

# Local Authority CO<sub>2</sub> emissions estimates 2011

## Methodology Summary

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# 2011 National Statistics on Carbon Dioxide emissions at Local Authority and Regional level

## Methodology Summary

National Statistics of carbon dioxide emissions for local authority areas for 2011, and revised figures for the years 2005-2010, have been produced on behalf of DECC by Ricardo-AEA.

This report provides a summary to the methodology used to calculate carbon dioxide emissions (CO<sub>2</sub>) at local authority (LA) level.

Full details of the results and methodology are available in the Technical Report and accompanying spreadsheets, which can be found at the following web-link:

[www.gov.uk/government/publications/local-authority-emissions-estimates](http://www.gov.uk/government/publications/local-authority-emissions-estimates)

<b>Contents</b>	<b>Page</b>
<b>1. Background on National CO<sub>2</sub> emissions estimates; National Atmospheric Emissions Inventory (NAEI)</b>	<b>4</b>
1.1 National Statistics accreditation	5
<b>2. Background on Local Authority CO<sub>2</sub> emissions estimates</b>	<b>6</b>
2.1 Sectoral breakdown	6
2.2 Summary of improvements and recalculations for 2011	6
<b>3. Methodology for Local Authority CO<sub>2</sub> emissions estimates</b>	<b>8</b>
3.1 Industrial and commercial	11
3.2 Domestic	14
3.3 Transport	17
3.4 Land use, land use change, and forestry (LULUCF)	19
<b>4. Reasons for changes to previous years' emissions</b>	<b>20</b>
<b>5. Carbon dioxide emissions within the scope of influence of Local Authorities (previously NI 186) – differences from the full National Statistics dataset</b>	<b>23</b>
<b>6. Planned improvements to the dataset</b>	<b>23</b>

## 1. Background on National CO<sub>2</sub> emissions estimates; National Atmospheric Emissions Inventory (NAEI)

The UK's National Greenhouse Gas (GHG) inventory, produced on behalf of DECC by Ricardo-AEA, includes estimates of greenhouse gas emissions, such as carbon dioxide (CO<sub>2</sub>), for the UK. DECC use these estimates to meet international reporting obligations such as reporting progress against Kyoto protocol targets.

To estimate national CO<sub>2</sub> emissions, they are first defined in terms of coverage and accountability:

- **Coverage:** The sources included and excluded in the estimates are based on guidelines set out by the Intergovernmental Panel on Climate Change (IPCC). For example, the estimates need to include emissions caused by all domestic, commercial, industrial and agricultural fuel and electricity use, as well as emissions associated with transport and land use change. However, international shipping and aviation are excluded.
- **Accountability:** There are two main definitions of who is responsible for the emissions – the producer (or source) and the end-user. The former definition assigns emissions to where they are geographically emitted. For the latter, the emissions are apportioned out to the end-user. For example, all the carbon dioxide produced by a power station is allocated to the power station when reporting on a source basis. However, when applying the end-user method, these emissions are reallocated to the users of the electricity generated, such as domestic homes or large industrial users.

Of the two accountability definitions the geographic source of the emissions may be the most useful for certain pollutants. However, for CO<sub>2</sub> emissions which have no localised effects (e.g. on health), the end-user approach can be more useful.

Further information on definitions can be found in the NAEI web site<sup>1</sup>.

To produce a national CO<sub>2</sub> emissions estimate, data are collected that allow either direct reporting (based on site operator emissions returns), calculation (from reported fuel use), or modelling of the different emission components specified by the definition. The end-user allocation is an additional step in the UK's National GHG inventory compilation and requires further modelling. Further details can be found in Annex 11 of the UK's National GHG inventory Report<sup>2</sup>.

Once measured/estimated, the components can be combined in different formats depending on user needs – by sector (e.g. all industrial emissions), by fuel type (e.g. all emissions associated with the burning of coal), and overall.

To produce estimates of CO<sub>2</sub> emissions by smaller geographic areas such as Local Authorities (LAs), the national emissions based on the end-user definition are used as a starting point. Some modelling already involved in producing component

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<sup>1</sup> <http://naei.defra.gov.uk/>

<sup>2</sup> [http://naei.defra.gov.uk/reports/reports?report\\_id=747](http://naei.defra.gov.uk/reports/reports?report_id=747)

estimates at the national level lends itself to dis-aggregation by smaller geographic area; however in some cases additional data is required.

## 1.1 National Statistics accreditation

The United Kingdom Statistics Authority (UKSA) has designated carbon dioxide emissions at local authority level as National Statistics, in accordance with the Statistics and Registration Service Act 2007 and signifying compliance with the Code of Practice for Official Statistics<sup>3</sup>.

Designation can be broadly interpreted to mean that the statistics:

- meet identified user needs;
- are well explained and readily accessible;
- are produced according to sound methods, and
- are managed impartially and objectively in the public interest.

Once statistics have been designated as National Statistics it is a statutory requirement that the Code of Practice shall continue to be observed.

In terms of comparability, these data need to represent a consistent time series, with previous estimates being revised to reflect the methodological changes used in calculating the 2011 estimates. This is important as it allows changes to be monitored over time. There is a commitment to back-cast any future improvements to methodology where appropriate so that a comparable time-series is maintained with a 2005 base year. Data for earlier years will not be made available because DECC sub-national data for gas and electricity are not available on a consistent basis for these years.

A range of Quality Assurance and Quality Control<sup>4</sup> procedures are used in the compilation of this dataset. The procedures follow a methodology consistent with that for the national inventory compilation. This report summarises the data sources used and the key assumptions used when compiling estimates. Further technical details are provided in the Technical Report that accompanies the statistical release.

