

# UNCERTAINTY ANALYSIS OF THE UK-MRIO MODEL

Research Report to the Department for  
Environment, Food and Rural Affairs  
by the Stockholm Environment  
Institute and the University of Sydney



The University of Sydney  
Integrated Sustainability Analysis™



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# UNCERTAINTY ANALYSIS OF THE UK-MRIO MODEL

## Results from a Monte-Carlo Analysis of the UK Multi-Region Input-Output Model (Embedded Emissions Indicator)

### Report to the Department for Environment, Food and Rural Affairs

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Views expressed in this report are those of the authors and do not necessarily reflect those of Defra.

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## Glossary

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AT	Analytical Table
BEET	Balance of emissions embedded in trade
CO <sub>2</sub> -e	Carbon dioxide equivalents
CPI	Consumer price index
CRAS	Conflicting RAS (matrix balancing procedure)
Defra	Department for Environment, Food and Rural Affairs
EEE	Emissions embedded in exports
EEI	Emissions embedded in imports
EET	Emissions embedded in trade
FC	Final consumption
FD	Final demand
GHG	Greenhouse gas
GTAP	Global Trade Analysis Project
GWP	Global warming potential
IEA	International Energy Agency
IO	Input-output
IPCC	Intergovernmental Panel on Climate Change
MRIO	Multi-region input-output
OECD	Organisation for Economic Co-operation and Development
ONS	Office for National Statistics
PPI	Producer price index
PPP	Purchasing power parity
RAS	Synonym for a matrix balancing approach used mainly to update input-output tables, developed by Richard A. Stone in 1961 <sup>1</sup>
RSE	Relative Standard Error
ROW	Rest of the world
SAM	Social accounting matrix
SCP	Sustainable consumption and production
SE	Standard error
SIOT	Symmetric input-output table
SRIO	Single region input-output
SUT	Supply and Use Table
UK-MRIO 1	Multi-region input-output model with global coverage, including the United Kingdom as one of the trading partners (also acronym for the model developed in this project, with the '1' meaning that this is the first stage of model development).
UNFCCC	United Nations Framework Convention on Climate Change

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<sup>1</sup> See (United Nations 1999).

# 1 Introduction

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The work described in this report is an extension to the 'Embedded Carbon Emissions Indicator' project in which the first stage of a multi-region input-output (MRIO) model was developed with the aim to set the basis for multi-country analyses of environmental impacts associated with UK trade flows, including detailed accounts of emissions embedded in trade flows to and from the UK.<sup>2</sup> A time series of direct and indirect carbon dioxide emissions associated with UK economic activities, in particular emissions that are embedded in imports to and exports from the UK, was calculated with this UK-MRIO 1 model.

One open question that had not been answered in this previous project was about the uncertainty of the results. The present work therefore set out to quantify the error margins associated with the results from the UK-MRIO 1 model. The sensitivity of the model system with respect to parameter uncertainty was to be tested by performing a Monte-Carlo analysis. This allows for the results to be presented with error margins.

A sensitivity analysis of the whole model system was therefore carried out by

- reviewing and justifying estimates for standard deviations of constraints,
- estimating IO table uncertainties from constraint uncertainties,
- estimating IO table uncertainties from matrix balancing,
- estimating multiplier uncertainties using Monte-Carlo simulations and
- calculating the error propagation for embedded emissions.

The calculations were carried out by The Centre for Integrated Sustainability Analysis (ISA) at the University of Sydney<sup>3</sup>, with the Stockholm Environment Institute<sup>4</sup> at the University of York providing initial uncertainty estimates and coordinating the report.

Although Monte-Carlo type analyses to determine possible errors from uncertainties in underlying databases is well described in the literature, only few economic and environment-economic studies actually go to such a length. No other environmental MRIO study has thus far undertaken a similarly thorough uncertainty analysis (for a review of such studies see Wiedmann et al. 2007; Wiedmann et al. 2008).

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<sup>2</sup> Wiedmann et al. (2008); project reference: EV02033; project website: [http://www2.defra.gov.uk/research/project\\_data/More.asp?I=EV02033&M=KWS&V=EV02033&SUBMIT1=Search&SCOPE=0](http://www2.defra.gov.uk/research/project_data/More.asp?I=EV02033&M=KWS&V=EV02033&SUBMIT1=Search&SCOPE=0)

<sup>3</sup> <http://www.isa.org.usyd.edu.au>

<sup>4</sup> <http://www.sei.se>

Section 2 describes how the uncertainties for the underlying data were derived; Section 3 explains the methodology and Section 4 present the results. Section 5 discusses the validity of the assumptions and calculations and concludes. For the definitions, general context and a detailed description of the UK-MRIO model and results we refer to the main report.<sup>2</sup>

## 2 Methodology for estimating uncertainties of model input data

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### General procedure for estimating data uncertainties

We define the *order of magnitude* of a data item  $x$  as its logarithm  $\log_{10}(x)$ . For example, the order of magnitude of £1,000 is 3, the order of magnitude of £10,000 is 4. Let the absolute standard error of a data item  $x$  be  $\Delta x$ , so that its Relative Standard Error (RSE) is  $r_x = \Delta x/x$ . The absolute error in the logarithms (the “order-of-magnitude” error) is then

$$\text{Eq. 1} \quad \Delta(\log_{10} x) \approx \log_{10}(x + \Delta x) - \log_{10}(x) = \log_{10}\left(\frac{x + \Delta x}{x}\right) = \log_{10}(1 + r_x).$$

Relative standard errors  $r_x$  can sometimes be obtained or derived from public data sources. If there are no data, error estimates can be solicited from informed judgement of statistical agency staff (Lenzen 2001). These relative standard error can then be transformed into the “order-of-magnitude” errors (or *log-normal errors*) by the approximation above.

The rationale for estimating error coefficients for the logarithms and not for the data values as such is based on the assumption that data are distributed log-normally, and not normally. The assumption of log-normality effectively ensures that all values in the error range of a data item remain positive.

Large data items are generally known with higher accuracy than small data items. This is due to the fact that large items often consist of many smaller data points (e.g. purchases by companies, emissions data from individual sources, etc.), thus cancelling out stochastic errors when accumulating. This holds in general for any data: For example employment in service sectors of an economy is large, because there is a large number businesses employing a small number of people. Another example is energy use in the electricity sector.

Even though there may not be many power plants in the country, the amount of black coal or natural gas is usually comprised of many supply batches adding up over the year.

For the sake of consistency and simplicity, we have chosen to regress all log-normal standard error data with a *linear function on the logarithms of the data*:

$$\text{Eq. 2} \quad \log_{10}(1 + r_x) = a \ln x + b.$$

where  $a$  and  $b$  are *regression coefficients*.

In order to perform a Monte-Carlo analysis of the UK-MRIO model, the uncertainties of all underlying input data had first to be determined. There are five types of data with their specific uncertainties:

- UK input-output data,
- UK CO<sub>2</sub> data,
- GTAP input-output data for three world regions,
- CPI data used for deflation,
- International CO<sub>2</sub> data, and
- Trade data.

## **UK input-output data**

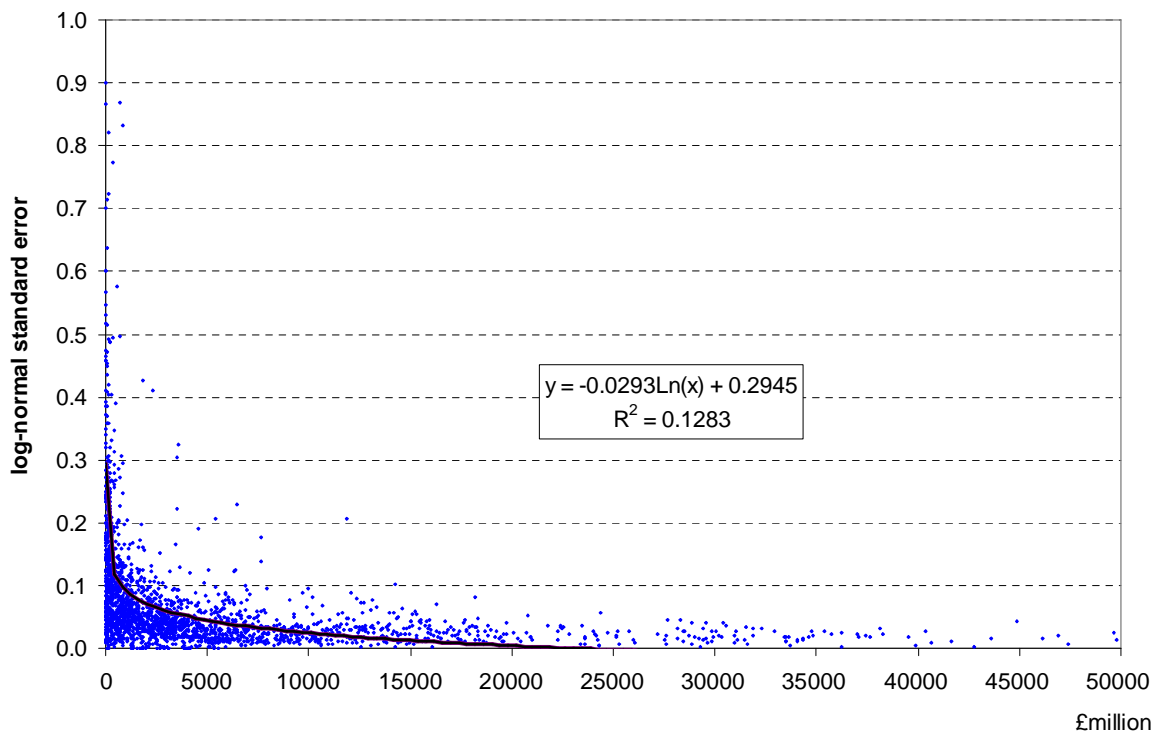
Input-output data for the UK were taken from the annual Supply and Use Tables reported by the Office for National Statistics (Wiedmann et al. 2008). The uncertainty of these data is well documented in the Annual Business Inquiry (ABI) published by ONS. The ABI reports the standard error for 'Total turnover', 'Approximate gross value added at basic prices', 'Total purchases of goods, materials and services' and 'Total net capital expenditure' by SIC 3-digit code for the years 1998 to 2005.<sup>5</sup> Altogether, this results in 2,166 data points  $x$  with as many absolute standard errors  $\Delta x$ , thus providing an excellent data pool from which RSE values can be calculated directly. Deriving the linear function on the logarithms of the data (2), results in the following equation (see also Figure 1):

---

<sup>5</sup> Table: ABI Quality Measures, Annual Business Inquiry, Sections A-O Whole Economy - Standard Error By Group, Release Date 18/06/2007; accessed in February 2008 on [http://www.statistics.gov.uk/abi/quality\\_measures.asp](http://www.statistics.gov.uk/abi/quality_measures.asp).



$$\text{Eq. 3} \quad y = \log_{10}(1 + r_x) = -0.0293 \ln(x) + 0.2945$$



**Figure 1: Error distribution of UK input-output data**

For  $x > 16,500$  £million the standard error becomes smaller than 1% and for  $x > 23,183$  £million it would become negative when using Eq.3. We have therefore set  $\Delta x/x = 0.01$  as the minimum value for all  $x > 16,500$  £million, to ensure positivity.

## UK CO<sub>2</sub> data

National carbon dioxide emissions data were taken from the Environmental Accounts (see Wiedmann et al. 2008). ONS does not currently classify uncertainty in respect of the Environmental Accounts per se, though uncertainty is considered for the core inventories (National Atmospheric Emissions Inventory and UK Greenhouse Gas Inventory) that form the basis of the ONS accounts.<sup>6</sup> Annex 7 of an AEAT report (AEAT 2006) provides more detail in this respect.

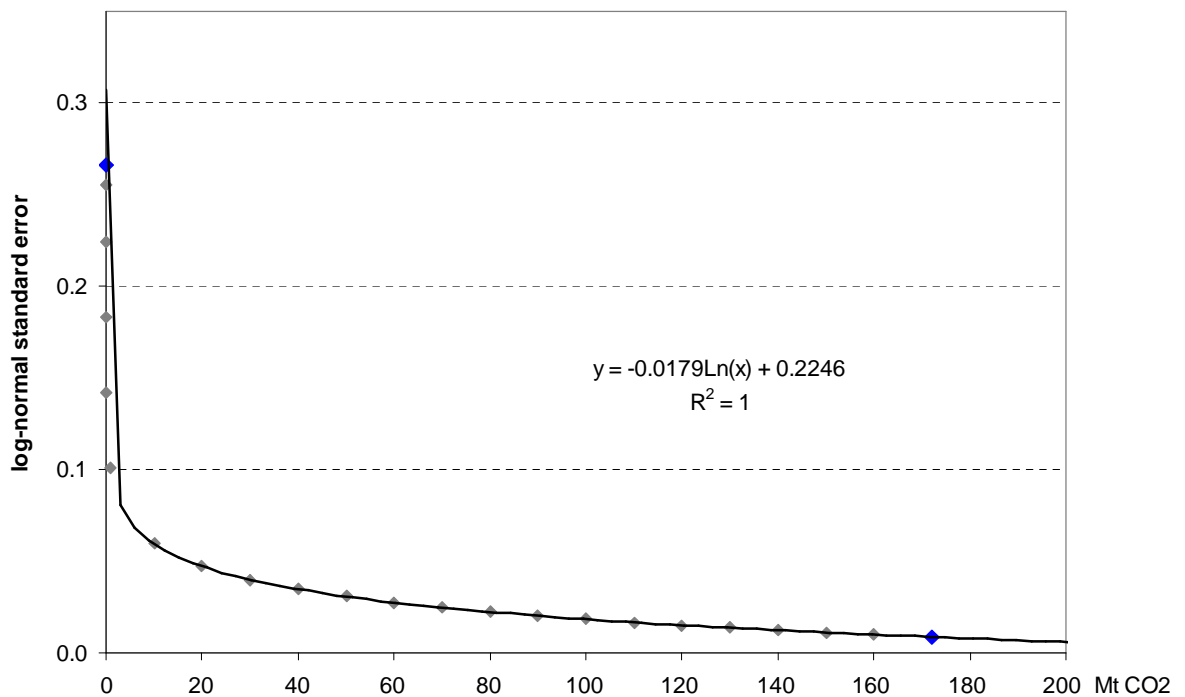
We have therefore chosen the following approach to estimate the uncertainty of Environmental Accounts CO<sub>2</sub> data. For the largest single value of CO<sub>2</sub> emissions for a sector (172 Mt from electricity generation) a RSE of 2% was

<sup>6</sup> Personal communication from Andrew Lelland, AEA Group, Warrington on 11 March 2008.

assumed, which is in line with the AEAT estimates (see Table A7.4a in AEAT 2006). For the smallest value (18 kt CO<sub>2</sub> from metal ore mining) it is reasonable to assume a much larger variation; some sectoral emission uncertainties can be over 300% (compare with Table A7.4b in AEAT 2006). Because of the lack of more precise information for CO<sub>2</sub> only, the RSE for the smallest value was set to 100%. The linear regression for the log-normal standard error of the smallest and the largest value is then:

$$\text{Eq. 4} \quad y = \log_{10}(1 + r_x) = -0.0179 \ln(x) + 0.2246$$

Figure 2 shows a fitted curve; values between the extremes have been interpolated by using Eq. 4.



**Figure 2: Error distribution of UK CO<sub>2</sub> emissions data** (the smallest and the largest x-values – blue dots – were used to generate the line; intermediate points – grey dots – were fit to this assumed functional form).

## GTAP input-output data for three world regions

Two types of uncertainties are associated with the input-output data from GTAP for three world regions used for the UK-MRIO model (Wiedmann et al. 2008):

- 1) Uncertainties associated with the compilation of IO tables by GTAP and the aggregation to three world regions.
- 2) Structural change over time. We used data from two years, 1997 and 2001, for modelling the whole time period 1992 to 2004. Changes in the economic structure of the three world regions introduce systematic errors in the results.

The sections below describe how the uncertainties for 1) and 2) were derived.

### ***Uncertainties associated with the compilation of GTAP IO tables***

In order to compile its input-output database the Global Trade Analysis Project (GTAP) performs a number of process steps which influence the accuracy and precision of the data. To understand the uncertainty in the GTAP database requires a brief description of how it is constructed:<sup>7</sup>

Firstly, input-output data are submitted by database contributors. These contributions are voluntary and so the data can be rather old. For instance, Sweden is from 1985, most EU countries are from the early 1990's. The GTAP scales the data to match 2001 GDP in international dollars, which means the data have the *structure* of its base-year, but the *volume* of 2001. The uncertainty in the original data is not reported and different countries might have different "definitions" making comparisons difficult.

Secondly, input-output data are harmonized. The data needs to be converted to the GTAP format. This requires various aggregations and disaggregations. Disaggregation is the main issue with some countries aggregated to as low as 20 sectors (Russia). Further disaggregations are performed in the food and agriculture sectors. The uncertainty introduced in the harmonization process is unknown.

And thirdly, GTAP includes various additional data, such as trade and energy volumes, to update the input-output data. Trade data, for example, are rebalanced, then fed into the IO tables (as exports and imports). Changes in stocks are removed, etc. Once all the data have been linked it has to be "balanced" to obtain a global equilibrium. The uncertainty introduced in the balancing is unknown.

Despite these obviously significant error sources, the GTAP data are at the core of most global economic models and is used by most international organisations. GTAP is widely accepted as a reputable data source for

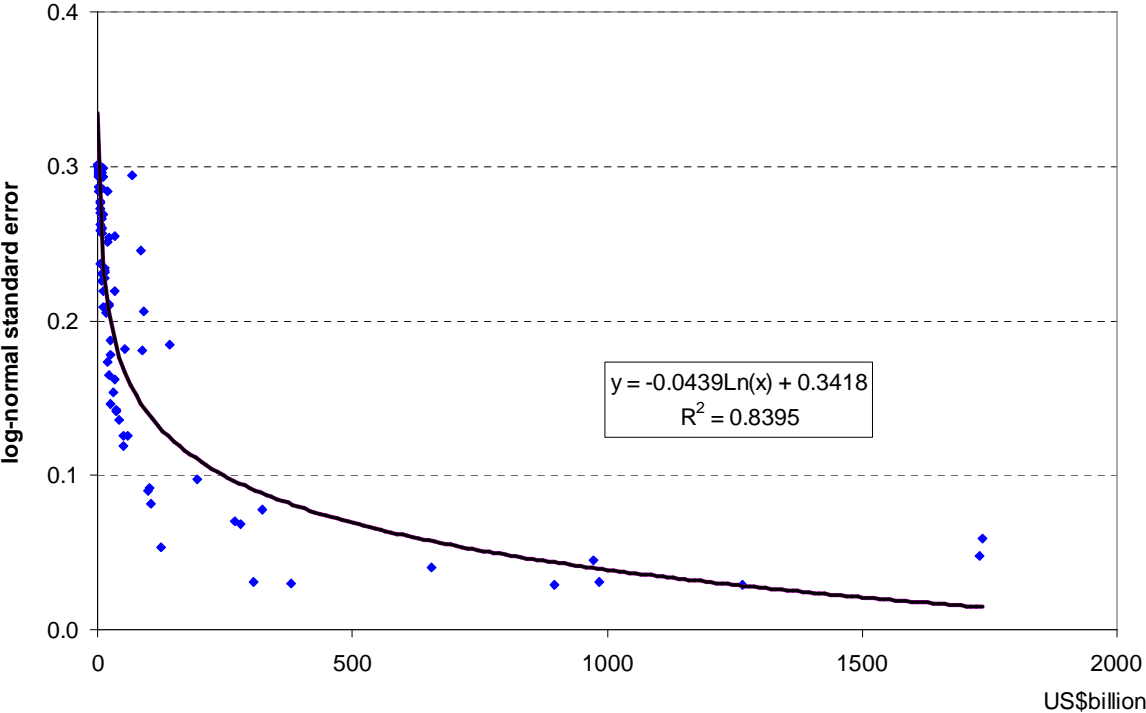
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<sup>7</sup> The following paragraphs are based on a personal communication with Dr Glen Peters, Industrial Ecology Programme, Norwegian University of Science and Technology (NTNU), Trondheim, in February 2008.

economic analysis. However, in most economic studies no uncertainty analysis is provided or only a rough estimate of possible error ranges.

Upon request for information on data uncertainty, GTAP referred to a report by Robert McDougall (McDougall 2006) as part of the GTAP documentation.<sup>8</sup> This document has information indicating the extent of change in individual tables' structure in order to accommodate international data such as trade targets, energy usage targets, and other international data sets. Table 19.6 from this document ("Selected Category Total Comparisons Between Unfitted and Fitted I-O Tables, US\$billion; page 19-11) includes over 100 data points on a sector level and was used for an error estimate, assuming that the differences between 'Unfitted/Initial' and 'Fitted/Final' represent a relative standard error. The resulting equation (5) and plot (Figure 3) show a reasonable correlation between log-normal standard error and financial data. Again, for x values larger than 1200 US\$billion, y was kept constant at 0.03 in order to reflect the uncertainty of the two largest x values in Figure 3 and to ensure positivity of all y.

Eq. 5  $y = \log_{10}(1 + r_x) = -0.0439\ln(x) + 0.3418$



**Figure 3: Error distribution of GTAP input-output data**

<sup>8</sup> Chapter 19: Updating and Adjusting the Regional Input-Output Tables ([https://www.gtap.agecon.purdue.edu/resources/res\\_display.asp?RecordID=2184](https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=2184)).

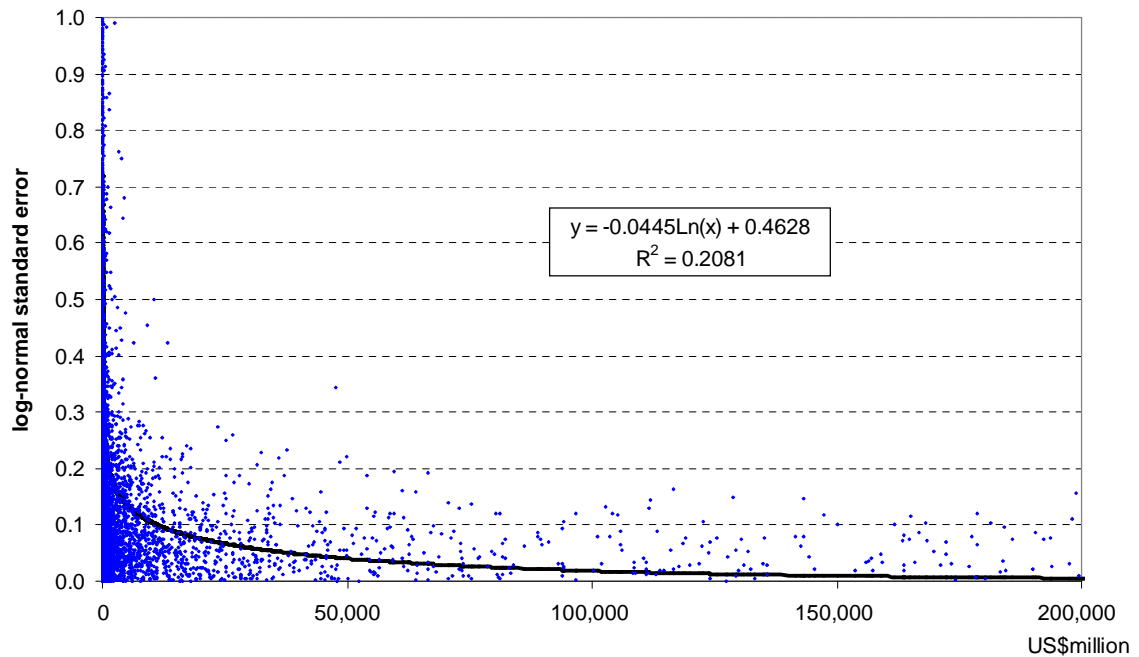
This approximation is not an ideal representation of GTAP data uncertainties, but in the light of a missing alternative it is a workable substitute for the errors associated with the data compilation procedure described above.

