V2, Table 2.5	Updated default available
N_2O	1A4bi_Residential	Domestic combustion	Fuel oil	0.632	IPCC, 1996	0.6 kg/Tj	V2, Table 2.5	Updated default available
N_2O	1A4bi_Residential	Domestic combustion	Gas oil	0.634	EMEP/CORINAIR	0.6 kg/Tj	V2, Table 2.5	Updated default available
N_2O	1A4bi_Residential	Domestic combustion	LPG	0.109	IPCC (1997c)	0.1 kg/Tj	V2, Table 2.5	Updated default available
N_2O	1A4bi_Residential	Domestic combustion	Natural gas	0.111	IPCC (1997c)	0.1 kg/Tj	V2, Table 2.5	Updated default available
N_2O	1A4bi_Residential	Domestic combustion	Petroleum coke	None	NA	0.6 kg/Tj	V2, Table 2.5	Default available
N_2O	1A4bi_Residential	Domestic combustion	Town gas	None	NA	0.1 kg/Tj	V2, Table 2.5	Default available
N_2O	1A4ci_Agriculture/Forestry/Fishing:Stationary	Agriculture - stationary combustion	Fuel oil	0.632	IPCC (1997c)	0.6 kg/Tj	V2, Table 2.5	Updated default available
N_2O	1A4ci_Agriculture/Forestry/Fishing:Stationary	Agriculture - stationary combustion	Gas oil	0.634	IPCC (1997c)	0.6 kg/Tj	V2, Table 2.5	Updated default available
N_2O	1A4ci_Agriculture/Forestry/Fishing:Stationary	Agriculture - stationary combustion	Natural gas	0.111	IPCC (1997c)	0.1 kg/Tj	V2, Table 2.5	Updated default available
N_2O	1A4ci_Agriculture/Forestry/Fishing:Stationary	Agriculture - stationary combustion	Vaporising oil	0.634	As for gas oil	0.6 kg/Tj	V2, Table 2.5	Updated default available
N_2O	1A4a_Commercial/Institutional	Miscellaneous industrial/commercial combustion	Burning oil	0.632	IPCC, 1996	0.6 kg/Tj	V2, Table 2.5	Updated default available
N_2O	1A4cii_Agriculture/Forestry/Fishing:Off-road	Agricultural engines	Lubricants	None	NA	0.6 kg/Tj	V2, Table 2.5	Default available

Pollutant	NFR	Source	Fuel Name	Current EF (kg/Tj unless stated otherwise)	Reference	Proposed EF	Reference	Reason for change
N_2O	1A4cii_Agriculture/Forestry/Fishing:Off-road	Agriculture - mobile machinery	Gas oil	30.656	IPCC (1997c)	0.6 kg/Tj	V2, Table 2.5	Updated default available
N_2O	1A4ciii_Fishing	Fishing vessels	Fuel oil	1.944	IPCC (1997c)	0.6 kg/Tj	V2, Table 2.5	Updated default available
N_2O	1A4ciii_Fishing	Fishing vessels	Gas oil	1.860	EMEP/CORINAIR (1996)	0.6 kg/Tj	V2, Table 2.5	Updated default available
Industrial Processes								
N_2O	2.B.2 Nitric acid production	Nitric acid production	Acid production	6 kt N2O/Mt 100% acid produced[9]	IPCC 1996	7 kt N2O/Mt 100% acid produced	IPCC 2006, (Table 3.3)	Updated default available
Waste								
CH_4	6 B WASTE-WATER HANDLING	Industrial Waste Water Treatment	Non-fuel combustion	0.175 kg CH4/kg COD	IPCC 1996	0.25 kg CH4/kg COD	IPCC 2006, (6.2.1)	Updated default available
N_2O	6 B WASTE-WATER HANDLING	Sewage Sludge Decomposition	Non-fuel domestic	0.01 kg N2O-N/kg sewage-N	IPCC 1996	0.005 kg N2O-N/kg sewage-N	IPCC 2006, (6.3.1.2)	Updated default available