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<sup>3</sup> [www.statisticsauthority.gov.uk/assessment/code-of-practice/index.html](http://www.statisticsauthority.gov.uk/assessment/code-of-practice/index.html)

<sup>4</sup> [www.gov.uk/government/publications/uk-greenhouse-gas-emissions-statistics-qaqc-plan](http://www.gov.uk/government/publications/uk-greenhouse-gas-emissions-statistics-qaqc-plan)  
(Contacts and further information section)

## **2. Background on Local Authority CO<sub>2</sub> emissions estimates**

### **2.1 Sectoral breakdown**

As with the national end-user estimates, the emissions associated with all domestic, commercial, industrial and agricultural fuel and electricity use, as well as emissions associated with transport and land use change must be measured or modelled but now at a lower level of geography. The additional spatial disaggregation required means some components must be estimated in a different way compared with the national methodology. The following sectors/sub-sectors are each estimated in a different way:

#### **Industrial and commercial**

- electricity use
- gas use
- large industrial installations
- other fuels
- agricultural combustion

#### **Domestic**

- electricity use
- gas use
- other fuels

#### **Transport**

- A-roads
- motorways
- minor roads
- diesel railways
- other

#### **Land use, land use change, and forestry**

### **2.2 Summary of improvements and recalculations for 2011**

The carbon dioxide emissions Local Authority dataset is reviewed every year, and the whole historical data series is revised to incorporate methodological improvements and new data. The main improvements made to the dataset this year are:

#### **Emissions from Northern Ireland gas use:**

There has been a change to the methodology to ensure that Northern Ireland gas consumption is treated differently to the GB gas consumption data, due to the nature of the respective datasets. Northern Ireland gas consumption data is not weather corrected, whereas the GB gas data is. Previously, total UK gas consumption data which is used in the UK GHG inventory – and is not weather corrected – was allocated to the rest of the UK using both weather corrected GB gas data and non-weather corrected Northern Ireland gas consumption data, in a single step. However, in order to make better use of the data available on Northern Ireland, the process now removes Northern Ireland data from the UK total before emissions are allocated to GB using sub-national data. This methodology change applies to both

the industrial and domestic sector, however the industrial sector also has incorporated revised gas consumption data from energy suppliers further adding to the changes.

### **Large Industrial Installations:**

There are significant changes to some sites arising from gaps that were identified during the annual UNFCCC review of the UK's National GHG inventory. These changes have been applied consistently across the time series.

### **Industrial and Commercial Other Fuels:**

There have been some small revisions in national emissions estimates for sources that fall within this sector. Changes have also occurred due to the re-allocation of aircraft support vehicles from this sector to "Transport – Other".

### **Road Transport (A roads)**

Previous annual average daily flows for road traffic in Northern Ireland were taken from 2009 data as this was the latest data available when these statistics were compiled in last year's dataset. Emissions for this sector are now estimated based on 2010 annual average daily flows.

### **Road Transport (Minor roads)**

A new methodology has been used in the UK GHG inventory this year to account for emissions from minor roads. This reflects changes on the road network and updates to the Department for Transport's minor road traffic counts.

### **Diesel Railways**

There is also an updated methodology which uses data from the Department for Transport's Rail Emissions Model. This provides emissions estimates from each strategic route in GB for passenger and freight trains. The emissions along each rail link are assumed to be uniform along the length of the rail link as no information on load variations is available.

### **Transport Other**

This sector was previously called "Road Transport Other" and included just LPG and lubricants used in road vehicles. This sector has now been redefined, and now includes a new source, inland waterways and aircraft support vehicles which have been re-allocated from Sector D (Industrial and Commercial Other Fuels). This category now also includes coal combustion which is thought to mainly be in use on heritage railways. However, there is not enough information on heritage railways to map these accurately and they have therefore been mapped using the same method as applied for regional rail emissions.

### **Land Use, Land Use Change and Forestry**

There have been a number of changes in this sector such as: changes to the mapping methodologies; adjustment on split of forest planting on mineral and organic soil; new data on wildfires; new estimates of biomass and dead organic matter losses based on country specific densities; and new activity data for peat extraction.

### 3. Methodology for Local Authority CO<sub>2</sub> emissions estimates

This section of the report summarises how emissions have been estimated within each of the separate sub-sectors, particularly with reference to the underlying data on which the estimates have been based. A separate Technical Report, available on the DECC website, provides further details of these sectoral methodologies.

Firstly, it is worth making explicit a distinction between the two generic types of methodology involved, which are either where emissions are *directly* measured or where they are *modelled*.

In the first case, the component of emissions is *directly* measured, such as with electricity and gas use (both industrial and domestic). Electricity and gas consumption data have been collected by DECC, aggregated to the LA level and published as National Statistics. Even where accurate activity data like this exist, an emissions factor that defines the amount of CO<sub>2</sub> produced per unit of activity (e.g. of electricity generation) needs to be applied to convert the activity to actual emissions. There are also data on emissions from “point sources” such as large industrial sites that can be assigned to the LA in which they are situated by overlaying their location on a UK map with LA boundaries. This sort of “bottom-up” processing tends to be more accurate and is therefore preferable, although the emissions factors, where required, do still introduce an element of modelling as the emissions themselves are not measured.

In the latter case, direct records of spatially located activity are not available. Therefore, the national emissions for that activity must be divided out geographically in some way instead. This might involve *modelling* local emissions using the most up to date population or employment data, for which location is known, so as to allocate domestic and industrial emissions in a proportional way. The type of employment/industry can be taken into account as different industry types use different types and amounts of fuel. Other supporting data, e.g. the location of smoke control areas where coal is not burned, can be used to constrain and improve these models. This type of processing can be called “top-down” and may be less accurate. In most cases though, it should be noted that these top-down models involve production of 1km<sup>2</sup> emissions distribution maps that are then aggregated back up to LA level using LA boundaries to determine which emissions belong where, in a similar way to point source emissions.

Some sectors of the UK national inventory are not included in the local CO<sub>2</sub> estimates because these could not be spatially disaggregated to LA level. These are offshore emissions from oil and gas extraction, domestic aviation emissions, fishing, coastal shipping, exports and waste incineration (except for energy generation). International aviation and shipping are excluded from the UK national inventory. Emissions in the UK Crown Dependencies and Overseas Territories are also not included in these estimates.

