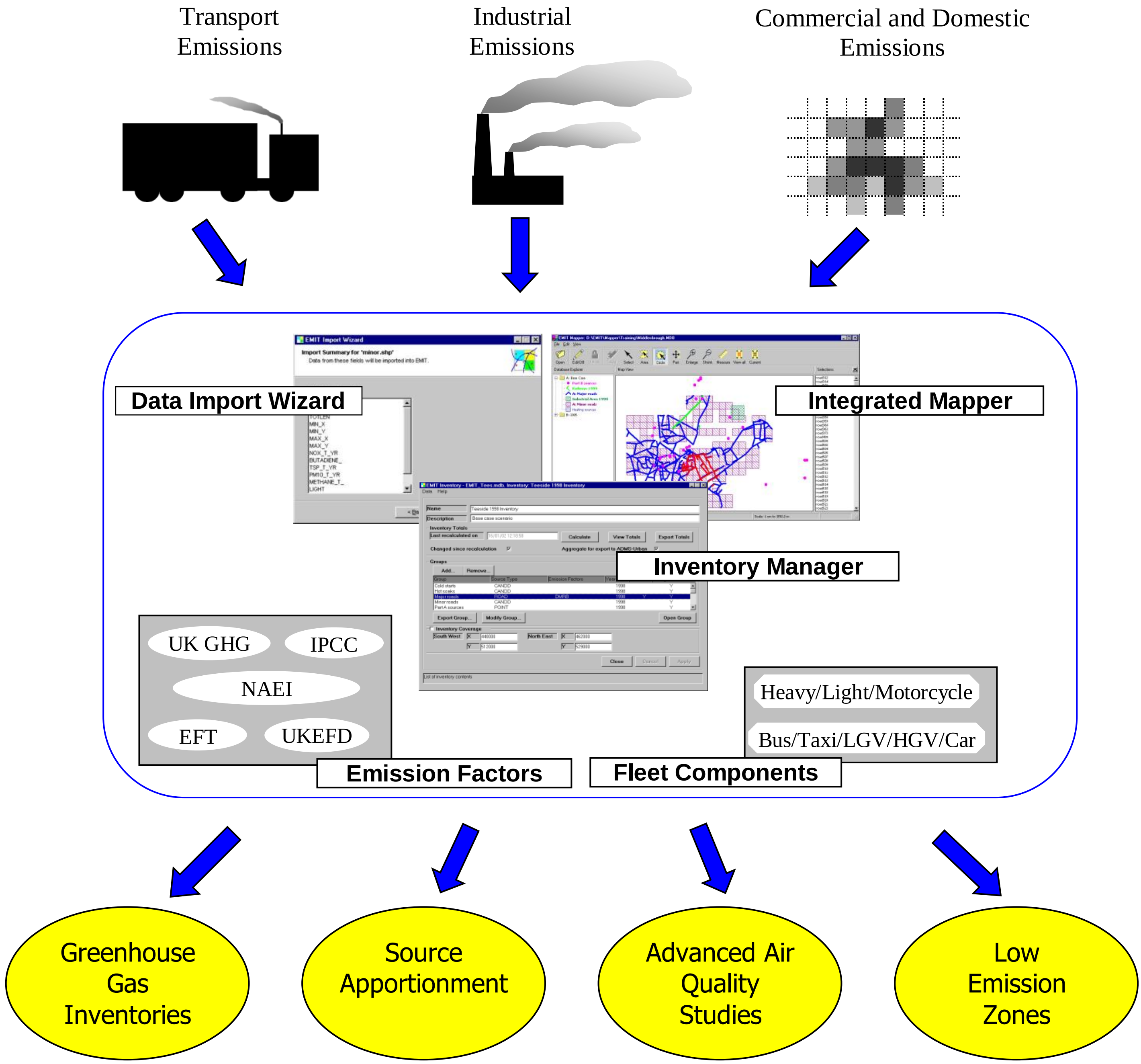
EMIT

Atmospheric Emissions Inventory Toolkit



User Guide **CERC**

EMIT

Atmospheric Emissions Inventory Toolkit

User Guide

Version 3.9

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Glossary

AADT — Annual Average Daily Traffic, measured in number of vehicles per day. Applies to both road and rail traffic.

activity data — Data such as traffic flows, fuel consumption or number of cattle, which can be used in combination with an appropriate emission factor dataset, to estimate emissions when explicit emissions are not available.

ADMS-Urban — Atmospheric Dispersion Modelling System for regional air quality modelling, developed by CERC.

aggregation — Combination of sources into a single effective source. Typically in EMIT this consists of combining all the sources (*traffic*, *industrial* and *commercial and domestic*) within a 1km^2 grid square to give an total emission rate for the entire square. Note that when the **Aggregate for export to ADMS-Urban** box is ticked on the **EMIT Inventory** screen, special treatment is applied to NO_x and NO_2.

APU — Auxiliary Power Unit. A power unit carried on an aircraft that can be used in addition to the main sources of power.

ArcGIS — ArcGIS is a *GIS* program.

area source — An EMIT source type: one of the *industrial source* types, in which the emissions are taken to occur uniformly over a specified area, for example a landfill site. The source may be elevated.

Benzo[a]pyrene — One of the most commonly monitored polycyclic aromatic hydrocarbons (PAH).

CandD source — See *commercial and domestic source*.

Catalytic converter (or "cat") — A catalytic converter ("cat") is a device used to reduce toxic emissions from an internal combustion engine. Three-way converters (typically used on petrol engines) reduce emissions of CO, HC, and NO_x; two-way converters (typically used on diesel engines) reduce emissions of CO and VOCs.

$CH_{1.85}$ — When VOC emissions are measured, their masses are quantified in terms of the mass of carbon in the release i.e. VOC emissions are measured 'as carbon'. In order to convert the 'as carbon' mass emission to an 'as VOC' mass emission, the empirical formula $CH_{1.85}$ is assumed i.e. the mass ratio of VOC to carbon is 13.85/12 = 1.154.

cold starts — Refers to the increased emissions from road vehicles starting with a cold engine. (Although the emission contribution due to cold starts

	is not currently activated on the **EMIT: Major Road** source screen, cold start emissions estimates can be included in an inventory by using the **UKEFD07 Road HotCold** activity dataset.)
commercial and domestic source	An EMIT source type, representing emissions due to commercial and/or domestic activities, or other diffuse activities. They are often specified over a grid. Commercial sources are typically factories or office heating, while domestic sources are also mostly associated with heating. This can also be used to represent natural sources and other greenhouse gas sources, for example, agricultural sources.
COPERT	A software tool used to calculate air pollutant and greenhouse gas emissions from road transport. The development of the model is coordinated by the European Environment Agency (EEA) for official road transport emission inventory preparation in the EEA member countries.
.csv file	Comma-Separated Value file, i.e. a text file containing columns of text or numerical data in which a comma separates adjacent data entries. Note that in some countries, where a comma is used as a decimal symbol, the delimiter in a .csv file is not a comma – it is usually a semi-colon. Users who make .csv files in Excel will not have to worry about this, as EMIT and Excel should use the same list separator character.
database	A collection of data organised into a well-defined structure. See also *EMIT database* and *emissions inventory database*.
Defra PPR110 RS [*], Defra PPR224 RS [*]	Speed independent *non-exhaust road traffic emission* factors for re-suspension taken from work done by TRL/CERC for Defra, categorised into light and heavy vehicles (**TRL 2007a**, **TRL 2007b**); * denotes number of fleet components.
DMRB, DMRB 2003	Redundant sets of road traffic *emission factor*s, no longer in the EMIT database.
drive cycle	Describes the pattern of acceleration and braking for a road or rail source. Some emission factor datasets are drive-cycle dependent.
EFT	An abbreviation used to denote a particular set of road traffic *emission factors* taken from the Emission Factor Toolkit (**EFT**).
EGR	Exhaust Gas Recirculation, i.e. a method of reducing NO_x emissions from a vehicle by recirculating a fraction of the exhaust gas back through the engine.
EMEP BW [*] *RT* 10, EMEP TW [*] *RT* 10, EMEP RW [*] *RT* 10	Urban *non-exhaust road traffic emission* factors taken from EMEP/EEA documentation (* denotes number of fleet components, ***RT*** indicates road type: ‘Urb’, ‘Rur’, ‘Mway’ for urban, rural and motorway respectively).

emission factors A set of data obtained from experimental results that relate emission rates for different pollutants to *vehicle sub-categories*. There are several different sets of emission factors available for road and rail traffic sources in the *EMIT database*, with the number of vehicle sub-categories ranging from 2 to 124, and for each of these there is a set of pollutant emission rates in g/vehicle/km. Most emission factors vary with speed, and some also vary with year.

emission rate The mass flux of a particular pollutant from a specified source. Units are typically g/s or kg/year.

emissions inventory Any listing of pollutant sources with their emission rates. An emissions inventory may have a well-defined structure, such as an inventory in an *EMIT database*, or else may be a simple listing.

emissions inventory database Refers to a specific database structure used to contain an emissions inventory for use by the *ADMS-Urban* dispersion model.

EMIT An atmospheric **EM**issions **I**nventory **T**oolkit: a flexible software tool to organise pollutant sources (*traffic, industrial, commercial and domestic*) and their corresponding emissions. For some types of source it can also estimate emission rates from *activity data* such as traffic flows and speeds using emission factor datasets. EMIT can be used to store data on toxic pollutants and greenhouse gases.

EMIT database EMIT uses databases (*.mdb* files), containing data arranged into a hierarchy of inventories, groups and individual sources. Typically, an EMIT database would correspond to emissions from a particular geographical area, such as a factory, town, city or region.

EMIT group Each EMIT inventory contains one or more groups of sources. Each group contains only sources of the same source type, i.e. point, major road, rail, etc.

EMIT Import Wizard An EMIT utility available to import data from a variety of file formats (ESRI Shape files, MapInfo *.mif* files, *.csv* files) into the EMIT database.

EMIT inventory Each EMIT database contains one or more inventories. An EMIT inventory contains a set of sources arranged into distinct groups. Typically, an inventory is constructed for a particular year, which may, for instance, be present or future, and it may contain modified sources taking into account a proposed traffic management scheme.

EMIT Mapper An EMIT utility allowing the user to visualise and manipulate source data.

EMIT profile (Not currently used in EMIT.) EMIT allows the definition of several types of profile to be stored, although these are not currently used in emission calculations. Available emission profile types are (a) time-varying profiles, (b) yearly profiles, allowing variation on a day-by-

	day basis, and (c) exit profiles, simulating variation in exit gas emission rate with ambient temperature.
EMIT source	A source belonging to one of the 8 source types (major) road, minor road, rail, point, line, area, volume, and CandD.
EURO 2009 Mway, EURO 2009 Rural, EURO 2009 Urban	A redundant set of road traffic *emission factor*s, no longer in the EMIT database.
EURO Base 03	A redundant set of road traffic *emission factor*s, no longer in the EMIT database.
EURO Feb 2002	A redundant set of road traffic *emission factor*s, no longer in the EMIT database.
EURO Scaled 03	A redundant set of road traffic *emission factor*s, no longer in the EMIT database.
EURO09 ROAD IDLING [*]	Exhaust emissions from idling road traffic, derived from the **EURO 2009 Urban** dataset (* denotes number of fleet components).
export	The user may export emissions data from EMIT into an *emissions inventory database* for use with *ADMS-Urban*, or to a *shape file* that can be viewed in ESRI's ArcGIS, or other *GIS* software.
fleet components	A classification of traffic according to a relatively small number of broad categories used to describe the traffic composition. This classification is likely to be similar to that output from a traffic model or from traffic count observations. For road traffic, EMIT supports either standard fleet components with 3 categories (heavy traffic/light traffic/motorcycles) as well as the 11 component categorisation used in the Greater London Authority inventory (the London Atmospheric Emissions Inventory, LAEI). For rail, EMIT includes emissions datasets with 2, 4 and 14 fleet components.
GHG	Abbreviation for Greenhouse Gas
GIS	Geographical Information System: combined data organisation and visualisation system commonly used to analyse the spatial relationships between data. Software systems include ArcGIS and MapInfo.
GLA inventory	Emissions inventory compiled for the Greater London Authority. See also *fleet components*.
greenhouse gases	Gases that contribute to the trapping of solar radiation within the atmosphere, specifically carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexaflouride (SF_6), perfluorocarbons (PFC) and hydrofluorocarbons (HFC).
grid source	An *ADMS-Urban* term. EMIT exports inventory totals as an *ADMS-*

	Urban grid source.
grid totals	For an inventory, total emission rates for each pollutant are given aggregated onto a rectangular grid of square cells.
group	See *EMIT group*.
GSE	Ground Support Equipment. Equipment used at airports to support aircraft.
HDV	Heavy duty (road) vehicle. The UK Highways Agency defines HDVs as vehicles with maximum gross vehicle weight over 3.5 tonnes. The *DMRB* road emissions factors use this classification. See also *HGV*.
HGV	Heavy goods (road) vehicle. In the *EURO* emission factors, HGV is used for vehicles with maximum gross vehicle weight over 3.5 tonnes. Note that the UK Highways Agency defines HGVs as vehicles with maximum gross vehicle weight over 7.5 tonnes. Contrast with *HDV*, the classification used in the *DMRB* factors.
hot soak	Emissions due to evaporation of fuel after a (hot) engine has been switched off.
ICAO	International Civil Aviation Organization, which periodically releases databases containing emission factors for jet aircraft.
import	A user may import data from ESRI Shape files, MapInfo *.mif* files or *.csv* files into EMIT using the *EMIT Import Wizard*.
industrial source	A *point source, line source, volume source* or *area source*.
inventory	See *emissions inventory*.
inventory coverage	The geographical area over which EMIT will calculate emissions. It may include some or all of the EMIT inventory. It is a rectangular region covered by a grid of square cells, defined by the cell size and the grid references of its southwest and northeast corners.
LAEI	London Atmospheric Emissions Inventory
LEZ	See *Low Emissions Zone*.
LGV	Light goods vehicle (weight less than or equal to 3.5 tonnes).
LGV N1(I)	An LGV weighing 1.305 tonnes or less.
LGV N1(II)	An LGV weighing between 1.305 and 1.76 tonnes.
LGV N1(III)	An LGV weighing more than 1.76 tonnes.
line source	EMIT industrial source type; a sequence of straight-line segments