### ***Uncertainties associated with structural change over time***

While the section above deals with the uncertainty inherent in the GTAP data of one year, this section deals with the structural changes over a four year time period. The UK-MRIO model uses GTAP IO data from 1997 and 2001. The economic structure – and thus the IO matrices – for the three world regions has changed over time. Although it can be assumed that these changes are of a systematic nature (i.e. changes are likely to go in one direction; e.g. some sectors become consistently more important over time while others loose in significance), we have not made sector specific assumptions on the directions of change. Rather, we have defined the changes observed between 1997 and 2001 as stochastic uncertainties that can either continue to go in one certain direction or in the other direction. With increasing distance from the base years 1997 and 2001, we have assumed that uncertainties grow with a linear annual rate, thus covering all possibilities of structural change over time.

The following procedure was applied. Prices in the GTAP IO tables for 2001 were corrected for inflation by dividing through the producer price index (PPI; taken from ONS), relative to 1997 on a sectoral level. Each cell value in the 1997 IO tables for all three world regions was then subtracted from the respective cell values in the 2001 tables. The resulting differences were converted in absolute values (removing the + or - signs) and defined as the relative standard error of the 1997 cell entries, resulting in the equation and plot provided below. A minimum value of 0.05 for the log-normal standard error was chosen for very large values of x. In the model, y values are divided by four to reflect annual change.

$$\text{Eq. 6} \quad y = \log_{10}(1 + r_x) = -0.0445 \ln(x) + 0.4628$$



**Figure 4: Error distribution of structural change in GTAP input-output data over a four year period.**

### Price indices used for deflation

As mentioned above, prices in the 1997 and 2001 IO tables from GTAP for the three world regions had to be corrected for inflation to be usable for other years in the time series. This was done by using the average producer price index (PPI) of selected countries in the three world regions, taken from OECD statistics<sup>9</sup>. Apart from the fact that these PPIs are averaged over the whole economy and are not specific to individual sectors, uncertainty is mainly introduced through variations between countries. From the OECD database, a statistically sufficient number of countries (15) was only available for the 'OECD Europe' region. For each year from 1992 to 2004 the average PPI of these 15 countries as well as the standard deviation was derived and overall relative variation was expressed as standard deviation over average. This variation depends on the year as PPIs are expressed as indices (base year 2000) and therefore the average variation over all years 1992 to 2004 of 10% was used as a general estimate of uncertainty for all years and world regions.

<sup>9</sup> Dataset 'Price indices (MEI)', extracted on 5 February 2008 from OECD.Stat.com

## International CO<sub>2</sub> data

Carbon dioxide emissions data for the three world regions were compiled from IEA data (Wiedmann et al. 2008). No documentation of uncertainty could be found for this data set. Therefore the same error function as derived for the national CO<sub>2</sub> data was used (see above).

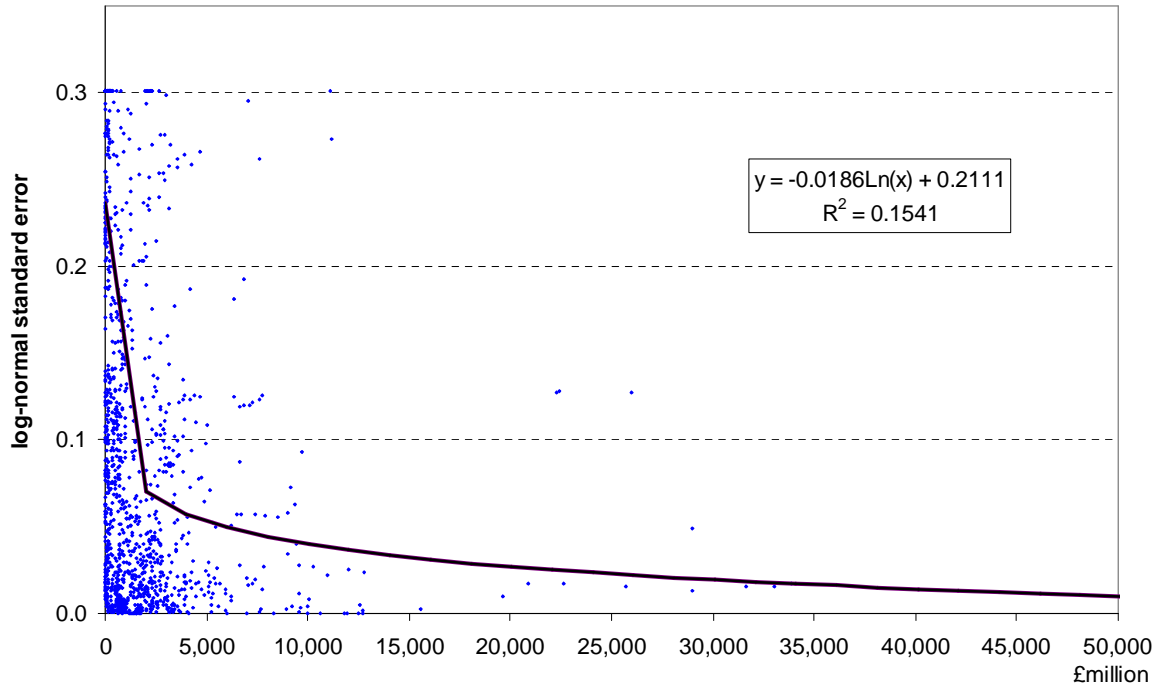
Another challenge in terms of uncertainty is posed by the mismatch of numbers of sectors in the UK tables (123 sectors) and GTAP tables (30 sectors). This leads to the situation that UK sectors that correspond to the same foreign sector get allocated the same foreign CO<sub>2</sub> intensity (in kt CO<sub>2</sub>/M£). As a result the carbon intensity of imports can systematically be over- or underestimated within a cluster of sectors. For example, GTAP distinguishes only one transport sector (and hence one carbon intensity for transport) whereas the UK table distinguishes five transport sectors with different CO<sub>2</sub> intensities.

In principle it would be possible to determine the degree of variation within each block of corresponding sectors by using the variation of UK intensities within this block as a measure for variation of foreign intensities. However, it was not possible within the limited scope of this project to implement the necessary routines which would have required substantially more resources. It can be assumed that the combined variation of absolute CO<sub>2</sub> emissions per sector and total industrial output per sector cover most of the possible variations and that the uncertainties of aggregate results can still be determined with sufficient robustness.

## Trade data

The total imports to the UK for each year and sector are directly taken from the UK Supply and Use Tables and therefore are associated with the uncertainty of UK IO data as described above. In addition to this, further uncertainty is introduced through the division of total trade into the three world regions. We used trade data from different sources to accomplish this task (for details see Wiedmann et al. 2008). The differences in the three-region split of trade data when using either SIC or SITC classification for the trade data can be used to determine the associated error. The equation and plot below capture the variation of over 1,200 data points that represent either trade transactions from the SUTs (SIC classification) or trade data from HMRC ([www.uktradeinfo.com](http://www.uktradeinfo.com), SITC classification).

$$\text{Eq. 7} \quad y = \log_{10}(1 + r_x) = -0.0186 \ln(x) + 0.2111$$



**Figure 5: Error distribution of UK import data from three world regions.**



### 3 Methodology for calculating the uncertainty of embedded emissions

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#### Introduction

The UK input-output tables for the UK-MRIO model were obtained using a multi-proportional balancing algorithm (CRAS; described in the original consultancy report, Wiedmann et al. 2008), with the aim of having the entries of the input-output table (vectorised as  $\mathbf{p}$ ) satisfy constraints  $\mathbf{c}$  according to  $\mathbf{G}\mathbf{p} = \mathbf{c}$ , where  $\mathbf{G}$  is a constraints coefficients matrix, and  $\mathbf{c}$  holds the constraints values. The balancing algorithm starts with an initial estimate  $\mathbf{p}_0$  for  $\mathbf{p}$ , and arrives at a final solution  $\mathbf{p}^{(final)}$ . This  $\mathbf{p}^{(final)}$  is a vectorised form of the input-output table  $\mathbf{T}$ .

The aim of the present work was to establish uncertainty estimates for the carbon multipliers  $\mathbf{m}$ , which are calculated from  $\mathbf{T}$  according to  $\mathbf{m} = \mathbf{q} [\mathbf{I} - \mathbf{T}\hat{\mathbf{x}}]^{-1}$ , where  $\mathbf{q}$  are sectoral carbon intensities,  $\mathbf{x}$  is sectoral gross output, and  $\mathbf{I}$  is a suitable unity matrix. These uncertainties will be expressed as standard deviations  $\Delta\mathbf{m}$ . A standard deviation  $\Delta\mathbf{m}$  denotes the 67% confidence interval around the mean  $\mathbf{m}$ ; in other words, 67% of a large number of observations of  $\mathbf{m}$  would fall into the interval  $[\mathbf{m} - \Delta\mathbf{m}, \mathbf{m} + \Delta\mathbf{m}]$ .

In order to calculate the  $\Delta\mathbf{m}$ , it is necessary to determine the standard deviations  $\Delta\mathbf{T}$  of the input-output table  $\mathbf{T}$  itself. Hence, the calculations carried out in this work proceed in 2 stages: 1) determine standard deviations  $\Delta\mathbf{T}$  of  $\mathbf{T}$ , and 2) determine standard deviations  $\Delta\mathbf{m}$  of  $\mathbf{m}$ . These stages are described in detail in the following.

#### Estimate table uncertainties $\Delta\mathbf{T}$ from balancing procedure

A first estimate of the uncertainties of  $\mathbf{p}$  (vectorised as  $\Delta\mathbf{p}$ ) can be obtained by the shift that the  $\mathbf{p}_0$  experience during the balancing run:  $\mathbf{dp}^{(0)} = \mathbf{p}^{(final)} - \mathbf{p}_0$ . Results from the work performed in the previous project CRAS; described in the original consultancy report, (Wiedmann et al. 2008) has been used to quantify  $\mathbf{dp}^{(0)}$ .

## Estimate table uncertainties from constraint uncertainties

The uncertainties of constraint values  $\mathbf{c}$  are known as  $\mathbf{dc}$ . These  $\mathbf{dc}$  have been sourced for all constraint values, see Section 2 (uncertainties of model input data).

Taking the first estimate of the  $\mathbf{dp}$  as a starting point, the uncertainties of the constraints would be  $\mathbf{dc}^{(0)} = \mathbf{G dp}^{(0)}$ . Generally,  $\mathbf{dc}^{(0)} \neq \mathbf{dc} = \mathbf{G dp}$ .

The  $\mathbf{dp}$  can now be subjected to a RAS-type adjustment process as follows:

- a) Calculate  $dc_1 / dc^{(0)}_1$
- b) Adjust  $dp_j^{(1)} = dp_j^{(0)} \times dc_1 / dc^{(0)}_1 \forall j$  where  $G_{1j} \neq 0$ , so that  $dc_1 = \sqrt{\sum_j (G_{1j} dp_j^{(1)})^2}$
- c) Calculate  $dc_2 / dc^{(0)}_2$ .
- d) Adjust  $dp_j^{(1)} = dp_j^{(0)} \times dc_2 / dc^{(0)}_2 \forall j$  where  $G_{2j} \neq 0$ , so that  $dc_2 = \sqrt{\sum_j (G_{2j} dp_j^{(1)})^2}$
- e) And so on  $\forall c_i$
- f) And so on  $\forall dc_i / dc^{(n)}_i$
- g) Exit if  $\|\mathbf{dc} - \mathbf{dc}^{(n)}\| \leq$  some small  $\epsilon$ , else goto a) and calculate  $dc_1 / dc^{(n+1)}_1$
- h) The  $\mathbf{dp}^{(n)}$  are the solution for  $\Delta\mathbf{p}$ ; they are the uncertainties  $\Delta\mathbf{T}$  of the entries of the input-output table  $\mathbf{T}$ .

## Assembling uncertainties into one table

The  $\Delta\mathbf{T}$  obtained from the stages above yield the standard deviations of the UK input-output tables for all years. Estimates of GTAP standard deviations and of carbon emissions were added, and from the combined information uncertainty tables  $\mathbf{dT}$  and  $\mathbf{dq}$  were constructed.

## Estimate multiplier uncertainties using Monte-Carlo simulation

Multipliers  $\mathbf{m}$  are calculated from direct intensities  $\mathbf{q}$ , the input-output table  $\mathbf{T}$  as well as gross output  $\mathbf{x}$  according to  $\mathbf{m} = \mathbf{q} [\mathbf{I} - \mathbf{T}\hat{\mathbf{x}}]^{-1}$ , where  $\mathbf{I}$  is a suitable unity matrix. The uncertainties  $\mathbf{dm}$  of the multipliers  $\mathbf{m}$  cannot be obtained analytically, but for example via Monte-Carlo analysis (Bullard and Sebald 1977,1988; Lenzen 2001). Here, a perturbation of the input-output table  $\mathbf{T} \rightarrow \mathbf{T} + \mathbf{dT}$  results in perturbed gross output  $\mathbf{x} \rightarrow \mathbf{x} + \mathbf{dx}$ , and together with the perturbed direct intensities  $\mathbf{q} \rightarrow \mathbf{q} + \mathbf{dq}$ , they result in a perturbed multiplier  $\mathbf{m}$

→  $\mathbf{m} + \mathbf{dm} = (\mathbf{q} + \mathbf{dq}) [ \mathbf{I} - (\mathbf{T} + \mathbf{dT}) (\mathbf{x} + \mathbf{dx}) ]^{-1}$ . This procedure has been repeated a large number of times (5,000 × per year), and multiplier uncertainties are extracted from the distribution of the  $\mathbf{m} + \mathbf{dm}$ .

In carrying out the Monte-Carlo analysis, we have followed a conservative approach, which results in slightly higher uncertainty estimates, in two aspects:

1. (Bullard and Sebald 1977,1988; Lenzen 2001) exclude “infeasible” Monte-Carlo runs with  $|\mathbf{dx}| / \mathbf{x} > 3\%$ , since they assume that gross output is a macro quantity that known with relatively high certainty. However, we do not require this knowledge of gross output, and hence include all Monte-Carlo runs, thus including runs yielding higher standard deviations  $\Delta\mathbf{T}$ .

2. Perturbing the input-output table  $\mathbf{T} \rightarrow \mathbf{T} + \mathbf{dT}$  results in the perturbed table  $\mathbf{T} + \mathbf{dT}$  being unbalanced, that is row sums will not necessarily equal column sums. In theory, row sums and column sums must balance (gross input = gross output). Applying a RAS-type balancing procedure so that  $\mathbf{T} + \mathbf{dT}$  conformed to row and column balance, would result in a reduced perturbation, and hence in reduced standard deviations. We have decided not to balance the perturbed table in order to reflect uncertainty of gross input and output, thus resulting in elevated standard deviations.

5000 Monte-Carlo simulation runs were performed on two parallel UNIX processors, taking about 60 hours of calculation time, respectively.

## Error propagation and uncertainty in embedded emissions

Once the (carbon) multiplier uncertainties  $\Delta\mathbf{m}$  have been calculated, the next and final stage is to combine this with the uncertainties in final demand  $\Delta\mathbf{y}$  in order to obtain error margins for the actual embedded emissions. This step includes additions and subtractions and the resulting error propagation is dealt with in the usual way by applying the "square root of square sums" formula.

Embedded emissions uncertainties are hence calculated as follows. Let  $J$  be a set of sectors, and  $AE_j$  its embedded emissions. Using

- final demand  $y$ , with absolute standard deviation  $\Delta\mathbf{y}$ ,
- multipliers  $m$ , with absolute standard deviation  $\Delta\mathbf{m}$ ,
- sectoral embedded emissions  $E$ , with absolute standard deviation  $\Delta E$ ,
- aggregate embedded emissions  $AE$ , with absolute standard deviation  $\Delta AE$ .
- $E_i = m_i y_i$  , and
- $AE_j = \sum_{i \in J} E_i$  ,

Using the general error propagation for a function  $f(x_i)$  as

$$\text{Eq. 8} \quad \Delta f = \sqrt{\left(\frac{\partial f}{\partial x_i}\right)^2 \Delta x_i^2},$$

we find

$$\text{Eq. 9} \quad \Delta E_i = \sqrt{m_i^2 \Delta y_i^2 + \Delta m_i^2 y_i^2} \Leftrightarrow \frac{\Delta E_i}{E_i} = \sqrt{\frac{\Delta y_i^2}{y_i^2} + \frac{\Delta m_i^2}{m_i^2}}$$

$$\Delta E_i = \sqrt{m_i^2 \Delta y_i^2 + \Delta m_i^2 y_i^2} \Leftrightarrow \frac{\Delta E_i}{E_i} = \sqrt{\frac{\Delta y_i^2}{y_i^2} + \frac{\Delta m_i^2}{m_i^2}} \text{ and}$$

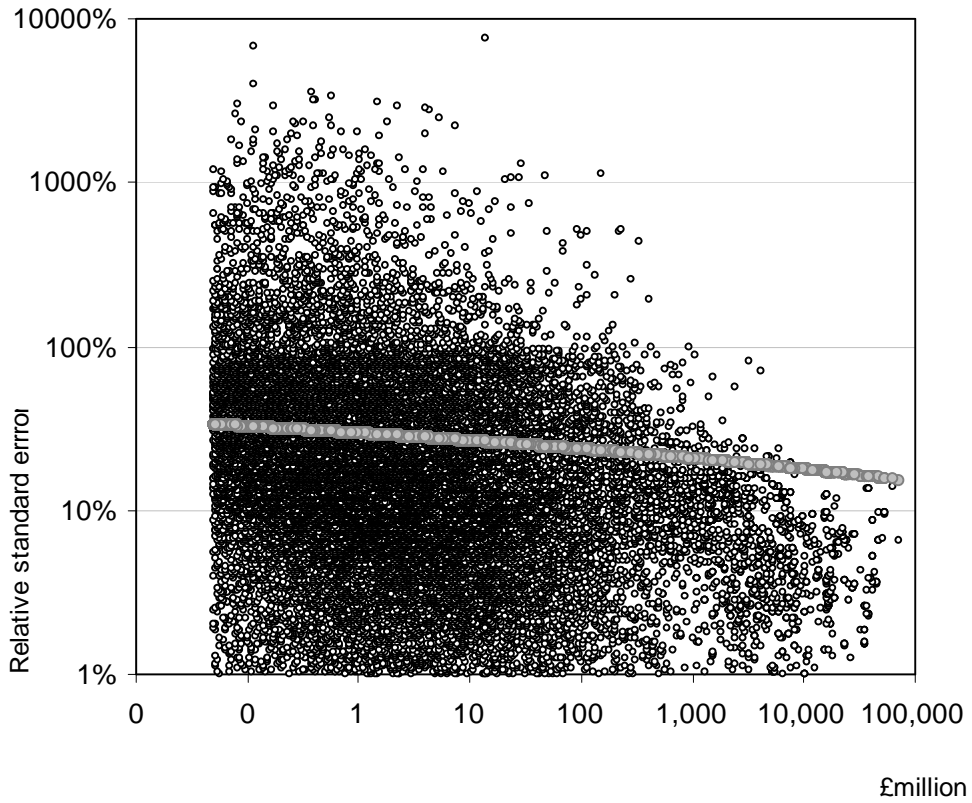
$$\text{Eq. 10} \quad \Delta A E_j = \sqrt{\sum_{i \in j} \Delta E_i^2}.$$

## 4 Results

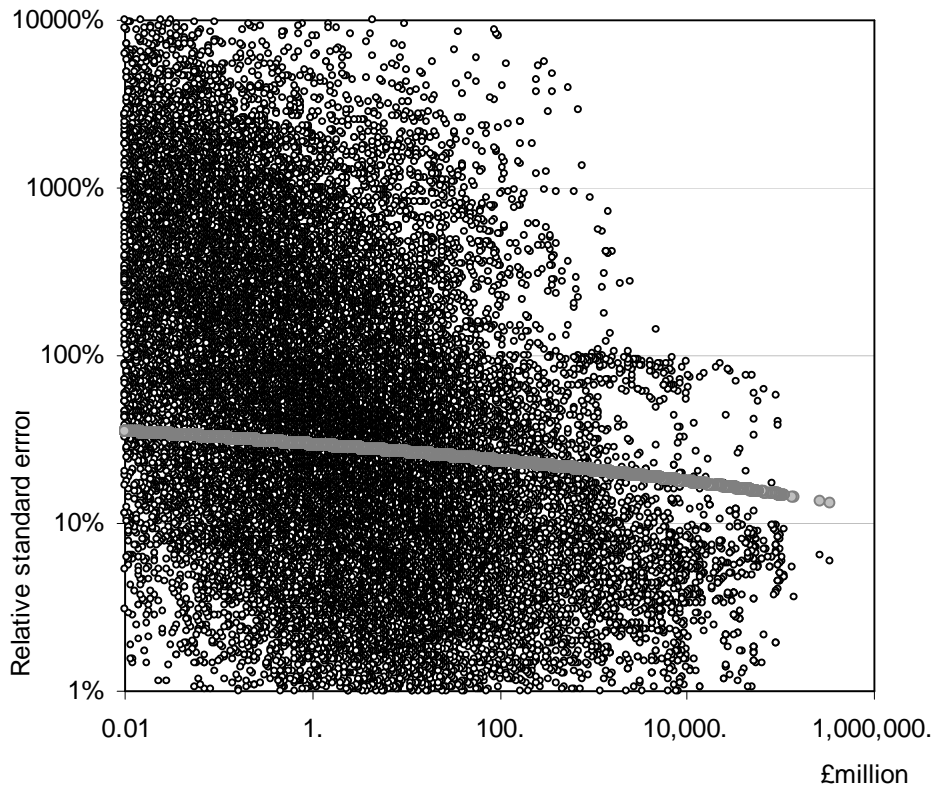
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### Results of the estimation of standard deviations of UK input-output table entries

The following graphs show the uncertainty of UK IO table entries as calculated with the methodology described above.