**Table 1** lists the sub-components of the dataset, along with the data source type, and a reference to a detailed methodology section in the Technical Report explaining how that element is estimated. **Figure 1**, that follows the table, illustrates the data sources, transformations and flows used to compile the final dataset.



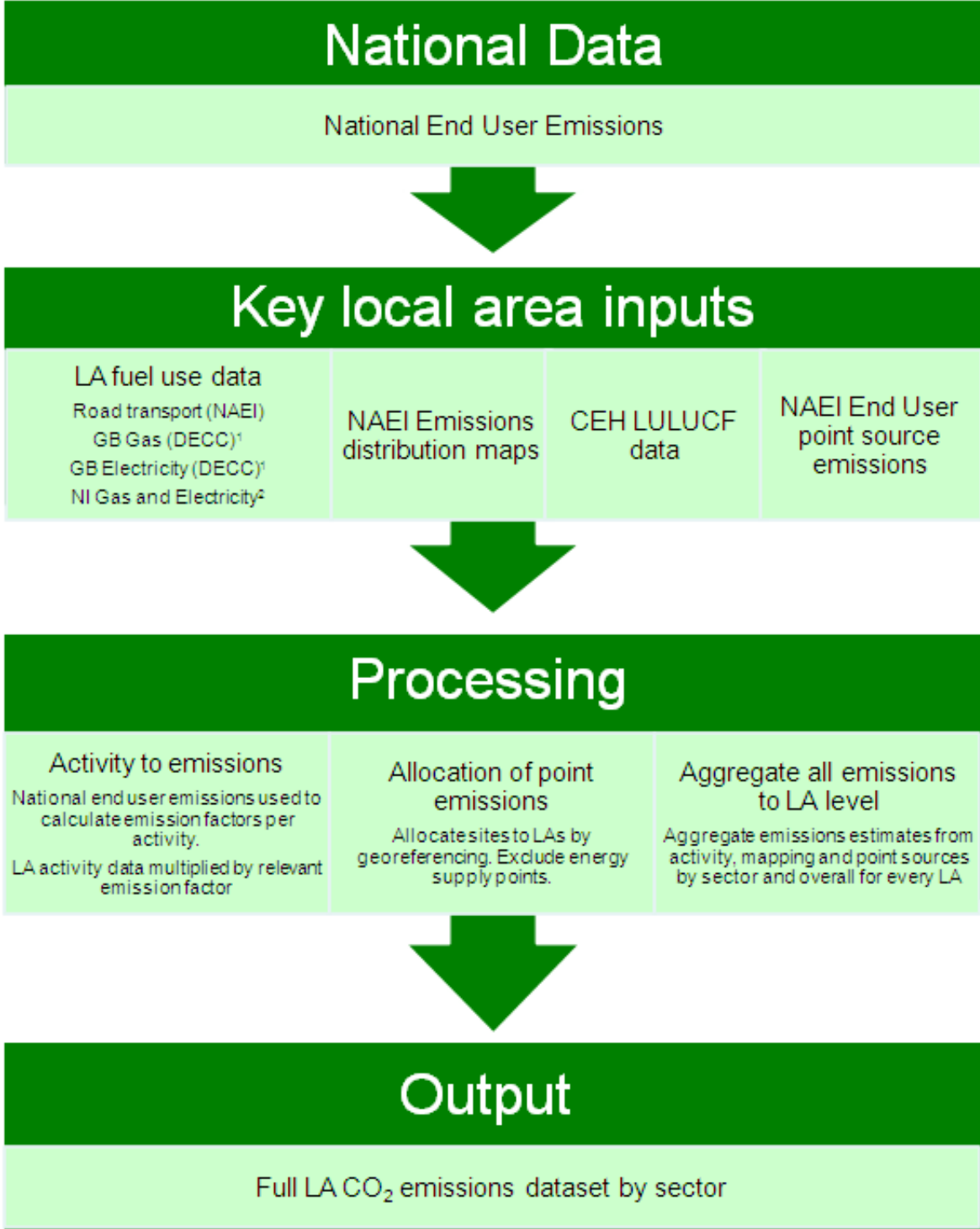
**Table 1. Methodology summary for local CO<sub>2</sub> reporting sectors and fuels**

Sector Code	New Sector Heading	Data source / method summary	Technical Report section
A	Industrial, Commercial and Electricity	DECC GB regional energy statistics and DECC NI non domestic electricity statistics	2
B	Industrial, Commercial and Gas	DECC regional energy statistics. Further data for Northern Ireland from energy providers	3
C	Large Industrial Installations	Point source emissions for large industrial installations.	4
D	Industrial and Commercial Other Fuels <sup>(1)(2) (4)</sup>	Remaining emissions (all fuels – excluding electricity and gas and large industrial installations emissions from old sectors D to I) distributed using high resolution (1km) emissions distribution of fuel use based in employment distributions and fuel intensity by sector.	5
E	Agricultural Combustion <sup>(3)</sup>	High resolution (1km) emissions distribution maps developed under the NAEI programme	6
F	Domestic Electricity	DECC regional energy statistics and DECC NI domestic electricity statistics	7
G	Domestic Gas	DECC regional energy statistics; Further data for Northern Ireland from energy providers.	8
H	Domestic 'Other Fuels'	High resolution (1km) emissions distribution maps developed under the NAEI programme	9
I	Road Transport (A roads)	Based on the NAEI data used by Ricardo-AEA to compile the DECC road transport fuel estimates. Emissions from fuel combustion in the road transport sector based on detailed DfT traffic census data and NAEI emissions factors.	10
J	Road Transport (Motorways)		
K	Road Transport (Minor roads)		
L	Diesel Railways	UK total based on DECC's DUKES statistics. The emissions are spatially disaggregated using data from the Department for Transport's Rail Emissions Model	11
M	Transport Other	NAEI traffic flow maps, movement of aircraft from Civil Aviation Authority, DECC energy statistics, British Waterways, DfT, Environment Agency, Maritime and Coastguard Agency, Waterways Ireland.	12
N	LULUCF Net Emissions	LULUCF regional data supplied by CEH	13
	Unallocated emissions	Emissions not allocated for confidentiality reasons or because of problems with geo-referencing	
	Sectors not included in these estimates that are included in national totals	Aviation <sup>(4)</sup> , Offshore gas and oil, Shipping (including coastal shipping and fishing) <sup>(4)</sup>	