	joining a set of vertices.
Low Emissions Zone	Geographical area where a deliberate attempt to restrict emissions has been made by banning vehicles that do not conform to certain emissions standards.
LPG	Liquefied Petroleum Gas. A fuel used in heating appliances and vehicles.
LRC	A redundant set of road traffic *emission factor*s, no longer in the EMIT database.
LTO	Landing Take Off cycle consisting of 2 aircraft operations: one landing operation and one take off operation.
major road source	EMIT source type, giving emissions from traffic on a road that is represented explicitly as a line source (as opposed to the aggregated *minor road source*).
MapInfo	MapInfo is a *GIS* program.
***.mif* file**	MapInfo Interchange Format file: a file format used by MapInfo to exchange data with other programs. Source data in this format can be imported into the EMIT via the *EMIT Import Wizard*.
minor road source	EMIT source type, giving emissions from traffic on small roads – these are not represented explicitly but their emissions are combined (aggregated) over one or more grid squares (as opposed to a *major road source* which is modelled as a line source).
NAEI	The UK National Atmospheric Emissions Inventory.
NAEI 2014 Mway, NAEI 2014 Rural, NAEI 2014 Urban	The latest set of detailed road traffic *emission factors* for use generally, as well as for investigating traffic management and emission-reduction scenarios. These factors are year dependent as they include adjustments due to vehicle mileage, and the uptake and effect of new fuels. The ‘Mway’, ‘Rural’ and ‘Urban’ classifications refer to the type of area in which the emission factor dataset is applied, where ‘Mway’ is an abbreviation for motorway.
noise mapping	The creation of a contour map showing noise exposure levels.
non-exhaust road traffic emissions	Road traffic particulate emissions due to mechanical abrasion and corrosion (primarily wear of brake, tyre and road surfaces), and the re-suspension of material deposited on the road surface by tyre shear, vehicle-induced turbulence and wind.
NO_x	Abbreviation for a mixture of the two nitrogen oxides NO and NO_2. NO_x values are “as NO_2”.
Part A source	A UK installation carrying on either a Part A(1) activity (regulated by UK Environment Agency) or Part A(2) activity (regulated by a

	local authority). For further details, refer to the Environmental Permitting (England and Wales) Regulations 2010.
Part B source	A UK installation carrying on either a Part B activity (regulated by a local authority). For further details, refer to the Environmental Permitting (England and Wales) Regulations 2010.
Particle trap	A particle trap or diesel particulate filter, sometimes called a DPF, is a device designed to remove diesel particulate matter or soot from the exhaust gas of a diesel engine.
Piston engine	A type of internal combustion engine, used to drive a propeller in some light aircraft.
PM	Emissions in the form of small particles resulting from combustion.
PM_{10}, $PM_{2.5}$	Emissions in the form of small particles resulting from combustion. The numerical suffix denotes the maximum particle diameter in microns, e.g. PM_{10} denotes particles up to 10µm in diameter.
P07 Base	A redundant set of road traffic *emission factor*s, no longer in the EMIT database.
P07 Scaled	A redundant set of road traffic *emission factor*s, no longer in the EMIT database.
point source	EMIT industrial source type used for chimney stack emissions.
profile	Any pattern of variation about a constant value, in particular variation of source emission rate with time about a steady value. See also *EMIT profile*.
rail source	EMIT source type, giving emissions from trains along a railway line explicitly represented as a line source.
reference data	Term used in the EMIT User Guide to denote data available for use by more than one source or group, for example, the sets of emission factors and the pre-defined route types. Reference data may be pre-loaded in EMIT, or user-defined.
region type	In EMIT, the region type describes a house type in terms of its energy use properties – such as house type, fuel type, insulation and efficiency. It is used when estimating the CO_2 emissions from domestic properties.
road source	See *major road source*.
route type	The route type describes the relative make-up of each fleet component, in terms of the percentage of that component in each vehicle sub-category. Route types can be year-dependent.
SAP	The UK Government's Standard Assessment Procedure for Energy

	Rating of Dwellings (**SAP, 2001**).
SCR	Selective Catalytic Reduction, i.e. a device that is designed to reduce the amount of NO_x in the exhaust gas from vehicles.
shape file	File format used by *ArcGIS* to store data.
source	Any entity giving rise to pollutant emissions. See also *EMIT source*.
source type	See *EMIT source*.
traffic data	Data giving the overall traffic parameters: *AADT*, speed, *fleet components*, *emission factors* and *route type*.
transport source	Road, rail, shipping or aircraft sources.
TSP	Total Suspended Particulates.
Turbofan	A type of jet engine used in commercial jet aircraft.
Turbojet	A type of jet engine, used in older jet aircraft. Modern commercial jet aircraft are manufactured with *turbofan* engines rather than turbojets.
Turboprop	A type of gas turbine engine used in smaller aircraft, where the engine power is used to drive a propeller. Compare with *turbofan*, *turbojet* and *piston* engines.
UKEA 09 Pigs, UKEA 09 Poultry	Datasets containing emission factors from intensive farming of pigs and poultry, as supplied by the UK Environment Agency.
UKEFD	UK Emission Factors Database – provides emission factors for road and rail traffic, and other sources (**UKEFD, 2001, 2003** and **2007**).
UKGHG	UK Greenhouse Gas Inventory, 1990 to 1999 (**Salway *et al.* 2001**). Source of greenhouse gas emission totals in the UK.
vehicle sub-categories	Categories used by a particular set of *emission factors* to classify road or rail vehicles – there are separate *emission factors* (for all pollutants covered) for each vehicle sub-category.
vertex/vertices	Point/points used to define the geometry of an EMIT source. For *major road*, *rail* and *line sources*, the vertices are the points where straight line segments join; for *point sources*, the vertex is the centre of the source; while for *area*, *minor road*, *volume* and *CandD* sources, the vertices are the corners of the region covered by the source.
VOC	Volatile Organic Compound – the term covers many different substances including Methane, Benzene and 1,3-Butadiene.
volume source	EMIT *industrial source* type. Corresponds to a source where the

emissions are distributed over a volume, e.g. dust from a quarry.

SECTION 1 Introduction

1.1 Why use EMIT?

EMIT is a database tool for storing, manipulating and assessing emissions data from a variety of sources. It can hold data from explicit sources such as major roads, rail and industrial sources. In addition, EMIT can hold data from sources that may be too small to be considered explicitly, and instead are treated as average emissions on a regular grid. Source data held in this way are minor road and commercial and domestic sources. EMIT holds emissions data that have been directly imported, or else it calculates emissions from source activity data (such as traffic flow, speed and source length for roads, fuel consumption for industrial sources, or number of cattle for area sources) using up-to-date emission factors. Additionally, when neither explicit emissions nor activity data are available, EMIT can calculate emissions using a scaling of a national emissions figure by a local statistic such as population.

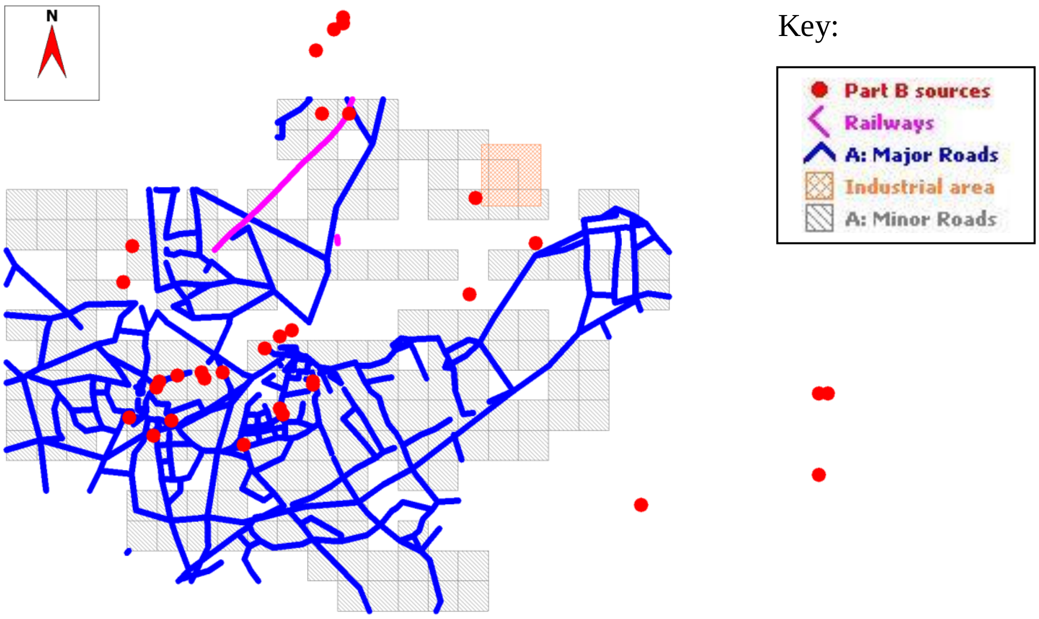


Figure 1.1 – Example emissions inventory held in EMIT as displayed in the EMIT Mapper

EMIT holds the emissions data from all sources in one place. This is very important as these data are required for a number of different environmental assessments, such as local air pollution studies of toxic pollutants, greenhouse gas (GHG) emissions inventories and noise mapping studies. The data used in all these projects must be consistent and traceable – EMIT can help to do this.

For air pollution studies, the emissions of local pollutants such as NO_x, NO_2, CO and particulates (PM_{10} and $PM_{2.5}$) are required as input for air dispersion modelling software, such as ADMS-Urban. Pollutant concentrations predicted by air dispersion modelling software are then compared to national and international air quality standards. Often, it is not only the present situation that is of interest. Predicted concentrations for future years to which the air quality standards apply, and changes due to various traffic management schemes are also of interest. EMIT has been specifically developed to facilitate the rapid calculation and assessment of emissions for these different scenarios.

The EMIT database includes sets of road traffic emission factors, including the latest detailed emission factors.

The latest simplified factors included in version 10.1 of the Emission Factor Toolkit (published by Defra and the Devolved Administrations, **EFT v10.1 2020**) are included in the EMIT database. These emissions factors are identical to those in EFT v11.0 2021; therefore, a separate EFT 11 dataset has not been included.

COPERT v5.5 emission factors have been included for pollutants not included within **EFT v10.1**.

The increase in air traffic has led to interest in the impact of airports on local air quality, in addition to the significant contribution that aircraft make to greenhouse gas emission totals. EMIT includes a number of emission factors datasets that allow users to calculate emissions totals from both aircraft (for example using the ICAO database, **EASA 2014**), as well as the associated auxiliary power units, ground support equipment and road traffic. For the purpose of calculating greenhouse gas emission totals from aircraft, EMIT includes an emissions dataset derived from information given in the IPCC manual (**IPCC 1996**).

It is often useful when considering emissions due to road transport to be able to apportion emissions by vehicle type. It is possible in EMIT to create user defined groups of vehicle classes and calculate emission rates of the pollutants of interest due to each group. SECTION 9 of the User Guide discusses traffic apportionment in more detail.

EMIT has the capability to export total emissions onto a grid for use in air quality modelling. The grid can be exported on a 2D plane or in 3D. The 3D grid can be output in a format suitable for use with ADMS-Urban or CMAQ air quality models.

In EMIT, it is straightforward to consider different traffic management schemes such as Low Emission Zones where vehicles that do not conform to certain emission standards are excluded, speed restriction areas, and Home Zones. SECTION 10 of the User Guide discusses how to calculate the change in emissions due to various traffic management schemes using EMIT.

There is government guidance on how Local Authorities should become accountable for their levels of GHG emissions (**GHG, 2001**). The six main greenhouse gases (carbon dioxide, methane, nitrous oxide, sulphur hexaflouride, hydrofluorocarbons and perfluorocarbons) are all present as pollutants in the EMIT database. Greenhouse gas emission totals are displayed in EMIT either in terms of actual emission, with 'carbon dioxide as C', or in terms of the Global Warming Potential of each gas. The majority of the road and rail emission factor datasets include emission factors for the relevant GHG pollutants. In addition, factors used in the UK's National Atmospheric Emissions Inventory (**UKEFD 2007**) have been included. A dataset based on the Government's Standard Assessment Procedure for Energy Rating of Dwellings (**SAP 2001**) has also been compiled in order to allow users to approximate CO_2 emissions from domestic dwellings in terms of house type, fuel type, insulation and heating efficiency.

GHG emission inventories are usually compiled using two approaches – a 'bottom-up' approach where emissions data are detailed and spatially varying, and a 'top-down' approach where emissions are calculated using a scaling of a national or other large scale emissions value by a relevant statistic. EMIT can be used to calculate GHG emissions using both these approaches. Section 11 gives full details of how EMIT can be used to calculate a GHG emissions inventory.

The main sources of local air pollution – road and rail sources – are also the main noise sources. These source data can be stored in EMIT. Specifically, EMIT can store texture depth and road surface type for major roads, and these data can be exported along with all other relevant source parameters in a form compatible with noise mapping software packages. Thus the same raw data can be used to assess both air quality and noise.

Whether it be for emission calculations, air quality modelling, greenhouse gas inventories or noise mapping, EMIT is a flexible tool for storing atmospheric emissions data.

1.2 EMIT User Guide overview

The contents of the EMIT User Guide are discussed briefly below.

Section 2 gives the system requirements for EMIT, and takes users through the installation of the software. Note that both EMIT and the EMIT Mapper are installed, each with their own icons on the desktop.

EMIT holds data from eight different source types: major road, rail, point, line, area, volume, minor road and commercial and domestic. These are discussed fully in Section 3 of the User Guide. This section also outlines the database structure in terms of inventories and source groups.

SECTION 4 of the User Guide takes the user on a guided tour of the EMIT interface. This section includes fully annotated pictures of the four main EMIT screens.

There are a number of issues to be considered prior to setting up an emissions inventory. For example, which sources are to be included in the inventory? Are explicit emissions from these sources available, or will the emissions have to be calculated using appropriate activity data? Or perhaps, if very little is known about the sources, a scaling approach may be required to approximate the emissions. Section 5 gives some background on the preparation required prior to setting up an emissions inventory. Within an inventory, sources are organised within groups; Section 5 also gives examples of how to create the various types of group.

Emissions data, other source parameters and text data containing notes and keywords can be imported in EMIT using the EMIT Import Wizard. The file types that can be imported using the wizard are ESRI shape files, MapInfo MIF files and comma separated variable (*.csv*) files. Note that emissions data held in spreadsheets, or tab-delimited text files can be saved in *.csv* format using a package such as Microsoft Excel for ready import into EMIT. SECTION 6 gives step-by-step instructions on how to import data using the EMIT Import Wizard.

Once all the emissions data have been imported into EMIT, they can be viewed and manipulated using the EMIT Mapper. Sources can be added and deleted using the Mapper, for instance, to keep the EMIT database up-to-date. For example, a new industrial source can be added and a railway line that has been shut down can be removed. Source locations can also be edited – this is useful both for correcting incorrectly aligned roads, perhaps using an imported map tile for guidance, as well as adding new roads to the database. Additionally, the Mapper allows sources in an area to be selected and then moved between groups in order to consider the emissions consequences of different traffic management schemes. Section 7 describes the EMIT Mapper and includes two worked examples to help familiarise users with this utility.

Emissions totals are displayed both on a grid square by grid square basis, as well as for the whole inventory; greenhouse gas emissions totals are also displayed. Totals from each group are given, and groups are categorised in terms of their greenhouse gas sector, when appropriate. All sources can be exported with their associated source and group parameters, activity data and emissions on a group-by-group basis to ESRI shape files. Emissions and relevant source parameters from road, point, area, line and volume sources can also be exported to the ADMS-Urban emissions inventory database in order to be modelled explicitly in ADMS-Urban or other air dispersion modelling software. Inventory totals can also be exported for use in ADMS-Urban in 2D or 3D format, 3D grid totals can also be exported in a format suitable for use in CMAQ. These outputs are discussed fully in SECTION 8 of the

User Guide.