**Figure 6: Calculated relative standard error of UK input-output table entries, 1992.**



**Figure 7: Calculated relative standard error of UK input-output table entries, 2004.**

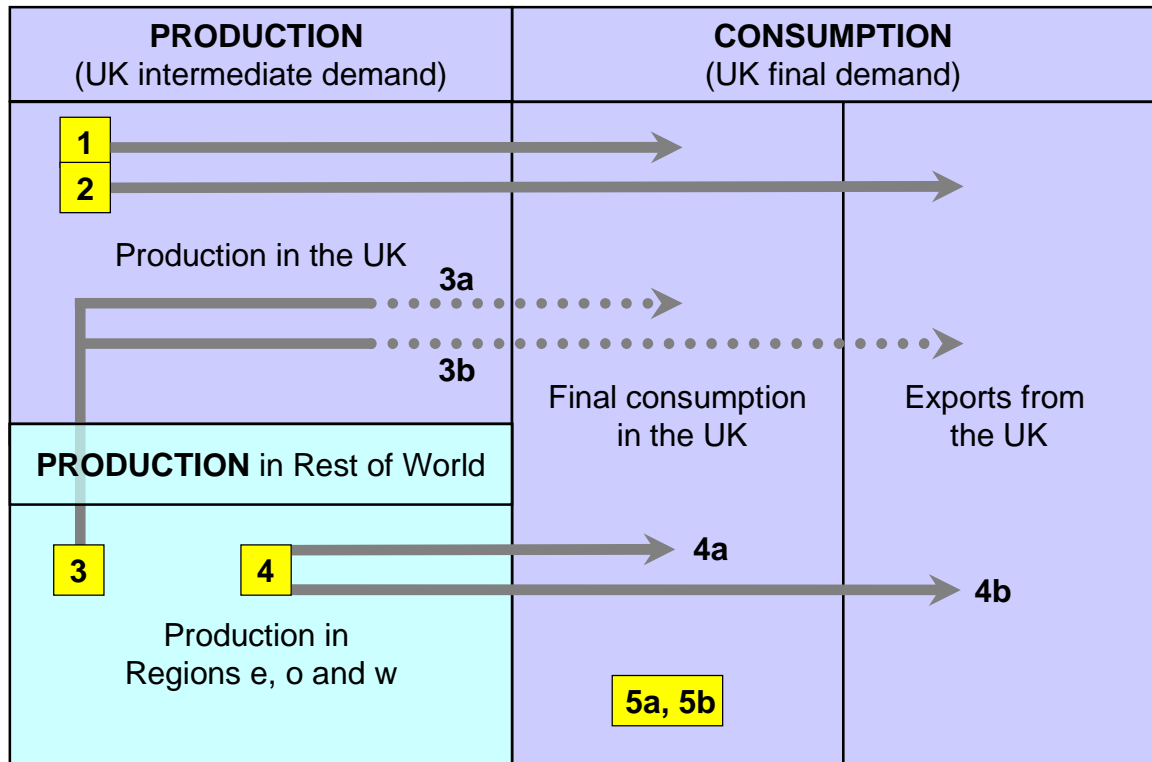
Black circles in these figures are the output of the first stage calculations – the standard deviations of the UK input-output table entries **a**. As expected, these values group around the regressed standard deviations. This is because the constraints are sums of input-output table elements, linked via the constraints matrix **G**, as in  $\mathbf{G} \mathbf{a} = \mathbf{c}$ . Therefore, the standard deviations of the constraints are square-rooted sums of squares of standard deviations of the table elements. In a typical sum, some standard deviations of input-output table elements are smaller than those of the constraints, some are larger. This is what we see in the diagrams for 1992 and 2004.

Grey circles are generated from standard deviations (RSEs) of the constraints **c**, calculated via the regression formula. It is these errors that the errors of the input-output table elements have to conform to, via the error propagation formula (square root formula).

Generally speaking, these estimates are very conservative, see the methodology section above. This means that they cover the full range of possible uncertainty, thereby overestimating total uncertainty rather than underestimating it.

## Results for embedded emissions

Before the uncertainty results are presented, we repeat the nomenclature used in the 'Embedded Emissions Report' (Wiedmann et al. 2008), for reference. **Error! Reference source not found.** and the text below explain the various 'streams' of (embedded) emissions caused by UK production and consumption.



Arrows should be read as “Emissions generated by [beginning of arrow] attributed to [end of arrow]”

**Producer Emissions** (production-based indicator):  $1 + 2 + 5a + 5b$

**Consumer Emissions** (consumption-based indicator):  $1 + 3a + 4a + 5a + 5b$

**Figure 8: Depiction of emissions occurring through UK economic activity, including trade, and different principles of emissions accounting** (Region e = OECD Europe, Region o = OECD non-Europe, Region w = non-OECD countries)

Legend to Figure 8

- 1 UK production emissions, including international aviation and shipping provided by UK operators, attributable to UK final consumption,
- 2 UK production emissions attributable to exports
- 3a Imported emissions through intermediate consumption of UK industry attributable to UK final consumption

- 3b** Imported emissions through intermediate consumption of UK industry attributable to UK exports
- 4a** Imported emissions direct to final demand attributable to UK final consumption
- 4b** Imported emissions direct to final demand attributable to UK exports
- 5a** UK emissions generated by households not from private motoring (e.g. housing)
- 5b** UK emissions generated by households from private motoring

Producer Emissions (PE): A production-based indicator (emissions accounting based on the producer principle) adds together all emissions that are generated by UK resident units, including international aviation and shipping emissions from UK registered operators, i.e. **1 + 2 + 5a + 5b** (blue shaded areas in Figure 1).

Consumer Emissions (CE): A consumption-based indicator (emissions accounting based on the consumption principle) adds together emissions that are required to satisfy final consumption in the UK (as shown in Figure 1), i.e. **1 + 3a + 4a + 5a + 5b**.

UNFCCC national total: This is calculated as the emissions occurring within the territory of the UK, including aviation and shipping between UK destinations. The UNFCCC national total is reconcilable with PE by means of the bridging data shown in Table 1.

Emissions Embedded<sup>10</sup> in Imports (EEI) are those emissions that occur outside the UK territory (green shaded areas) but are caused by UK economic activity (incl. production, consumption and exports): **3a + 3b + 4a + 4b**.

Emissions Embedded in Exports (EEE) are caused by exports from the UK (final demand from the rest of the world) and occur mostly on UK territory (**2**) but some of these emissions occur outside of the UK (**3b + 4b**) when imports are re-exported: **2 + 3b + 4b**.

Balance of Emissions Embedded in Trade (BEET): A balance of trade is defined as (value of) exports minus (value of) imports, i.e. if a country exports more than it imports it has a trade surplus, if it imports more than it exports it has a trade deficit. This principle can be adopted for emissions embedded in trade and the BEET becomes: **2 – 3a – 4a**.

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<sup>10</sup> In the literature the term 'embodied' emissions seems to be more widespread. We treat 'embedded' and 'embodied' as synonyms.



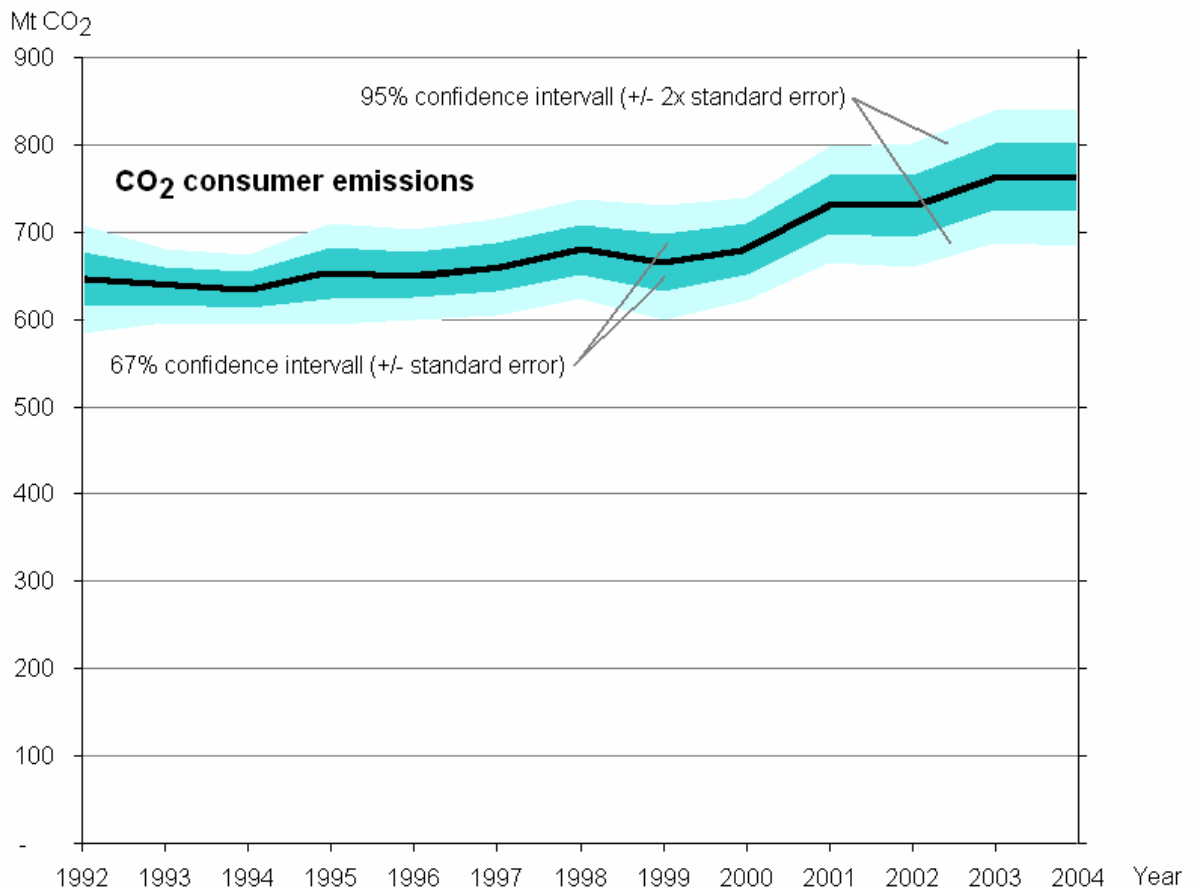
The method of allocation for CE and PE is driven by consumption, as all emissions are ultimately allocated to final demand (all arrows in the figure end in the UK final demand box). The UNFCCC national total is driven by territorial definition.

The following graphs and tables present the uncertainty results for total embedded emissions. Detailed results broken down by economic sector can be found in Appendix A (Section 7). For details of the original results (without error margins) we refer to the original report.

The relative standard error (RSE) for total CO<sub>2</sub> consumer emissions lies within 3.3% for 1994 and 5.5% for 2004 (see Table 1). The uncertainty range of +/- RSE covers 67% of all observed data from the Monte-Carlo analysis. 95% of all variation lies within a +/- 2RSE band (see Figure 9).

**Table 1: Total CO<sub>2</sub> consumer emissions and their uncertainty ranges**  
(results from the UK-MRIO 1 model; numbers in Mt of CO<sub>2</sub>)

Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
<b>Consumer Emissions (CE) (1+3a+4a+5a+5b)</b>	<b>647</b>	<b>639</b>	<b>634</b>	<b>653</b>	<b>651</b>	<b>661</b>	<b>680</b>	<b>665</b>	<b>681</b>	<b>732</b>	<b>730</b>	<b>763</b>	<b>762</b>
<b>Relative standard error</b>	<b>4.2%</b>	<b>3.4%</b>	<b>3.3%</b>	<b>4.4%</b>	<b>4.0%</b>	<b>4.3%</b>	<b>4.3%</b>	<b>5.0%</b>	<b>4.5%</b>	<b>4.9%</b>	<b>5.2%</b>	<b>5.4%</b>	<b>5.5%</b>
Lower uncertainty (- standard error)	620	617	613	624	625	632	651	632	650	696	692	722	720
Upper uncertainty (+standard error)	674	661	655	681	677	689	710	698	711	768	768	805	804



**Figure 9: UK CO<sub>2</sub> emissions from a consumer perspective ("consumer emissions") between 1992 and 2004. Uncertainty ranges are presented as bands of +/- RSE and +/- 2RSE.**

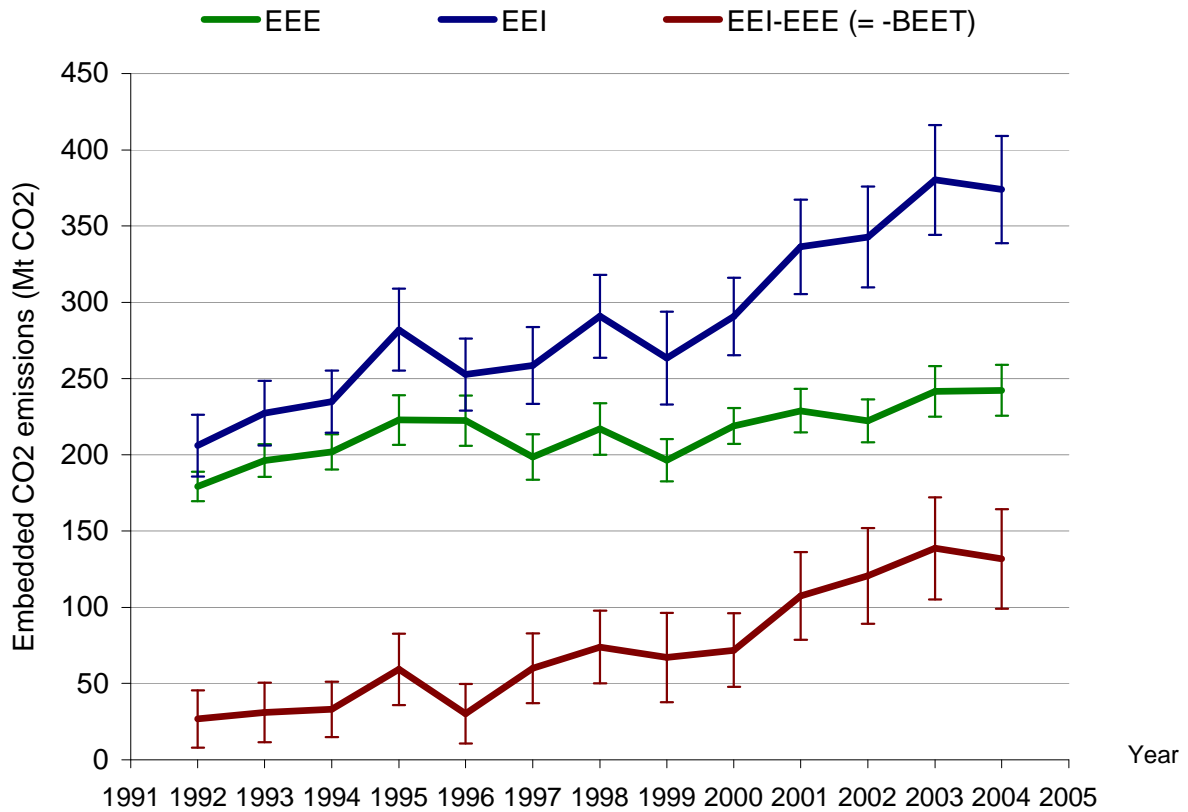
Statistically, there is a significant increase in consumer emissions; in the last four years CE were significantly higher than in the first five years of the time series.

Over the time period 1994 to 2004 there is a tendency towards larger error margins. It is likely that this increase is connected to the distance from the Analytical (IO) Table for 1995. The ATs 1995 were the only available information on the true structure of imports to the UK. The import matrices for all other years were derived through CRAS balancing to match actual year totals (Wiedmann et al. 2008). It is logical to assume that uncertainties rise when these totals are increasingly different from the 1995 base year, although this has not been proven analytically in this study. Other tendencies are overlapping, e.g. an increasing distance from the two base years for GTAP data, 1997 and 2001, will also increase error margins.

Table 2 and Figure 10 below show detailed results for CO<sub>2</sub> emissions embedded in UK trade. The relative standard error for these results is larger than for total consumer emissions because additional uncertainties for IO and CO<sub>2</sub> data for the three world regions come into play. Generally, the higher aggregated the results, the smaller is the relative error because the standard errors of parts of emissions are added together via the "square root of square sums" formula (see Eq.10). However, if a subtraction is involved in the calculation, as is the case for BEET (= 2-3a-4a), relative standard errors can become very large and even indefinite if the subtraction results in zero.

**Table 2: CO<sub>2</sub> emissions embedded in UK trade and their uncertainties.**  
(results from the UK-MRIO 1 model; numbers in Mt of CO<sub>2</sub>)

Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
EEl (3a+3b+4a+4b)	206	227	235	282	253	259	291	263	291	336	343	380	374
Absolute standard error of EEl	20.2	21.3	20.3	26.9	23.5	25.1	27.3	30.4	25.4	30.9	33.1	36.0	35.1
Relative standard error of EEl	9.8%	9.3%	8.6%	9.5%	9.3%	9.7%	9.4%	11.5%	8.7%	9.2%	9.7%	9.5%	9.4%
EEE (2+3b+4b)	179	196	202	223	222	199	217	196	219	229	222	242	242
Absolute standard error of EEE	9.7	10.7	11.5	16.2	16.5	14.8	16.9	13.9	11.7	14.2	14.0	16.6	16.6
Relative standard error of EEE	5.4%	5.5%	5.7%	7.3%	7.4%	7.5%	7.8%	7.1%	5.3%	6.2%	6.3%	6.9%	6.9%
BEET (2-3a-4a)	-27	-31	-33	-59	-30	-60	-74	-67	-72	-107	-121	-139	-132
EEl-EEE (= -BEET)	27	31	33	59	30	60	74	67	72	107	121	139	132
Absolute standard error of BEET	18.8	19.6	18.1	23.3	19.5	22.9	23.8	29.2	24.1	28.9	31.3	33.5	32.7
Relative standard error of BEET	70.2%	63.1%	54.9%	39.3%	64.7%	38.2%	32.3%	43.6%	33.5%	26.9%	26.0%	24.2%	24.8%

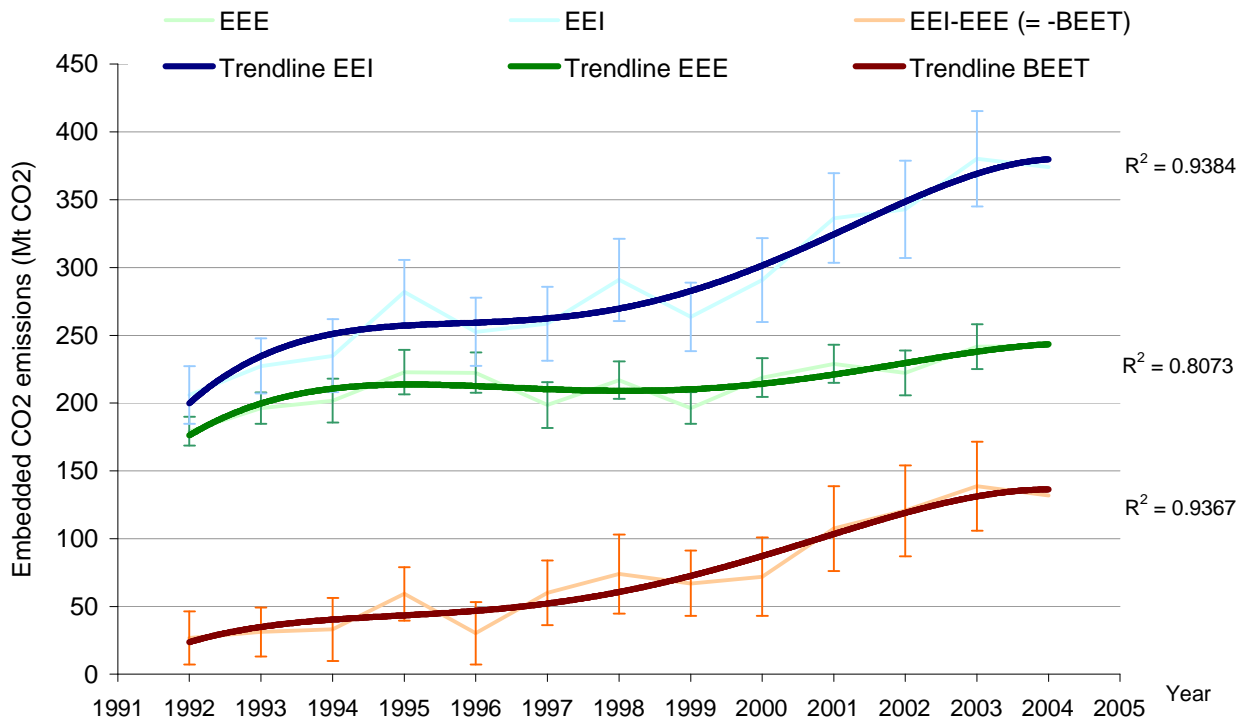


**Figure 10: CO<sub>2</sub> emissions embedded in total UK imports (EEI), total UK exports (EEE) and the difference EEI-EEE (equal to -BEET) from 1992 to 2004. The error bars represent standard errors, covering 67% of data obtained with Monte-Carlo analysis.**

Figure 10 shows that the increase in EEI is statistically significant, at least for the last four years compared to the first three years of the time series.

As discussed above, a small difference of two large numbers is always associated with a high relative error. If emissions embedded in trade were almost balanced, the error could become larger than BEET itself, and it would not be possible to conclude whether there was a net import or export. However, the results of the uncertainty analysis in this study show with statistical significance that EEI were higher than EEE in all years from 1992 to 2004 and that EEI were growing faster than EEE thus widening the gap between territorial (producer) emissions and consumer emissions.

As each data point in Figure 10 has a specified uncertainty it is reasonable to depict the general trend over time by a smoothed line that still lies within the standard error ranges but flattens the ups and downs from one year to another. Polynomial trendlines of fourth order seem to best represent the general trend; they are shown in the following figure.



**Figure 11: Polynomial trendlines for CO<sub>2</sub> emissions embedded in UK trade**  
(the polynomial trendlines are of fourth order).

## 5 Discussion and Conclusions

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### Discussion

The presented analysis of uncertainties of UK-MRIO model results tries to capture all possible variations of underlying data and calculation procedures. For the majority of data this takes account of the random uncertainty of data points due to statistical variation and random errors. In other words, we have determined the stochastic variation of the whole model system.

There are also possible systematic error sources:

- 1) structural change of foreign input-output data that cannot be captured systematically due to the lack of time series data;
- 2) sectoral distinction of changes in prices of foreign input-output data over time;

- 3) systematic over- and underestimation of carbon intensities of foreign industries due to the mismatch of sectors in UK and foreign IO and CO<sub>2</sub> data;
- 4) change of import structure over time due to the lack of imports matrices (Analytical Tables) for the UK for years other than 1995; and
- 5) choice of price conversion factors, e.g. 'purchasing power parity' versus 'market exchange rate' or choice of lead countries for CPI.

In principle it is possible to investigate and model these systematic errors methodically. For each data cell in the environmental input-output system one could, in principle, assume a function associated with uncertainty over time. Also, some cell entries are dependent from each other and it is conceivable that this dependency can be defined mathematically. Such detailed modelling of systematic uncertainty, however, was way beyond the scope of the current study and instead we have dealt with the uncertainties arising from systematic changes by allowing a stochastic variation large enough to capture anticipated systematic variation.

As a result, the presented error margins can be seen as conservative estimates which are rather over- than underestimated. In other words, the calculated uncertainties are on the "safe side" and the true values are likely to lie within the presented error bars and confidence intervals.