CO_2	6 C a Clinical waste incineration (d)	Incineration - clinical waste	Clinical waste	228 kt/Mt burnt	IPCC 2000	240 kt/Mt burnt	IPCC 2006, 5.18, Table 5.2 (Clinical waste)	Updated default available
N_2O	6 C b Industrial waste incineration (d)	Incineration - sewage sludge	Sewage sludge combustion	0.8 kt/Mt	IPCC 2000	990 g/t (0.99 kt/Mt)	IPCC 2006, 5.22, Table 5.6 (Sewage sludge dry weight)	Updated default available
CH_4	6 C c Municipal waste incineration (d)	Incineration	MSW	2.85 kt/Mt	IPCC, 1996	30 kg/TJ (0.399 kt/Mt)	IPCC 2006, 2.23, Table 2.2	Updated default available
CH_4	6 C b Industrial waste incineration (d)	Incineration - sewage sludge	Sewage sludge combustion	0.39 kt/Mt	EMEP/CORINAIR (2003)	9.7 g/t wet weight (0.0097 kt/Mt)	IPCC 2006, 5.20 (emission factor for Japan). No longer included in EMEP/EEA Guidelines	Updated default available
N_2O	6 C a Clinical waste incineration (d)	Incineration - clinical waste	Clinical waste	0.03 kt/Mt	IPCC 2000	4 kg/TJ (0.0532 kt/Mt)[10]	IPCC 2006, 2.17, Table 2.2 (Industrial wastes)	Updated default available

[9] this EF should only be used to replace the 1996 GL EFs in the current methodology.

[10] This use of this factor has been queried by the Inventory Agency. Using this EF keeps consistency with approach for CH_4 below. An alternative from Waste chapter would be EF for industrial waste incineration which would be 100g/t or 0.1 kt/Mt (so a more conservative estimate).

Pollutant	NFR	Source	Fuel Name	Current EF (kg/Tj unless stated otherwise)	Reference	Proposed EF	Reference	Reason for change
N_2O	6 C c Municipal waste incineration (d)	Incineration	MSW	0.038 kt/Mt	IPCC (1997c)	50 g/t (0.05 kt/Mt)	Recommend updating to value from IPCC, 5.22, Table 5.6 "MSW continuous / semi-continuous)" 50g/t or 0.05kt/Mt	Updated default available
CH_4	6 C a Clinical waste incineration (d)	Incineration - clinical waste	Clinical waste	0.018894 kt/Mt	EMEP/CORINAIR (2003)	30 kg/TJ (0.339 kt/Mt)	IPCC 2006, 2.17, Table 2.2	Updated default available
CH_4	6 C b Industrial waste incineration (d)	Incineration - chemical waste	Chemical waste	NONE	NA	30 kg/TJ (0.339 kt/Mt)	IPCC 2006, 2.23, Table 2.2	Default available

Annex B – UK IEF Categories Containing Outliers

Lower outliers	Upper outliers
1.A.1.A-Public Electricity and Heat Production,,Biomass,Implied emission factor,N2O,,(kg/TJ)	1.A.1.A-Public Electricity and Heat Production,,Gaseous Fuels,Implied emission factor,CO2,,(t/TJ)
1.A.1.A-Public Electricity and Heat Production,,Other Fuels,Implied emission factor,CO2,,(t/TJ)	1.A.1.A-Public Electricity and Heat Production,,Liquid Fuels,Implied emission factor,CH4,,(kg/TJ)
1.A.1-Energy Industries,,Biomass,Implied emission factor,N2O,,(kg/TJ)	1.A.1.A-Public Electricity and Heat Production,,Liquid Fuels,Implied emission factor,CO2,,(t/TJ)
1.A.1-Energy Industries,,Other Fuels,Implied emission factor,CO2,,(t/TJ)	1.A.1.A-Public Electricity and Heat Production,,Other Fuels,Implied emission factor,CH4,,(kg/TJ)