SECTION 10 discusses how to use EMIT to investigate the emissions consequences of various traffic management schemes. An example is given showing how EMIT is used to calculate the change in present and future emissions due to a speed restriction area, and a Low Emission Zone.

EMIT can be used to compile GHG emission inventories; Section 11 of the User Guide shows how this can be done.

EMIT includes a domestic dwelling emissions dataset that has been compiled using the Government's Standard Assessment Procedure for Energy Rating of Dwellings (SAP, 2001). This dataset allows users to estimate the CO_2 emissions from domestic dwellings by defining the properties in their area in terms of house type, fuel type, insulation and heating efficiency. The methodology used to create this dataset is described in Section 12.

References are given in Section 13.

APPENDIX A gives full details of the road, rail and shipping emission factor datasets in EMIT, as well as the example route types included in the database. The concepts of 'route type' and 'fleet components' are discussed. Also included in this appendix is a mathematical description of how road and rail source emissions totals are calculated from a combination of emission factors, 'route types', 'fleet components' and road lengths.

The emission factor datasets associated with airports are described in APPENDIX B, and the non-transport activity datasets included in EMIT are described in Appendix C.

Finally, APPENDIX D is a reference section describing all the EMIT menus and screens with their controls.

1.3 Conventions

This document is intended as both an introduction for new users and as a reference guide for experienced users of EMIT.

To make the User Guide easier to use, the following typographical conventions have been adopted.

- All controls on the interface, whether they are menu titles/options, buttons, dialogue boxes, etc., are shown in **this** style, e.g. the **Modify Group**… button, the **Open** option on the **File** menu.
- All file, directory and path names are shown in *italics*, e.g. *EMIT_database.mdb.*

SECTION 2 Getting started

This section gives detailed instructions for installing and uninstalling EMIT, in addition to advice on how to run the model.

2.1 System requirements

EMIT is supported for use with the following operating systems: Windows 8 (Professional, Business, Enterprise and Ultimate editions only), Windows 10 and Windows 11. Starter and Home editions are not supported. The 64 bit operating systems we support are Windows 8, 10 and 11. The minimum memory specification is 1 GB of RAM and 20 GB of free disk space.

The EMIT Mapper requires administrator permissions. Windows will usually allow you to run the Mapper from a normal user account, but it will require you to supply an administrator password when you start the Mapper.

If your Windows configuration has been altered from the default settings, this may have an effect on the EMIT Mapper. **Table 2.1** below shows the effects of the relevant settings in Windows User Account Control (UAC). You may wish to consult your IT department if these settings are affecting your use of the EMIT Mapper.

User Account Control Setting Name	Value of the Setting	Effect on the EMIT Mapper
Behaviour of the elevation prompt for standard users	Automatically deny elevation requests	Prevents Mapper being used from a standard user logon. If you use this UAC setting, you must use an administrator logon to run the Mapper.
Run all administrators in Admin Approval Mode	Disabled	Prevents Mapper being used from a standard user logon. If you use this UAC setting, you must use an administrator logon to run the Mapper.
Only elevate executables that are signed and validated	Enabled	This setting prevents the EMIT Mapper being used at all. If your organisation's IT policy requires this setting, please contact CERC for advice.

Table 2.1 – Windows User Account Control configurations

2.2 Installation

The Installation Wizard will guide you through the process of installing EMIT on your PC. If you are an existing user of EMIT please follow the instructions given in Section 2.2.1. If you are installing EMIT for the first time on your computer, please proceed to Section 2.2.2.

2.2.1 Existing users of EMIT

If you have an earlier version of EMIT installed on your computer, you must uninstall it before installing the latest version. For further details of how to uninstall EMIT, please refer to Section 2.3.

To install EMIT 3.9 follow the instructions in Section 2.2.2 below.

Using old EMIT databases

Old EMIT databases cannot be opened in the new version of EMIT. If you wish to use your existing data with the new model you will need to export each group to shapefiles from the old version of EMIT. Then create a new project in EMIT 3.9, set up your groups in the project then import your activity and emissions data to the groups.

2.2.2 Running the EMIT Installation Wizard

To install EMIT follow the step-by-step procedure described below. Note that on some operating systems you may be prompted to restart your computer during this procedure. If this occurs the installation will resume automatically following the restart.

Step 1 Log on to your PC as Administrator. Note that if you are prompted to restart your computer during the install you should log in again as Administrator.

Step 2 EMIT will either have been supplied by download link or on CD. Follow the appropriate instructions:

Download: Unzip the downloaded *.zip* file to a local directory. In Explorer, browse to this directory and double-click on the file '*setup.exe*'.

CD: Insert the installation CD and the install program should automatically start. If it does not, browse to locate the CD in Explorer and double-click on the file '*setup.exe*'.

Step 3 The installation now begins with several preliminary message boxes before the Welcome screen of the Wizard is displayed, **Figure 2.1**. Click **Next>** to continue with the installation.

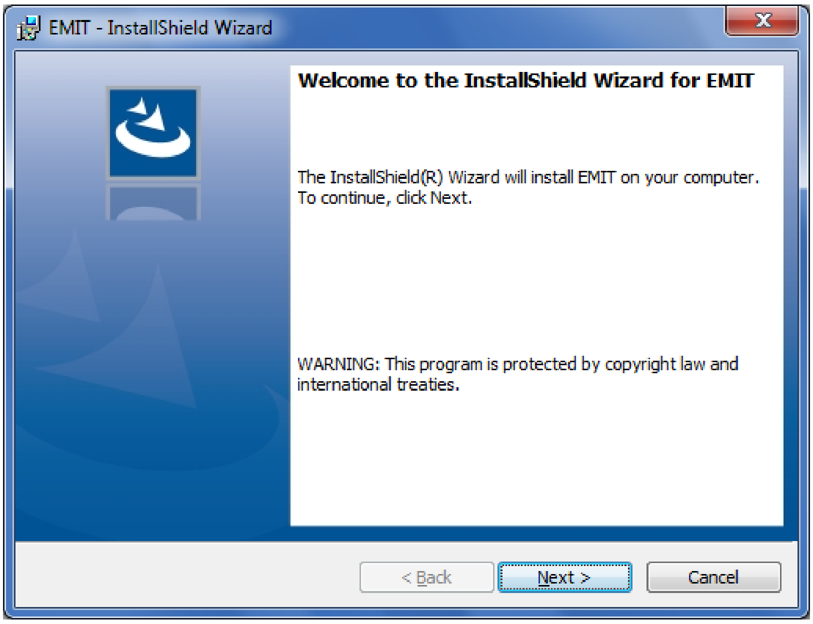


Figure 2.1 – Welcome screen for the EMIT Installation Wizard.

Step 4 The next screen is the Licence Agreement screen, **Figure 2.2**. If you accept the licence conditions select **I accept the terms in the licence agreement** and then click **Next>**. The licence text is also installed in the *Documents* sub-directory (file name *EMIT Licence Agreement.rtf*) of the EMIT installation directory.

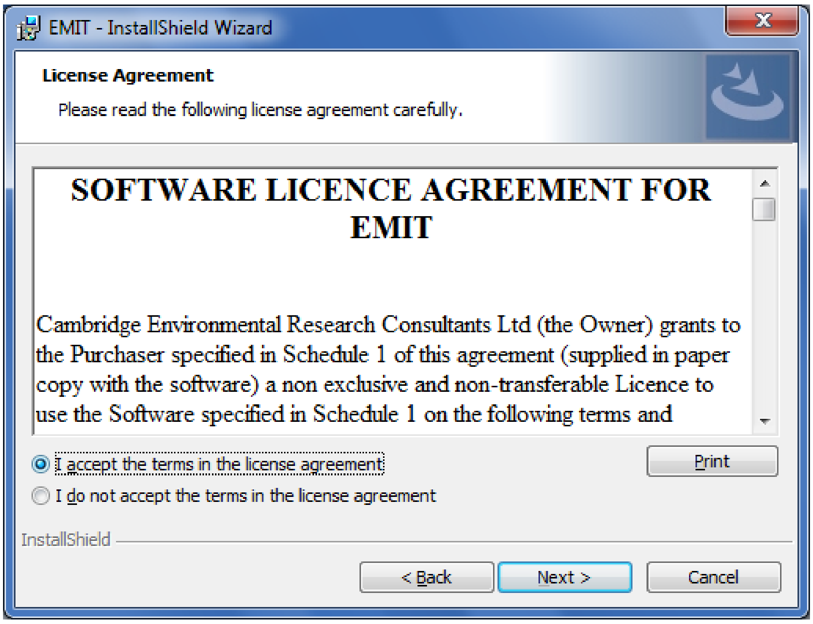


Figure 2.2 – The EMIT **Licence Agreement** screen.

Step 5 Enter your details on the Customer Information screen, **Figure 2.3**. Click **Next**> to continue.

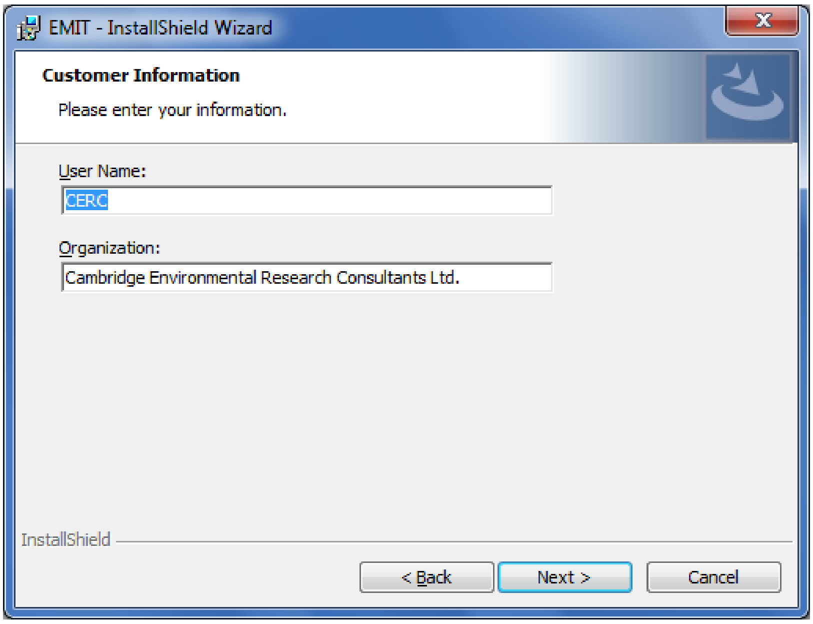


Figure 2.3 – The EMIT **Customer Information** screen.

Step 6 Specify the directory into which you would like EMIT to be installed on the **Destination Folder** screen, **Figure 2.4**. The default is *C:\Program Files\CERC\EMIT*. You may wish to change this. You can do so by first clicking the **Change...** button.

On the **Change Current Destination Folder** screen, **Figure 2.5**, use the **Look in:** list to locate the directory required. Click **OK** to return to the **Destination Folder** screen and then **Next>** to continue with the install.

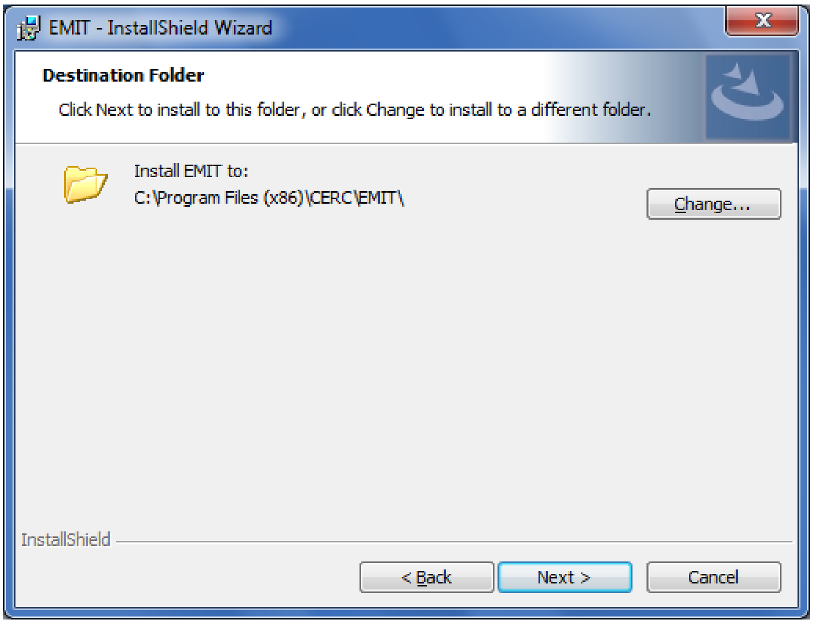


Figure 2.4 – The EMIT **Destination Folder** screen.

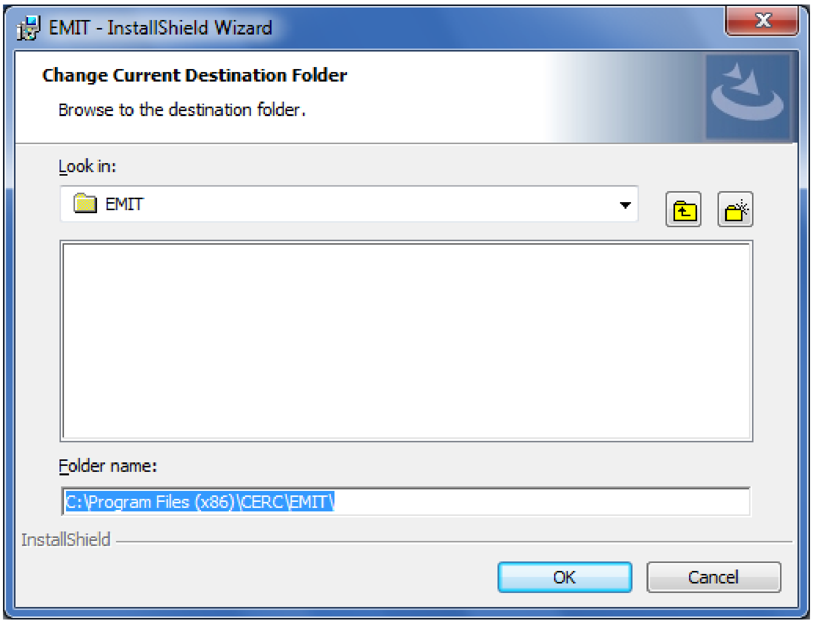


Figure 2.5 – The EMIT **Change Current Destination Folder** screen.

Step 7 The Installation Wizard is now ready to install EMIT, **Figure 2.6**.

Choose whether to install for all users of your computer or just for you. Note that if you take the latter option, and you are logged on as Administrator, this means that the EMIT and EMIT Mapper icons, and the link to EMIT and the EMIT Mapper available from the **Start** menu will only be set up for the Administrator.

The installation of the EMIT files will begin after you have made this choice.