A final note on the purpose of the UK-MRIO 1 model. For aggregated results (CO<sub>2</sub> consumer emissions), the relative standard error has been shown to be between 3.3% and 5.5%. Therefore, the estimate of total embedded emissions can be regarded as robust and reliable. One should bear in mind though that on an individual sector level these errors are generally higher (see Appendix A on page 30). Relative standard errors can be large, especially when the absolute value for E in a sector is small. Results on a sectoral level should therefore be interpreted with more caution, not least because of the sector aggregation leading to different product mixes in sectors from different countries/regions. At this stage, i.e. with the current resolution and underlying database, the UK-MRIO 1 model is not capable of performing detailed life-cycle analyses of individual products with sufficient accuracy. More work is needed if the model is to be developed with this aim.

## Conclusions

This is the **first study in the world** that has undertaken a comprehensive Monte-Carlo analysis of the uncertainties in a global multi-region input-output model.<sup>11</sup> Uncertainty functions were determined for all input variables to the model, the IO tables uncertainties were estimated from constraint uncertainties and matrix balancing, 5000 Monte-Carlo simulation runs were carried out to determine the multiplier uncertainties and the error propagation for embedded emissions was calculated.

The results of the uncertainty analysis in this study show with statistical significance that CO<sub>2</sub> emissions embedded in UK imports (EEI) were higher than those for exports (EEE) in all years from 1992 to 2004 and that EEI were growing faster than EEE thus widening the gap between territorial (producer) emissions and consumer emissions.

We think that with the available resources, a comprehensive, adequate and robust estimation of uncertainties was undertaken. The results prove that the UK-MRIO model is robust enough to provide a reliable indication of CO<sub>2</sub> emissions embedded in UK economic activity, including trade from and to the UK.

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<sup>11</sup> Weber and Matthews (2007) vary their MRIO calculations by using different input parameters for two of the major uncertainties in their model, the ROW approximation and the MER/PPP issue, and present "feasible ranges for EEE and EEI" (page 4876); but they do not carry out a Monte-Carlo analysis.



## 6 Acknowledgements

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A special thanks goes to Dr Glen Peters from NTNU Trondheim for his explanation of GTAP data compilation and uncertainties and also to Dr Christopher Weber from Carnegie Mellon University.

## 7 Appendix A: Detailed Uncertainty Results for Embedded Emissions

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The following tables show CO<sub>2</sub> consumer emissions and associated uncertainty broken down by 123 economic sectors. Relative standard errors can be large, especially when the absolute value for E is small. The higher the results are aggregated the smaller the error becomes.

Uncertainty of embedded CO2 emissions by sector; year 1992	CO2 CONSUMER	Standard error of	Relative error of CO2
	emissions	CO2 CONSUMER	CONSUMER
	E (Mt CO2)	emissions dE (Mt CO2)	emissions dE/E
1 Agriculture, hunting and related service activities	8.807	1.246	14%
2 Forestry, logging and related service activities	0.054	0.365	674%
3 Fishing, operation of fish hatcheries and fish farms; service activities	0.112	0.113	101%
4 Mining of coal and lignite; extraction of peat	0.694	0.888	128%
5 Extraction of crude petroleum and natural gas; service activities	3.395	1.004	30%
6 Mining of metal ores	0.092	0.288	314%
7 Other mining and quarrying	1.071	1.072	100%
8 Production, processing and preserving of meat and meat products	6.931	1.179	17%
9 Processing and preserving of fish and fish products; fruit and vegetables	4.392	0.930	21%
10 Vegetable and animal oils and fats	0.654	0.204	31%
11 Dairy products	4.596	0.973	21%
12 Grain mill products, starches and starch products	0.893	0.201	22%
13 Prepared animal feeds	0.699	0.159	23%
14 Bread, rusks and biscuits; manufacture of pastry goods and cakes	3.333	0.623	19%
15 Sugar	0.197	0.116	59%
16 Cocoa; chocolate and sugar confectionery	1.965	0.568	29%
17 Other food products	2.652	0.822	31%
18 Alcoholic beverages	1.479	6.041	408%
19 Production of mineral waters and soft drinks	1.714	0.678	40%
20 Tobacco products	0.753	0.269	36%
21 Preparation and spinning of textile fibres	0.175	1.259	718%
22 Textile weaving	0.392	0.357	91%
23 Finishing of textiles	0.017	0.013	75%
24 Made-up textile articles, except apparel	1.196	0.336	28%
25 Carpets and rugs	0.731	0.216	30%
26 Other textiles	0.181	0.130	72%
27 Knitted and crocheted fabrics and articles	2.083	1.059	51%
28 Wearing apparel; dressing and dyeing of fur	6.840	4.469	65%
29 Tanning and dressing of leather; manufacture of luggage, vanity cases, vanity bags, purses and wallets	0.242	0.103	42%
30 Footwear	1.286	0.776	60%
31 Wood and wood products, except furniture	1.258	0.572	45%
32 Pulp, paper and paperboard	1.772	1.809	102%
33 Articles of paper and paperboard	1.320	0.377	29%
34 Publishing, printing and reproduction of recorded media	2.805	0.580	21%
35 Coke, refined petroleum products and nuclear fuel	15.331	4.109	27%
36 Industrial gases, dyes and pigments	0.252	0.164	65%
37 Other inorganic basic chemicals	0.166	0.758	458%
38 Other organic basic chemicals	0.256	1.098	428%
39 Fertilisers and nitrogen compounds	0.176	0.132	75%
40 Plastics and synthetic rubber in primary forms	1.106	3.368	304%
41 Pesticides and other agro-chemical products	0.144	0.085	59%
42 Paints, varnishes and similar coatings, printing ink and mastics	0.355	0.131	37%
43 Pharmaceuticals, medicinal chemicals and botanical products	1.489	0.745	50%
44 Soap and detergents, cleaning and polishing preparations	2.256	0.750	33%
45 Other chemical products	1.413	0.861	61%
46 Man-made fibres	0.291	0.585	201%
47 Rubber products	1.125	0.391	35%
48 Plastic products	2.524	0.741	29%
49 Glass and glass products	1.012	0.623	62%
50 Ceramic goods	0.985	0.374	38%
51 Bricks, tiles and construction products, baked in clay	0.176	0.188	106%
52 Cement, lime and plaster	0.563	0.096	17%
53 Articles of concrete, plaster and cement; cutting, shaping and finishing of stone	0.649	0.284	44%
54 Basic iron and steel and of ferro-alloys; manufacture of tubes and pipes	4.612	3.710	80%
55 Basic precious and non-ferrous metals	1.781	1.308	73%
56 Casting of metals	0.002	0.003	148%
57 Structural metal products	2.993	0.717	24%
58 Tanks, reservoirs and containers of metal; manufacture of metal structures	0.786	0.179	23%
59 Forging, pressing, stamping and roll forming of metal; powder metallurgy	0.514	0.165	32%
60 Cutlery, tools and general hardware	1.106	0.333	30%
61 Other fabricated metal products	1.466	0.430	29%
62 Machinery for the production and use of mechanical power	1.246	0.500	40%
63 Other general purpose machinery	3.234	0.879	27%

Uncertainty of embedded CO2 emissions by sector; year 1992	CO2 CONSUMER	Standard error of	Relative error of CO2
	emissions	CO2 CONSUMER	CONSUMER
	E (Mt CO2)	emissions dE (Mt CO2)	emissions dE/E
64 Agricultural and forestry machinery	0.928	0.239	26%
65 Machine tools	0.789	0.720	91%
66 Other special purpose machinery	1.343	2.034	151%
67 Weapons and ammunition	0.055	0.053	96%
68 Domestic appliances not elsewhere classified	1.753	0.518	30%
69 Office machinery and computers	4.857	3.041	63%
70 Electric motors, generators and transformers; manufacture	1.304	0.718	55%
71 Insulated wire and cable	0.220	0.083	38%
72 Electrical equipment not elsewhere classified	1.047	0.669	64%
73 Electronic valves and tubes and other electronic compone	0.236	0.213	90%
74 Television and radio transmitters and line for telephony an	1.555	0.598	38%
75 Television and radio receivers, sound or video recording o	1.559	0.818	53%
76 Medical, precision and optical instruments, watches and cl	2.591	1.143	44%
77 Motor vehicles, trailers and semi-trailers	14.120	4.343	31%
78 Building and repairing of ships and boats	0.702	0.486	69%
79 Other transport equipment	1.463	0.349	24%
80 Aircraft and spacecraft	0.764	1.147	150%
81 Furniture	6.477	3.382	52%
82 Jewellery and related articles; manufacture of musical inst	5.835	3.368	58%
83 Sports goods, games and toys	8.524	4.982	58%
84 Miscellaneous manufacturing not elsewhere classified; rec	2.923	2.157	74%
85 Production and distribution of electricity	88.660	4.129	5%
86 Gas; distribution of gaseous fuels through mains; steam ai	6.819	2.661	39%
87 Collection, purification and distribution of water	1.023	0.063	6%
88 Construction	38.932	4.123	11%
89 Sale, maintenance and repair of motor vehicles, and moto	7.073	1.240	18%
90 Wholesale trade and commission trade, except of motor vi	15.020	6.181	41%
91 Retail trade, except of motor vehicles and motor cycles; re	12.166	7.458	61%
92 Hotels and restaurants	27.397	5.619	21%
93 Transport via railways	3.064	8.423	275%
94 Other land transport; transport via pipelines	9.023	0.970	11%
95 Water transport	6.023	1.989	33%
96 Air Transport	19.289	7.868	41%
97 Supporting and auxiliary transport activities; activities of tr	1.270	1.010	79%
98 Post and courier activities	0.294	0.081	27%
99 Telecommunications	2.324	0.576	25%
100 Financial intermediation, except insurance and pension fu	1.052	0.162	15%
101 Insurance and pension funding, except compulsory social	7.873	1.012	13%
102 Activities auxiliary to financial intermediation	0.310	0.241	78%
103 Real estate activities with own property; letting of own prop	0.047	0.038	80%
104 Letting of dwellings, including imputed rent	7.511	1.118	15%
105 Real estate activities on a fee or contract basis	0.190	0.021	11%
106 Renting of machinery and equipment without operator and	4.667	0.334	7%
107 Computer and related activities	1.921	0.319	17%
108 Research and development	0.106	0.042	40%
109 Legal activities	0.306	0.034	11%
110 Accounting, book-keeping and auditing activities; tax cons	0.014	0.007	47%
111 Market research and public opinion polling; business and i	0.210	0.032	15%
112 Architectural and engineering activities and related technic	0.881	0.205	23%
113 Advertising	0.058	0.037	64%
114 Other business services	1.132	23.692	2093%
115 Public administration and defence; compulsory social secu	35.232	5.155	15%
116 Education	17.178	1.088	6%
117 Human health and veterinary activities	20.480	3.093	15%
118 Social work activities	7.146	0.792	11%
119 Sewage and refuse disposal, sanitation and similar activiti	4.216	0.151	4%
120 Activities of membership organisations not elsewhere clas	1.336	0.126	9%
121 Recreational, cultural and sporting activities	8.063	0.959	12%
122 Other service activities	2.702	0.632	23%
123 Private households with employed persons	0.206	0.005	3%
	86.41		
	59.23		
<b>Total CO2 consumer emissions</b>	<b>647</b>	<b>+/- 27</b>	<b>+/- 4.2%</b>

Uncertainty of embedded CO2 emissions by sector; year 1993	CO2 CONSUMER	Standard error of	Relative error of CO2
	emissions	CO2 CONSUMER	CONSUMER
	E (Mt CO2)	emissions dE (Mt CO2)	emissions dE/E
1 Agriculture, hunting and related service activities	7.173	0.853	12%
2 Forestry, logging and related service activities	0.064	0.280	440%
3 Fishing, operation of fish hatcheries and fish farms; service activities	0.090	0.068	75%
4 Mining of coal and lignite; extraction of peat	0.379	0.576	152%
5 Extraction of crude petroleum and natural gas; service activities	2.513	0.882	35%
6 Mining of metal ores	0.002	0.002	76%
7 Other mining and quarrying	0.004	0.016	385%
8 Production, processing and preserving of meat and meat products	6.436	1.179	18%
9 Processing and preserving of fish and fish products; fruit and vegetables	4.054	0.918	23%
10 Vegetable and animal oils and fats	0.402	0.133	33%
11 Dairy products	4.273	1.030	24%
12 Grain mill products, starches and starch products	0.695	0.166	24%
13 Prepared animal feeds	0.591	0.150	25%
14 Bread, rusks and biscuits; manufacture of pastry goods and cakes	3.003	0.619	21%
15 Sugar	0.142	0.111	78%
16 Cocoa; chocolate and sugar confectionery	1.806	0.533	30%
17 Other food products	2.364	0.708	30%
18 Alcoholic beverages	1.225	6.026	492%
19 Production of mineral waters and soft drinks	1.381	0.508	37%
20 Tobacco products	0.856	0.295	34%
21 Preparation and spinning of textile fibres	0.037	0.159	428%
22 Textile weaving	0.049	0.020	41%
23 Finishing of textiles	0.009	0.015	167%
24 Made-up textile articles, except apparel	1.047	0.292	28%
25 Carpets and rugs	0.740	0.202	27%
26 Other textiles	0.060	0.023	37%
27 Knitted and crocheted fabrics and articles	2.261	1.123	50%
28 Wearing apparel; dressing and dyeing of fur	7.112	4.636	65%
29 Tanning and dressing of leather; manufacture of luggage, vanity cases, vanity bags, purses and wallets	0.191	0.097	51%
30 Footwear	1.311	0.815	62%
31 Wood and wood products, except furniture	0.877	0.207	24%
32 Pulp, paper and paperboard	0.116	0.095	82%
33 Articles of paper and paperboard	0.903	0.199	22%
34 Publishing, printing and reproduction of recorded media	2.794	0.608	22%
35 Coke, refined petroleum products and nuclear fuel	13.174	3.986	30%
36 Industrial gases, dyes and pigments	0.040	0.015	36%
37 Other inorganic basic chemicals	0.000	0.013	3644%
38 Other organic basic chemicals	0.347	1.332	384%
39 Fertilisers and nitrogen compounds	0.268	0.057	21%
40 Plastics and synthetic rubber in primary forms	0.045	0.136	299%
41 Pesticides and other agro-chemical products	0.029	0.019	65%
42 Paints, varnishes and similar coatings, printing ink and mastics	0.198	0.080	40%
43 Pharmaceuticals, medicinal chemicals and botanical products	0.996	0.260	26%
44 Soap and detergents, cleaning and polishing preparations	2.383	0.757	32%
45 Other chemical products	0.674	0.381	56%
46 Man-made fibres	0.006	0.014	239%
47 Rubber products	0.862	0.209	24%
48 Plastic products	1.559	0.283	18%
49 Glass and glass products	0.403	0.152	38%
50 Ceramic goods	0.826	0.349	42%
51 Bricks, tiles and construction products, baked in clay	0.138	0.139	101%
52 Cement, lime and plaster	0.502	0.043	9%
53 Articles of concrete, plaster and cement; cutting, shaping and finishing of stone	0.342	0.039	11%
54 Basic iron and steel and of ferro-alloys; manufacture of tubes and pipes	1.110	0.127	11%
55 Basic precious and non-ferrous metals	0.194	0.170	87%
56 Casting of metals	0.016	0.006	37%
57 Structural metal products	2.628	0.709	27%
58 Tanks, reservoirs and containers of metal; manufacture of metal structures	0.557	0.142	26%
59 Forging, pressing, stamping and roll forming of metal; powder metallurgy	0.299	0.105	35%
60 Cutlery, tools and general hardware	0.844	0.236	28%
61 Other fabricated metal products	1.056	0.258	24%
62 Machinery for the production and use of mechanical power	0.706	0.230	33%
63 Other general purpose machinery	3.000	0.908	30%

Uncertainty of embedded CO2 emissions by sector; year 1993	CO2 CONSUMER	Standard error of	Relative error of CO2
	emissions	CO2 CONSUMER	CONSUMER
	E (Mt CO2)	emissions dE (Mt CO2)	emissions dE/E
64 Agricultural and forestry machinery	0.840	0.268	32%
65 Machine tools	0.804	0.639	79%
66 Other special purpose machinery	1.373	2.149	156%
67 Weapons and ammunition	0.001	0.051	5597%
68 Domestic appliances not elsewhere classified	1.680	0.496	30%
69 Office machinery and computers	4.473	3.484	78%
70 Electric motors, generators and transformers; manufacture	1.146	0.718	63%
71 Insulated wire and cable	0.426	0.148	35%
72 Electrical equipment not elsewhere classified	0.751	0.425	57%
73 Electronic valves and tubes and other electronic compone	0.095	0.021	22%
74 Television and radio transmitters and line for telephony an	1.411	0.728	52%
75 Television and radio receivers, sound or video recording o	1.493	0.752	50%
76 Medical, precision and optical instruments, watches and cl	2.451	1.126	46%
77 Motor vehicles, trailers and semi-trailers	11.221	3.217	29%
78 Building and repairing of ships and boats	0.727	0.326	45%
79 Other transport equipment	1.042	0.378	36%
80 Aircraft and spacecraft	1.296	1.406	108%
81 Furniture	6.496	4.636	71%
82 Jewellery and related articles; manufacture of musical inst	6.704	3.924	59%
83 Sports goods, games and toys	8.993	5.203	58%
84 Miscellaneous manufacturing not elsewhere classified; rec	3.019	2.421	80%
85 Production and distribution of electricity	77.200	2.516	3%
86 Gas; distribution of gaseous fuels through mains; steam ai	6.912	2.639	38%
87 Collection, purification and distribution of water	0.936	0.049	5%
88 Construction	37.458	4.453	12%
89 Sale, maintenance and repair of motor vehicles, and moto	7.374	1.475	20%
90 Wholesale trade and commission trade, except of motor vi	15.846	5.337	34%
91 Retail trade, except of motor vehicles and motor cycles; re	12.797	6.861	54%
92 Hotels and restaurants	28.097	6.132	22%
93 Transport via railways	2.952	4.463	151%
94 Other land transport; transport via pipelines	9.303	0.845	9%
95 Water transport	5.867	1.958	33%
96 Air Transport	20.065	7.830	39%
97 Supporting and auxiliary transport activities; activities of tr	0.535	0.213	40%
98 Post and courier activities	0.309	0.047	15%
99 Telecommunications	2.390	0.681	29%
100 Financial intermediation, except insurance and pension fu	1.155	0.196	17%
101 Insurance and pension funding, except compulsory social	6.942	1.029	15%
102 Activities auxiliary to financial intermediation	0.259	0.061	23%
103 Real estate activities with own property; letting of own prop	0.008	0.001	13%
104 Letting of dwellings, including imputed rent	7.868	1.402	18%
105 Real estate activities on a fee or contract basis	0.207	0.021	10%
106 Renting of machinery and equipment without operator and	4.496	0.368	8%
107 Computer and related activities	1.920	0.375	20%
108 Research and development	0.067	0.012	18%
109 Legal activities	0.292	0.017	6%
110 Accounting, book-keeping and auditing activities; tax cons	0.008	0.001	10%
111 Market research and public opinion polling; business and i	0.140	0.021	15%
112 Architectural and engineering activities and related technic	0.800	0.142	18%
113 Advertising	0.019	0.004	21%
114 Other business services	0.724	0.062	9%
115 Public administration and defence; compulsory social secu	34.837	5.185	15%
116 Education	15.501	1.026	7%
117 Human health and veterinary activities	19.103	3.393	18%
118 Social work activities	6.580	0.813	12%
119 Sewage and refuse disposal, sanitation and similar activiti	4.090	0.189	5%
120 Activities of membership organisations not elsewhere clas	1.130	0.121	11%
121 Recreational, cultural and sporting activities	8.338	1.067	13%
122 Other service activities	2.726	0.688	25%
123 Private households with employed persons	0.208	0.006	3%
	90.34		
	59.44		
<b>Total CO2 consumer emissions</b>	<b>639</b>	<b>+/- 22</b>	<b>+/- 3.4%</b>

Uncertainty of embedded CO2 emissions by sector; year 1994	CO2 CONSUMER	Standard error of	Relative error of CO2
	emissions	CO2 CONSUMER	CONSUMER
	E (Mt CO2)	emissions dE (Mt CO2)	emissions dE/E
1 Agriculture, hunting and related service activities	7.114	0.844	12%
2 Forestry, logging and related service activities	0.071	0.277	392%
3 Fishing, operation of fish hatcheries and fish farms; service activities	0.077	0.044	57%
4 Mining of coal and lignite; extraction of peat	0.065	0.662	1016%
5 Extraction of crude petroleum and natural gas; service activities	1.685	0.581	34%
6 Mining of metal ores	0.005	0.008	143%
7 Other mining and quarrying	0.013	0.014	106%
8 Production, processing and preserving of meat and meat products	6.023	1.170	19%
9 Processing and preserving of fish and fish products; fruit and vegetables	4.073	0.918	23%
10 Vegetable and animal oils and fats	0.411	0.132	32%
11 Dairy products	3.968	1.020	26%
12 Grain mill products, starches and starch products	0.676	0.153	23%
13 Prepared animal feeds	0.675	0.195	29%
14 Bread, rusks and biscuits; manufacture of pastry goods and cakes	2.931	0.627	21%
15 Sugar	0.103	0.108	105%
16 Cocoa; chocolate and sugar confectionery	1.886	0.527	28%
17 Other food products	2.333	0.695	30%
18 Alcoholic beverages	1.416	6.946	491%
19 Production of mineral waters and soft drinks	1.398	0.508	36%
20 Tobacco products	0.881	0.316	36%
21 Preparation and spinning of textile fibres	0.051	0.068	132%
22 Textile weaving	0.070	0.019	27%
23 Finishing of textiles	0.022	0.017	76%
24 Made-up textile articles, except apparel	1.087	0.326	30%
25 Carpets and rugs	0.725	0.214	29%
26 Other textiles	0.081	0.026	32%
27 Knitted and crocheted fabrics and articles	2.276	1.174	52%
28 Wearing apparel; dressing and dyeing of fur	7.473	4.935	66%
29 Tanning and dressing of leather; manufacture of luggage, vanity cases, vanity bags, purses and wallets	0.152	0.123	81%
30 Footwear	1.501	0.920	61%
31 Wood and wood products, except furniture	0.991	0.203	20%
32 Pulp, paper and paperboard	0.039	0.040	103%
33 Articles of paper and paperboard	0.829	0.417	50%
34 Publishing, printing and reproduction of recorded media	3.150	0.695	22%
35 Coke, refined petroleum products and nuclear fuel	13.764	3.929	29%
36 Industrial gases, dyes and pigments	0.067	0.012	19%
37 Other inorganic basic chemicals	0.011	0.006	53%
38 Other organic basic chemicals	0.280	1.363	487%
39 Fertilisers and nitrogen compounds	0.313	0.069	22%
40 Plastics and synthetic rubber in primary forms	0.007	0.225	3098%
41 Pesticides and other agro-chemical products	0.035	0.019	53%
42 Paints, varnishes and similar coatings, printing ink and mastics	0.237	0.078	33%
43 Pharmaceuticals, medicinal chemicals and botanical products	0.735	0.269	37%
44 Soap and detergents, cleaning and polishing preparations	2.607	0.741	28%
45 Other chemical products	0.741	0.371	50%
46 Man-made fibres	0.025	0.018	74%
47 Rubber products	0.921	0.228	25%
48 Plastic products	1.575	0.273	17%
49 Glass and glass products	0.459	0.149	33%
50 Ceramic goods	0.995	0.435	44%
51 Bricks, tiles and construction products, baked in clay	0.137	0.179	131%
52 Cement, lime and plaster	0.560	0.041	7%
53 Articles of concrete, plaster and cement; cutting, shaping and finishing of stone	0.393	0.036	9%
54 Basic iron and steel and of ferro-alloys; manufacture of tubes and pipes	0.652	0.085	13%
55 Basic precious and non-ferrous metals	0.048	0.159	334%
56 Casting of metals	0.022	0.006	27%
57 Structural metal products	2.317	0.607	26%
58 Tanks, reservoirs and containers of metal; manufacture of metal structures	0.570	0.129	23%
59 Forging, pressing, stamping and roll forming of metal; powder metallurgy	0.212	0.059	28%
60 Cutlery, tools and general hardware	0.895	0.236	26%
61 Other fabricated metal products	0.968	0.231	24%
62 Machinery for the production and use of mechanical power	0.695	0.223	32%
63 Other general purpose machinery	3.151	0.867	28%