1.A.2.B-Non-Ferrous Metals,,Solid Fuels,Implied emission factor,CH4,,(kg/TJ)	1.A.1.B-Petroleum Refining,,Gaseous Fuels,Implied emission factor,CO2,,(t/TJ)
1.A.2.B-Non-Ferrous Metals,,Solid Fuels,Implied emission factor,CO2,,(t/TJ)	1.A.1.C-Manufacture of Solid Fuels and Other Energy Industries,,Gaseous Fuels,Implied emission factor,CO2,,(t/TJ)
1.A.2.C-Chemicals,,Solid Fuels,Implied emission factor,CH4,,(kg/TJ)	1.A.1.C-Manufacture of Solid Fuels and Other Energy Industries,,Gaseous Fuels,Implied emission factor,N2O,,(kg/TJ)
1.A.2.D-Pulp, Paper and Print,,Solid Fuels,Implied emission factor,CH4,,(kg/TJ)	1.A.1.C-Manufacture of Solid Fuels and Other Energy Industries,,Liquid Fuels,Implied emission factor,CH4,,(kg/TJ)
1.A.2.D-Pulp, Paper and Print,,Solid Fuels,Implied emission factor,CO2,,(t/TJ)	1.A.1.C-Manufacture of Solid Fuels and Other Energy Industries,,Liquid Fuels,Implied emission factor,N2O,,(kg/TJ)
1.A.2.E-Food Processing, Beverages and Tobacco,,Solid Fuels,Implied emission factor,CH4,,(kg/TJ)	1.A.1.C-Manufacture of Solid Fuels and Other Energy Industries,,Solid Fuels,Implied emission factor,CH4,,(kg/TJ)
1.A.2.E-Food Processing, Beverages and Tobacco,,Solid Fuels,Implied emission factor,CO2,,(t/TJ)	1.A.1.C-Manufacture of Solid Fuels and Other Energy Industries,,Solid Fuels,Implied emission factor,N2O,,(kg/TJ)
1.A.2.F-Other (please specify),,Liquid Fuels,Implied emission factor,CO2,,(t/TJ)	1.A.1-Energy Industries,,Gaseous Fuels,Implied emission factor,CO2,,(t/TJ)
1.A.2.F-Other non-specified,,Liquid Fuels,Implied emission factor,CO2,,(t/TJ)	1.A.1-Energy Industries,,Gaseous Fuels,Implied emission factor,N2O,,(kg/TJ)
1.A.2.F-Other non-specified,,Other Fuels,Implied emission factor,CO2,,(t/TJ)	1.A.1-Energy Industries,,Liquid Fuels,Implied emission factor,CH4,,(kg/TJ)
1.A.2.F-Other non-specified,,Solid Fuels,Implied emission factor,CO2,,(t/TJ)	1.A.1-Energy Industries,,Liquid Fuels,Implied emission factor,N2O,,(kg/TJ)
1.A.2-Manufacturing Industries and Construction,,Liquid Fuels,Implied emission factor,CO2,,(t/TJ)	1.A.1-Energy Industries,,Other Fuels,Implied emission factor,CH4,,(kg/TJ)
1.A.3.B-Road Transportation,,Gasoline,Implied emission factor,CH4,,(kg/TJ)	1.A.2.A-Iron and Steel,,Gaseous Fuels,Implied emission factor,CH4,,(kg/TJ)
1.A.3.D-Navigation,,Gas/Diesel Oil,Implied emission factor,CH4,,(kg/TJ)	1.A.2.A-Iron and Steel,,Gaseous Fuels,Implied emission factor,CO2,,(t/TJ)
1.A.3.D-Navigation,,Residual Oil,Implied emission factor,CH4,,(kg/TJ)	1.A.2.A-Iron and Steel,,Liquid Fuels,Implied emission factor,CO2,,(t/TJ)
1.A.3-Transport,,Liquid Fuels,Implied emission factor,CH4,,(kg/TJ)	1.A.2.A-Iron and Steel,,Solid Fuels,Implied emission factor,CH4,,(kg/TJ)
1.A.4.B-Residential,,Solid Fuels,Implied emission factor,CO2,,(t/TJ)	1.A.2.A-Iron and Steel,,Solid Fuels,Implied emission factor,CO2,,(t/TJ)