Notes

- (1) Includes the management of airports (stationary heating and power)
- (2) Includes industry autogeneration of electricity
- (3) Includes agricultural off-road machinery
- (4) International aviation and shipping are outside scope of the UK inventory and are therefore not included in the National Totals
- (5) Colours represent the high level sectors: industrial/commercial, domestic, transport and LULUCF

**Figure 1. Summary of data sources, transformations and flows used to compile the Local CO<sub>2</sub> emissions**



Notes:  
 1. DECC LA electricity and gas use data are now National Statistics meaning the data meet stringent data quality criteria. Emissions related to these sources account for a large proportion of total local emissions.  
 2. NI LA electricity uses DECC subnational NI domestic and non domestic electricity dataset. NI LA gas is provided by Northern Ireland energy providers.

### **3.1 Industrial and commercial**

Since the input data – the LA energy and fuel use data produced by DECC – groups industrial and commercial activities together for the LA, carbon dioxide emissions for this sector follow the same grouping. Industrial and commercial emissions are therefore grouped together, meaning that the LA CO<sub>2</sub> data shows fewer sectoral breakdowns than the national end-user emissions data.

#### ***3.1.1 Industry and commercial electricity use***

Electricity consumption data for 2005-2011 published by DECC<sup>5</sup> is geographically accurate to the level of an address. Industrial and commercial meter data is reported separately from domestic data, and for domestic meters logging over a threshold of 100,000kWh has nominally been re-classified as industrial. Further, the addresses of those meters logging usage between 50,000 and 100,00kWh are manually checked, and if the address is indicative of industrial or commercial activity these records are also re-classified.

To convert the LA electricity use into estimates of CO<sub>2</sub> emissions, an emissions factor defining CO<sub>2</sub> per GWh is applied. This varies from year to year and is based on the proportion of electricity produced using different fuel types for that year at the national level. In other words, if the local power station burns coal which produces relatively more CO<sub>2</sub> per unit of electricity, then all local users who get their electricity from that power station will not be “penalised” for not having a choice.

For Northern Ireland, emissions are allocated based on the estimates of non-domestic electricity consumption in 2009-2010 at District Council level, published by DECC<sup>6</sup>. These estimates are based on aggregated meter point data derived from NIE’s Distribution Use of System (DUoS) Billing system.

#### ***3.1.2 Industry and commercial gas use***

Gas use per LA per calendar year is produced by DECC<sup>7</sup> using meter point data that is geographically accurate to the level of an address. The only way to distinguish industrial and commercial users from domestic users for this data is to use an arbitrary cut off. DECC have classified all users above 73,200kWh as industrial and commercial, meaning some small and medium businesses with usage below this threshold are incorrectly included in the domestic sector.

There are two factors users should note about the relationship between emissions and energy consumption for this sector.

Firstly, the Annual Quantities (AQ) data used in the sub-national analysis – which is an estimate of annualised consumption between two meter readings at least 6 months apart – covers the gas year from 1<sup>st</sup> October to 30<sup>th</sup> September, rather than a calendar year basis, i.e. January to December.

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<sup>5</sup> [www.gov.uk/government/statistical-data-sets/regional-and-local-authority-electricity-consumption-statistics-2005-to-2011](http://www.gov.uk/government/statistical-data-sets/regional-and-local-authority-electricity-consumption-statistics-2005-to-2011)

<sup>6</sup> [www.gov.uk/government/statistical-data-sets/sub-national-non-domestic-electricity-consumption-in-northern-ireland-2010](http://www.gov.uk/government/statistical-data-sets/sub-national-non-domestic-electricity-consumption-in-northern-ireland-2010)

<sup>7</sup> [www.gov.uk/government/statistical-data-sets/gas-sales-and-numbers-of-customers-by-region-and-local-authority](http://www.gov.uk/government/statistical-data-sets/gas-sales-and-numbers-of-customers-by-region-and-local-authority)

Secondly, DECC local consumption gas data are weather corrected using a 17 year average weather correction<sup>8</sup>. However the national total, as reported in DUKES, is not weather corrected. The total LA CO<sub>2</sub> emissions from gas consumption are consistent with those from the national inventory, which is not weather corrected. This therefore results in a partial weather correction whereby the impact of changes in the weather are still evident in the time series for an individual Local Authority but the magnitude of change is reduced. This is covered in more detail in section 3.1 of the *Technical Report*.

More information on the weather correction methodology can be found on the National Grid website<sup>9</sup>.

Large industrial users at specific locations are not included in the DECC data, due to statistical disclosure control. Ricardo-AEA used alternative data held on these installations in the NAEI and liaised with DECC to ensure the correct installations were covered (to avoid both complete exclusion and double counting of any specific location). The total gas used by these large installations is approximately a quarter of the national estimate for industrial and commercial gas use and, as their location is known, these installations can be assigned to the correct LA. (The total gas use for all the excluded installations in the DECC data is known and is close to but not the same as the total when using the alternative data from the national inventory).

The remaining three quarters of the national emissions estimate (i.e. after the above emissions are subtracted) are then added to the emissions associated with domestic gas use. This new total is used to calculate an emissions factor per unit of gas at the National level that can then be multiplied by actual gas use at the local level as captured by the local meter point data.