Uncertainty of embedded CO2 emissions by sector; year 1994	CO2 CONSUMER	Standard error of	Relative error of CO2
	emissions E (Mt CO2)	CO2 CONSUMER emissions dE (Mt CO2)	CONSUMER emissions dE/E
64 Agricultural and forestry machinery	0.827	0.250	30%
65 Machine tools	0.773	0.328	42%
66 Other special purpose machinery	1.493	2.232	149%
67 Weapons and ammunition	0.117	0.060	52%
68 Domestic appliances not elsewhere classified	1.717	0.501	29%
69 Office machinery and computers	4.360	2.436	56%
70 Electric motors, generators and transformers; manufacture	1.173	0.459	39%
71 Insulated wire and cable	0.367	0.121	33%
72 Electrical equipment not elsewhere classified	0.656	0.447	68%
73 Electronic valves and tubes and other electronic compone	0.092	0.022	24%
74 Television and radio transmitters and line for telephony an	1.667	0.932	56%
75 Television and radio receivers, sound or video recording o	1.703	0.802	47%
76 Medical, precision and optical instruments, watches and cl	2.489	1.357	55%
77 Motor vehicles, trailers and semi-trailers	12.185	3.405	28%
78 Building and repairing of ships and boats	1.700	0.607	36%
79 Other transport equipment	1.125	0.392	35%
80 Aircraft and spacecraft	2.098	1.568	75%
81 Furniture	7.018	1.847	26%
82 Jewellery and related articles; manufacture of musical inst	7.714	4.549	59%
83 Sports goods, games and toys	7.281	3.867	53%
84 Miscellaneous manufacturing not elsewhere classified; rec	2.991	1.682	56%
85 Production and distribution of electricity	73.041	2.241	3%
86 Gas; distribution of gaseous fuels through mains; steam ai	6.795	1.964	29%
87 Collection, purification and distribution of water	0.899	0.055	6%
88 Construction	39.713	4.689	12%
89 Sale, maintenance and repair of motor vehicles, and moto	7.318	1.655	23%
90 Wholesale trade and commission trade, except of motor vi	15.248	4.866	32%
91 Retail trade, except of motor vehicles and motor cycles; re	14.034	5.504	39%
92 Hotels and restaurants	28.058	6.321	23%
93 Transport via railways	3.068	2.320	76%
94 Other land transport; transport via pipelines	9.439	0.909	10%
95 Water transport	5.784	1.979	34%
96 Air Transport	21.147	8.490	40%
97 Supporting and auxiliary transport activities; activities of tr	0.538	0.164	30%
98 Post and courier activities	0.339	0.055	16%
99 Telecommunications	2.399	0.733	31%
100 Financial intermediation, except insurance and pension fu	1.080	0.204	19%
101 Insurance and pension funding, except compulsory social	6.512	1.032	16%
102 Activities auxiliary to financial intermediation	0.303	0.077	25%
103 Real estate activities with own property; letting of own prop	0.007	0.001	15%
104 Letting of dwellings, including imputed rent	8.012	1.503	19%
105 Real estate activities on a fee or contract basis	0.216	0.024	11%
106 Renting of machinery and equipment without operator and	4.206	0.361	9%
107 Computer and related activities	2.338	0.527	23%
108 Research and development	0.068	0.013	19%
109 Legal activities	0.293	0.018	6%
110 Accounting, book-keeping and auditing activities; tax cons	0.007	0.001	10%
111 Market research and public opinion polling; business and i	0.095	0.016	17%
112 Architectural and engineering activities and related technic	0.867	0.164	19%
113 Advertising	0.017	0.004	23%
114 Other business services	0.641	0.061	9%
115 Public administration and defence; compulsory social secu	35.041	5.285	15%
116 Education	14.311	0.988	7%
117 Human health and veterinary activities	19.241	3.744	19%
118 Social work activities	6.566	0.870	13%
119 Sewage and refuse disposal, sanitation and similar activiti	4.039	0.187	5%
120 Activities of membership organisations not elsewhere clas	1.040	0.120	12%
121 Recreational, cultural and sporting activities	8.017	1.091	14%
122 Other service activities	2.635	0.714	27%
123 Private households with employed persons	0.211	0.006	3%
	86.00		
	58.08		
<b>Total CO2 consumer emissions</b>	<b>634</b>	<b>+/- 21</b>	<b>+/- 3.3%</b>

Uncertainty of embedded CO2 emissions by sector; year 1995	CO2 CONSUMER	Standard error of	Relative error of CO2
	emissions	CO2 CONSUMER	CONSUMER
	E (Mt CO2)	emissions dE (Mt CO2)	emissions dE/E
1 Agriculture, hunting and related service activities	5.482	1.247	23%
2 Forestry, logging and related service activities	0.051	0.053	104%
3 Fishing, operation of fish hatcheries and fish farms; service activities	0.053	0.095	178%
4 Mining of coal and lignite; extraction of peat	0.316	0.722	229%
5 Extraction of crude petroleum and natural gas; service activities	2.894	2.803	97%
6 Mining of metal ores	0.001	0.001	255%
7 Other mining and quarrying	0.018	0.006	31%
8 Production, processing and preserving of meat and meat products	5.551	1.395	25%
9 Processing and preserving of fish and fish products; fruit and vegetables	3.953	1.163	29%
10 Vegetable and animal oils and fats	0.285	0.240	84%
11 Dairy products	3.822	1.261	33%
12 Grain mill products, starches and starch products	0.564	0.296	53%
13 Prepared animal feeds	0.588	0.209	36%
14 Bread, rusks and biscuits; manufacture of pastry goods and cakes	2.716	0.859	32%
15 Sugar	0.101	0.145	143%
16 Cocoa; chocolate and sugar confectionery	1.610	0.538	33%
17 Other food products	2.243	0.825	37%
18 Alcoholic beverages	1.861	6.953	374%
19 Production of mineral waters and soft drinks	1.505	0.566	38%
20 Tobacco products	0.690	0.212	31%
21 Preparation and spinning of textile fibres	0.011	0.116	1019%
22 Textile weaving	0.069	0.075	109%
23 Finishing of textiles	0.019	0.075	389%
24 Made-up textile articles, except apparel	1.096	0.428	39%
25 Carpets and rugs	0.609	0.269	44%
26 Other textiles	0.080	0.062	77%
27 Knitted and crocheted fabrics and articles	2.358	1.332	56%
28 Wearing apparel; dressing and dyeing of fur	7.579	5.360	71%
29 Tanning and dressing of leather; manufacture of luggage, vanity cases, vanity bags, purses and wallets	0.143	0.209	146%
30 Footwear	1.388	0.982	71%
31 Wood and wood products, except furniture	0.426	0.413	97%
32 Pulp, paper and paperboard	0.016	0.057	366%
33 Articles of paper and paperboard	0.561	0.728	130%
34 Publishing, printing and reproduction of recorded media	2.932	0.890	30%
35 Coke, refined petroleum products and nuclear fuel	9.998	4.204	42%
36 Industrial gases, dyes and pigments	0.079	0.143	182%
37 Other inorganic basic chemicals	0.019	0.020	107%
38 Other organic basic chemicals	0.060	0.055	91%
39 Fertilisers and nitrogen compounds	0.054	0.034	62%
40 Plastics and synthetic rubber in primary forms	0.079	0.050	63%
41 Pesticides and other agro-chemical products	0.082	0.027	33%
42 Paints, varnishes and similar coatings, printing ink and mastics	0.210	0.080	38%
43 Pharmaceuticals, medicinal chemicals and botanical products	0.519	0.469	90%
44 Soap and detergents, cleaning and polishing preparations	2.660	0.843	32%
45 Other chemical products	0.911	0.590	65%
46 Man-made fibres	0.024	0.384	1595%
47 Rubber products	0.877	0.627	72%
48 Plastic products	0.914	0.541	59%
49 Glass and glass products	0.366	0.291	80%
50 Ceramic goods	1.199	0.804	67%
51 Bricks, tiles and construction products, baked in clay	0.117	0.499	428%
52 Cement, lime and plaster	0.347	0.163	47%
53 Articles of concrete, plaster and cement; cutting, shaping and surface treatment of stone	0.183	0.126	69%
54 Basic iron and steel and of ferro-alloys; manufacture of tubes and profiles	0.205	0.680	332%
55 Basic precious and non-ferrous metals	0.141	0.331	235%
56 Casting of metals	0.028	0.016	58%
57 Structural metal products	2.488	1.138	46%
58 Tanks, reservoirs and containers of metal; manufacture of metal structures	0.714	0.273	38%
59 Forging, pressing, stamping and roll forming of metal; powder metallurgy	0.111	0.046	41%
60 Cutlery, tools and general hardware	0.736	0.734	100%
61 Other fabricated metal products	0.703	0.386	55%
62 Machinery for the production and use of mechanical power	0.795	0.519	65%
63 Other general purpose machinery	4.003	1.617	40%



Uncertainty of embedded CO2 emissions by sector; year 1995	CO2 CONSUMER	Standard error of	Relative error of CO2
	emissions E (Mt CO2)	CO2 CONSUMER emissions dE (Mt CO2)	CONSUMER emissions dE/E
64 Agricultural and forestry machinery	0.732	0.336	46%
65 Machine tools	1.227	0.760	62%
66 Other special purpose machinery	2.500	1.695	68%
67 Weapons and ammunition	0.077	0.059	77%
68 Domestic appliances not elsewhere classified	1.842	0.703	38%
69 Office machinery and computers	6.359	4.855	76%
70 Electric motors, generators and transformers; manufacture	1.318	0.806	61%
71 Insulated wire and cable	0.296	0.330	111%
72 Electrical equipment not elsewhere classified	0.761	0.559	73%
73 Electronic valves and tubes and other electronic compone	0.044	0.022	50%
74 Television and radio transmitters and line for telephony an	1.937	1.162	60%
75 Television and radio receivers, sound or video recording o	1.967	1.355	69%
76 Medical, precision and optical instruments, watches and cl	2.436	1.921	79%
77 Motor vehicles, trailers and semi-trailers	12.491	4.682	37%
78 Building and repairing of ships and boats	1.095	0.302	28%
79 Other transport equipment	1.198	0.392	33%
80 Aircraft and spacecraft	0.616	0.533	87%
81 Furniture	8.082	4.043	50%
82 Jewellery and related articles; manufacture of musical inst	5.809	4.417	76%
83 Sports goods, games and toys	7.310	4.575	63%
84 Miscellaneous manufacturing not elsewhere classified; rec	3.759	2.956	79%
85 Production and distribution of electricity	66.560	13.807	21%
86 Gas; distribution of gaseous fuels through mains; steam ai	6.706	6.603	98%
87 Collection, purification and distribution of water	0.954	0.156	16%
88 Construction	41.352	8.136	20%
89 Sale, maintenance and repair of motor vehicles, and moto	7.783	2.229	29%
90 Wholesale trade and commission trade, except of motor v	15.197	5.267	35%
91 Retail trade, except of motor vehicles and motor cycles; re	15.619	5.296	34%
92 Hotels and restaurants	26.928	6.267	23%
93 Transport via railways	2.714	4.929	182%
94 Other land transport; transport via pipelines	9.008	4.231	47%
95 Water transport	6.044	2.071	34%
96 Air Transport	21.567	8.243	38%
97 Supporting and auxiliary transport activities; activities of tr	0.447	0.880	197%
98 Post and courier activities	0.310	0.142	46%
99 Telecommunications	2.409	1.029	43%
100 Financial intermediation, except insurance and pension fu	1.162	0.279	24%
101 Insurance and pension funding, except compulsory social	6.320	1.134	18%
102 Activities auxiliary to financial intermediation	0.268	0.130	48%
103 Real estate activities with own property; letting of own prop	0.009	0.020	227%
104 Letting of dwellings, including imputed rent	8.419	1.995	24%
105 Real estate activities on a fee or contract basis	0.220	0.091	42%
106 Renting of machinery and equipment without operator and	3.855	0.522	14%
107 Computer and related activities	2.663	0.830	31%
108 Research and development	0.047	0.042	89%
109 Legal activities	0.271	0.090	33%
110 Accounting, book-keeping and auditing activities; tax cons	0.017	0.006	39%
111 Market research and public opinion polling; business and i	0.073	0.020	27%
112 Architectural and engineering activities and related technic	0.882	0.248	28%
113 Advertising	0.014	0.010	69%
114 Other business services	0.641	0.106	17%
115 Public administration and defence; compulsory social secu	35.593	6.247	18%
116 Education	14.736	1.779	12%
117 Human health and veterinary activities	19.979	5.278	26%
118 Social work activities	6.352	1.776	28%
119 Sewage and refuse disposal, sanitation and similar activiti	4.082	0.507	12%
120 Activities of membership organisations not elsewhere clas	1.056	0.147	14%
121 Recreational, cultural and sporting activities	8.434	1.462	17%
122 Other service activities	2.725	0.848	31%
123 Private households with employed persons	0.212	0.005	2%
	81.68		
	56.82		
<b>Total CO2 consumer emissions</b>	<b>653</b>	<b>+/- 29</b>	<b>+/- 4.4%</b>

Uncertainty of embedded CO2 emissions by sector; year 1996	CO2 CONSUMER	Standard error of	Relative error of CO2
	emissions	CO2 CONSUMER	CONSUMER
	E (Mt CO2)	emissions dE (Mt CO2)	emissions dE/E
1 Agriculture, hunting and related service activities	7.752	1.286	17%
2 Forestry, logging and related service activities	0.077	0.141	183%
3 Fishing, operation of fish hatcheries and fish farms; service activities	0.072	0.049	68%
4 Mining of coal and lignite; extraction of peat	0.298	0.431	145%
5 Extraction of crude petroleum and natural gas; service activities	1.599	0.714	45%
6 Mining of metal ores	0.009	0.010	114%
7 Other mining and quarrying	0.040	0.275	682%
8 Production, processing and preserving of meat and meat products	6.397	1.473	23%
9 Processing and preserving of fish and fish products; fruit and vegetables	4.575	1.105	24%
10 Vegetable and animal oils and fats	0.436	0.168	38%
11 Dairy products	3.989	1.238	31%
12 Grain mill products, starches and starch products	0.814	0.258	32%
13 Prepared animal feeds	0.757	0.411	54%
14 Bread, rusks and biscuits; manufacture of pastry goods and cakes	2.972	1.016	34%
15 Sugar	0.156	0.106	68%
16 Cocoa; chocolate and sugar confectionery	1.831	0.587	32%
17 Other food products	2.439	0.783	32%
18 Alcoholic beverages	1.460	1.097	75%
19 Production of mineral waters and soft drinks	1.645	0.590	36%
20 Tobacco products	1.046	0.535	51%
21 Preparation and spinning of textile fibres	0.015	0.049	335%
22 Textile weaving	0.053	0.021	40%
23 Finishing of textiles	0.013	0.025	190%
24 Made-up textile articles, except apparel	1.132	0.482	43%
25 Carpets and rugs	0.625	0.232	37%
26 Other textiles	0.091	0.036	39%
27 Knitted and crocheted fabrics and articles	2.331	1.242	53%
28 Wearing apparel; dressing and dyeing of fur	7.530	5.228	69%
29 Tanning and dressing of leather; manufacture of luggage, vanity cases, vanity bags, purses and wallets	0.157	0.145	92%
30 Footwear	1.338	0.941	70%
31 Wood and wood products, except furniture	0.930	0.192	21%
32 Pulp, paper and paperboard	0.218	0.087	40%
33 Articles of paper and paperboard	0.835	0.543	65%
34 Publishing, printing and reproduction of recorded media	3.128	0.809	26%
35 Coke, refined petroleum products and nuclear fuel	14.569	5.350	37%
36 Industrial gases, dyes and pigments	0.037	0.020	54%
37 Other inorganic basic chemicals	0.002	0.030	1205%
38 Other organic basic chemicals	0.007	0.660	9517%
39 Fertilisers and nitrogen compounds	0.171	0.069	40%
40 Plastics and synthetic rubber in primary forms	0.002	0.074	3498%
41 Pesticides and other agro-chemical products	0.078	0.075	97%
42 Paints, varnishes and similar coatings, printing ink and mastics	0.240	0.093	39%
43 Pharmaceuticals, medicinal chemicals and botanical products	0.889	0.422	48%
44 Soap and detergents, cleaning and polishing preparations	2.563	0.902	35%
45 Other chemical products	0.975	0.418	43%
46 Man-made fibres	0.006	0.028	446%
47 Rubber products	1.057	0.376	36%
48 Plastic products	1.595	0.330	21%
49 Glass and glass products	0.456	0.176	39%
50 Ceramic goods	1.055	0.531	50%
51 Bricks, tiles and construction products, baked in clay	0.154	0.138	90%
52 Cement, lime and plaster	0.776	0.241	31%
53 Articles of concrete, plaster and cement; cutting, shaping and finishing of stone	0.377	0.090	24%
54 Basic iron and steel and of ferro-alloys; manufacture of tubes and pipes	0.264	1.217	461%
55 Basic precious and non-ferrous metals	0.175	0.176	101%
56 Casting of metals	0.022	0.013	59%
57 Structural metal products	2.767	1.301	47%
58 Tanks, reservoirs and containers of metal; manufacture of metal structures	0.617	0.244	40%
59 Forging, pressing, stamping and roll forming of metal; powder metallurgy	0.084	0.038	45%
60 Cutlery, tools and general hardware	0.878	0.351	40%
61 Other fabricated metal products	0.916	0.273	30%
62 Machinery for the production and use of mechanical power	0.770	0.261	34%
63 Other general purpose machinery	4.366	1.505	34%

Uncertainty of embedded CO2 emissions by sector; year 1996	CO2 CONSUMER	Standard error of	Relative error of CO2
	emissions	CO2 CONSUMER	CONSUMER
	E (Mt CO2)	emissions dE (Mt CO2)	emissions dE/E
64 Agricultural and forestry machinery	0.737	0.264	36%
65 Machine tools	0.884	0.422	48%
66 Other special purpose machinery	1.555	0.957	62%
67 Weapons and ammunition	0.002	0.022	1048%
68 Domestic appliances not elsewhere classified	1.881	0.834	44%
69 Office machinery and computers	5.331	2.765	52%
70 Electric motors, generators and transformers; manufacture	1.282	0.518	40%
71 Insulated wire and cable	0.391	0.168	43%
72 Electrical equipment not elsewhere classified	0.551	0.259	47%
73 Electronic valves and tubes and other electronic compone	0.020	0.072	364%
74 Television and radio transmitters and line for telephony an	2.453	1.270	52%
75 Television and radio receivers, sound or video recording o	1.756	0.865	49%
76 Medical, precision and optical instruments, watches and cl	2.354	1.472	63%
77 Motor vehicles, trailers and semi-trailers	13.727	4.717	34%
78 Building and repairing of ships and boats	0.948	0.351	37%
79 Other transport equipment	1.052	0.415	39%
80 Aircraft and spacecraft	1.186	1.843	155%
81 Furniture	7.446	2.052	28%
82 Jewellery and related articles; manufacture of musical inst	5.206	3.432	66%
83 Sports goods, games and toys	6.441	3.441	53%
84 Miscellaneous manufacturing not elsewhere classified; rec	3.153	1.896	60%
85 Production and distribution of electricity	70.289	13.654	19%
86 Gas; distribution of gaseous fuels through mains; steam ai	7.533	7.430	99%
87 Collection, purification and distribution of water	0.920	0.120	13%
88 Construction	36.078	7.062	20%
89 Sale, maintenance and repair of motor vehicles, and moto	8.117	1.958	24%
90 Wholesale trade and commission trade, except of motor vi	16.771	3.135	19%
91 Retail trade, except of motor vehicles and motor cycles; re	16.830	3.981	24%
92 Hotels and restaurants	28.068	6.244	22%
93 Transport via railways	3.434	3.286	96%
94 Other land transport; transport via pipelines	9.601	1.815	19%
95 Water transport	6.216	2.190	35%
96 Air Transport	21.781	9.169	42%
97 Supporting and auxiliary transport activities; activities of tr	0.570	0.363	64%
98 Post and courier activities	0.405	0.136	34%
99 Telecommunications	2.665	1.084	41%
100 Financial intermediation, except insurance and pension fu	1.563	0.410	26%
101 Insurance and pension funding, except compulsory social	5.739	1.218	21%
102 Activities auxiliary to financial intermediation	0.400	0.151	38%
103 Real estate activities with own property; letting of own prop	0.009	0.001	17%
104 Letting of dwellings, including imputed rent	7.767	1.904	25%
105 Real estate activities on a fee or contract basis	0.259	0.128	49%
106 Renting of machinery and equipment without operator and	4.264	0.639	15%
107 Computer and related activities	2.581	0.781	30%
108 Research and development	0.070	0.016	23%
109 Legal activities	0.292	0.115	39%
110 Accounting, book-keeping and auditing activities; tax cons	0.013	0.012	96%
111 Market research and public opinion polling; business and i	0.071	0.025	36%
112 Architectural and engineering activities and related technic	0.909	0.251	28%
113 Advertising	0.018	0.006	34%
114 Other business services	0.684	0.145	21%
115 Public administration and defence; compulsory social secu	33.456	6.271	19%
116 Education	17.152	2.151	13%
117 Human health and veterinary activities	19.677	4.902	25%
118 Social work activities	6.875	2.025	29%
119 Sewage and refuse disposal, sanitation and similar activiti	3.975	0.490	12%
120 Activities of membership organisations not elsewhere clas	0.968	0.141	15%
121 Recreational, cultural and sporting activities	8.584	1.487	17%
122 Other service activities	2.828	0.849	30%
123 Private households with employed persons	0.212	0.022	10%
	92.80		
	60.03		
<b>Total CO2 consumer emissions</b>	<b>651</b>	<b>+/- 26</b>	<b>+/- 4.0%</b>