1.A.4.C-Agriculture/Forestry/Fisheries,,Solid Fuels,Implied emission factor,CH4,,(kg/TJ)	1.A.2.A-Iron and Steel,,Solid Fuels,Implied emission factor,N2O,,(kg/TJ)
1.A.4.C-Agriculture/Forestry/Fisheries,,Solid Fuels,Implied emission factor,CO2,,(t/TJ)	1.A.2.B-Non-Ferrous Metals,,Gaseous Fuels,Implied emission factor,CH4,,(kg/TJ)
1.A.4-Other Sectors,,Solid Fuels,Implied emission factor,CO2,,(t/TJ)	1.A.2.B-Non-Ferrous Metals,,Gaseous Fuels,Implied emission factor,CO2,,(t/TJ)
1.A-Fuel Combustion - Sectoral Approach,,Biomass,Implied emission factor,CH4,,(kg/TJ)	1.A.2.B-Non-Ferrous Metals,,Solid Fuels,Implied emission factor,N2O,,(kg/TJ)
1.A-Fuel Combustion - Sectoral Approach,,Biomass,Implied emission factor,N2O,,(kg/TJ)	1.A.2.C-Chemicals,,Gaseous Fuels,Implied emission factor,CO2,,(t/TJ)
1.A-Fuel Combustion - Sectoral Approach,,Liquid Fuels,Implied emission factor,CH4,,(kg/TJ)	1.A.2.C-Chemicals,,Liquid Fuels,Implied emission factor,CO2,,(t/TJ)
1.A-Fuel Combustion - Sectoral Approach,,Other Fuels,Implied emission factor,CO2,,(t/TJ)	1.A.2.C-Chemicals,,Solid Fuels,Implied emission factor,N2O,,(kg/TJ)
1.C1.B-Marine,,Gas/Diesel Oil,Implied emission factor,CH4,,(t/TJ)	1.A.2.D-Pulp, Paper and Print,,Gaseous Fuels,Implied emission factor,CO2,,(t/TJ)
1.C1.B-Marine,,Residual Fuel Oil,Implied emission factor,CH4,,(t/TJ)	1.A.2.D-Pulp, Paper and Print,,Liquid Fuels,Implied emission factor,CO2,,(t/TJ)
2.A.2-Lime Production,,,Implied emission factor,CO2,,(t/t)	1.A.2.D-Pulp, Paper and Print,,Solid Fuels,Implied emission factor,N2O,,(kg/TJ)
2.A.7.1-Glass Production,,,Implied emission factor,CO2,,(t/t)	1.A.2.E-Food Processing, Beverages and Tobacco,,Gaseous Fuels,Implied emission factor,CO2,,(t/TJ)
2.B.1-Ammonia Production,,,Implied emission factor,CO2,,(t/t)	1.A.2.E-Food Processing, Beverages and Tobacco,,Liquid Fuels,Implied emission factor,CO2,,(t/TJ)
2.B.2-Nitric Acid Production,,,Implied emission factor,N2O,,(t/t)	1.A.2.F-Other (please specify),,Gaseous Fuels,Implied emission factor,CO2,,(t/TJ)
2.B.5.5-Methanol,,,Implied emission factor,CH4,,(t/t)	1.A.2.F-Other (please specify),,Liquid Fuels,Implied emission factor,CH4,,(kg/TJ)
2.C.1-Iron and Steel Production,,,Implied emission factor,CO2,,(t/t)	1.A.2.F-Other (please specify),,Liquid Fuels,Implied emission factor,N2O,,(kg/TJ)
4.A-Enteric Fermentation,,Cattle,Implied emission factor,CH4,,(kg/head/yr)	1.A.2.F-Other (please specify),,Other Fuels,Implied emission factor,CH4,,(kg/TJ)
4.A-Enteric Fermentation,,Deer,Implied emission factor,CH4,,(kg/head/yr)	1.A.2.F-Other (please specify),,Other Fuels,Implied emission factor,CO2,,(t/TJ)
4.A-Enteric Fermentation,,Non-Dairy Cattle,Implied emission factor,CH4,,(kg/head/yr)	1.A.2.F-Other (please specify),,Other Fuels,Implied emission factor,N2O,,(kg/TJ)
4.A-Enteric Fermentation,,Sheep,Implied emission factor,CH4,,(kg/head/yr)	1.A.2.F-Other (please specify),,Solid Fuels,Implied emission factor,N2O,,(kg/TJ)