Data for Northern Ireland gas consumption has been provided directly to Ricardo-AEA by the energy suppliers Phoenix and Firmus energy who this year have provided revised non-weather corrected gas consumption data. There has been a change to the methodology to ensure that Northern Ireland gas consumption is treated differently to the GB gas consumption data, which is weather corrected. Previously, total UK gas consumption data which is used in the UK GHG inventory – and is not weather corrected – was allocated to the rest of the UK using both weather corrected GB gas data and non-weather corrected Northern Ireland gas consumption data, in a single step. However, in order to make better use of the data available on Northern Ireland, the process now removes Northern Ireland data from the UK total before emissions are allocated to GB using sub-national data.

### **3.1.3 Large industrial installations**

Emissions from large industrial installations are mapped using the NAEI database of point sources. A “point source” is in general a large energy consumer, such as a large industrial site. The site specific data have been compiled from a number of various sources like the Environment Agency Pollution Inventory, the EU Emissions

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<sup>8</sup> [www.gov.uk/government/publications/regional-energy-data-guidance-note](http://www.gov.uk/government/publications/regional-energy-data-guidance-note)

<sup>9</sup> [www.nationalgrid.com/uk/Gas/OperationalInfo/operationaldocuments/Gas+Demand+and+Supply+Forecasting+Methodology/](http://www.nationalgrid.com/uk/Gas/OperationalInfo/operationaldocuments/Gas+Demand+and+Supply+Forecasting+Methodology/)

Trading Scheme Installations (which reported emissions to the Environment Agency for the period 2005-2011) and other information obtained from Ricardo-AEA's industry contacts.

The emissions in the NAEI point source database are calculated as "at source" emissions. Therefore, where appropriate, an "end-user" adjustment was made to take into account the additional emissions generated by the use of electricity in that particular site.

There are significant changes to some sites arising from gaps that were identified during the annual UNFCCC review of the UK's National GHG inventory. These changes have been applied consistently across the time series. There has also been a change in the factor which is applied to source emissions to estimate end-user emissions for blast furnaces; this factor has been revised downwards resulting in a decrease in emissions 2009 and 2010.

Details of how emissions from large industrial installations have been derived, can be found in Section 4 of the Technical Report.

### **3.1.4 Industrial and commercial 'Other fuels' (oil and other solid fuels)**

While electricity and gas emissions for the industrial and commercial sector are estimated using DECC regional statistics and emissions from large industrial installations are provided directly to Ricardo-AEA, there are other emissions that cannot be directly measured and need to be estimated with the use of additional modelling. This includes emissions from the other fuels for the public, commercial and agricultural sectors.

The industrial sectors in the NAEI are mapped using a combination of "point source" estimates of emissions and area source employment based distributions. The national level data to distribute locally come from the DECC UK Energy Consumption statistics. For some sectors the NAEI's UK total emissions estimate is entirely accounted for by point source emissions; in this instance all emissions will belong to the sector labelled "Large industrial installations". In other cases there are sectors that have no identified point sources, in which case all emissions have to be modelled as an area source. Many sectors, however, are comprised of a combination of point source and area source emissions. In this situation, point source emissions are mapped explicitly in the LA where they belong and the remaining emissions (national total minus point source emissions total) are treated as an area source and are distributed across the UK using modelling based on detailed employment data and fuel used.

To do this, the emissions for each sector, by fuel type, are matched up with the equivalent total number of employees who work in that sector using data from the Inter-Departmental Business Register (IDBR). The matching is possible using Standard Industrial Classification (SIC) codes<sup>10</sup> that define the activity type in both datasets. This matching allows calculation of the average fuel use, or "fuel intensity", per employee for each different type of activity (or SIC code). The IDBR data also

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<sup>10</sup> [www.gov.uk/government/organisations/department-of-energy-climate-change/series/energy-consumption-in-the-uk](http://www.gov.uk/government/organisations/department-of-energy-climate-change/series/energy-consumption-in-the-uk)

includes geographic location so that each employee (and their estimated fuel use) can be assigned to a 1km<sup>2</sup> grid square, and by extension to the relevant LA using LA boundary information. This estimated LA fuel use can then be multiplied by emissions factors depending on the fuel in question (oil, solid). Finally, the resulting emissions are combined with point source emissions to calculate final oil and solid fuel related emissions per LA.

This modelling approach also incorporates various other factors. Firstly, since the point source emissions are often from sites that employ large numbers of people, these sites are removed from the employment data before it is used to distribute the remaining emissions, so as to prevent double counting. Secondly, data on gas availability is used to build up a picture of the gas network, and in particular to determine the locations that do not have access to gas and that are therefore most likely to be using oil and solid fuel. Finally, data on the location of Smoke Control Areas (SCAs) is used to constrain burning of coal to outside these areas, which has the effect of reducing the emissions from oil within these areas.

It should be noted that a limitation of this modelling approach is that it assumes the same fuel intensity per sector is present uniformly across the whole country, which may not be the case in practice.

Other national end-user industrial and commercial emissions from sectors such as waste, dry cleaning, petrol stations and chemical manufacture are also distributed similarly using employment data.

There have been some small revisions in national emissions estimates for sources that fall within this sector. Changes have also occurred due to the re-allocation of aircraft support vehicles from this sector to “Transport – Other”

### **3.1.5 Agricultural combustion**

Emissions from agricultural oil and solid fuel use are estimated at the local level using IDBR employment data.

Other agricultural emissions estimated at the national level are those associated with off-road machinery use and breakdowns of pesticides. Emissions from off-road machinery use are distributed using arable, pasture and forestry land use data combined with information on the number of hours of use of tractors and other machinery on the different types of land. Emissions from pesticides applied to crops are distributed using maps of arable land cover.

## **3.2 Domestic**

### **3.2.1 Domestic electricity use**

The emissions estimates are based on LA domestic electricity use data produced by DECC<sup>11</sup>. The methodology is the same as for the industrial and commercial electricity emissions in that there is a 50,000kWh cut off for domestic users with the rest being

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<sup>11</sup> [www.gov.uk/government/statistical-data-sets/regional-and-local-authority-electricity-consumption-statistics-2005-to-2011](http://www.gov.uk/government/statistical-data-sets/regional-and-local-authority-electricity-consumption-statistics-2005-to-2011)

re-classified as industrial, and the same emissions factors are applied to each unit of electricity used.