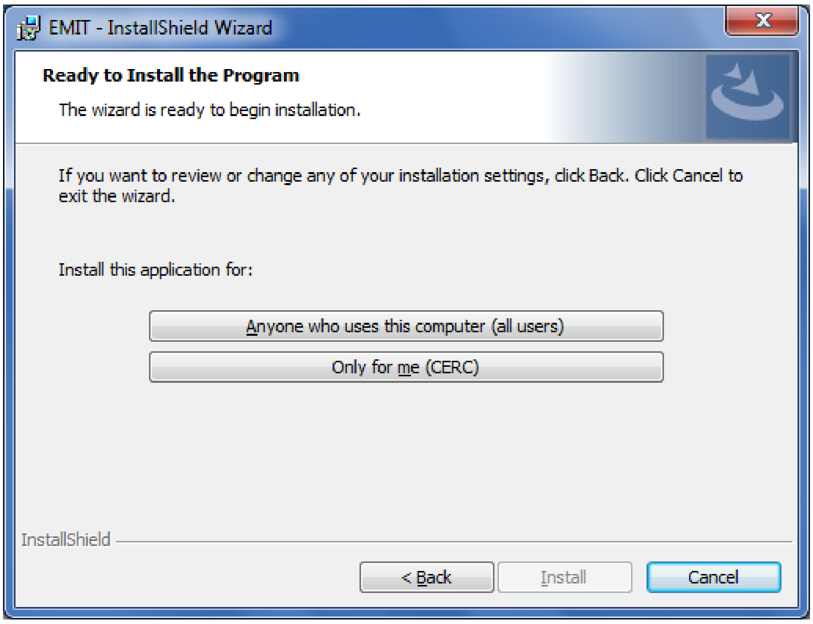


Figure 2.6 – Choose which users to install the application for.

Step 8 While EMIT is installing, a series of screens are displayed showing progress, for example, **Figure 2.7**. You need take no further action while installation is taking place.

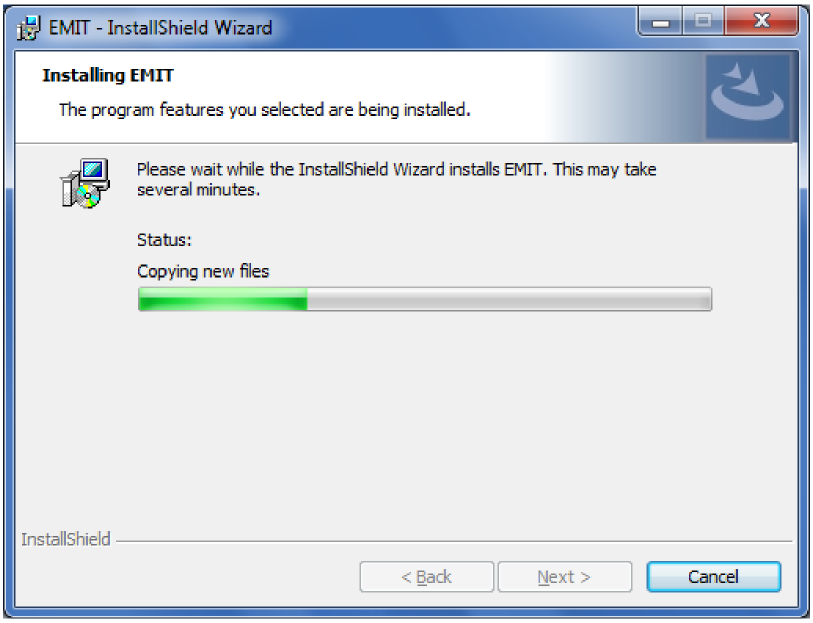


Figure 2.7 – Typical screen showing progress during the EMIT installation.

Step 9 When installation has been completed successfully, the screen shown in **Figure 2.8** is displayed.

Select **Finish** to close the EMIT Installation Wizard. If the **Show the readme file** option box is ticked, the 'What's New in EMIT 3.4?' *.pdf* file will open.

At this stage of the install, you may be prompted to restart your computer. After restarting your computer, you should log in again as Administrator.

Returning to your Windows desktop, you will see that shortcuts to EMIT and the EMIT Mapper have automatically been placed on the desktop, and there are links to EMIT and the EMIT Mapper from the **Start** menu, under Programs.

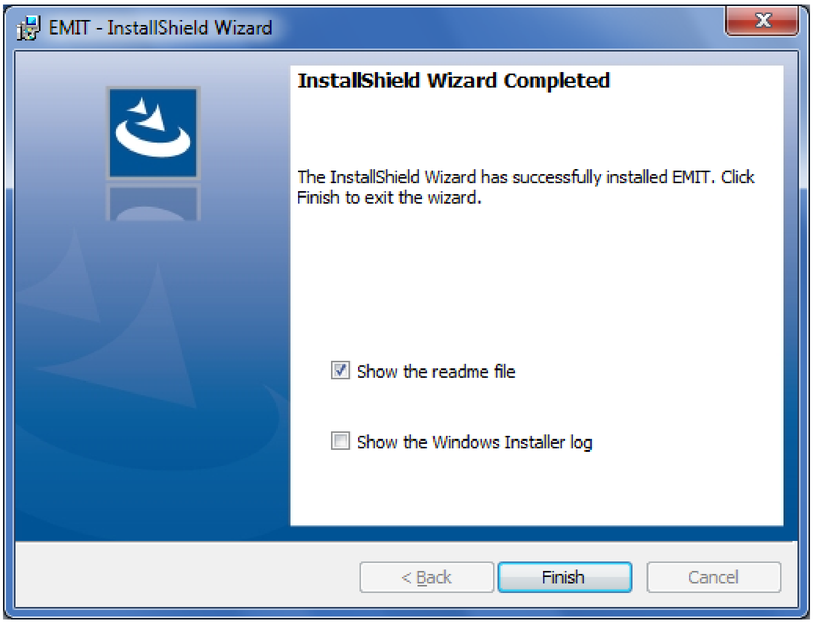


Figure 2.8 – The EMIT **Installation Wizard Completed** screen.

Step 10 Before you can start using EMIT, you need a valid licence file. The file is called *Emit.lic* and should have been supplied to you separately (it is not with the EMIT install files). You need to copy this file to the installation directory specified in **Step 6**, for example *C:\Program Files\CERC\EMIT.*

2.3 Uninstalling EMIT

If you uninstall EMIT following the steps described in this section, EMIT databases that you have created will not be deleted. However, before uninstalling you may wish to make a backup copy of all your data files in a backup directory.

2.3.1 Uninstalling EMIT

The simplest way to uninstall EMIT and the EMIT Mapper from your computer is to follow these two steps:

Step 1 Log on to your PC with the same identity as you did to install EMIT (e.g. Administrator).

Step 2 From the **Start** menu, open the **Control Panel** and navigate to **Add/Remove Programs** (wording may differ depending on the operating system). Double-click on the EMIT entry in the list of installed applications and you will be prompted to uninstall the program. Click **Yes** to uninstall EMIT.

2.4 Running EMIT

Having successfully completed the installation, you are now ready to begin using EMIT.

2.4.1 Running EMIT

You can start EMIT by

(a) clicking on the Windows **Start** menu button and selecting **Programs** then **EMIT**, or

(b) double-clicking on the EMIT shortcut icon on your desktop.

Please refer to SECTION 4 for a guided tour of the EMIT interface.

It is recommended that all EMIT database edits and calculations are performed on a local PC, not over a network of computers.

2.4.2 Running the EMIT Mapper

You can start the EMIT Mapper by

(a) clicking on the Windows **Start** menu button and selecting **Programs** then **EMIT Mapper**, or

(b) double-clicking on the EMIT Mapper shortcut icon on your desktop.

For information about the EMIT Mapper, please refer to Section 7 of this User Guide.

SECTION 3 EMIT Data Structure

The EMIT data are held in a database (*.mdb*). Within each database the sources are arranged into groups and the groups collected to form inventories. One EMIT database can therefore contain many emission inventories. This section describes the organisation of data in EMIT, both source data (inventory, group, source) and the use of associated reference data such as emission factors (both transport and non-transport) and route type data for road and rail sources.

3.1 EMIT Source data

There are eight types of sources stored by EMIT. These are:

(a) ***major road*** also called just ***road*** source, a sequence of straight line segments joining a set of vertices, with a given elevation and gradient

(b) ***minor road*** an aggregated representation of roads on a $1km^2$ grid with effective aggregated properties

(c) ***rail*** similar to a (major) road source but corresponding to a section of railway line

(d) ***point*** also called ***industrial point*** source, typically a stack emission

(e) ***line*** source, a sequence of straight line segments joining a set of vertices, for example an aircraft taxiway

(f) ***area*** also called ***industrial area*** source, corresponds to an industrial source that is too large to be treated as a point source, e.g. distributed over a large area near ground level

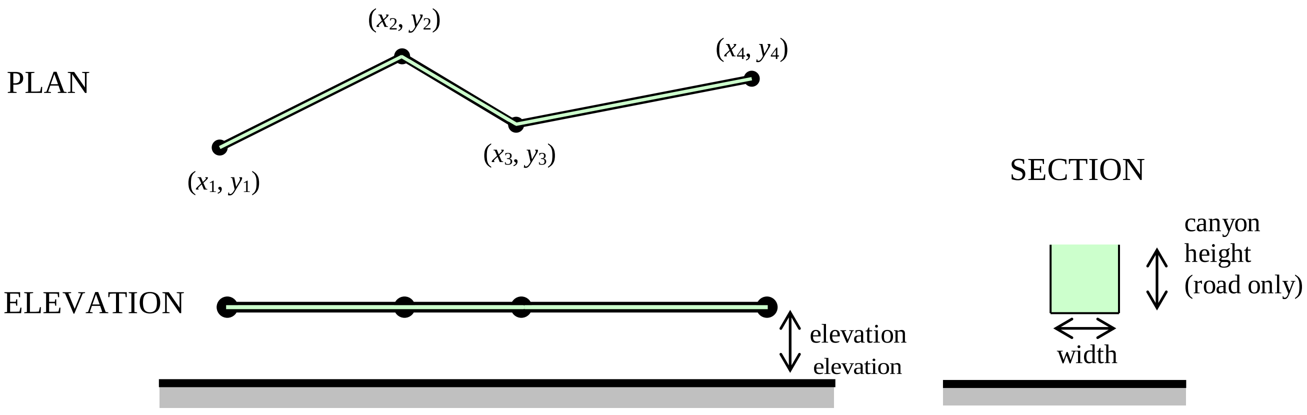
(g) ***volume*** corresponds to a source where the emissions are distributed over a volume, e.g. dust from a quarry

(h) ***commercial and domestic*** also called ***CandD*** sources, these are defined as regions with aggregated properties. These might typically be emissions due to commercial or domestic heating

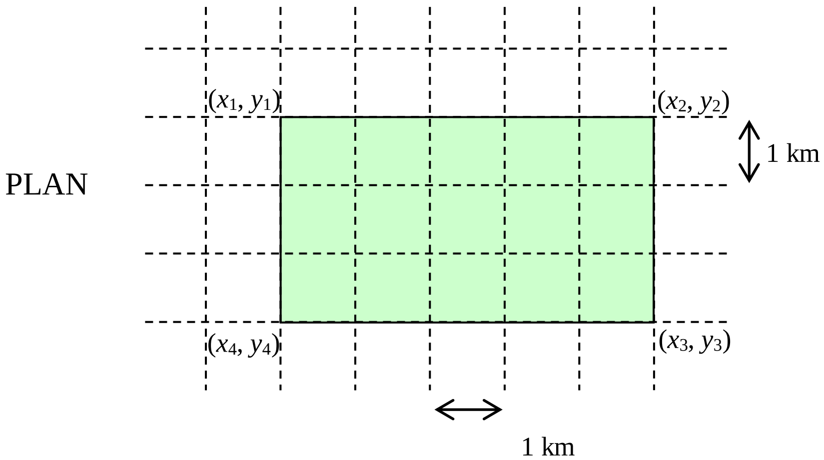
The different source types are illustrated in **Figure 3.1** and described in Section 3.1.4. Sources stored in the EMIT database must have a unique name, therefore, each ***source*** only appears once in the database. Each source is a member of a ***group*** e.g. *'town centre roads'* or *'Part A processes'*. All the sources in a group must be of the same type i.e. point, area, line, volume, major road, minor road, rail or CandD. A collection of groups is called an ***inventory*** e.g. *'Any city current emissions', 'Any city future emissions'*. An EMIT ***database*** can hold a number of inventories. This is illustrated in **Figure 3.2** and explained further in Sections 3.1.1 to 3.1.4.

The right-hand section of **Figure 3.2** shows the Reference data. Some Reference data are pre-loaded in EMIT databases and other data can be entered by the user when starting to build an EMIT database. These Reference data are described in more detail in Section 3.2.

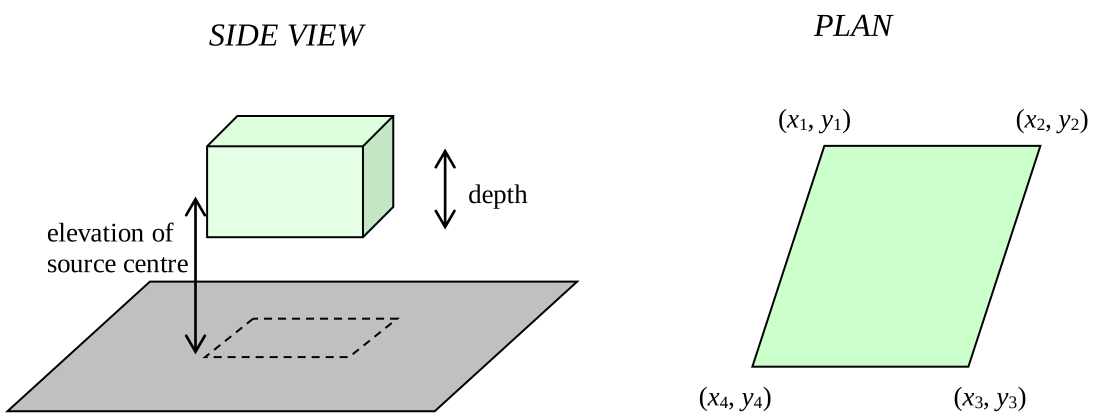
(i) Major road, rail, and line sources



(ii) Minor road sources



(iii)Volume sources



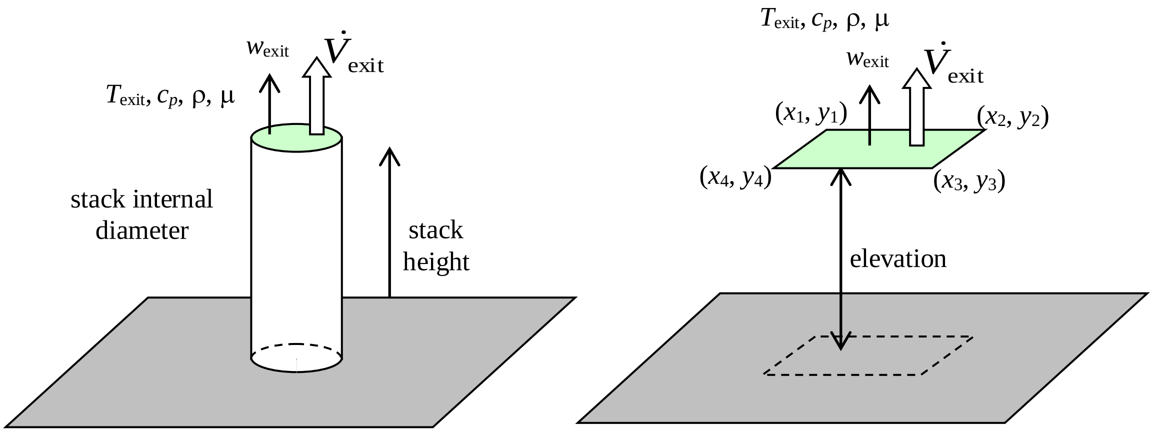
NB. Although the volume source shown has four sides, volume sources can have any number of sides from 3 to 50.