Uncertainty of embedded CO2 emissions by sector; year 1997	CO2 CONSUMER	Standard error of	Relative error of CO2
	emissions	CO2 CONSUMER	CONSUMER
	E (Mt CO2)	emissions dE (Mt CO2)	emissions dE/E
1 Agriculture, hunting and related service activities	7.731	5.203	67%
2 Forestry, logging and related service activities	0.066	0.194	296%
3 Fishing, operation of fish hatcheries and fish farms; service activities	0.027	1.506	5476%
4 Mining of coal and lignite; extraction of peat	0.139	0.441	318%
5 Extraction of crude petroleum and natural gas; service activities	1.746	0.339	19%
6 Mining of metal ores	0.006	0.008	146%
7 Other mining and quarrying	0.327	0.071	22%
8 Production, processing and preserving of meat and meat products	5.815	3.526	61%
9 Processing and preserving of fish and fish products; fruit and vegetables	4.173	2.184	52%
10 Vegetable and animal oils and fats	0.277	0.397	143%
11 Dairy products	3.658	3.661	100%
12 Grain mill products, starches and starch products	0.640	0.712	111%
13 Prepared animal feeds	0.797	0.629	79%
14 Bread, rusks and biscuits; manufacture of pastry goods and cakes	2.904	4.002	138%
15 Sugar	0.046	0.266	579%
16 Cocoa; chocolate and sugar confectionery	1.766	1.083	61%
17 Other food products	2.220	1.291	58%
18 Alcoholic beverages	1.708	1.831	107%
19 Production of mineral waters and soft drinks	1.505	0.767	51%
20 Tobacco products	1.072	0.596	56%
21 Preparation and spinning of textile fibres	0.040	0.307	758%
22 Textile weaving	0.051	0.073	143%
23 Finishing of textiles	0.056	0.026	47%
24 Made-up textile articles, except apparel	1.186	0.945	80%
25 Carpets and rugs	0.711	0.742	104%
26 Other textiles	0.055	0.075	138%
27 Knitted and crocheted fabrics and articles	2.334	1.372	59%
28 Wearing apparel; dressing and dyeing of fur	8.161	6.556	80%
29 Tanning and dressing of leather; manufacture of luggage, vanity cases, vanity bags, purses and wallets	0.150	1.071	715%
30 Footwear	1.430	1.189	83%
31 Wood and wood products, except furniture	1.036	0.451	44%
32 Pulp, paper and paperboard	1.045	3.050	292%
33 Articles of paper and paperboard	0.799	1.813	227%
34 Publishing, printing and reproduction of recorded media	3.285	1.774	54%
35 Coke, refined petroleum products and nuclear fuel	18.593	51.541	277%
36 Industrial gases, dyes and pigments	0.004	0.109	2911%
37 Other inorganic basic chemicals	0.024	2.512	10647%
38 Other organic basic chemicals	0.114	1.095	958%
39 Fertilisers and nitrogen compounds	0.231	3.196	1385%
40 Plastics and synthetic rubber in primary forms	0.008	2.000	>1000%
41 Pesticides and other agro-chemical products	0.028	0.060	213%
42 Paints, varnishes and similar coatings, printing ink and mastics	0.303	2.352	776%
43 Pharmaceuticals, medicinal chemicals and botanical products	0.856	0.872	102%
44 Soap and detergents, cleaning and polishing preparations	2.786	2.161	78%
45 Other chemical products	1.115	0.703	63%
46 Man-made fibres	0.003	0.493	>1000%
47 Rubber products	0.996	3.684	370%
48 Plastic products	1.979	2.556	129%
49 Glass and glass products	0.369	1.563	424%
50 Ceramic goods	1.080	0.678	63%
51 Bricks, tiles and construction products, baked in clay	0.199	2.673	1342%
52 Cement, lime and plaster	1.113	0.825	74%
53 Articles of concrete, plaster and cement; cutting, shaping and finishing of stone	0.287	0.120	42%
54 Basic iron and steel and of ferro-alloys; manufacture of tubes and profiles	0.967	0.539	56%
55 Basic precious and non-ferrous metals	0.061	1.823	2998%
56 Casting of metals	0.017	0.011	67%
57 Structural metal products	3.487	1.403	40%
58 Tanks, reservoirs and containers of metal; manufacture of metal structures	0.636	1.570	247%
59 Forging, pressing, stamping and roll forming of metal; powder metallurgy	0.053	0.052	97%
60 Cutlery, tools and general hardware	1.492	1.720	115%
61 Other fabricated metal products	1.310	0.974	74%
62 Machinery for the production and use of mechanical power	0.873	0.455	52%
63 Other general purpose machinery	4.647	1.304	28%

Uncertainty of embedded CO2 emissions by sector; year 1997	CO2 CONSUMER	Standard error of	Relative error of CO2
	emissions	CO2 CONSUMER	CONSUMER
	E (Mt CO2)	emissions dE (Mt CO2)	emissions dE/E
64 Agricultural and forestry machinery	0.835	0.341	41%
65 Machine tools	1.278	0.666	52%
66 Other special purpose machinery	1.985	3.188	161%
67 Weapons and ammunition	0.025	0.036	142%
68 Domestic appliances not elsewhere classified	2.534	2.266	89%
69 Office machinery and computers	6.638	4.194	63%
70 Electric motors, generators and transformers; manufacture	1.363	0.897	66%
71 Insulated wire and cable	0.279	0.214	77%
72 Electrical equipment not elsewhere classified	0.330	2.439	739%
73 Electronic valves and tubes and other electronic compone	0.113	0.079	70%
74 Television and radio transmitters and line for telephony an	2.419	2.338	97%
75 Television and radio receivers, sound or video recording o	1.729	1.540	89%
76 Medical, precision and optical instruments, watches and cl	2.967	1.361	46%
77 Motor vehicles, trailers and semi-trailers	14.437	10.285	71%
78 Building and repairing of ships and boats	1.083	2.305	213%
79 Other transport equipment	1.043	0.604	58%
80 Aircraft and spacecraft	3.031	2.582	85%
81 Furniture	7.347	15.874	216%
82 Jewellery and related articles; manufacture of musical inst	7.596	5.467	72%
83 Sports goods, games and toys	6.921	4.071	59%
84 Miscellaneous manufacturing not elsewhere classified; rec	2.535	3.469	137%
85 Production and distribution of electricity	64.522	14.750	23%
86 Gas; distribution of gaseous fuels through mains; steam ai	8.919	8.808	99%
87 Collection, purification and distribution of water	0.738	0.407	55%
88 Construction	37.038	6.264	17%
89 Sale, maintenance and repair of motor vehicles, and moto	11.026	6.750	61%
90 Wholesale trade and commission trade, except of motor v	18.673	2.946	16%
91 Retail trade, except of motor vehicles and motor cycles; re	17.828	2.309	13%
92 Hotels and restaurants	27.424	4.513	16%
93 Transport via railways	4.572	34.029	744%
94 Other land transport; transport via pipelines	10.011	10.784	108%
95 Water transport	6.826	4.018	59%
96 Air Transport	24.469	30.638	125%
97 Supporting and auxiliary transport activities; activities of tr	1.159	0.635	55%
98 Post and courier activities	0.374	0.432	115%
99 Telecommunications	2.474	1.283	52%
100 Financial intermediation, except insurance and pension fu	1.775	0.291	16%
101 Insurance and pension funding, except compulsory social	5.926	0.488	8%
102 Activities auxiliary to financial intermediation	0.000	0.563	>1000%
103 Real estate activities with own property; letting of own prop	0.008	0.001	16%
104 Letting of dwellings, including imputed rent	7.927	1.133	14%
105 Real estate activities on a fee or contract basis	0.313	0.252	81%
106 Renting of machinery and equipment without operator and	4.093	1.710	42%
107 Computer and related activities	3.090	0.556	18%
108 Research and development	0.083	0.009	11%
109 Legal activities	0.346	0.142	41%
110 Accounting, book-keeping and auditing activities; tax cons	0.024	0.011	45%
111 Market research and public opinion polling; business and i	0.074	0.016	21%
112 Architectural and engineering activities and related technic	0.881	0.976	111%
113 Advertising	0.000	0.028	>1000%
114 Other business services	0.659	0.518	79%
115 Public administration and defence; compulsory social secu	31.634	4.923	16%
116 Education	16.898	1.953	12%
117 Human health and veterinary activities	18.510	3.153	17%
118 Social work activities	6.342	1.905	30%
119 Sewage and refuse disposal, sanitation and similar activiti	3.540	0.505	14%
120 Activities of membership organisations not elsewhere clas	0.851	0.039	5%
121 Recreational, cultural and sporting activities	7.975	5.364	67%
122 Other service activities	2.661	1.218	46%
123 Private households with employed persons	0.213	0.005	2%
	85.74		
	60.97		
<b>Total CO2 consumer emissions</b>	<b>661</b>	<b>+/- 28</b>	<b>+/- 4.3%</b>

Uncertainty of embedded CO2 emissions by sector; year 1998	CO2 CONSUMER	Standard error of	Relative error of CO2
	emissions	CO2 CONSUMER	CONSUMER
	E (Mt CO2)	emissions dE (Mt CO2)	emissions dE/E
1 Agriculture, hunting and related service activities	8.401	1.714	20%
2 Forestry, logging and related service activities	0.086	0.134	155%
3 Fishing, operation of fish hatcheries and fish farms; service activities	0.059	0.096	163%
4 Mining of coal and lignite; extraction of peat	0.248	1.714	690%
5 Extraction of crude petroleum and natural gas; service activities	1.370	0.632	46%
6 Mining of metal ores	0.008	0.013	176%
7 Other mining and quarrying	0.834	0.490	59%
8 Production, processing and preserving of meat and meat products	6.012	1.402	23%
9 Processing and preserving of fish and fish products; fruit and vegetables	4.725	1.227	26%
10 Vegetable and animal oils and fats	0.414	0.155	37%
11 Dairy products	3.938	1.345	34%
12 Grain mill products, starches and starch products	0.779	0.247	32%
13 Prepared animal feeds	0.791	0.328	42%
14 Bread, rusks and biscuits; manufacture of pastry goods and cakes	3.003	0.944	31%
15 Sugar	0.163	0.118	72%
16 Cocoa; chocolate and sugar confectionery	1.637	0.520	32%
17 Other food products	2.466	0.790	32%
18 Alcoholic beverages	1.870	1.235	66%
19 Production of mineral waters and soft drinks	1.653	0.567	34%
20 Tobacco products	1.581	0.789	50%
21 Preparation and spinning of textile fibres	0.003	0.042	1339%
22 Textile weaving	0.033	0.019	56%
23 Finishing of textiles	0.013	0.026	196%
24 Made-up textile articles, except apparel	1.245	0.484	39%
25 Carpets and rugs	0.558	0.203	36%
26 Other textiles	0.084	0.034	41%
27 Knitted and crocheted fabrics and articles	2.557	1.586	62%
28 Wearing apparel; dressing and dyeing of fur	8.926	6.307	71%
29 Tanning and dressing of leather; manufacture of luggage, vanity cases, vanity bags, purses and wallets	0.218	0.164	75%
30 Footwear	1.441	1.066	74%
31 Wood and wood products, except furniture	0.991	0.227	23%
32 Pulp, paper and paperboard	0.050	0.136	272%
33 Articles of paper and paperboard	0.709	0.502	71%
34 Publishing, printing and reproduction of recorded media	3.137	0.769	25%
35 Coke, refined petroleum products and nuclear fuel	8.976	3.771	42%
36 Industrial gases, dyes and pigments	0.062	0.032	51%
37 Other inorganic basic chemicals	0.001	0.124	8448%
38 Other organic basic chemicals	0.020	0.670	3340%
39 Fertilisers and nitrogen compounds	0.340	0.181	53%
40 Plastics and synthetic rubber in primary forms	0.045	0.414	921%
41 Pesticides and other agro-chemical products	0.057	0.080	139%
42 Paints, varnishes and similar coatings, printing ink and mastics	0.404	0.171	42%
43 Pharmaceuticals, medicinal chemicals and botanical products	0.949	0.510	54%
44 Soap and detergents, cleaning and polishing preparations	2.393	0.879	37%
45 Other chemical products	1.083	0.495	46%
46 Man-made fibres	0.012	0.012	94%
47 Rubber products	1.242	0.377	30%
48 Plastic products	1.778	0.396	22%
49 Glass and glass products	0.450	0.176	39%
50 Ceramic goods	1.244	0.708	57%
51 Bricks, tiles and construction products, baked in clay	0.148	0.209	141%
52 Cement, lime and plaster	0.476	0.278	58%
53 Articles of concrete, plaster and cement; cutting, shaping and finishing of concrete	0.335	0.089	26%
54 Basic iron and steel and of ferro-alloys; manufacture of tubes and pipes	0.440	0.970	221%
55 Basic precious and non-ferrous metals	1.958	0.937	48%
56 Casting of metals	0.004	0.015	360%
57 Structural metal products	3.683	1.539	42%
58 Tanks, reservoirs and containers of metal; manufacture of metal structures	0.638	0.248	39%
59 Forging, pressing, stamping and roll forming of metal; powder metallurgy	0.092	0.083	89%
60 Cutlery, tools and general hardware	1.220	0.348	29%
61 Other fabricated metal products	0.992	0.334	34%
62 Machinery for the production and use of mechanical power	0.916	0.308	34%
63 Other general purpose machinery	4.379	1.415	32%

Uncertainty of embedded CO2 emissions by sector; year 1998	CO2 CONSUMER	Standard error of	Relative error of CO2
	emissions	CO2 CONSUMER	CONSUMER
	E (Mt CO2)	emissions dE (Mt CO2)	emissions dE/E
64 Agricultural and forestry machinery	0.623	0.288	46%
65 Machine tools	1.085	0.506	47%
66 Other special purpose machinery	2.134	1.129	53%
67 Weapons and ammunition	0.036	0.045	124%
68 Domestic appliances not elsewhere classified	1.999	0.656	33%
69 Office machinery and computers	7.681	4.533	59%
70 Electric motors, generators and transformers; manufacture	1.589	0.696	44%
71 Insulated wire and cable	0.458	0.185	40%
72 Electrical equipment not elsewhere classified	0.601	0.245	41%
73 Electronic valves and tubes and other electronic compone	0.064	0.044	69%
74 Television and radio transmitters and line for telephony an	3.050	1.535	50%
75 Television and radio receivers, sound or video recording o	1.535	0.843	55%
76 Medical, precision and optical instruments, watches and cl	2.994	1.511	50%
77 Motor vehicles, trailers and semi-trailers	16.504	4.591	28%
78 Building and repairing of ships and boats	0.610	0.214	35%
79 Other transport equipment	1.044	0.353	34%
80 Aircraft and spacecraft	3.896	3.079	79%
81 Furniture	8.692	3.482	40%
82 Jewellery and related articles; manufacture of musical inst	6.441	3.920	61%
83 Sports goods, games and toys	7.656	4.203	55%
84 Miscellaneous manufacturing not elsewhere classified; rec	3.713	2.162	58%
85 Production and distribution of electricity	64.860	12.969	20%
86 Gas; distribution of gaseous fuels through mains; steam ai	9.492	8.818	93%
87 Collection, purification and distribution of water	1.276	0.158	12%
88 Construction	39.579	8.017	20%
89 Sale, maintenance and repair of motor vehicles, and moto	10.060	2.289	23%
90 Wholesale trade and commission trade, except of motor vi	17.902	3.437	19%
91 Retail trade, except of motor vehicles and motor cycles; re	20.044	4.703	23%
92 Hotels and restaurants	28.968	6.415	22%
93 Transport via railways	3.686	6.415	174%
94 Other land transport; transport via pipelines	10.691	1.389	13%
95 Water transport	7.168	2.471	34%
96 Air Transport	27.946	11.023	39%
97 Supporting and auxiliary transport activities; activities of tr	0.624	0.511	82%
98 Post and courier activities	0.384	0.135	35%
99 Telecommunications	3.108	1.244	40%
100 Financial intermediation, except insurance and pension fu	1.864	0.359	19%
101 Insurance and pension funding, except compulsory social	7.675	1.567	20%
102 Activities auxiliary to financial intermediation	0.379	0.118	31%
103 Real estate activities with own property; letting of own prop	0.009	0.001	16%
104 Letting of dwellings, including imputed rent	8.305	2.086	25%
105 Real estate activities on a fee or contract basis	0.289	0.129	45%
106 Renting of machinery and equipment without operator and	4.011	0.542	14%
107 Computer and related activities	3.756	1.330	35%
108 Research and development	0.097	0.020	20%
109 Legal activities	0.324	0.111	34%
110 Accounting, book-keeping and auditing activities; tax cons	0.019	0.009	47%
111 Market research and public opinion polling; business and i	0.083	0.027	32%
112 Architectural and engineering activities and related technic	0.981	0.273	28%
113 Advertising	0.018	0.004	21%
114 Other business services	0.600	0.093	16%
115 Public administration and defence; compulsory social secu	33.819	7.197	21%
116 Education	17.634	2.292	13%
117 Human health and veterinary activities	19.939	5.359	27%
118 Social work activities	6.123	1.892	31%
119 Sewage and refuse disposal, sanitation and similar activiti	3.637	0.447	12%
120 Activities of membership organisations not elsewhere clas	0.903	0.116	13%
121 Recreational, cultural and sporting activities	8.021	1.440	18%
122 Other service activities	2.926	0.874	30%
123 Private households with employed persons	0.214	0.016	8%
	87.73		
	60.48		
<b>Total CO2 consumer emissions</b>	<b>680</b>	<b>+/- 29</b>	<b>+/- 4.3%</b>

Uncertainty of embedded CO2 emissions by sector; year 1999	CO2 CONSUMER	Standard error of	Relative error of CO2
	emissions	CO2 CONSUMER	CONSUMER
	E (Mt CO2)	emissions dE (Mt CO2)	emissions dE/E
1 Agriculture, hunting and related service activities	8.419	3.449	41%
2 Forestry, logging and related service activities	0.101	0.215	212%
3 Fishing, operation of fish hatcheries and fish farms; service activities	0.039	0.260	667%
4 Mining of coal and lignite; extraction of peat	0.162	4.579	2826%
5 Extraction of crude petroleum and natural gas; service activities	0.171	0.765	448%
6 Mining of metal ores	0.000	0.018	>1000%
7 Other mining and quarrying	1.398	0.702	50%
8 Production, processing and preserving of meat and meat products	5.473	3.011	55%
9 Processing and preserving of fish and fish products; fruit and vegetables	4.275	1.781	42%
10 Vegetable and animal oils and fats	0.377	0.227	60%
11 Dairy products	3.945	2.840	72%
12 Grain mill products, starches and starch products	0.683	0.551	81%
13 Prepared animal feeds	0.770	0.677	88%
14 Bread, rusks and biscuits; manufacture of pastry goods and cakes	2.844	2.080	73%
15 Sugar	0.264	0.207	78%
16 Cocoa; chocolate and sugar confectionery	1.564	1.072	69%
17 Other food products	2.347	1.597	68%
18 Alcoholic beverages	2.197	6.728	306%
19 Production of mineral waters and soft drinks	1.550	0.509	33%
20 Tobacco products	1.653	1.064	64%
21 Preparation and spinning of textile fibres	0.035	0.099	284%
22 Textile weaving	0.070	0.044	62%
23 Finishing of textiles	0.026	0.030	118%
24 Made-up textile articles, except apparel	1.219	0.476	39%
25 Carpets and rugs	0.495	0.252	51%
26 Other textiles	0.116	0.055	48%
27 Knitted and crocheted fabrics and articles	2.302	1.491	65%
28 Wearing apparel; dressing and dyeing of fur	8.004	5.867	73%
29 Tanning and dressing of leather; manufacture of luggage, vanity cases, vanity bags, purses and wallets	0.274	0.318	116%
30 Footwear	1.463	1.072	73%
31 Wood and wood products, except furniture	0.985	0.527	54%
32 Pulp, paper and paperboard	0.113	0.093	82%
33 Articles of paper and paperboard	0.759	0.826	109%
34 Publishing, printing and reproduction of recorded media	3.097	0.613	20%
35 Coke, refined petroleum products and nuclear fuel	8.817	16.570	188%
36 Industrial gases, dyes and pigments	0.058	0.074	129%
37 Other inorganic basic chemicals	0.000	0.073	>1000%
38 Other organic basic chemicals	0.193	0.956	494%
39 Fertilisers and nitrogen compounds	0.434	0.206	48%
40 Plastics and synthetic rubber in primary forms	0.000	0.140	>1000%
41 Pesticides and other agro-chemical products	0.070	0.040	57%
42 Paints, varnishes and similar coatings, printing ink and mastics	0.417	0.226	54%
43 Pharmaceuticals, medicinal chemicals and botanical products	1.321	0.719	54%
44 Soap and detergents, cleaning and polishing preparations	2.040	0.881	43%
45 Other chemical products	1.309	0.749	57%
46 Man-made fibres	0.003	0.095	3510%
47 Rubber products	1.288	0.546	42%
48 Plastic products	2.003	2.305	115%
49 Glass and glass products	0.531	0.318	60%
50 Ceramic goods	1.245	0.742	60%
51 Bricks, tiles and construction products, baked in clay	0.116	0.131	113%
52 Cement, lime and plaster	0.145	0.044	30%
53 Articles of concrete, plaster and cement; cutting, shaping and finishing of stone	0.377	0.085	23%
54 Basic iron and steel and of ferro-alloys; manufacture of tubes and pipes	0.655	0.232	35%
55 Basic precious and non-ferrous metals	1.118	0.876	78%
56 Casting of metals	0.000	0.393	>1000%
57 Structural metal products	3.791	1.245	33%
58 Tanks, reservoirs and containers of metal; manufacture of metal structures	0.657	0.322	49%
59 Forging, pressing, stamping and roll forming of metal; powder metallurgy	0.080	0.052	66%
60 Cutlery, tools and general hardware	1.328	0.588	44%
61 Other fabricated metal products	1.040	0.400	38%
62 Machinery for the production and use of mechanical power	0.809	0.398	49%
63 Other general purpose machinery	4.031	1.281	32%