For Northern Ireland, emissions are allocated based on the estimates of domestic electricity consumption in 2008-2009 at District Council level, published by DECC<sup>12</sup>. These estimates are based on aggregated meter point data derived from NIE's Distribution Use of System (DUoS) Billing system.

### **3.2.2 Domestic gas use**

The emissions estimates are based on LA domestic gas use data produced by DECC<sup>13</sup>. The methodology is the same as for the industrial and commercial gas emissions in that there is a 73,200kWh cut off for domestic users with the rest being re-classified as industrial.

In this case, there are no exclusions from the DECC dataset due to statistical disclosure control as is the case with the industrial users. Therefore the national CO<sub>2</sub> emissions factor per unit of gas use, as defined for industrial and commercial gas use earlier, is then multiplied by the local meter point data.

There has been a change to the methodology to ensure that Northern Ireland gas consumption is treated differently to the GB gas consumption data, which is weather corrected. Previously, total UK gas consumption data which is used in the UK GHG inventory – and is not weather corrected – was allocated to the rest of the UK using both weather corrected GB gas data and non-weather corrected Northern Ireland gas consumption data, in a single step. However, in order to make better use of the data available on Northern Ireland, the process now removes Northern Ireland data from the UK total before emissions are allocated to GB using sub-national data.

### **3.2.3 Domestic 'other fuels' (oil and solid fuels)**

High resolution distributions of domestic solid and liquid fuels for Great Britain (England, Scotland and Wales) have been updated for the sub-national energy data and these were used to generate the emissions estimates presented in this report. In the 2008 and 2009 inventories, two mapping methods were implemented; one method being applied to England, Scotland and Wales (Great Britain) and the other method for Northern Ireland. This approach was necessary owing to varying levels of data quality and availability in Northern Ireland compared to the rest of GB where higher resolution datasets were more readily available.

The revised methodology has adopted a new logic to model the distribution of the domestic fuel consumption across Great Britain. The methods and inputs needed to model the data are the following:

- ONS 2001 census: census data gives details of the composition of the house, number of floors, number of rooms etc; it is used to calculate percentages of houses types within each local area.

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<sup>12</sup> [www.gov.uk/government/statistical-data-sets/experimental-sub-national-domestic-electricity-consumption-statistics-for-northern-ireland-2009](http://www.gov.uk/government/statistical-data-sets/experimental-sub-national-domestic-electricity-consumption-statistics-for-northern-ireland-2009)

<sup>13</sup> [www.gov.uk/government/statistical-data-sets/gas-sales-and-numbers-of-customers-by-region-and-local-authority](http://www.gov.uk/government/statistical-data-sets/gas-sales-and-numbers-of-customers-by-region-and-local-authority)

- Ordnance Survey Code-Point data: used to generate a full-postcode spatial distribution database.
- DECC 1x1km domestic gas for Great Britain: used to identify locations where a gas network is present.
- Electricity and gas at Middle Level Super Output Area (MLSOA) for Scotland and electricity and gas at Lower Level Super Output Area (LLSOA) for England and Wales: these data are used to generate domestic electricity and gas spatial distribution.
- Building Research Establishment (BRE) data: data on total energy use by dwelling and fuel type, which is used in combination with the postcode database to generate the domestic solid and liquid fuels distribution across Great Britain.

Additional assumptions are used to constrain and improve the model:

- Data on Smoke Control Areas (SCAs) are used such that the burning of coal is assumed to occur exclusively outside these areas.
- It is assumed smokeless solid fuel only is used within SCAs.
- It is assumed oil is only burned outside the largest cities; those larger than 100,000 populations.

For Northern Ireland, high resolution distributions of domestic solid and liquid fuel use are produced using datasets specific to Northern Ireland. These include: the Ordnance Survey Code-Point data and Address Point data; the Northern Ireland House Condition Survey; the gas connections information for domestic properties provided by Phoenix Gas and Firmus Gas; and the particular domestic fuel use characteristics of this part of the UK. From these datasets a bottom-up approach to the characterisation of domestic fuel emissions was prepared using local data. In particular:

- An updated geographic distribution of house type was prepared using the Ordnance Survey Code Point, Address Point data and information from the 2001 Census at an output area level and scaled to 2009, using information from the Northern Ireland House Condition Survey (HCS) 2009.
- Fuel used in private properties was derived from the 2001 HCS and then scaled to 2009, while fuel used in social housing stock was taken from the 2009 Northern Ireland Housing Executive survey (NIHE).
- Phoenix Gas and Firmus Gas provided information on gas distribution.
- BRE data was used in conjunction with the postcode database to generate the domestic solid and liquid fuels distribution across Northern Ireland.



## 3.3 Transport

### 3.3.1 Road transport

It is difficult to measure emissions from road transport. Within the NAEI, hot exhaust emissions and the related fuel consumption are calculated using fuel consumption and emission factors for each vehicle type. These in turn are calculated on the basis of the composition of the vehicle fleet (age profile and fuel mix). The resulting fuel consumption and emission factors are applied to detailed mapped traffic movements. The fleet mix varies by location and therefore different factors are applied to different road types in different geographical areas.

#### *Vehicle kilometres:*

The Department for Transport (DfT) collects average annual daily flow statistics by vehicle type at thousands of census points in major roads (Motorways and A-roads) throughout Great Britain; equivalent data for Northern Ireland are collected by the Department for the Environment in Northern Ireland. These counts are applied to road links with matching road names in close proximity of the census point. Where possible, minor road count points have been allocated to minor roads in a similar way as for major roads, but also using local parameters for these census points. Where the above methodology is not possible, regional average flows by vehicle type are applied.