(iv) CandD sources

CandD sources have the same geometry as volume sources. When modelling using a 2D grid of emissions, the sources are always on the ground. When considering a 3D grid of emissions, a vertical profile with proportions of emissions in each layer is defined.

Note that it is often convenient to tile an area with a set of square CandD sources, using them in a similar way to minor road sources (see ii above).

(v) Industrial point, area sources



NB. Although the area source shown has four sides, area sources can have any number of sides from 3 to 50.

Figure 3.1 – Illustration of the 8 types of source available in EMIT.

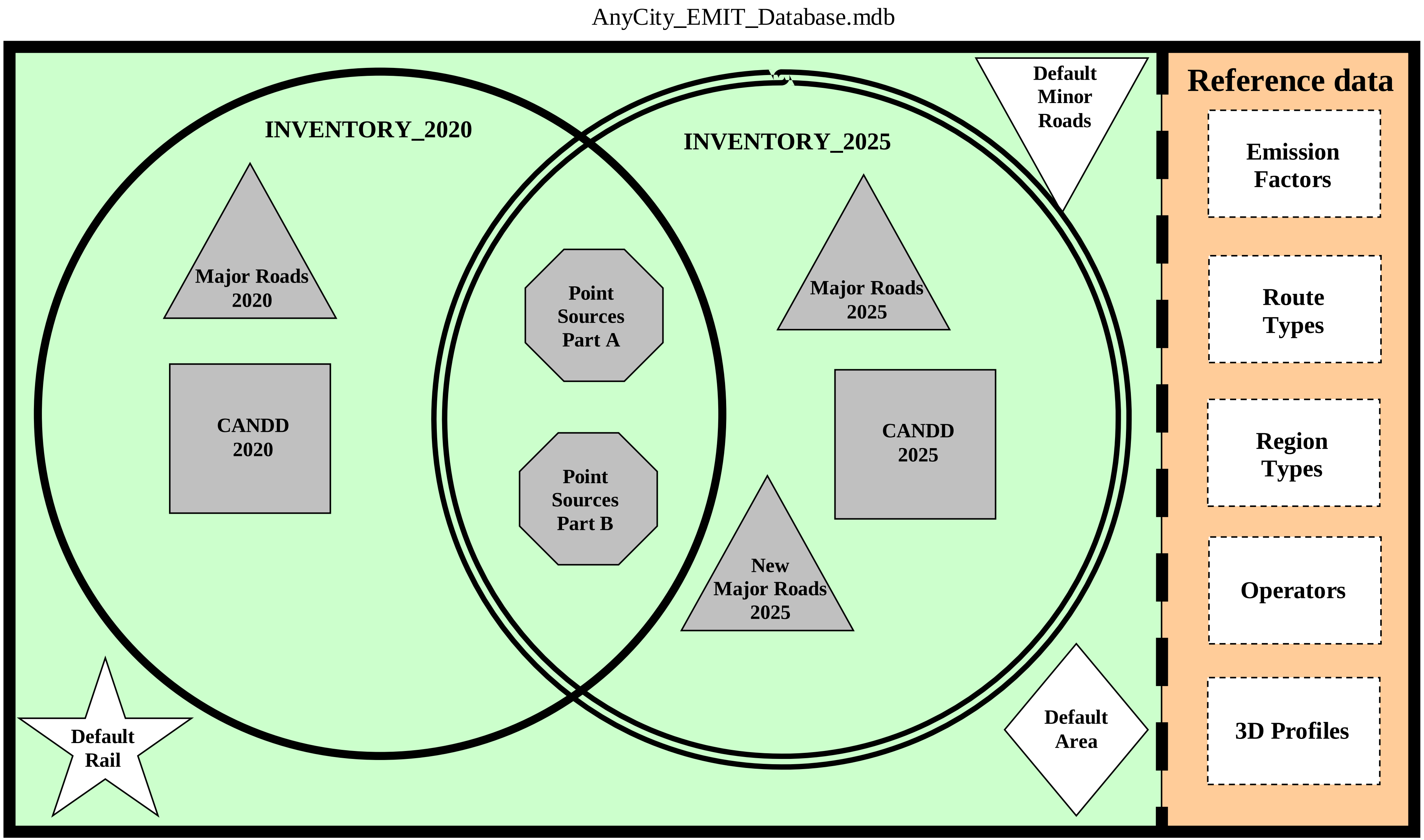


Figure 3.2 – Representation of data hierarchy in EMIT: a database containing inventories which each contain several groups. Each shape represents a different source type. Also in the database are the various 'reference' data, i.e. emission factors, etc

3.1.1 Databases

In **Figure 3.2** the EMIT database is *AnyCity_EMIT_Database.mdb*, shown by the outer rectangular box. Let us assume that this contains information on all the identified sources of pollutants in an imaginary city named AnyCity and their emissions. It contains two inventories, *Inventory_2020* and *Inventory_2025*, shown by the two large circles.

3.1.2 Inventories

Inventory_2020 is likely to contain data on the current emissions whereas *Inventory_2025* will be the best estimate of future emissions, taking into account changes in emissions from cars, closures of industrial plants and likely new industrial units or new dwellings. Inventories may therefore be used to compare the emissions now and in several years' time, when engine technology has reduced certain traffic emissions, or to compare the emissions from alternative traffic schemes.

Each of the inventories contains a number of groups of sources. The groups are shown with a different shape for the different source types, as each group can contain only one type of source. However, not all the main roads are in one group for main roads. In the 2025 inventory they have been split into two groups, *Major roads 2025* and *New major roads 2025*. *Major roads 2025* probably contains the same roads (same names, same geometry) as *Major roads 2020*, but the emissions will be different because vehicle emissions are predicted to change over time. The estimates of vehicle numbers and speeds may also change. *New major roads 2025* probably contains the roads that will be built between 2020 and 2025.

3.1.3 Groups

In **Figure 3.2**, there are two groups that are members of both inventories. Although sources must be unique, and so cannot be repeated in different groups or inventories, groups of sources can be shared between inventories. Then changes made to sources in a shared group will affect all inventories of which that group is a member. The two groups that are shared, *Point sources Part A* and *Point sources Part B* will contain source and emissions data for sources that are not anticipated to change between 2020 and 2025.

Some groups are already set up in each new EMIT database. These are groups such as *Default minor roads*, *Default rail* and *Default Area*. Groups can be defined and contain source information without being members of any inventory. For instance, these default groups do not belong to an inventory.

How exactly you structure the groups and inventories in your EMIT database will depend on what data you have, how you will use the data and what you want to investigate. For further details of how to set up an inventory, please refer to Section 5.

For each group held in EMIT, the emissions in that group are either:

- User defined;
- Calculated by using activity data and a pre-defined emission factor dataset held within the EMIT database; or
- Calculated by the scaling of a national emissions value by a local statistic.

These different group types are described below.

User-defined emissions

Groups of all source types can be created in EMIT that hold user-defined emissions data. For industrial point sources, emissions are usually in terms of g/s or tonnes/year; for road and rail sources, they are either in g/km/s or tonnes/year; for line sources they are in g/m/s or tonnes/year; for volume sources they are in $g/m^3/s$ or tonnes/year; and for minor road, area and CandD sources, emissions are usually defined in terms of $g/m^2/s$ or tonnes/year.

Activity data groups

There are a number of emission factor datasets held in EMIT. These datasets can be used, in conjunction with activity data imported by the user, to estimate emissions from various sources. For transport sources (road, rail and minor road), the activity data are usually traffic counts, speeds and fleet compositions; for industrial point, line, volume and area sources, the activity data may be the amount of fuel consumed, or the amount of product produced. Emissions from domestic properties can also be estimated – the activity data in this case would be the number of dwellings in an area.

Scaling groups

For some sources, neither explicit emission rates nor relevant activity data are available. In such cases, emissions can be approximated by scaling a national emissions figure using a local statistic (such as population). Scaling groups may only be created as area or CandD source groups.

Note the following:

- Each group has associated with it:
    - a unique name,
    - a source type,
    - a year, and
    - a Greenhouse Gas sector.

  Groups that use activity data to calculate emissions additionally have an associated emission factor dataset. The majority of the transport activity groups additionally have a set of fleet components and a route type assigned.

- 3D grid characteristics may be applied to each group. This option can be ignored if the sources are going to be modelled using a 2D grid.

- Groups may be empty, i.e. contain no sources.
- The maximum number of sources in a group is 90,000.
- Groups are first defined, using the **Data**, **Groups** screen, then added to an inventory and then populated with sources.

3.1.4 Sources

At the bottom of the EMIT database hierarchy, there are the individual sources within a given group. All the sources in a given group share the parameters from the group, i.e. source type, year, emission factors (if appropriate), 3D grid profiles etc. In addition, each source has its own set of data: the items that make up these data depend on the source type.

Sources are unique, so although the sources in *Major Roads 2020* and *Major Roads 2025* may in reality represent the same roads, they are considered as different sources in EMIT because the traffic data for each year could be different.

In this section we discuss the remaining data needed to describe a source, namely the physical characteristics of the source and its emissions (see **Figure 3.1**).

Geometry

The physical location of each source is specified by its vertices:

- a line, major road or rail source is specified as a set of straight line segments joining between 2 and 50 points (vertices)
- a point source is specified by a single point (one vertex only)
- an area source, CandD source, or volume source is specified by between 3 and 50 points corresponding to the corners (vertices) of a convex polygon.
- a minor road source is specified by four points corresponding to the four corners (vertices) of a rectangle in clockwise cyclic order. The vertices must lie on the corners of a $1km^2$ grid.

Spatial properties

As illustrated in **Figure 3.1**, the spatial characteristics of the source depend on the source type:

- major road – road width, elevation, canyon height and gradient must be specified. The road length is calculated by EMIT from the vertices data.
- rail or line – width and elevation must be specified. Length is calculated by EMIT from the vertices data.
- point – stack height and diameter must be specified.
- area – elevation must be specified. Area is calculated by EMIT from the vertices data.
- volume – source depth and elevation of the source centre must be specified. Area is calculated by EMIT from the vertices data.

- CandD – source depth must be specified. Area is calculated by EMIT from the vertices data.
- minor road – area is calculated by EMIT from the vertices data.

Release properties

For point, line and area sources, which are viewed as industrial in origin, the physical characteristics of the efflux gas are required. These consist of:

- exit velocity, w_{exit} or exit flow rate, $\dot{v}_{exit}$
- exit temperature, T_{exit}
- molecular weight, μ
- specific heat capacity, c_p
- density, ρ

These parameters are not used by EMIT but are stored and are available for export to, say, an emission inventory database used by the ADMS-Urban dispersion model.

3.1.5 Pollutants

EMIT contains 51 pollutant species. These are listed in **Tables 3.1** to **3.4**: greenhouse gases are given in **Table 3.1**, metallic pollutants are given in **Table 3.2**, poly-aromatic hydrocarbons are given in **Table 3.3**, non-metallic, acidic, and common toxic air pollutants, halogens and chloro chemicals are given in **Table 3.4**.

In addition to the pollutants listed in these tables, the Traffic Apportionment option creates special pollutant names e.g. "NOx_VC1", "NOx_VC2." The extra component on the pollutant name represents the vehicle category number, for example vehicle category 1 is represented by VC1. SECTION 9 of the User Guide discusses traffic apportionment in more detail.

No other pollutants may be added to the database.

Note that when emission factors are used to calculate emissions for a particular source group, this fixes the pollutants considered for that group; no other pollutants can be added for that group.

Pollutant name used in EMIT	Full name
CO2	Carbon Dioxide
CO2INDIECT	Carbon Dioxide due to vehicle charging
HFC	Hydro-Fluoro Carbons
METHANE	Methane
N2O	Nitrous Oxide
PFC	Per-Fluoro Carbons
SF6	Sulphur Hexafluoride

Table 3.1 – Greenhouse gas (GHG) pollutants available in EMIT

Pollutant name used in EMIT	Full name
BERYLLIUM	Beryllium
CADMIUM	Cadmium
CHROMIUM	Chromium
COPPER	Copper
LEAD	Lead
MERCURY	Mercury
NICKEL	Nickel
TIN	Tin
VANADIUM	Vanadium
ZINC	Zinc

Table 3.2 – Metallic pollutants available in EMIT

Pollutant name used in EMIT	Full name
ACENAPTHENE	Acenaphthene
ACENAPTHYLE	Acenaphthylene
ANTHRACENE	Anthracene
B[a]A	Benz[a]anthracene
B[a]P	Benzo[a]pyrene
B[b]F	Benzo[b]fluoranthene
B[ghi]P	Benzo[ghi]perylene
B[k]F	Benzo[k]fluoranthene
CHRYSENE	Chrysene
D[ah]A	Dibenz[ah]anthracene
FLUORANTHEN	Fluoranthene
I[cd]P	Indeno[123cd]pyrene
NAPHTHALENE	Naphthalene
PHENANTHREN	Phenanthrene
PYRENE	Pyrene

Table 3.3 – Poly-aromatic hydrocarbon pollutants available in EMIT

Pollutant name used in EMIT	Full name	Type
BENZENE	Benzene	Common toxic air pollutants
BUTADIENE	1,3-Butadiene	
CO	Carbon Monoxide	
NO2	Nitrogen Dioxide	
NOx	Nitrogen Oxides	
PM10	Particulate Matter (up to ten microns diameter)	
PM2.5	Particulate Matter (up to 2.5 microns diameter)	
SO2	Sulphur Dioxide	
VOC	Volatile Organic Compounds	
NH3	Ammonia	
TSP	Total Suspended Particulates	
ARSENIC	Arsenic	Non-metals
SELENIUM	Selenium	
HCl	Hydrochloric acid	Acids
HF	Hydrofluoric acid	
PCB	Polychlorobiphenyls	Chloro chemicals
C6Cl6	Hexachlorobenzene	
PCP	Pentachlorophenol	
FLUORENE	Fluorene	Halogen

Table 3.4 – Non-metallic, acidic, and common toxic air pollutants, halogens and chloro chemicals available in EMIT

3.2 EMIT Reference data

EMIT comes with a template database that contains all the pre-defined reference data: emission factor datasets, some pre-defined route types for road and rail sources and some pre-defined operators and dwelling region types as well as some pre-defined empty groups. There are no pre-defined sources. The contents of the template database are common to all EMIT databases.