Uncertainty of embedded CO2 emissions by sector; year 1999	CO2 CONSUMER	Standard error of	Relative error of CO2
	emissions	CO2 CONSUMER	CONSUMER
	E (Mt CO2)	emissions dE (Mt CO2)	emissions dE/E
64 Agricultural and forestry machinery	0.485	0.700	144%
65 Machine tools	0.848	0.453	53%
66 Other special purpose machinery	1.444	0.925	64%
67 Weapons and ammunition	0.027	0.028	102%
68 Domestic appliances not elsewhere classified	1.749	0.746	43%
69 Office machinery and computers	7.625	4.509	59%
70 Electric motors, generators and transformers; manufacture	1.740	0.770	44%
71 Insulated wire and cable	0.447	0.151	34%
72 Electrical equipment not elsewhere classified	0.713	0.534	75%
73 Electronic valves and tubes and other electronic compone	0.045	0.024	55%
74 Television and radio transmitters and line for telephony an	3.414	1.877	55%
75 Television and radio receivers, sound or video recording o	1.820	1.033	57%
76 Medical, precision and optical instruments, watches and cl	2.934	1.640	56%
77 Motor vehicles, trailers and semi-trailers	13.664	5.570	41%
78 Building and repairing of ships and boats	0.744	0.435	58%
79 Other transport equipment	0.848	0.335	39%
80 Aircraft and spacecraft	3.784	2.898	77%
81 Furniture	8.729	3.902	45%
82 Jewellery and related articles; manufacture of musical inst	5.053	3.225	64%
83 Sports goods, games and toys	7.092	4.294	61%
84 Miscellaneous manufacturing not elsewhere classified; rec	3.528	3.265	93%
85 Production and distribution of electricity	56.395	11.210	20%
86 Gas; distribution of gaseous fuels through mains; steam ai	12.710	8.315	65%
87 Collection, purification and distribution of water	1.280	0.131	10%
88 Construction	39.244	6.520	17%
89 Sale, maintenance and repair of motor vehicles, and moto	9.500	1.195	13%
90 Wholesale trade and commission trade, except of motor vi	20.198	5.425	27%
91 Retail trade, except of motor vehicles and motor cycles; re	20.070	5.183	26%
92 Hotels and restaurants	27.101	5.782	21%
93 Transport via railways	3.695	3.004	81%
94 Other land transport; transport via pipelines	9.602	2.681	28%
95 Water transport	7.125	2.404	34%
96 Air Transport	29.753	11.377	38%
97 Supporting and auxiliary transport activities; activities of tr	0.843	0.504	60%
98 Post and courier activities	0.339	0.136	40%
99 Telecommunications	2.883	0.679	24%
100 Financial intermediation, except insurance and pension fu	2.229	0.279	13%
101 Insurance and pension funding, except compulsory social	7.630	1.273	17%
102 Activities auxiliary to financial intermediation	0.172	0.089	52%
103 Real estate activities with own property; letting of own prop	0.008	0.012	143%
104 Letting of dwellings, including imputed rent	8.390	3.748	45%
105 Real estate activities on a fee or contract basis	0.309	0.202	65%
106 Renting of machinery and equipment without operator and	3.924	0.538	14%
107 Computer and related activities	3.407	0.492	14%
108 Research and development	0.145	0.062	43%
109 Legal activities	0.337	0.147	44%
110 Accounting, book-keeping and auditing activities; tax cons	0.045	0.035	78%
111 Market research and public opinion polling; business and i	0.071	0.023	32%
112 Architectural and engineering activities and related technic	0.893	0.337	38%
113 Advertising	0.022	0.027	128%
114 Other business services	0.515	0.299	58%
115 Public administration and defence; compulsory social secu	34.079	5.395	16%
116 Education	16.597	2.292	14%
117 Human health and veterinary activities	20.366	3.948	19%
118 Social work activities	6.190	2.225	36%
119 Sewage and refuse disposal, sanitation and similar activiti	3.540	0.479	14%
120 Activities of membership organisations not elsewhere clas	0.828	0.079	10%
121 Recreational, cultural and sporting activities	7.226	1.033	14%
122 Other service activities	2.698	0.292	11%
123 Private households with employed persons	0.214	0.209	98%
	87.19		
	61.60		
<b>Total CO2 consumer emissions</b>	<b>665</b>	<b>+/- 33</b>	<b>+/- 5.0%</b>

Uncertainty of embedded CO2 emissions by sector; year 2000	CO2 CONSUMER	Standard error of	Relative error of CO2
	emissions	CO2 CONSUMER	CONSUMER
	E (Mt CO2)	emissions dE (Mt CO2)	emissions dE/E
1 Agriculture, hunting and related service activities	8.491	1.502	18%
2 Forestry, logging and related service activities	0.113	0.024	22%
3 Fishing, operation of fish hatcheries and fish farms; service activities	0.050	0.084	168%
4 Mining of coal and lignite; extraction of peat	0.202	0.405	201%
5 Extraction of crude petroleum and natural gas; service activities	0.506	0.523	104%
6 Mining of metal ores	0.019	0.031	165%
7 Other mining and quarrying	0.491	0.116	24%
8 Production, processing and preserving of meat and meat products	5.845	1.350	23%
9 Processing and preserving of fish and fish products; fruit and vegetables	4.136	0.966	23%
10 Vegetable and animal oils and fats	0.408	0.149	36%
11 Dairy products	3.887	1.371	35%
12 Grain mill products, starches and starch products	0.795	0.267	34%
13 Prepared animal feeds	0.805	0.359	45%
14 Bread, rusks and biscuits; manufacture of pastry goods and cakes	3.085	1.005	33%
15 Sugar	0.094	0.066	70%
16 Cocoa; chocolate and sugar confectionery	1.446	0.462	32%
17 Other food products	2.299	0.706	31%
18 Alcoholic beverages	1.703	1.234	72%
19 Production of mineral waters and soft drinks	1.655	0.562	34%
20 Tobacco products	1.173	0.665	57%
21 Preparation and spinning of textile fibres	0.018	0.052	282%
22 Textile weaving	0.057	0.031	54%
23 Finishing of textiles	0.006	0.023	353%
24 Made-up textile articles, except apparel	1.546	0.555	36%
25 Carpets and rugs	0.643	0.199	31%
26 Other textiles	0.121	0.038	31%
27 Knitted and crocheted fabrics and articles	2.310	1.476	64%
28 Wearing apparel; dressing and dyeing of fur	8.246	6.080	74%
29 Tanning and dressing of leather; manufacture of luggage, vanity cases, vanity bags, purses and wallets	0.164	0.139	85%
30 Footwear	1.345	1.025	76%
31 Wood and wood products, except furniture	1.085	0.201	18%
32 Pulp, paper and paperboard	0.235	0.097	41%
33 Articles of paper and paperboard	0.749	0.458	61%
34 Publishing, printing and reproduction of recorded media	3.245	0.741	23%
35 Coke, refined petroleum products and nuclear fuel	14.024	6.526	47%
36 Industrial gases, dyes and pigments	0.058	0.018	31%
37 Other inorganic basic chemicals	0.006	0.243	4277%
38 Other organic basic chemicals	0.006	0.012	194%
39 Fertilisers and nitrogen compounds	0.110	0.044	41%
40 Plastics and synthetic rubber in primary forms	0.064	0.080	126%
41 Pesticides and other agro-chemical products	0.066	0.020	31%
42 Paints, varnishes and similar coatings, printing ink and mastics	0.385	0.163	42%
43 Pharmaceuticals, medicinal chemicals and botanical products	1.097	0.478	44%
44 Soap and detergents, cleaning and polishing preparations	2.134	0.863	40%
45 Other chemical products	1.371	0.622	45%
46 Man-made fibres	0.029	0.016	57%
47 Rubber products	1.366	0.398	29%
48 Plastic products	1.888	0.374	20%
49 Glass and glass products	0.628	0.204	33%
50 Ceramic goods	1.357	0.643	47%
51 Bricks, tiles and construction products, baked in clay	0.278	0.112	40%
52 Cement, lime and plaster	0.458	0.122	27%
53 Articles of concrete, plaster and cement; cutting, shaping and finishing of stone	0.525	0.103	20%
54 Basic iron and steel and of ferro-alloys; manufacture of tubes and pipes	0.703	0.198	28%
55 Basic precious and non-ferrous metals	0.387	0.139	36%
56 Casting of metals	0.022	0.013	59%
57 Structural metal products	3.258	1.340	41%
58 Tanks, reservoirs and containers of metal; manufacture of metal structures	0.702	0.254	36%
59 Forging, pressing, stamping and roll forming of metal; powder metallurgy	0.116	0.040	34%
60 Cutlery, tools and general hardware	1.016	0.324	32%
61 Other fabricated metal products	0.933	0.295	32%
62 Machinery for the production and use of mechanical power	0.852	0.286	34%
63 Other general purpose machinery	4.413	1.494	34%

Uncertainty of embedded CO2 emissions by sector; year 2000	CO2 CONSUMER	Standard error of	Relative error of CO2
	emissions	CO2 CONSUMER	CONSUMER
	E (Mt CO2)	emissions dE (Mt CO2)	emissions dE/E
64 Agricultural and forestry machinery	0.523	0.153	29%
65 Machine tools	0.824	0.390	47%
66 Other special purpose machinery	1.836	2.541	138%
67 Weapons and ammunition	0.022	0.019	87%
68 Domestic appliances not elsewhere classified	1.964	0.780	40%
69 Office machinery and computers	7.125	3.908	55%
70 Electric motors, generators and transformers; manufacture	1.854	0.686	37%
71 Insulated wire and cable	0.636	0.263	41%
72 Electrical equipment not elsewhere classified	0.730	0.371	51%
73 Electronic valves and tubes and other electronic compone	0.163	0.074	45%
74 Television and radio transmitters and line for telephony an	4.024	2.261	56%
75 Television and radio receivers, sound or video recording o	2.116	1.044	49%
76 Medical, precision and optical instruments, watches and cl	2.447	1.046	43%
77 Motor vehicles, trailers and semi-trailers	14.327	5.110	36%
78 Building and repairing of ships and boats	0.659	0.275	42%
79 Other transport equipment	1.034	0.334	32%
80 Aircraft and spacecraft	2.400	1.680	70%
81 Furniture	9.540	2.909	30%
82 Jewellery and related articles; manufacture of musical inst	3.979	2.295	58%
83 Sports goods, games and toys	6.860	3.823	56%
84 Miscellaneous manufacturing not elsewhere classified; rec	3.161	2.077	66%
85 Production and distribution of electricity	56.843	11.231	20%
86 Gas; distribution of gaseous fuels through mains; steam ai	17.684	10.077	57%
87 Collection, purification and distribution of water	1.358	0.124	9%
88 Construction	37.488	8.062	22%
89 Sale, maintenance and repair of motor vehicles, and moto	9.667	2.302	24%
90 Wholesale trade and commission trade, except of motor vi	17.467	4.301	25%
91 Retail trade, except of motor vehicles and motor cycles; re	21.155	7.334	35%
92 Hotels and restaurants	28.548	6.629	23%
93 Transport via railways	3.883	2.624	68%
94 Other land transport; transport via pipelines	11.226	1.778	16%
95 Water transport	6.769	2.467	36%
96 Air Transport	34.397	14.839	43%
97 Supporting and auxiliary transport activities; activities of tr	0.674	0.206	31%
98 Post and courier activities	0.331	0.115	35%
99 Telecommunications	3.129	1.405	45%
100 Financial intermediation, except insurance and pension fu	2.495	0.595	24%
101 Insurance and pension funding, except compulsory social	9.173	1.911	21%
102 Activities auxiliary to financial intermediation	0.255	0.081	32%
103 Real estate activities with own property; letting of own prop	0.009	0.003	29%
104 Letting of dwellings, including imputed rent	8.831	2.172	25%
105 Real estate activities on a fee or contract basis	0.310	0.134	43%
106 Renting of machinery and equipment without operator and	4.071	0.576	14%
107 Computer and related activities	3.616	0.938	26%
108 Research and development	0.101	0.025	25%
109 Legal activities	0.357	0.109	31%
110 Accounting, book-keeping and auditing activities; tax cons	0.003	0.002	76%
111 Market research and public opinion polling; business and i	0.063	0.017	27%
112 Architectural and engineering activities and related technic	0.795	0.222	28%
113 Advertising	0.035	0.007	21%
114 Other business services	0.413	0.073	18%
115 Public administration and defence; compulsory social secu	34.519	6.759	20%
116 Education	16.109	2.044	13%
117 Human health and veterinary activities	20.699	6.416	31%
118 Social work activities	5.833	1.876	32%
119 Sewage and refuse disposal, sanitation and similar activiti	3.429	0.425	12%
120 Activities of membership organisations not elsewhere clas	0.811	0.114	14%
121 Recreational, cultural and sporting activities	7.177	1.350	19%
122 Other service activities	2.642	0.767	29%
123 Private households with employed persons	0.214	0.006	3%
	87.73		
	61.24		
<b>Total CO2 consumer emissions</b>	<b>682</b>	<b>+/- 31</b>	<b>+/- 4.5%</b>

Uncertainty of embedded CO2 emissions by sector; year 2001	CO2 CONSUMER	Standard error of	Relative error of CO2
	emissions	CO2 CONSUMER	CONSUMER
	E (Mt CO2)	emissions dE (Mt CO2)	emissions dE/E
1 Agriculture, hunting and related service activities	9.033	1.667	18%
2 Forestry, logging and related service activities	0.102	0.031	30%
3 Fishing, operation of fish hatcheries and fish farms; service activities	0.067	0.111	165%
4 Mining of coal and lignite; extraction of peat	0.300	0.514	171%
5 Extraction of crude petroleum and natural gas; service activities	0.904	0.610	68%
6 Mining of metal ores	0.003	0.008	244%
7 Other mining and quarrying	0.082	0.042	51%
8 Production, processing and preserving of meat and meat products	5.849	1.397	24%
9 Processing and preserving of fish and fish products; fruit and vegetables	4.606	1.133	25%
10 Vegetable and animal oils and fats	0.446	0.164	37%
11 Dairy products	3.797	1.349	36%
12 Grain mill products, starches and starch products	0.876	0.272	31%
13 Prepared animal feeds	0.806	0.384	48%
14 Bread, rusks and biscuits; manufacture of pastry goods and cakes	3.244	1.081	33%
15 Sugar	0.110	0.078	71%
16 Cocoa; chocolate and sugar confectionery	1.462	0.471	32%
17 Other food products	2.499	0.782	31%
18 Alcoholic beverages	2.029	1.286	63%
19 Production of mineral waters and soft drinks	1.861	0.685	37%
20 Tobacco products	1.273	0.722	57%
21 Preparation and spinning of textile fibres	0.029	0.049	171%
22 Textile weaving	0.037	0.026	69%
23 Finishing of textiles	0.026	0.030	118%
24 Made-up textile articles, except apparel	1.825	0.726	40%
25 Carpets and rugs	0.634	0.224	35%
26 Other textiles	0.146	0.040	27%
27 Knitted and crocheted fabrics and articles	2.592	1.881	73%
28 Wearing apparel; dressing and dyeing of fur	9.786	7.518	77%
29 Tanning and dressing of leather; manufacture of luggage, vanity cases, vanity bags, purses and wallets	0.228	0.195	86%
30 Footwear	1.754	1.347	77%
31 Wood and wood products, except furniture	1.140	0.267	23%
32 Pulp, paper and paperboard	0.131	0.060	46%
33 Articles of paper and paperboard	0.803	0.597	74%
34 Publishing, printing and reproduction of recorded media	3.477	0.823	24%
35 Coke, refined petroleum products and nuclear fuel	16.518	8.929	54%
36 Industrial gases, dyes and pigments	0.046	0.025	56%
37 Other inorganic basic chemicals	0.066	0.246	375%
38 Other organic basic chemicals	0.028	0.019	69%
39 Fertilisers and nitrogen compounds	0.094	0.047	50%
40 Plastics and synthetic rubber in primary forms	0.003	0.075	2202%
41 Pesticides and other agro-chemical products	0.035	0.028	79%
42 Paints, varnishes and similar coatings, printing ink and mastics	0.434	0.209	48%
43 Pharmaceuticals, medicinal chemicals and botanical products	1.452	0.741	51%
44 Soap and detergents, cleaning and polishing preparations	2.550	1.095	43%
45 Other chemical products	1.430	0.660	46%
46 Man-made fibres	0.014	0.012	90%
47 Rubber products	1.285	0.393	31%
48 Plastic products	2.196	0.476	22%
49 Glass and glass products	0.711	0.227	32%
50 Ceramic goods	1.518	0.763	50%
51 Bricks, tiles and construction products, baked in clay	0.132	0.080	60%
52 Cement, lime and plaster	0.333	0.086	26%
53 Articles of concrete, plaster and cement; cutting, shaping and finishing of stone	0.450	0.110	25%
54 Basic iron and steel and of ferro-alloys; manufacture of tubes and pipes	0.777	0.227	29%
55 Basic precious and non-ferrous metals	0.925	0.269	29%
56 Casting of metals	0.012	0.010	78%
57 Structural metal products	3.505	1.506	43%
58 Tanks, reservoirs and containers of metal; manufacture of metal structures	0.719	0.302	42%
59 Forging, pressing, stamping and roll forming of metal; powder metallurgy	0.075	0.024	32%
60 Cutlery, tools and general hardware	1.118	0.410	37%
61 Other fabricated metal products	1.231	0.423	34%
62 Machinery for the production and use of mechanical power	1.092	0.349	32%
63 Other general purpose machinery	4.784	1.669	35%

Uncertainty of embedded CO2 emissions by sector; year 2001	CO2 CONSUMER	Standard error of	Relative error of CO2
	emissions	CO2 CONSUMER	CONSUMER
	E (Mt CO2)	emissions dE (Mt CO2)	emissions dE/E
64 Agricultural and forestry machinery	0.653	0.208	32%
65 Machine tools	0.829	0.422	51%
66 Other special purpose machinery	1.793	2.552	142%
67 Weapons and ammunition	0.096	0.042	43%
68 Domestic appliances not elsewhere classified	2.363	0.991	42%
69 Office machinery and computers	6.997	3.749	54%
70 Electric motors, generators and transformers; manufacture	1.867	0.687	37%
71 Insulated wire and cable	0.495	0.255	51%
72 Electrical equipment not elsewhere classified	0.444	0.460	104%
73 Electronic valves and tubes and other electronic compone	0.028	0.097	351%
74 Television and radio transmitters and line for telephony an	3.835	2.526	66%
75 Television and radio receivers, sound or video recording o	2.700	1.371	51%
76 Medical, precision and optical instruments, watches and cl	2.755	1.631	59%
77 Motor vehicles, trailers and semi-trailers	16.723	6.343	38%
78 Building and repairing of ships and boats	1.087	0.377	35%
79 Other transport equipment	0.885	0.285	32%
80 Aircraft and spacecraft	3.295	2.632	80%
81 Furniture	10.284	3.249	32%
82 Jewellery and related articles; manufacture of musical inst	3.934	2.384	61%
83 Sports goods, games and toys	6.716	3.868	58%
84 Miscellaneous manufacturing not elsewhere classified; rec	3.254	2.228	68%
85 Production and distribution of electricity	55.734	10.884	20%
86 Gas; distribution of gaseous fuels through mains; steam ai	21.084	11.736	56%
87 Collection, purification and distribution of water	1.442	0.102	7%
88 Construction	40.903	9.059	22%
89 Sale, maintenance and repair of motor vehicles, and moto	10.519	2.747	26%
90 Wholesale trade and commission trade, except of motor v	18.189	5.164	28%
91 Retail trade, except of motor vehicles and motor cycles; re	23.857	9.791	41%
92 Hotels and restaurants	31.554	7.560	24%
93 Transport via railways	4.127	5.159	125%
94 Other land transport; transport via pipelines	12.117	1.840	15%
95 Water transport	8.245	3.133	38%
96 Air Transport	37.338	16.194	43%
97 Supporting and auxiliary transport activities; activities of tr	0.936	0.209	22%
98 Post and courier activities	0.337	0.121	36%
99 Telecommunications	3.788	1.764	47%
100 Financial intermediation, except insurance and pension fu	2.566	0.662	26%
101 Insurance and pension funding, except compulsory social	11.177	2.552	23%
102 Activities auxiliary to financial intermediation	0.372	0.101	27%
103 Real estate activities with own property; letting of own prop	0.011	0.004	38%
104 Letting of dwellings, including imputed rent	9.491	2.521	27%
105 Real estate activities on a fee or contract basis	0.364	0.151	42%
106 Renting of machinery and equipment without operator and	3.950	0.585	15%
107 Computer and related activities	3.291	0.906	28%
108 Research and development	0.137	0.033	24%
109 Legal activities	0.378	0.125	33%
110 Accounting, book-keeping and auditing activities; tax cons	0.004	0.001	39%
111 Market research and public opinion polling; business and i	0.027	0.018	68%
112 Architectural and engineering activities and related technic	0.955	0.253	26%
113 Advertising	0.001	0.005	457%
114 Other business services	0.448	0.085	19%
115 Public administration and defence; compulsory social secu	37.358	7.433	20%
116 Education	16.927	2.339	14%
117 Human health and veterinary activities	24.278	8.601	35%
118 Social work activities	6.662	2.061	31%
119 Sewage and refuse disposal, sanitation and similar activiti	3.701	0.476	13%
120 Activities of membership organisations not elsewhere clas	0.813	0.129	16%
121 Recreational, cultural and sporting activities	7.700	1.547	20%
122 Other service activities	2.942	0.856	29%
123 Private households with employed persons	0.215	0.006	3%
	89.97		
	62.01		
<b>Total CO2 consumer emissions</b>	<b>732</b>	<b>+/- 36</b>	<b>+/- 4.9%</b>

Uncertainty of embedded CO2 emissions by sector; year 2002	CO2 CONSUMER	Standard error of	Relative error of CO2
	emissions	CO2 CONSUMER	CONSUMER
	E (Mt CO2)	emissions dE (Mt CO2)	emissions dE/E
1 Agriculture, hunting and related service activities	9.867	1.710	17%
2 Forestry, logging and related service activities	0.116	0.020	18%
3 Fishing, operation of fish hatcheries and fish farms; service activities	0.077	0.120	156%
4 Mining of coal and lignite; extraction of peat	0.152	0.722	474%
5 Extraction of crude petroleum and natural gas; service activities	0.939	0.715	76%
6 Mining of metal ores	0.034	0.035	105%
7 Other mining and quarrying	0.928	0.245	26%
8 Production, processing and preserving of meat and meat products	6.116	1.426	23%
9 Processing and preserving of fish and fish products; fruit and vegetables	4.716	1.189	25%
10 Vegetable and animal oils and fats	0.468	0.167	36%
11 Dairy products	3.618	1.300	36%
12 Grain mill products, starches and starch products	0.876	0.300	34%
13 Prepared animal feeds	0.845	0.381	45%
14 Bread, rusks and biscuits; manufacture of pastry goods and cakes	3.318	1.118	34%
15 Sugar	0.127	0.077	61%
16 Cocoa; chocolate and sugar confectionery	1.477	0.487	33%
17 Other food products	2.506	0.795	32%
18 Alcoholic beverages	2.074	1.341	65%
19 Production of mineral waters and soft drinks	1.842	0.700	38%
20 Tobacco products	1.128	0.740	66%
21 Preparation and spinning of textile fibres	0.013	0.572	4359%
22 Textile weaving	0.036	0.032	90%
23 Finishing of textiles	0.024	0.035	147%
24 Made-up textile articles, except apparel	1.966	0.831	42%
25 Carpets and rugs	0.699	0.244	35%
26 Other textiles	0.156	0.047	30%
27 Knitted and crocheted fabrics and articles	2.420	1.758	73%
28 Wearing apparel; dressing and dyeing of fur	10.387	7.960	77%
29 Tanning and dressing of leather; manufacture of luggage, vanity cases, vanity bags, purses and wallets	0.209	0.190	91%
30 Footwear	1.824	1.409	77%
31 Wood and wood products, except furniture	1.190	0.364	31%
32 Pulp, paper and paperboard	0.127	0.072	57%
33 Articles of paper and paperboard	0.903	0.667	74%
34 Publishing, printing and reproduction of recorded media	3.549	0.827	23%
35 Coke, refined petroleum products and nuclear fuel	16.081	10.191	63%
36 Industrial gases, dyes and pigments	0.045	0.025	57%
37 Other inorganic basic chemicals	0.099	0.048	49%
38 Other organic basic chemicals	0.233	0.120	51%
39 Fertilisers and nitrogen compounds	0.234	0.103	44%
40 Plastics and synthetic rubber in primary forms	0.069	0.093	134%
41 Pesticides and other agro-chemical products	0.205	0.050	25%
42 Paints, varnishes and similar coatings, printing ink and mastics	0.234	0.103	44%
43 Pharmaceuticals, medicinal chemicals and botanical products	1.613	0.788	49%
44 Soap and detergents, cleaning and polishing preparations	2.864	1.220	43%
45 Other chemical products	1.284	0.641	50%
46 Man-made fibres	0.003	0.015	434%
47 Rubber products	1.291	0.413	32%
48 Plastic products	2.200	0.521	24%
49 Glass and glass products	0.652	0.238	36%
50 Ceramic goods	1.544	0.780	51%
51 Bricks, tiles and construction products, baked in clay	0.167	0.175	105%
52 Cement, lime and plaster	1.025	0.254	25%
53 Articles of concrete, plaster and cement; cutting, shaping and finishing of stone	0.375	0.102	27%
54 Basic iron and steel and of ferro-alloys; manufacture of tubes and pipes	0.793	0.246	31%
55 Basic precious and non-ferrous metals	0.840	0.266	32%
56 Casting of metals	0.006	0.032	502%
57 Structural metal products	3.376	1.427	42%
58 Tanks, reservoirs and containers of metal; manufacture of metal structures	0.605	0.389	64%
59 Forging, pressing, stamping and roll forming of metal; powder metallurgy	0.040	0.031	78%
60 Cutlery, tools and general hardware	1.208	0.443	37%
61 Other fabricated metal products	1.257	0.443	35%
62 Machinery for the production and use of mechanical power	0.880	0.319	36%
63 Other general purpose machinery	4.268	1.486	35%