#### *Emissions factors:*

Emissions from road transport depend on many variables including the age, size and efficiency of the vehicle, the speed and manner in which it is driven, and the type of fuel used (petrol or diesel). As such, different emissions factors are estimated for the following categories of vehicle:

- Passenger cars
- Mopeds/motorcycles
- Light goods vehicles (LGVs)
- Rigid heavy goods vehicles (HGVs)
- Articulated HGVs
- Buses / coaches

There are further divisions by fuel type and regulatory emission standard. The categories for the latter are pre-Euro 1, Euro 1, 2 or 3 – categories actually related to pollutants, not CO<sub>2</sub> emissions but a good proxy for the proportion of cars in the total fleet that are of different ages. Finally, how emissions vary by average speed per vehicle category is also estimated. This is at present an unavoidable over-generalisation, and possible limitation, of the modelling as the fuel use / emissions for the same average speed can vary depending on the range of speeds and amount of acceleration / deceleration involved in the journey.

Finally, the vehicle kilometres for each road link (regional averages for minor roads) are multiplied by the appropriate emissions factors according to the vehicle types recorded there, and average speed per vehicle type on that road link. The

incorporation of DfT's Automatic Number Plate Recognition (ANPR) data has led to revisions in the emission factors for road transport. Emissions factors have been adjusted to reflect the different vehicle fleets (e.g. the age of the vehicles, Euro standard mix and the petrol-diesel split) in each of the Devolved Administrations (DAs). Previously the four DAs used the same emission factors. Once emissions have been modelled to the road network, it is split out into 1km<sup>2</sup> grids that can be overlaid with LA boundaries to distribute the emissions accordingly.

It is worth mentioning that the methodology assumes that diesel cars travel more miles in a year than petrol cars, on average around 1.6 times higher.

### **3.3.2 Railways**

CO<sub>2</sub> emissions from rail are associated with electricity and diesel use depending on the type of train.

Electricity use by rail travel cannot currently be separated out from the industrial and commercial electricity use covered earlier, and as such is included in that total.

Emissions associated with diesel rail use are modelled using data on the number of vehicle kilometres broken down by location and type (freight, intercity and regional), which are then multiplied by an appropriate emissions factor. The spatial element of the vehicle kilometres data is then used to assign the emissions to the appropriate LAs.

Emissions from railways now include emissions from combustion of coal which have recently been included in DUKES. These emissions make up 2% of all railway emissions in the Local CO<sub>2</sub> data and have been mapped using the same method as for regional rail emissions. They are now included in the "Transport – Other" sector.

### **3.4 Land use, land use change, and forestry (LULUCF)**

Land Use, Land Use Change and Forestry activities remove as well as produce atmospheric CO<sub>2</sub>. Generally emissions are produced from soils and liming of soils and are removed through forest growth. Currently in the UK, LULUCF activities result in a net removal of emissions from the atmosphere.

The Centre for Ecology and Hydrology (CEH) in Edinburgh annually prepares estimates of the uptake (removal from atmosphere) of CO<sub>2</sub> by afforestation and net loss or gain of CO<sub>2</sub> from soils (emissions to or removals from the atmosphere) for inclusion in the UK GHG Inventory.

Each year improvements are made where possible to the LULUCF data for the National Greenhouse Gas Inventory as with all inventory sectors. For this dataset the Local Authority LULUCF data are rescaled with updated LULUCF data where necessary.

Emissions are estimated using dynamic models of change in stored carbon driven by land use change data. For forestry, the model deals primarily with plant carbon and is driven by the area of land newly afforested each year. Changes in soil carbon are

driven by estimated time series of land use transitions between semi-natural, cultivated (farm), woodland and urban. LULUCF emissions and removals have been estimated for every year in the time series. In previous years, it was only possible to estimate the latest year and apply that distribution to earlier years.

More information on the LULUCF methodology can be found in the report entitled *Mapping carbon emissions & removals for the Land Use, Land Use Change & Forestry (LULUCF) sector*<sup>14</sup>, which is published alongside these statistics on the DECC area of the GOV.UK website.

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<sup>14</sup> [www.gov.uk/government/publications/mapping-carbon-emissions-and-removals-for-the-land-use-land-use-change-and-forestry-sector](http://www.gov.uk/government/publications/mapping-carbon-emissions-and-removals-for-the-land-use-land-use-change-and-forestry-sector)

#### 4. Reasons for changes to previous years' emissions estimates

In order to produce a consistent time series, the 2005 to 2010 estimates have been recalculated to reflect the methodological changes and revisions to data used in calculating the 2011 estimates. This is important as it allows changes to be monitored over time. Furthermore, there is a commitment to back-cast any future improvements to methodology where appropriate so that a comparable series starting in 2005 is always maintained. Details of the changes to estimates for earlier years in the series can be found in **Table 2** below.

**Table 2. Reasons for changes to previous years' emissions**

<b>Sector</b>	<b>Nature of change in emissions</b>	<b>Reason(s) for changes</b>	<b>Notable examples of changes</b>
<b>A. Industry and Commercial Electricity</b>	No significant changes	N/A	N/A
<b>B. Industry and Commercial Gas</b>	Changes ranging from a decrease of 18% to an increase of 7% for some LAs in Northern Ireland.	Change to methodology to ensure that NI gas consumption is treated differently to GB gas consumption data, together with revised gas consumption data received from energy suppliers	Antrim, Armagh, Ballymena, Ballymoney, Coleraine, Derry, Limvady, Newry and Mourne
<b>C. Large Industrial Installations</b>	Various changes, some large, to some point sources (maximum 1,390 kt CO <sub>2</sub> ).	Some sites affected by changes to the national inventory, arising from the UNFCCC review. These changes have been applied consistently across the time series. A small number of corrections to data included in point source database.	Durham, North Lincolnshire, Rotherham, Horsham, Isle of Anglesey, Neath Port Talbot, Redcar and Cleveland
<b>D. Industrial and Commercial Other Fuels</b>	Up to 87 kt CO <sub>2</sub> decrease	There have been revisions (decreases) in national emissions estimates for sources that fall into this sector. Changes have also occurred due to reallocations of aircraft support vehicles from this sector to 'Transport Other'.	Ryedale, Flintshire, Ballymena, Cookstown, Dungannon and South Tyrone, Magherafelt, Hillingdon, Manchester, Crawley, North West Leicestershire, Uttlesford, Tewkesbury, Antrim, Adur