The Operators data is described in SECTION 4 and in APPENDIX D. Traffic apportionment is described in SECTION 9. The dwelling region types are discussed in Section 12. The remainder of this section briefly discusses the emission factor datasets and the road/rail route types included within EMIT. For further details users should refer to Appendix A for full details of the road, rail and shipping data, APPENDIX B for aircraft data and Appendix C for full details of the non-transport data. In addition, the Greenhouse Gas (GHG) part of this User Guide (Section 11) discusses these emission factors in terms of using a bottom up approach to calculating a GHG emission inventory.

Note that although the majority of the discussion in the transport emission factors and route types sections below is about major road sources, both minor roads and rail sources also use emission factors and route types. A note on these source types is given at the end of this section.

3.2.1 Emission factors

There are two categories of emission factor datasets held in EMIT: transport datasets, including emission factors for road, rail, shipping and aircraft sources, and non-transport datasets that include emission factors for point, line, volume, area and grid (CandD) sources. With the exception of the two detailed road traffic emissions datasets, emission factors are *not* editable by the user.

Transport emission factors

Table A.3 and **Table A.13** in Appendix A summarise the exhaust and non-exhaust road transport emission factor datasets respectively. **Table A.22** in Appendix A gives the rail emission factor datasets and activity emission factor datasets relating to airport activities are summarised in **Table B.1** in APPENDIX B.

The majority of the road traffic emission factor data sets have been developed from measurements of vehicle emissions and are given as functions of average speed and vehicle sub-categories. For these ‘speed-emission’ datasets, the number of sub-categories in EMIT varies between datasets, for example EFT v10.1 has 917 vehicle sub-categories. There are also additional datasets included in EMIT that allow users to approximate the emissions from hot soaks and cold starts (refer to **Table A.15** in Appendix A).

The speed-emission datasets give the emission factors for a range of pollutants in g/vehicle/km for each category of vehicle. The emissions vary with the vehicle speed. Also, most of the emission factors vary with year – in some cases, this is because the datasets include some aggregation of vehicles of different ages, so the factors include the emission reductions due to cleaner technologies being introduced with time; for other datasets that have separate categories for each vehicle type, the yearly variation is due to the uptake of new vehicle technologies and fuels. A traffic idling emission factor dataset is also included within EMIT, and for this, activity data is defined in terms of vehicle hours per year.

An example sample of a set of emission factors is shown below in **Table 3.5**, which gives the **EFT v6.01** data for England in 2015 and a vehicle speed of 30 km/hr, in mg/vehicle/km:

Vehicle sub-categories	NO_x	NO_2	PM_{10}	$PM_{2.5}$
CAR urban England	451	104	36	21
CAR Rural England	481	119	27	18
CAR Mway England	531	131	23	16
BUS Urban England	4 399	1 011	166	108
BUS Rural England	3 991	984	133	90
BUS Mway England	4 010	990	112	80

Table 3.5 – EFT v6.0.1 emission factors (in mg/vehicle/km) for England in 2015 for a vehicle speed of 30km/hr.

Each row corresponds to one of the six vehicle sub-categories in the England region (there are 32 vehicle subcategories in total in the **EFT v6.0.1** dataset) and each column to a particular pollutant. For example, the emission rate of NO_x for a light vehicle in an urban area is taken to be 451 mg/vehicle/km (for a constant speed of 30 km/hr and with the distribution of engines and vehicle ages expected for 2015).

The number of fleet components for which there is count data will depend on the nature of the traffic count data available, whether it is from a manual count, an automatic count or a traffic model. One commonly employed set of fleet components for roads has 3 components:

- Heavy
- Light
- Motorcycles

EMIT offers both this categorisation for road sources and a more detailed one with 11 fleet components, which is the one used in the LAEI (London Atmospheric Emissions Inventory):

- Motorcycles
- Cars

- Taxis
- Buses and coaches
- LGVs
- Rigid HGVs 2 axles
- Rigid HGVs 3 axles
- Rigid HGVs 4+ axles
- Artic HGVs 3&4 axles
- Artic HGVs 5 axles
- Artic HGVs 6+ axles

Section 3.2.2 describes how EMIT links emission factors to fleet components.

Non-Transport emission factors

Table C**.1** in Appendix C summarises the available datasets for non-transport sources. These datasets have been collated from a number of sources, which are listed at the beginning of the section.

These datasets are *activity* datasets. That is, the total emission *E* of a particular pollutant in tonnes/year is equal to the product of the activity, *A* (unit activity)/year, and the emission factor, e_f, in tonnes of pollutant/unit activity i.e.

$$E = Ae_f$$

For example, the activity *A* could be tonnes of fuel used per year, amount of product produced per year, or number of people per year. The activity data are entered by the user; EMIT holds the emission factors e_f for a large number of activities, and calculates the emission rate *E*.

The emission factors in these activity datasets can be applied to point, area, line, volume and grid (CandD) sources, with the exception of SAP 2001 which cannot be applied to point sources.

3.2.2 Route types

When using the speed-emission traffic datasets included within EMIT***, route type*** data are required to link the traffic count data/fleet components and the emission factor vehicle sub-categories.

For most datasets, fleet composition is described in terms of relatively few categories, while emission factors require finer sub-divisions. The route type provides the link between the two, partitioning each fleet component between the emission factor sub-categories.

In EMIT, there are a number of pre-defined route types associated with the emission factor datasets. For example, **Table 3.6** below shows the taxi part of the 'E10.1 NOX [11]Eng U25' route type. The entries in the 'Fleet component "Taxis"' column sum to

100%. Each row corresponds to one of the taxi vehicle sub-categories in this emission factors dataset. The meanings of the code names are given in **Table A.19** in Appendix A. For example, “E0156” represents a taxi with Euro 6c emission standard.

Vehicle sub-categories	Fleet component “Taxis”
E0094	0.12
E0095	1.76
E0096	11.48
E0097	8.30
E0156	19.26
E0157	59.08

Table 3.6 – Percentage contribution from each taxi vehicle sub-category to the taxi fleet component for the ‘E10.1 NOX [11]Eng U25’ route type.

Using this example route type, if the user enters an AADT of 10,000 taxis, then emissions will be calculated assuming the approximate vehicle break-down given below.

- 12 E0094 Euro 3 taxis.
- 176 E0095 Euro 4 taxis.
- 1,148 E0096 Euro 5 taxis.
- 830 E0097 Euro 6 taxis.
- 1,926 E0156 Euro 6c taxis.
- 5,908 E0157 Euro 6d taxis.

The route type changes with both emission factor dataset and number of fleet components. In EMIT, pre-defined route types are available for all emission factor datasets (please refer to Appendix A).

The above discussion has focused on major road sources. EMIT also considers rail sources and minor road sources.

Minor road sources

To characterise minor roads, mostly the same parameters are used as for major roads but minor road sources are treated in an aggregated fashion, since it is not necessary to describe each individual road. Situations where this would be appropriate are residential and rural areas. For minor road sources

(i) the source is taken to occupy an area of specified dimensions, rather than a line, and

(ii) instead of the length and AADT (vehicles per day), the annual vehicle kilometres per fleet component is used, i.e. the traffic composition is given in terms of the total number of kilometres travelled by all vehicles in each fleet component within the designated area.

The same emission factors, route types and fleet components are used for estimating emissions as for major roads.

Rail sources

These are treated in an identical fashion to major roads except that they have their own separate sets of emission factors, fleet components and route types which are described in detail in Appendix A. The counts required may be of power cars, locomotives or carriages.

SECTION 4 A Guided Tour of EMIT

4.1 Introduction

EMIT comprises the main EMIT interface, an Import Wizard and a Mapper for display and manipulation of data. The Import Wizard and Mapper are described in detail in Section 6 and Section 7 respectively. This section provides an overview of the components of the EMIT interface.

The initial EMIT screen is shown in **Figure 4.1**.

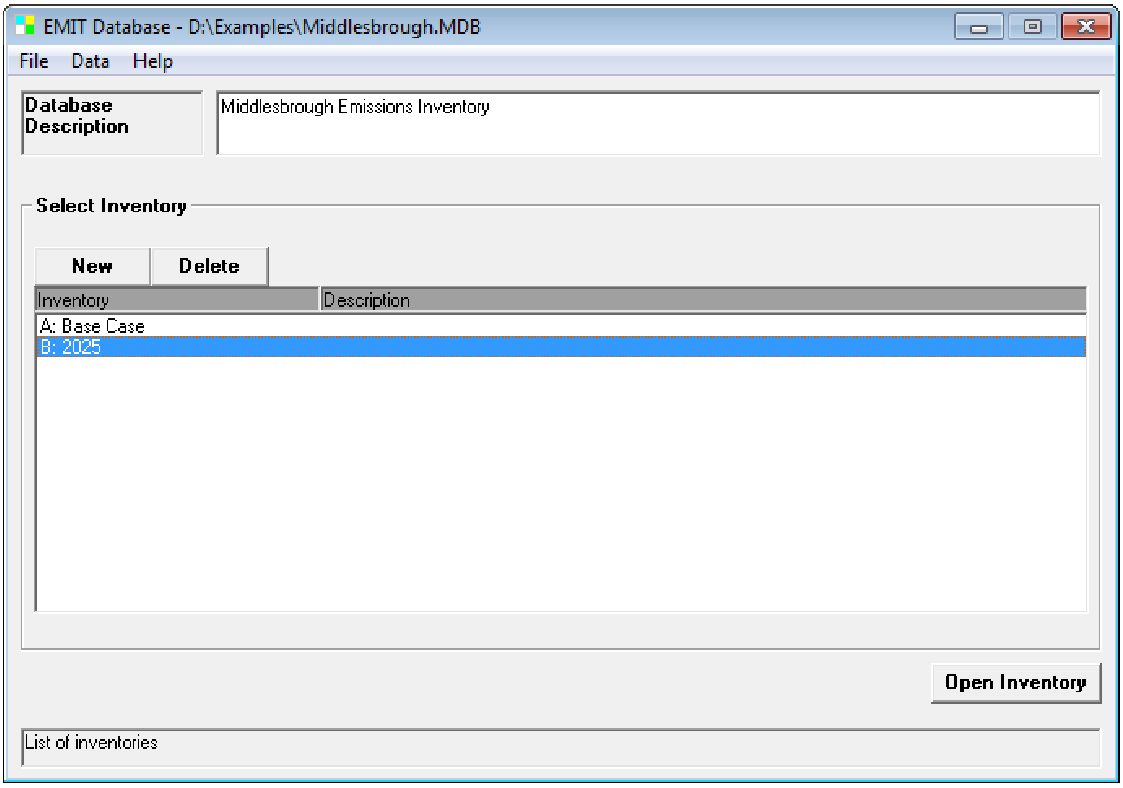


Figure 4.1 – Typical EMIT interface screen, in this case showing an EMIT database and the inventories it contains.

The main features of the EMIT interface are:

- the banner giving details of the data displayed in the screen, e.g. the current EMIT database or set of emission factors;
- the drop-down menus at the top of the window, which are mainly used to display the reference data screens (via the **Data** menu), run the Import Wizard, to open, close or compact the database (via the **File** menu) or to provide help information (**Help** menu);
- the main part of the window displaying a screen of data: this either shows *source-related data*, i.e. one part of the data hierarchy and the data associated with it, such as a particular EMIT database or a particular industrial source, or the screen contains *reference data*, i.e. data that can be used in defining sources, groups, etc., such as sets of emission factors or route types.

The EMIT screens are used to:

- navigate through the data hierarchy (inventory, group, source) and view or edit contents of the data relating to individual inventories, groups and sources. These screens are described in Section 4.2, using annotated screens to summarise the main features; and to
- view or edit the reference data, for example emission factors, route types or list of operators. These screens are described in Section 4.3 using annotated screens.

The reference data is so-called as it is not particular to one inventory, group or source but can be used throughout the database. An example is the **EFT v10.1 NOx Eng U** set of vehicle emission factors that can be used by any group of road sources. Some reference data are pre-loaded in the template EMIT database but other reference data can be added by the user.

There is only one EMIT window, so only one screen is visible at a time. In particular, this means that you must ascend/descend through successive levels of the data hierarchy rather than stepping directly to a given level. Data for only one inventory, group, or source is visible at a time.

Reference data screens are also superimposed over the current source data screen. Use the **Close** button to return to the previous display (usually located at the bottom left hand corner of the screen).

4.2 EMIT source data screens

In this sub-section you will find a set of annotated screens summarising the main features of each of the data hierarchy screens:

- Database screen (**Figure 4.2**)
- Inventory screen (**Figure 4.3**)
- Group screen (**Figure 4.4**)
- Source screen (in this case showing a major road source) (**Figure 4.5**)

The annotations are numbered so as to guide you around each figure. Some general information on the screen and its use are given after each one. Full details of all the controls on each screen are contained in Appendix D.

4.2.1 EMIT Database screen

This is the initial screen that appears when you start EMIT (**Figure 4.2**). Use the **File** menu to select the EMIT database you want to use (**File, Open**) or to create a new EMIT database (**File**, **New**). In both cases, the inventories contained in the database are listed in the table.

You can use the **New** button to create a new inventory within the database, or the **Delete** button to remove an inventory.

Having opened the database, all subsequent changes, such as creating a new group or defining a new route type, are restricted to that database. The only data shared between databases are those contained in the EMIT template database, e.g. the sets of emission factors, pre-defined route types and other pre-loaded reference data.

To open a particular inventory either double-click its name in the table or click once to highlight its name and then using the **Open Inventory** button. This will take you to the **EMIT Inventory** screen.