Uncertainty of embedded CO2 emissions by sector; year 2002	CO2 CONSUMER	Standard error of	Relative error of CO2
	emissions	CO2 CONSUMER	CONSUMER
	E (Mt CO2)	emissions dE (Mt CO2)	emissions dE/E
64 Agricultural and forestry machinery	0.642	0.235	37%
65 Machine tools	0.803	0.419	52%
66 Other special purpose machinery	1.721	2.318	135%
67 Weapons and ammunition	0.107	0.051	47%
68 Domestic appliances not elsewhere classified	2.586	1.180	46%
69 Office machinery and computers	6.141	3.260	53%
70 Electric motors, generators and transformers; manufacture	1.648	0.584	35%
71 Insulated wire and cable	0.411	0.182	44%
72 Electrical equipment not elsewhere classified	0.647	0.478	74%
73 Electronic valves and tubes and other electronic compone	0.034	0.087	258%
74 Television and radio transmitters and line for telephony an	4.928	2.321	47%
75 Television and radio receivers, sound or video recording o	3.019	1.606	53%
76 Medical, precision and optical instruments, watches and cl	2.662	1.527	57%
77 Motor vehicles, trailers and semi-trailers	16.737	6.881	41%
78 Building and repairing of ships and boats	0.987	0.292	30%
79 Other transport equipment	1.039	0.343	33%
80 Aircraft and spacecraft	4.170	3.299	79%
81 Furniture	11.139	3.869	35%
82 Jewellery and related articles; manufacture of musical inst	4.623	2.686	58%
83 Sports goods, games and toys	7.698	4.365	57%
84 Miscellaneous manufacturing not elsewhere classified; rec	3.716	2.452	66%
85 Production and distribution of electricity	51.914	10.591	20%
86 Gas; distribution of gaseous fuels through mains; steam ai	22.908	11.171	49%
87 Collection, purification and distribution of water	1.289	0.104	8%
88 Construction	40.715	9.419	23%
89 Sale, maintenance and repair of motor vehicles, and moto	9.992	3.205	32%
90 Wholesale trade and commission trade, except of motor vi	17.209	4.838	28%
91 Retail trade, except of motor vehicles and motor cycles; re	23.429	10.876	46%
92 Hotels and restaurants	32.301	8.044	25%
93 Transport via railways	4.072	6.812	167%
94 Other land transport; transport via pipelines	12.724	1.977	16%
95 Water transport	10.016	3.205	32%
96 Air Transport	37.652	17.238	46%
97 Supporting and auxiliary transport activities; activities of tr	0.737	0.214	29%
98 Post and courier activities	0.333	0.121	36%
99 Telecommunications	3.837	1.855	48%
100 Financial intermediation, except insurance and pension fu	2.058	0.551	27%
101 Insurance and pension funding, except compulsory social	8.481	1.932	23%
102 Activities auxiliary to financial intermediation	0.303	0.083	28%
103 Real estate activities with own property; letting of own prop	0.009	0.005	53%
104 Letting of dwellings, including imputed rent	8.747	2.316	26%
105 Real estate activities on a fee or contract basis	0.405	0.176	44%
106 Renting of machinery and equipment without operator and	3.353	0.478	14%
107 Computer and related activities	2.914	0.816	28%
108 Research and development	0.146	0.038	26%
109 Legal activities	0.455	0.152	33%
110 Accounting, book-keeping and auditing activities; tax cons	0.012	0.003	27%
111 Market research and public opinion polling; business and i	0.066	0.016	24%
112 Architectural and engineering activities and related technic	0.800	0.248	31%
113 Advertising	0.000	0.006	1998%
114 Other business services	0.490	0.093	19%
115 Public administration and defence; compulsory social secu	39.222	8.294	21%
116 Education	15.719	2.278	14%
117 Human health and veterinary activities	23.698	8.845	37%
118 Social work activities	7.096	2.280	32%
119 Sewage and refuse disposal, sanitation and similar activiti	3.682	0.479	13%
120 Activities of membership organisations not elsewhere clas	0.761	0.127	17%
121 Recreational, cultural and sporting activities	8.502	1.736	20%
122 Other service activities	2.696	0.836	31%
123 Private households with employed persons	0.216	0.006	3%
	86.89		
	63.89		
<b>Total CO2 consumer emissions</b>	<b>730</b>	<b>+/- 38</b>	<b>+/- 5.2%</b>

Uncertainty of embedded CO2 emissions by sector; year 2003	CO2 CONSUMER	Standard error of	Relative error of CO2
	emissions	CO2 CONSUMER	CONSUMER
	E (Mt CO2)	emissions dE (Mt CO2)	emissions dE/E
1 Agriculture, hunting and related service activities	9.630	1.750	18%
2 Forestry, logging and related service activities	0.105	0.048	46%
3 Fishing, operation of fish hatcheries and fish farms; service activities	0.081	0.139	171%
4 Mining of coal and lignite; extraction of peat	0.251	0.610	243%
5 Extraction of crude petroleum and natural gas; service activities	0.640	0.665	104%
6 Mining of metal ores	0.001	0.008	560%
7 Other mining and quarrying	0.575	0.174	30%
8 Production, processing and preserving of meat and meat products	6.077	1.496	25%
9 Processing and preserving of fish and fish products; fruit and vegetables	4.711	1.413	30%
10 Vegetable and animal oils and fats	0.378	0.151	40%
11 Dairy products	3.504	1.303	37%
12 Grain mill products, starches and starch products	0.885	0.298	34%
13 Prepared animal feeds	0.794	0.393	49%
14 Bread, rusks and biscuits; manufacture of pastry goods and cakes	3.447	1.173	34%
15 Sugar	0.100	0.072	72%
16 Cocoa; chocolate and sugar confectionery	1.407	0.457	32%
17 Other food products	2.350	0.806	34%
18 Alcoholic beverages	2.271	1.704	75%
19 Production of mineral waters and soft drinks	1.886	0.736	39%
20 Tobacco products	0.927	0.668	72%
21 Preparation and spinning of textile fibres	0.059	0.045	76%
22 Textile weaving	0.058	0.029	50%
23 Finishing of textiles	0.006	0.019	302%
24 Made-up textile articles, except apparel	1.961	0.856	44%
25 Carpets and rugs	0.683	0.255	37%
26 Other textiles	0.195	0.065	33%
27 Knitted and crocheted fabrics and articles	2.407	2.084	87%
28 Wearing apparel; dressing and dyeing of fur	10.453	8.826	84%
29 Tanning and dressing of leather; manufacture of luggage, vanity cases, vanity bags, purses and wallets	0.236	0.213	90%
30 Footwear	1.711	1.391	81%
31 Wood and wood products, except furniture	1.246	0.433	35%
32 Pulp, paper and paperboard	0.134	0.071	53%
33 Articles of paper and paperboard	1.174	0.835	71%
34 Publishing, printing and reproduction of recorded media	3.782	0.996	26%
35 Coke, refined petroleum products and nuclear fuel	15.731	11.264	72%
36 Industrial gases, dyes and pigments	0.043	0.031	73%
37 Other inorganic basic chemicals	0.003	0.031	1037%
38 Other organic basic chemicals	0.057	0.087	152%
39 Fertilisers and nitrogen compounds	0.162	0.076	47%
40 Plastics and synthetic rubber in primary forms	0.036	0.053	148%
41 Pesticides and other agro-chemical products	0.060	0.029	48%
42 Paints, varnishes and similar coatings, printing ink and mastics	0.269	0.130	48%
43 Pharmaceuticals, medicinal chemicals and botanical products	1.551	1.027	66%
44 Soap and detergents, cleaning and polishing preparations	3.574	1.780	50%
45 Other chemical products	1.694	1.070	63%
46 Man-made fibres	0.029	0.020	69%
47 Rubber products	1.362	0.567	42%
48 Plastic products	2.452	0.659	27%
49 Glass and glass products	0.786	0.316	40%
50 Ceramic goods	1.600	1.004	63%
51 Bricks, tiles and construction products, baked in clay	0.123	0.290	235%
52 Cement, lime and plaster	0.541	0.139	26%
53 Articles of concrete, plaster and cement; cutting, shaping and finishing of concrete	0.509	0.117	23%
54 Basic iron and steel and of ferro-alloys; manufacture of tubes and pipes	0.562	0.169	30%
55 Basic precious and non-ferrous metals	0.506	0.196	39%
56 Casting of metals	0.045	0.025	56%
57 Structural metal products	3.705	1.620	44%
58 Tanks, reservoirs and containers of metal; manufacture of metal structures	0.851	0.516	61%
59 Forging, pressing, stamping and roll forming of metal; powder metallurgy	0.013	0.024	182%
60 Cutlery, tools and general hardware	1.421	0.700	49%
61 Other fabricated metal products	1.496	0.640	43%
62 Machinery for the production and use of mechanical power	1.203	0.577	48%
63 Other general purpose machinery	4.930	2.022	41%



Uncertainty of embedded CO2 emissions by sector; year 2003	CO2 CONSUMER	Standard error of	Relative error of CO2
	emissions	CO2 CONSUMER	CONSUMER
	E (Mt CO2)	emissions dE (Mt CO2)	emissions dE/E
64 Agricultural and forestry machinery	0.788	0.280	35%
65 Machine tools	0.953	0.813	85%
66 Other special purpose machinery	2.239	2.685	120%
67 Weapons and ammunition	0.107	0.056	52%
68 Domestic appliances not elsewhere classified	2.888	1.543	53%
69 Office machinery and computers	6.881	5.051	73%
70 Electric motors, generators and transformers; manufacture	1.848	1.017	55%
71 Insulated wire and cable	0.404	0.178	44%
72 Electrical equipment not elsewhere classified	0.913	0.692	76%
73 Electronic valves and tubes and other electronic compone	0.035	0.030	85%
74 Television and radio transmitters and line for telephony an	4.559	2.919	64%
75 Television and radio receivers, sound or video recording o	3.796	2.719	72%
76 Medical, precision and optical instruments, watches and cl	3.727	2.378	64%
77 Motor vehicles, trailers and semi-trailers	20.575	8.757	43%
78 Building and repairing of ships and boats	1.501	0.546	36%
79 Other transport equipment	1.371	0.534	39%
80 Aircraft and spacecraft	4.969	4.307	87%
81 Furniture	12.120	5.174	43%
82 Jewellery and related articles; manufacture of musical inst	5.615	4.048	72%
83 Sports goods, games and toys	8.452	5.456	65%
84 Miscellaneous manufacturing not elsewhere classified; rec	3.992	2.944	74%
85 Production and distribution of electricity	54.812	10.645	19%
86 Gas; distribution of gaseous fuels through mains; steam ai	25.764	12.268	48%
87 Collection, purification and distribution of water	1.352	0.238	18%
88 Construction	44.128	10.439	24%
89 Sale, maintenance and repair of motor vehicles, and moto	10.532	3.004	29%
90 Wholesale trade and commission trade, except of motor v	17.227	5.415	31%
91 Retail trade, except of motor vehicles and motor cycles; re	23.733	12.183	51%
92 Hotels and restaurants	32.175	8.463	26%
93 Transport via railways	3.905	6.742	173%
94 Other land transport; transport via pipelines	12.929	1.894	15%
95 Water transport	9.847	3.405	35%
96 Air Transport	36.948	16.454	45%
97 Supporting and auxiliary transport activities; activities of tr	0.719	0.243	34%
98 Post and courier activities	0.351	0.129	37%
99 Telecommunications	4.321	2.300	53%
100 Financial intermediation, except insurance and pension fu	1.857	0.495	27%
101 Insurance and pension funding, except compulsory social	7.285	1.733	24%
102 Activities auxiliary to financial intermediation	0.330	0.095	29%
103 Real estate activities with own property; letting of own prop	0.009	0.006	72%
104 Letting of dwellings, including imputed rent	9.037	2.486	28%
105 Real estate activities on a fee or contract basis	0.390	0.170	44%
106 Renting of machinery and equipment without operator and	2.885	0.419	15%
107 Computer and related activities	2.697	0.767	28%
108 Research and development	0.160	0.043	27%
109 Legal activities	0.384	0.127	33%
110 Accounting, book-keeping and auditing activities; tax cons	0.005	0.002	40%
111 Market research and public opinion polling; business and i	0.041	0.015	37%
112 Architectural and engineering activities and related technic	0.784	0.242	31%
113 Advertising	0.034	0.007	21%
114 Other business services	0.520	0.105	20%
115 Public administration and defence; compulsory social secu	44.503	10.459	24%
116 Education	15.913	2.391	15%
117 Human health and veterinary activities	26.195	10.785	41%
118 Social work activities	8.385	2.558	31%
119 Sewage and refuse disposal, sanitation and similar activiti	3.797	0.516	14%
120 Activities of membership organisations not elsewhere clas	0.781	0.143	18%
121 Recreational, cultural and sporting activities	9.339	2.022	22%
122 Other service activities	2.723	0.897	33%
123 Private households with employed persons	0.216	0.005	2%
	87.72		
	63.20		
<b>Total CO2 consumer emissions</b>	<b>763</b>	<b>+/- 41</b>	<b>+/- 5.4%</b>

Uncertainty of embedded CO2 emissions by sector; year 2004	CO2 CONSUMER	Standard error of	Relative error of CO2
	emissions	CO2 CONSUMER	CONSUMER
	E (Mt CO2)	emissions dE (Mt CO2)	emissions dE/E
1 Agriculture, hunting and related service activities	8.922	1.705	19%
2 Forestry, logging and related service activities	0.087	0.045	51%
3 Fishing, operation of fish hatcheries and fish farms; service activities	0.064	0.054	84%
4 Mining of coal and lignite; extraction of peat	0.381	0.454	119%
5 Extraction of crude petroleum and natural gas; service activities	0.664	0.674	102%
6 Mining of metal ores	0.003	0.009	297%
7 Other mining and quarrying	0.320	0.085	27%
8 Production, processing and preserving of meat and meat products	5.778	1.460	25%
9 Processing and preserving of fish and fish products; fruit and vegetables	4.434	1.356	31%
10 Vegetable and animal oils and fats	0.351	0.143	41%
11 Dairy products	3.279	1.216	37%
12 Grain mill products, starches and starch products	0.787	0.256	33%
13 Prepared animal feeds	0.723	0.370	51%
14 Bread, rusks and biscuits; manufacture of pastry goods and cakes	3.264	1.556	48%
15 Sugar	0.156	0.070	45%
16 Cocoa; chocolate and sugar confectionery	1.311	0.457	35%
17 Other food products	2.341	0.777	33%
18 Alcoholic beverages	2.066	1.686	82%
19 Production of mineral waters and soft drinks	1.758	0.802	46%
20 Tobacco products	0.866	0.663	77%
21 Preparation and spinning of textile fibres	0.015	0.121	789%
22 Textile weaving	0.049	0.036	74%
23 Finishing of textiles	0.002	0.019	1065%
24 Made-up textile articles, except apparel	1.907	1.087	57%
25 Carpets and rugs	0.578	0.359	62%
26 Other textiles	0.085	0.036	43%
27 Knitted and crocheted fabrics and articles	2.154	1.903	88%
28 Wearing apparel; dressing and dyeing of fur	9.697	8.474	87%
29 Tanning and dressing of leather; manufacture of luggage, vanity cases, vanity bags, purses and wallets	0.224	0.451	201%
30 Footwear	1.546	1.290	83%
31 Wood and wood products, except furniture	1.048	0.634	60%
32 Pulp, paper and paperboard	0.100	0.093	93%
33 Articles of paper and paperboard	1.101	0.960	87%
34 Publishing, printing and reproduction of recorded media	3.727	0.980	26%
35 Coke, refined petroleum products and nuclear fuel	18.739	13.299	71%
36 Industrial gases, dyes and pigments	0.082	0.025	30%
37 Other inorganic basic chemicals	0.021	0.145	690%
38 Other organic basic chemicals	0.069	0.122	176%
39 Fertilisers and nitrogen compounds	0.057	0.091	160%
40 Plastics and synthetic rubber in primary forms	0.086	0.051	59%
41 Pesticides and other agro-chemical products	0.068	0.030	44%
42 Paints, varnishes and similar coatings, printing ink and mastics	0.346	0.129	37%
43 Pharmaceuticals, medicinal chemicals and botanical products	1.309	0.890	68%
44 Soap and detergents, cleaning and polishing preparations	3.413	1.782	52%
45 Other chemical products	1.770	1.080	61%
46 Man-made fibres	0.004	0.046	1141%
47 Rubber products	1.220	0.558	46%
48 Plastic products	2.424	0.653	27%
49 Glass and glass products	0.730	0.321	44%
50 Ceramic goods	1.546	1.041	67%
51 Bricks, tiles and construction products, baked in clay	0.054	0.249	463%
52 Cement, lime and plaster	0.523	0.166	32%
53 Articles of concrete, plaster and cement; cutting, shaping and finishing of stone	0.506	0.116	23%
54 Basic iron and steel and of ferro-alloys; manufacture of tubes and pipes	0.086	0.144	167%
55 Basic precious and non-ferrous metals	0.555	0.232	42%
56 Casting of metals	0.023	0.012	51%
57 Structural metal products	3.282	1.579	48%
58 Tanks, reservoirs and containers of metal; manufacture of metal structures	0.885	0.509	58%
59 Forging, pressing, stamping and roll forming of metal; powder metallurgy	0.117	0.043	37%
60 Cutlery, tools and general hardware	1.319	0.679	52%
61 Other fabricated metal products	1.529	0.651	43%
62 Machinery for the production and use of mechanical power	1.085	0.526	48%
63 Other general purpose machinery	4.635	1.978	43%

Uncertainty of embedded CO2 emissions by sector; year 2004	CO2 CONSUMER	Standard error of	Relative error of CO2
	emissions	CO2 CONSUMER	CONSUMER
	E (Mt CO2)	emissions dE (Mt CO2)	emissions dE/E
64 Agricultural and forestry machinery	0.733	0.298	41%
65 Machine tools	0.867	0.764	88%
66 Other special purpose machinery	1.890	2.428	128%
67 Weapons and ammunition	0.048	0.028	58%
68 Domestic appliances not elsewhere classified	2.745	1.479	54%
69 Office machinery and computers	6.302	4.698	75%
70 Electric motors, generators and transformers; manufacture	1.809	0.984	54%
71 Insulated wire and cable	0.501	0.220	44%
72 Electrical equipment not elsewhere classified	0.980	0.707	72%
73 Electronic valves and tubes and other electronic compone	0.090	0.039	43%
74 Television and radio transmitters and line for telephony an	4.053	3.108	77%
75 Television and radio receivers, sound or video recording o	4.090	3.020	74%
76 Medical, precision and optical instruments, watches and cl	3.500	2.252	64%
77 Motor vehicles, trailers and semi-trailers	18.905	8.695	46%
78 Building and repairing of ships and boats	1.213	0.427	35%
79 Other transport equipment	1.247	0.514	41%
80 Aircraft and spacecraft	3.264	2.723	83%
81 Furniture	12.040	5.417	45%
82 Jewellery and related articles; manufacture of musical inst	4.932	3.566	72%
83 Sports goods, games and toys	7.799	5.140	66%
84 Miscellaneous manufacturing not elsewhere classified; rec	3.491	2.690	77%
85 Production and distribution of electricity	59.068	11.485	19%
86 Gas; distribution of gaseous fuels through mains; steam ai	28.215	13.046	46%
87 Collection, purification and distribution of water	1.345	0.173	13%
88 Construction	45.772	10.514	23%
89 Sale, maintenance and repair of motor vehicles, and moto	10.713	3.024	28%
90 Wholesale trade and commission trade, except of motor v	16.810	5.494	33%
91 Retail trade, except of motor vehicles and motor cycles; re	24.436	13.274	54%
92 Hotels and restaurants	31.038	8.290	27%
93 Transport via railways	4.045	5.139	127%
94 Other land transport; transport via pipelines	12.191	2.059	17%
95 Water transport	9.269	3.994	43%
96 Air Transport	37.439	16.717	45%
97 Supporting and auxiliary transport activities; activities of tr	0.758	0.201	27%
98 Post and courier activities	0.339	0.160	47%
99 Telecommunications	4.320	2.220	51%
100 Financial intermediation, except insurance and pension fu	1.793	0.496	28%
101 Insurance and pension funding, except compulsory social	6.940	1.649	24%
102 Activities auxiliary to financial intermediation	0.355	0.103	29%
103 Real estate activities with own property; letting of own prop	0.009	0.012	137%
104 Letting of dwellings, including imputed rent	8.666	2.300	27%
105 Real estate activities on a fee or contract basis	0.510	0.213	42%
106 Renting of machinery and equipment without operator and	2.363	0.335	14%
107 Computer and related activities	2.579	0.739	29%
108 Research and development	0.126	0.035	28%
109 Legal activities	0.661	0.216	33%
110 Accounting, book-keeping and auditing activities; tax cons	0.011	0.003	25%
111 Market research and public opinion polling; business and i	0.042	0.014	33%
112 Architectural and engineering activities and related technic	0.911	0.295	32%
113 Advertising	0.015	0.004	26%
114 Other business services	0.453	0.072	16%
115 Public administration and defence; compulsory social secu	43.872	10.144	23%
116 Education	15.817	2.231	14%
117 Human health and veterinary activities	26.750	10.603	40%
118 Social work activities	8.943	2.810	31%
119 Sewage and refuse disposal, sanitation and similar activiti	3.773	0.506	13%
120 Activities of membership organisations not elsewhere clas	0.774	0.136	18%
121 Recreational, cultural and sporting activities	9.613	2.121	22%
122 Other service activities	2.599	0.835	32%
123 Private households with employed persons	0.216	0.005	2%
	89.41		
	63.49		
<b>Total CO2 consumer emissions</b>	<b>762</b>	<b>+/- 42</b>	<b>+/- 5.5%</b>

## 8 Appendix G: References

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