<b>E. Agricultural Combustion</b>	No significant changes	N/A	N/A
<b>F. Domestic Electricity</b>	No significant changes	N/A	N/A
<b>G. Domestic Gas</b>	Changes ranging from a decrease of 8% to an increase of 7% for some LAs in Northern Ireland.	Change to methodology to ensure that NI gas consumption is treated differently to GB gas consumption data.	All NI LAs affected in the same way.
<b>H. Domestic 'Other Fuels'</b>	No significant changes	N/A	N/A
<b>I. Road Transport (A roads)</b>	Up to 13% change in emissions (increases and decreases observed)	Previous annual average daily flow data in Northern Ireland were taken from 2009. This is now based on the actual 2010 annual average daily flow data.	Carrickfergus, Larne, Newry and Mourne, but affects most LAs in NI.
<b>J. Road Transport (Motorways)</b>	Up to 7% change in emissions (increases and decreases observed).	Previous annual average daily flow data in Northern Ireland were taken from 2009. This is now based on the actual 2010 annual average daily flow data.	Belfast and Lisburn, but affects most LAs in NI.
<b>K. Road Transport (Minor roads)</b>	Up to 20% change in emissions (increases and decreases observed)	New minor roads emissions methodology used in the inventory this year. This reflects changes on the road network, and updates to DfT's minor road traffic counts.	Durham, Gateshead, Middlesbrough, Newcastle upon Tyne, North Tyneside, Northumberland, Redcar and Cleveland, Stockton-on-Tees, Sunderland, Hillingdon, Bromley, Croydon, Lewisham

<p><b>L, Diesel Railways</b></p>	<p>Various changes both increases and decreases.</p>	<p>Updated rail emissions model used for national and sub-national inventories uses DfT's Rail Emissions Model data, which provides emissions from each strategic route in GB.</p>	<p>South Northamptonshire, Tandridge, Vale of White Horse, Forest of Dean, Mendip, Mid Devon, South Hams, Taunton Deane, Teignbridge</p>
<p><b>M. Transport Other</b></p>	<p>Up to 71% increase in emissions.</p>	<p>Change to sector - was previously 'Road Transport Other' which included just LPG and lubricants from road vehicles. Now includes inland waterways which is a new source and aircraft support vehicles which has been reallocated from Sector D and coal combustion from railways.</p>	<p>Cheshire East, Cheshire West and Chester, Hillingdon, Manchester, Crawley, Lichfield, Shropshire, South Staffordshire, Stafford, Broadland, Great Yarmouth, Uttlesford, North Norfolk, South Norfolk, South Oxfordshire, Vale of White Horse</p>
<p><b>N. LULUCF Net Emissions</b></p>	<p>Up to 195 kt CO<sub>2</sub> difference (increases and decreases observed).</p>	<p>Changes to national emissions and mapping methodologies. Adjustment of area split between forest planting on mineral and organic soil; new data on wildfires; new estimates of biomass and DOM losses based on country specific biomass densities; new activity data for peat extraction.</p>	<p>Aberdeenshire, Highland, Fermanagh, Limvady, Dumfries and Galloway, Scottish Borders, Gwynned, Powys, Tynedale, Carmarthenshire, Monmouth, Pembrokeshire, Doncaster, North Lincolnshire, Ceredigion</p>

## **5. Carbon dioxide emissions within the scope of influence of Local Authorities (previously NI186) – differences from the full National Statistics dataset**

Carbon dioxide emissions within the scope of influence of Local Authorities (LAs) is based on a subset of the full National Statistics dataset. The full dataset includes all the emissions that occur within the boundaries of each local authority; however, the reduced dataset excludes certain emissions, which it has been considered local authorities are unable to directly influence. The emissions that are removed from the National Statistics dataset to compile the CO<sub>2</sub> emissions within the scope of influence of LAs are:

- Motorways – all emissions from the “Road transport (motorways)” sector have been removed.
- EU Emissions trading system sites – these emissions have been removed from the “Large industrial installations” sector with the exception of energy suppliers (e.g. power stations), whose emissions are indirectly included via the end-user estimates for electricity use. Note that not all the emissions from the “Large industrial installations” sector are produced by EU ETS installations, hence the fact that there are emissions remaining in this sector.
- Diesel railways – all emissions from the “Diesel Railways” sector have been excluded.
- Land Use, Land Use Change, and Forestry – all emission belonging to the “LULUCF Net emissions” sector have been excluded from the main dataset.

In effect, these are emissions that LAs can be least expected to responsible for. Arguments can be made for other exclusions, but a line has to be drawn somewhere that results in a dataset that is fair in terms of local authority actions actually affecting changes in the dataset, and where real change at the local level will be captured. LAs were consulted during development of this subset of the data.

## **6. Planned improvements to the dataset**

There are currently no planned improvements to the LA CO<sub>2</sub> emissions dataset. However the local authority estimates are consistent with the national emissions estimates and any future updates to the local authority dataset will therefore need to reflect any changes made at the national level, including those made in response to revisions to underlying data.

## Comments

We would welcome comments on these statistics. These should be sent to:

UK Greenhouse Gas Emissions Statistics and Inventory Team  
Department of Energy and Climate Change  
Area 6A  
3 Whitehall Place  
London  
SW1A 2AW

e-mail: [ClimateChange.Statistics@decc.gsi.gov.uk](mailto:ClimateChange.Statistics@decc.gsi.gov.uk)

## Useful links

Details of DECC's estimates of local and regional energy statistics are available here:

[www.gov.uk/government/organisations/department-of-energy-climate-change/series/sub-national-energy-consumption](http://www.gov.uk/government/organisations/department-of-energy-climate-change/series/sub-national-energy-consumption)

The home pages of the UK National Atmospheric Emissions Inventory are here:

[www.naei.org.uk](http://www.naei.org.uk)