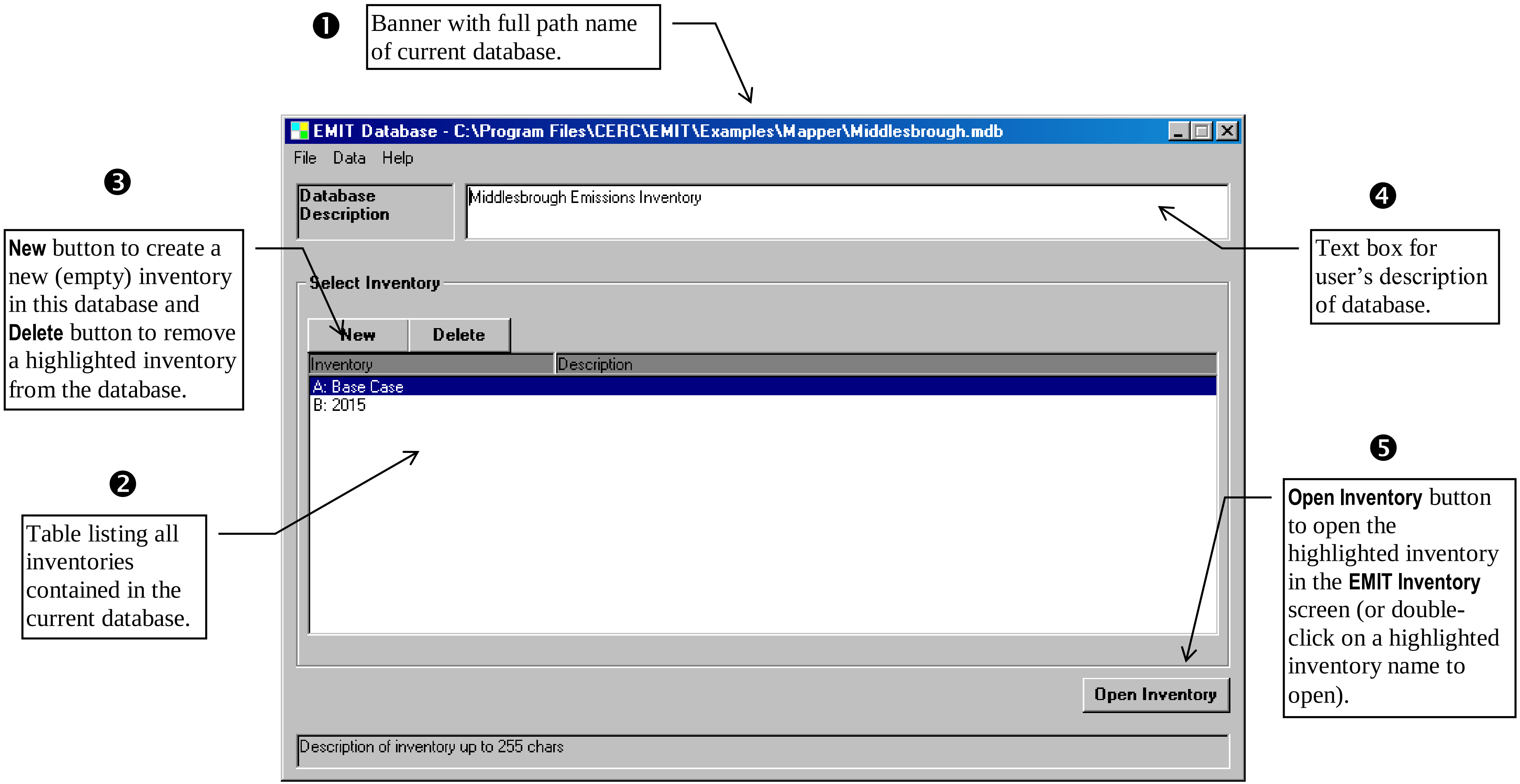


Figure 4.2 – **EMIT Database** screen.

4.2.2 EMIT Inventory screen

Use this screen to manage the groups within an individual inventory, to make overall changes to the inventory and to calculate the inventory's emission totals.

You will have arrived here (**Figure 4.3**) by creating a new inventory or by opening an existing inventory on the EMIT Database screen (Section 4.2.1), or by closing an EMIT Group screen (Section 4.2.3). If the inventory is new, the default name is based on the date and time when it was created. Give it a more meaningful name by editing the text in the **Name** text box.

The table lists the groups in the inventory along with their chief characteristics. Use the **Add...** button to add groups to the inventory. A new inventory is empty, so must be populated with groups one at a time. These groups must be taken from the pool of groups defined for the current database, which are either default groups that come with the template database or groups that have been defined by the user via the Group Data screen, (**Figure 4.14**). You must therefore make sure that the group you want to add to the inventory has been defined in the database before trying to add it to the inventory. A list of available groups is shown when you click the **Add...** button. If the group you want is not already defined, define it using the Group Data screen (see Section 4.3.7).

The **Remove...** button moves a group outside the current inventory, but the group still remains defined in the database. The **Modify Group...** button can be used to change the Group name, Year, Route Type or Emission Factors for the group.

The **Inventory Properties...** button can be used to change the inventory coverage or cell size, specify its time period and define 3D grid properties. The inventory coverage is the extent and cell size of the grid used in calculation of inventory totals. The time period is used in the display of the inventory totals. If a specific time period is given, the totals screen will show the total emissions for the period, in tonnes. Otherwise, the totals screen shows annual average emissions in tonnes/year. The 3D grid properties should be left blank when modelling a 2D grid. If you are intending to model a 3D grid in ADMS-Urban or CMAQ you will need to input the settings for the output 3D grid, these include: Grid name; Output time settings; Coordinate system data; Vertical levels; and Chemical mechanism.

Check the box labelled **Aggregate for export to ADMS-Urban** if you ultimately wish to export your inventory data to an ADMS-Urban emissions inventory database for use in dispersion modelling.

Use the **Calculate** button to find emissions totals for the area defined by the inventory coverage on the **Inventory Properties** screen and use **View Totals** to view the results. The results can be shown for the whole area or for each grid square. In addition, Greenhouse Gas emission inventory totals can be viewed. The date on which the emissions totals were last recalculated is displayed in the **Last recalculated on** box, and if the totals are out of date then the **Inventory totals out of date** message is displayed.

If you are using EMIT to set up data for use with the ADMS-Urban dispersion model, use the **Export Totals** and **Export Groups...** buttons to export emissions data to an ADMS-Urban emissions inventory database. Further details on calculating total emissions and exporting data may be found in Section 9.

Use the **Open Group** button, or double-click on the group in the table, to open the EMIT Group screen for that group.

❶ Banner with file name of current database and name of open inventory.

❷ **Name** and **Description** of inventory entered by user.

❸ Table listing all groups in current inventory, together with their principal characteristics.

❹ **Add** button to add pre-defined group and **Remove** button to remove group from the inventory.

❺ **Modify Group...** button allows user to change the group name, year, route type and emission factors for a group.

❻ Controls to recalculate emission rates (**Calculate**), view numerical totals (**View Totals**) and export numerical data to *.csv* file or emissions inventory database (**Export Totals**).

❼ The date and time that the inventory totals were calculated is displayed in the **Last recalculated on** box. If the totals are out of date, then the **Inventory totals out of date** message is displayed.

❽ **Inventory Properties...** button allows user to change the inventory coverage, cell size, or inventory time period.

❾ **Export Group...** button exports the group to an ESRI shape file, a *.csv* file or an emissions inventory database.

❿ **Open Group** button to open the highlighted group in the **EMIT Group** screen (or double-click on a highlighted group name to open).

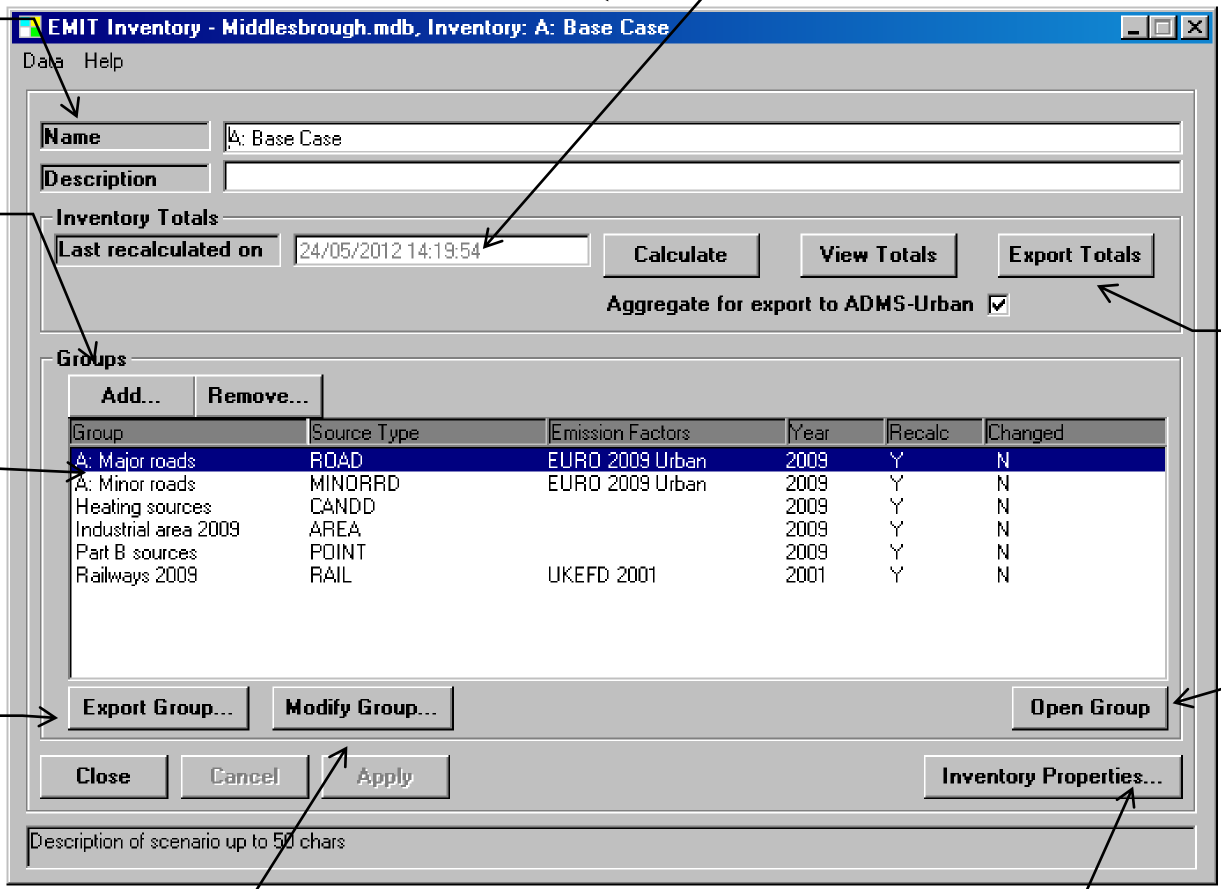


Figure 4.3 – **EMIT Inventory** screen.

4.2.3 EMIT Group screen

This screen is used to manage the sources within the group and edit multiple sources. You will have arrived here (**Figure 4.4**) by opening a group on the EMIT Inventory screen or by closing an EMIT source screen.

The screen lists all the sources in the group. The contents of the group can be managed with the **Add** and **Delete** buttons. Use the **Filter...** button to restrict the sources listed either by part of the source name or one of the associated keywords (see **Table 4.1**). If you click on the **Add** button a new source is created and added to the current group and the source data screen (Section 4.2.4) is opened for you to enter the source data. The **Delete** button will remove the source from the database, so any data for that source are permanently deleted.

You may also copy one or more selected sources with the **Copy** button. Making a copy of a source effectively creates a new source with the same initial parameters as the original source and with the prefix "C1_" added to the source name. The parameters of the original and copy source can be edited independently as sources in an EMIT database are unique. You can choose whether to add the copy source to the same group or to a different group.

You can edit one or more sources in the group with the **Edit** button. When one source is highlighted, the source data screen appropriate for the source type is opened allowing any data for that source to be edited. If multiple sources are selected a restricted set of data items may be changed by a specified factor or to a specified value, depending on the item in question.

The **Select All** button provides a convenient way to select all the sources in the group for copying, deleting or editing.

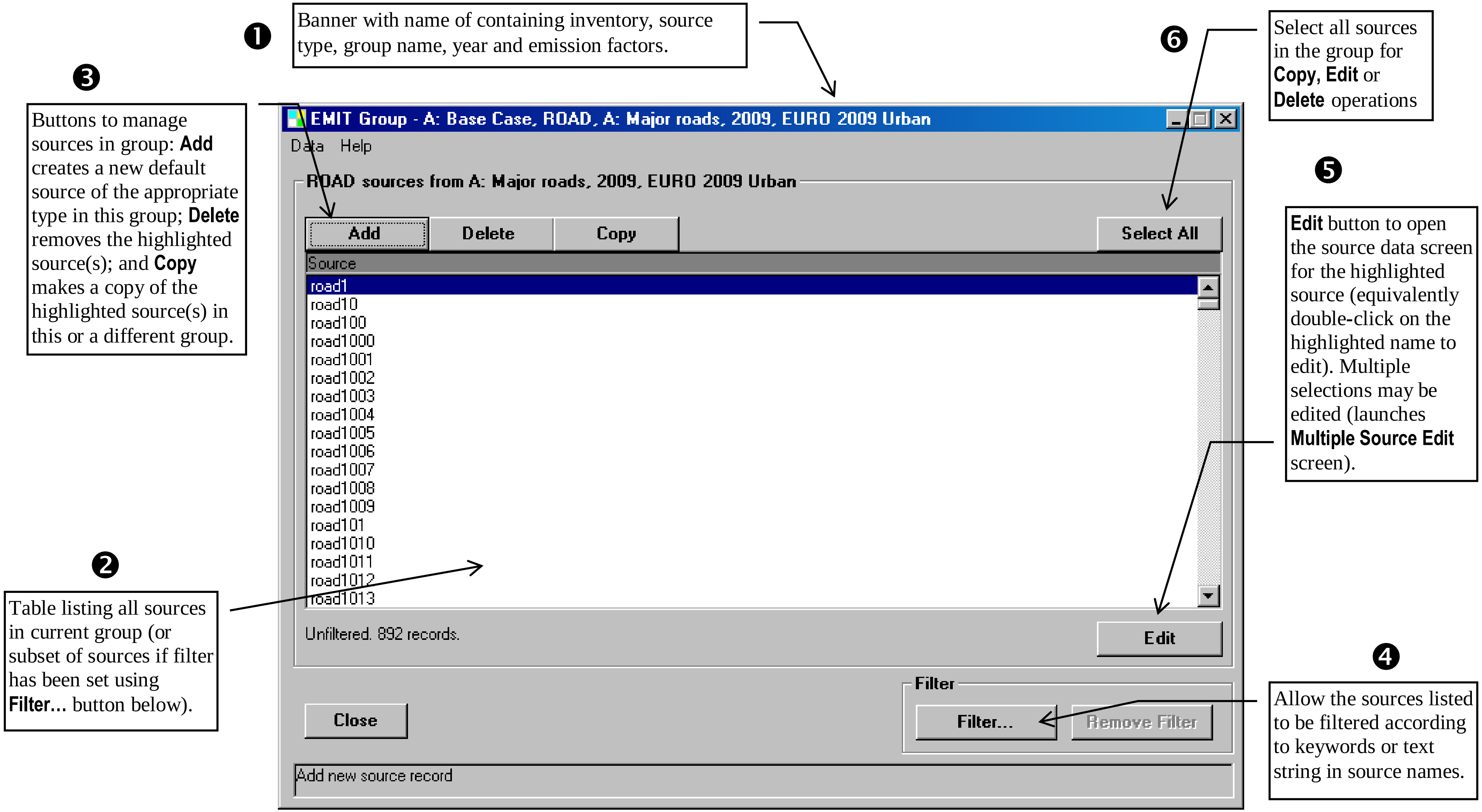


Figure 4.4 – **Emit Group** screen.

4.2.4 EMIT source screens

You will have arrived here (**Figure 4.5**) from the EMIT Group screen (Section 4.2.3) for the parent group or via the Mapper (Section 7).

Each type of source has its own data screen, through which you can view and edit data for an individual source. However, they all have the same general form, and **Figure 4.5** shows a typical example, in this case for a Major Road source.