6.B.2.1-Domestic and Commercial (w/o human sewage),,Sludge,Implied emission factor,CH4,,(kg/kg DC)	1.A.2.F-Other non-specified,,Gaseous Fuels,Implied emission factor,CH4,,(kg/TJ)

Lower outliers	Upper outliers
6.C.2-Incineration of hospital wastes,,,Implied emission factor,CH4,,(kg/t)	1.A.2.F-Other non-specified,,Gaseous Fuels,Implied emission factor,CO2,,(t/TJ)
6.C.2-Incineration of hospital wastes,,,Implied emission factor,N2O,,(kg/t)	1.A.2.F-Other non-specified,,Liquid Fuels,Implied emission factor,CH4,,(kg/TJ)
Feedstocks and non-energy use of fuels,,Petroleum Coke,Implied emission factor,C,,(t/TJ)	1.A.2.F-Other non-specified,,Liquid Fuels,Implied emission factor,N2O,,(kg/TJ)
KP.B.1-Forest Management,,Biomass Burning,Implied emission factor,CO2,,	1.A.2.F-Other non-specified,,Other Fuels,Implied emission factor,CH4,,(kg/TJ)
KP.B.1-Forest Management,,Biomass Burning,Implied emission factor,CO2,,Wildfires	1.A.2.F-Other non-specified,,Other Fuels,Implied emission factor,CO2,,(t/TJ)
KP.B.1-Forest Management,,CSC,Implied emission/ removal factor per area,CO2,,(Mg/ha)	1.A.2.F-Other non-specified,,Other Fuels,Implied emission factor,N2O,,(kg/TJ)
	1.A.2.F-Other non-specified,,Solid Fuels,Implied emission factor,N2O,,(kg/TJ)
	1.A.2-Manufacturing Industries and Construction,,Biomass,Implied emission factor,CH4,,(kg/TJ)
	1.A.2-Manufacturing Industries and Construction,,Gaseous Fuels,Implied emission factor,CO2,,(t/TJ)
	1.A.2-Manufacturing Industries and Construction,,Liquid Fuels,Implied emission factor,CH4,,(kg/TJ)
	1.A.2-Manufacturing Industries and Construction,,Liquid Fuels,Implied emission factor,N2O,,(kg/TJ)
	1.A.2-Manufacturing Industries and Construction,,Other Fuels,Implied emission factor,CH4,,(kg/TJ)
	1.A.2-Manufacturing Industries and Construction,,Other Fuels,Implied emission factor,CO2,,(t/TJ)
	1.A.2-Manufacturing Industries and Construction,,Other Fuels,Implied emission factor,N2O,,(kg/TJ)
	1.A.2-Manufacturing Industries and Construction,,Solid Fuels,Implied emission factor,CH4,,(kg/TJ)
	1.A.2-Manufacturing Industries and Construction,,Solid Fuels,Implied emission factor,CO2,,(t/TJ)
	1.A.2-Manufacturing Industries and Construction,,Solid Fuels,Implied emission factor,N2O,,(kg/TJ)
	1.A.3.A-Civil Aviation,,Aviation Gasoline,Implied emission factor,CH4,,(kg/TJ)
	1.A.3.B-Road Transportation,,Diesel Oil,Implied emission factor,CH4,,(kg/TJ)
	1.A.3.B-Road Transportation,,LPG,Implied emission factor,N2O,,(kg/TJ)
	1.A.3.C-Railways,,Solid Fuels,Implied emission factor,CH4,,(kg/TJ)
	1.A.3.C-Railways,,Solid Fuels,Implied emission factor,CO2,,(t/TJ)
	1.A.3.E-Other Transportation (please specify),,Liquid Fuels,Implied emission factor,N2O,,(kg/TJ)
	1.A.3-Transport,,Solid Fuels,Implied emission factor,CH4,,(kg/TJ)
	1.A.3-Transport,,Solid Fuels,Implied emission factor,CO2,,(t/TJ)
	1.A.4.A-Commercial/Institutional,,Gaseous Fuels,Implied emission factor,CO2,,(t/TJ)
	1.A.4.A-Commercial/Institutional,,Liquid Fuels,Implied emission factor,CH4,,(kg/TJ)
	1.A.4.A-Commercial/Institutional,,Liquid Fuels,Implied emission factor,CO2,,(t/TJ)
	1.A.4.A-Commercial/Institutional,,Solid Fuels,Implied emission factor,N2O,,(kg/TJ)
	1.A.4.B-Residential,,Gaseous Fuels,Implied emission factor,CO2,,(t/TJ)
	1.A.4.B-Residential,,Solid Fuels,Implied emission factor,N2O,,(kg/TJ)
	1.A.4.C-Agriculture/Forestry/Fisheries,,Biomass,Implied emission factor,CH4,,(kg/TJ)
	1.A.4.C-Agriculture/Forestry/Fisheries,,Biomass,Implied emission factor,CO2,,(t/TJ)
	1.A.4.C-Agriculture/Forestry/Fisheries,,Gaseous Fuels,Implied emission factor,CO2,,(t/TJ)
	1.A.4.C-Agriculture/Forestry/Fisheries,,Liquid Fuels,Implied emission factor,CO2,,(t/TJ)
	1.A.4.C-Agriculture/Forestry/Fisheries,,Liquid Fuels,Implied emission factor,N2O,,(kg/TJ)
	1.A.4.C-Agriculture/Forestry/Fisheries,,Solid Fuels,Implied emission factor,N2O,,(kg/TJ)
	1.A.4-Other Sectors,,Gaseous Fuels,Implied emission factor,CO2,,(t/TJ)
	1.A.4-Other Sectors,,Liquid Fuels,Implied emission factor,N2O,,(kg/TJ)
	1.A.4-Other Sectors,,Solid Fuels,Implied emission factor,CH4,,(kg/TJ)
	1.A.4-Other Sectors,,Solid Fuels,Implied emission factor,N2O,,(kg/TJ)
	1.A-Fuel Combustion - Sectoral Approach,,Gaseous Fuels,Implied emission factor,CO2,,(t/TJ)
	1.A-Fuel Combustion - Sectoral Approach,,Other Fuels,Implied emission factor,CH4,,(kg/TJ)
	1.AD.5-Feedstocks and non-energy use of fuels,,Natural Gas,Implied emission factor,C,,(t/TJ)

Lower outliers	Upper outliers
	1.AD.7-Feedstocks and non-energy use of fuels,,LPG,Implied emission factor,C,,(t/TJ)
	1.AD.9-Feedstocks and non-energy use of fuels,,Ethane,Implied emission factor,C,,(t/TJ)
	1.B.1.A.1.1-Mining Activities,,,Implied emission factor,CH4,,(kg/t)
	1.B.1.A.1-Underground Mines,,,Implied emission factor,CH4,,(kg/t)
	1.B.2.B.4-Distribution,,,Implied emission factor,CO2,,
	1.C1.A-Aviation,,Gasoline,Implied emission factor,N2O,,(t/TJ)
	2.A.3-Limestone and Dolomite Use,,,Implied emission factor,CO2,,(t/t)
	4.B-Manure Management,,,Implied emission factor,N2O,Other AWMS,(kg N2O-N/kg N)
	5.A.1-Forest Land remaining Forest Land,,5(II) Non-CO2 emissions from drainage of soils and wetlands,Implied emission factor,N2O,,Mineral Soils(kg N2O-N/ha)
	5.D.2-Land converted to Wetlands,,5(II) Non-CO2 emissions from drainage of soils and wetlands,Implied emission factor,N2O,,(kg N2O-N/ha)
	5.D.2-Land converted to Wetlands,,5(II) Non-CO2 emissions from drainage of soils and wetlands,Implied emission factor,N2O,,Peatland(kg N2O-N/ha)
	5.D-Wetlands,,5(II) Non-CO2 emissions from drainage of soils and wetlands,Implied emission factor,N2O,,(kg N2O-N/ha)
	6.B.1-Industrial Wastewater,,Wastewater,Implied emission factor,CH4,,(kg/kg DC)
	6.C.2-Incineration of hospital wastes,,,Implied emission factor,CO2,,(kg/t)

Department of Energy & Climate Change
3 Whitehall Place
London SW1A 2AW
www.gov.uk/decc

URN