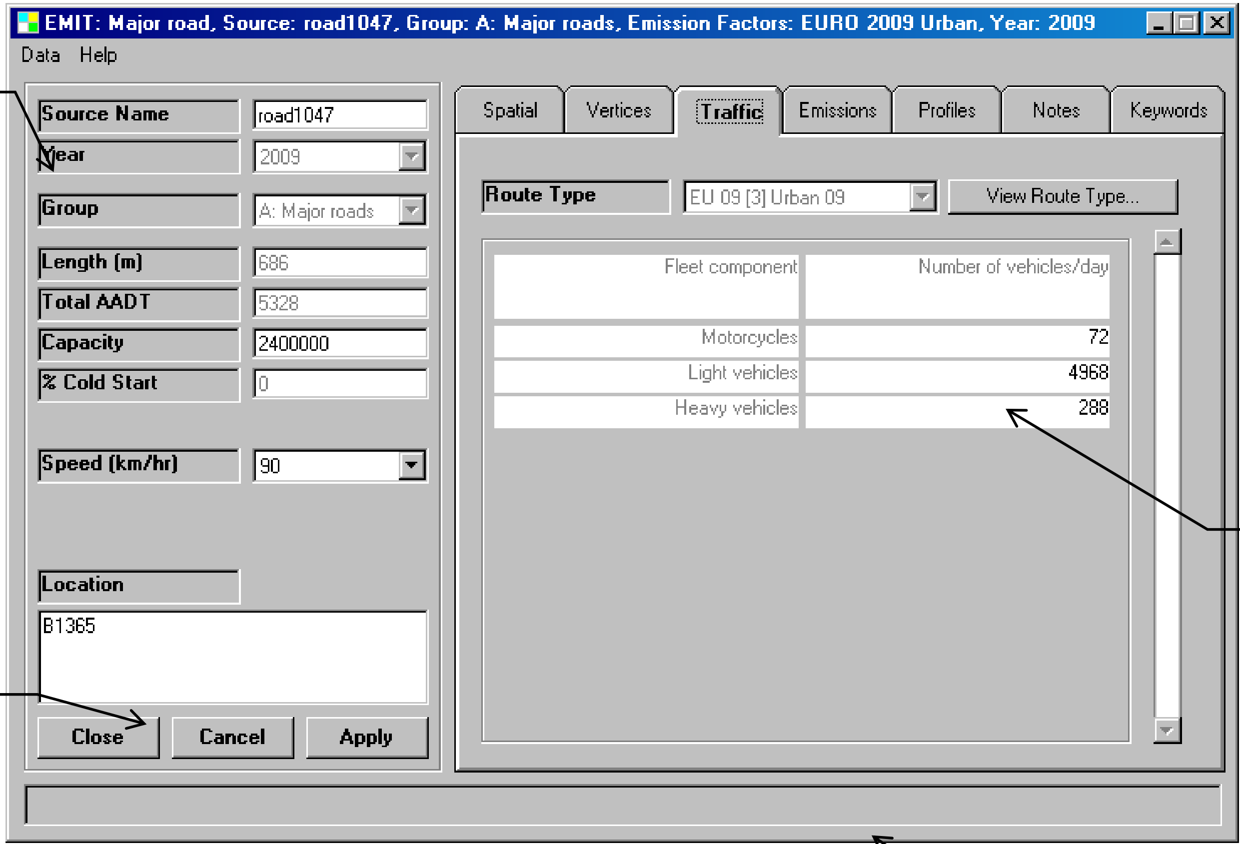
The screen, which includes a number of tabs, each containing data, contains all the data specifying a given source, so the screen may be used to change directly any parameter for the source. Data on this screen may also be changed in other ways via the Import Wizard and the Mapper (see Section 6 and Section 7).

Table 4.1 summarises the main features of each source screen. See Appendix D for a more complete listing of the features of the EMIT source screens.

❶ Banner with source type and name, and group name, emission factors and year.

❷ Left-hand side of screen contains individual values parameters.

❸ Right-hand side of screen comprises a set of tabs containing source data that require multiple items to be specified, e.g. here the traffic data.



❻ Traffic tab – defines fleet component AADT values for this major road source.

❺ **Apply** button implements changes; **Cancel** rejects edits since last **Apply**; **Close** implements changes and returns to next highest level.

❹ Help line gives brief description of control currently selected.

Figure 4.5 – EMIT Major road screen. See also Table 4.1 for more details of data on other tabs.

Main features	Notes
Banner – source type, source name, group and main defining properties.	
Data box – lists a number of single-value parameters for the source.	Contents of this area of the screen are source type dependent.
Tabs	
Spatial tab – specifies the physical characteristics of the source, e.g. width, height above ground level.	Major road and rail sources only.
Vertices tab – lists the co-ordinates of the source vertices points that define the source position.	All sources, but different number of vertices required for different source types. A road, rail or line source can have up to 50 vertices.
Traffic tab – route type and traffic count data.	Major road, rail and minor road activity source groups only.
<Dataset key word> tab – gives the activity data and time period over which the activities occur.	Point, area, line, volume and CandD activity source groups only.
Housing tab – region type, number of dwellings, and associated carbon statistics.	Area and CandD SAP source groups only (domestic emissions).
Emissions tab – emission rate for each pollutant, either entered directly or estimated by EMIT. **<Statistic>** also displayed if the emissions are calculated by scaling.	All sources (**<Statistic>** only for Area, volume and CandD scaling groups).
Exit Gas tab – physical properties of the gas leaving the source.	Point, line and area sources only.
Notes tab – useful for keeping notes on the specific source (including changes made).	All sources.
Keywords tab – keywords specified here can be used to filter sources on **EMIT Group** screen.	All sources.

Table 4.1 – General features of source data screens.

4.3 EMIT menus

EMIT has a set of menus accessible from the menu bar at the top of the window. The number of main menu options varies according to the screen currently in view. **File** is only available from the Inventory screen. If the user selects **Data** and enters a reference data screen **Help** is the only available menu item.

Each main option has a set of options presented in a drop-down list, and **Table 4.2** provides a summary of each of these. A detailed description is given in Appendix D.

The remainder of this section describes the reference data screens that are entered when the user selects data from the menu bar. The reference data screens are:

- **Emission Factors** screen (**Figure 4.6**)
- **Edit NO2 Percentage for Roads** screen (**Figure 4.7**)
- **Edit Roads Factors** screen (**Figure 4.8**)
- **Traffic Apportionment** screen (**Figure 4.9** to **Figure 4.11**)
- **Route Types** screen (**Figure 4.12**)
- **Region Types** screen (**Figure 4.13**)
- **Groups** screen (**Figure 4.14**)
- **Operators** screen (**Figure 4.15**)

The annotations are numbered to guide you around each figure. Some general information on the screen and its use are given after each one. Full details of all the controls on each screen are contained in Appendix D.

Main menu	Menu option	Function
File	**New** **Open** **Close**	Create a new EMIT database; Open an existing EMIT database; Close the currently-open EMIT database.
	Import Data	Start the EMIT Import Wizard for importing data from shape files, etc.
	About Database **Compact Database**	View data about the current database; Compact the database (reduce it in size).
	Previous.mdb	Quick access list of recently-opened EMIT databases.
	Exit	Close down the EMIT program.
Data	**Operators**	Opens the EMIT Operator screen for viewing and editing data on operators.
	Route Types	Opens the EMIT Route Type screens for viewing and editing data on route types. There are separate **Road** and **Rail** sub-options.
	Traffic Apportionment	The EMIT Traffic Apportionment option is controlled using three screens: • The **Define Apportioned Pollutants** sub-option allows users to define which pollutants to include with the traffic apportionment option. • The **Vehicle Categories** sub-option allows users to define the vehicle category names. • The **Vehicle Category Membership** sub-option allows users to allocate vehicle sub-categories to the vehicle categories defined in the above screen.
	Emission Factors	Opens the EMIT Emission Factors screens. There are four sub-options: • The **Roads** and **Rail** sub-options allow users to view the road and rail emission factors contained within the database. These emission factors are *not editable*. • The **Edit NO2 Percentage for Roads** sub-option allows users to edit the proportion of NO_x that is NO_2 for the underlying emission factors within the '**NAEI 2012**' and '**NAEI 2014**' datasets. • The **Edit Roads Factors** sub-option allows users to edit the underlying emission factors certain datasets, for all pollutants within the dataset, with the exception of NO_2.
	Region Types	Opens the EMIT region type screen for viewing and editing data on region types defined for domestic dwelling source groups.
	Groups	Opens the EMIT Groups screen for defining new groups or modifying group properties.
Help	**User Guide**	Opens the User Guide in Adobe Acrobat Reader, if this is installed.
	About…	Displays version information on EMIT.

	Licence Details…	Displays licence information.

Table 4.2 – Summary of EMIT menu options.

4.3.1 Road and Rail Emission Factors screen

Road and rail emission factors are discussed in detail in Appendix A. They are used to calculate emission rates for road and rail sources. **Figure 4.6** shows the Emission Factors data screen for road sources: you may access it from the **Data** menu (**Data, Emission Factors, Road**) at any time.

The emissions factor data displayed on the right of the screen are not editable. The screen shows the emission factors for any allowed combination of **Emission factors** dataset, **Year** and vehicle **Speed (km/hr)** selected from the drop-down list box on the left-hand side of the screen. The available datasets include:

- EFT v6.0.1
- EFT v5.2

The scroll bars to the bottom and the left of the table displaying the factors can be used to display more pollutants or vehicle categories. The most recent emission factor datasets should be used in preference; these are **EFT v10.1 NOx and PM** datasets. The emission factors for EFT versions 8 onwards cannot be viewed via this option, instead the data files can be found under the *<install path>\ROADEM* directory, where they are in *.csv* file format.

The example of the **Emission Factors** screen shown in **Figure 4.6** is for road sources but there is a similar screen for rail sources, accessed via **Data**, **Emission Factors**, **Rail**.

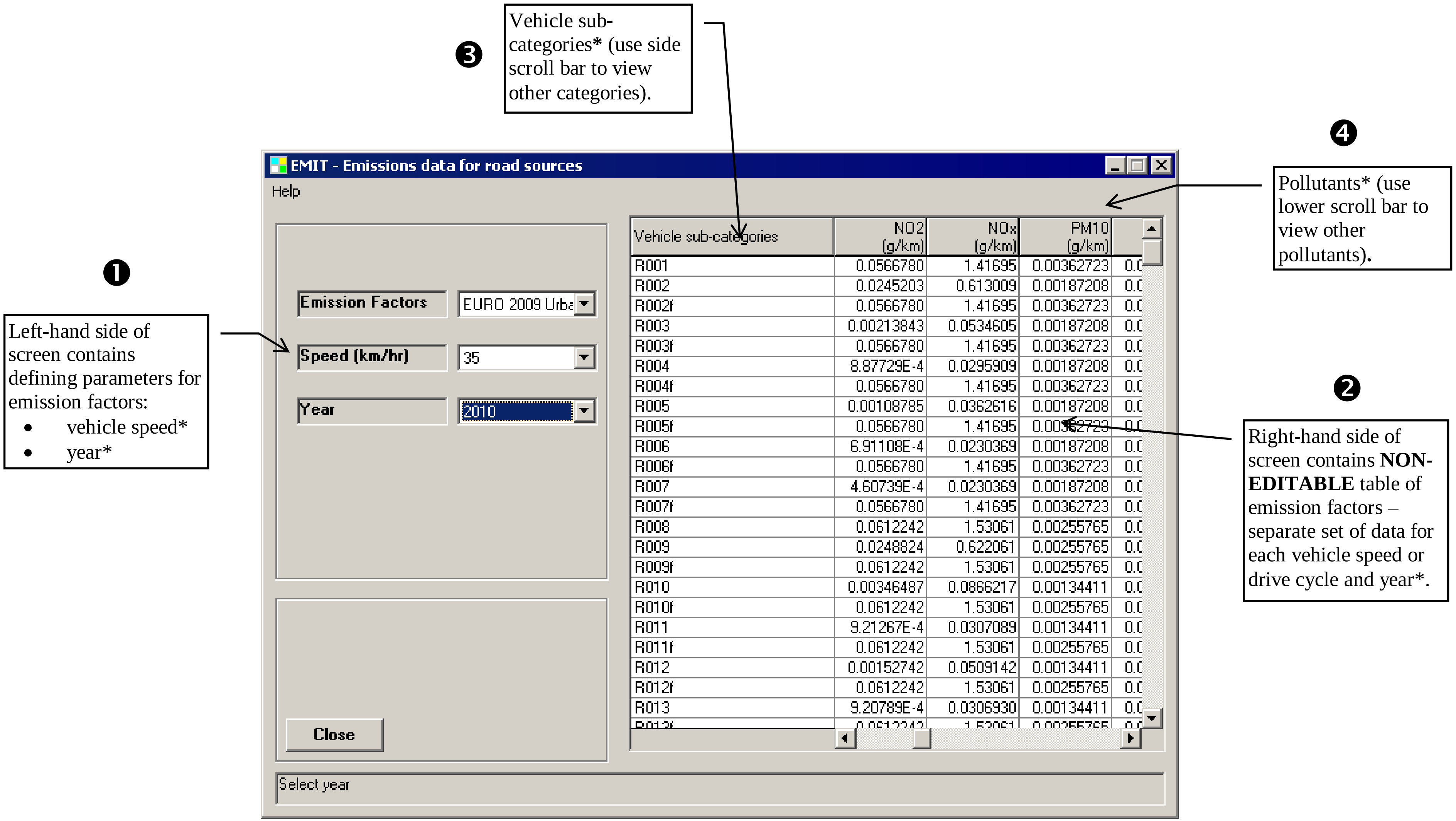


Figure 4.6 – Transport Emission factors data screen (road sources). Features marked with an asterisk* are dependent on the choice of emission factors for this group.

4.3.2 Edit NO2 Percentage for Roads screen

Background

The source data for road traffic NOx emission factor datasets specifies NO_2 emission factors in terms of a percentage of the corresponding NO_x emission factor for each vehicle category.

EMIT allows users to edit the proportion of NO_x that is NO_2. This is done using the **Road Emission Factors – Edit NO2 Percentage** screen, described below.

The **Road Emission Factors – Edit NO_2 Percentage** *screen*

Figure 4.7 shows the **Road Emission Factors – Edit NO_2 Percentage** screen. At the top of the screen, the user selects the emission factor dataset of interest from the **Emission Factors** list. The following descriptive comments are displayed:

This table shows NO2 as a percentage of emitted NOx for each vehicle sub-category. The values are editable. They apply to all calculations in this database with these emission factors. The percentages apply to the original NOx factors, and do not take account of changes made to NOx on the Edit Road Emission Factors screen.

This reminds the user of the important point that these NO_2 proportions are applied directly to the original NO_x factors contained within the EMIT database. If the user has changed the underlying NO_x factors (by using the **Edit Road Emission Factors** screen – see Section 4.3.3 below), then a corresponding change must be made to the NO_2 factors by using the **Road Emission Factors – Edit NO2 Percentage** screen.

The information is displayed in a table. The first and second columns give the vehicle sub-category name and description respectively. The fourth column displays the **Recommended percentage** by which the original NO_x emission factor should be multiplied. The third column is user editable, and contains the actual value by which the NO_x emission factor will be multiplied in order to obtain the NO_2 emission factor used by EMIT. If NO_2 percentage data for any vehicle sub-categories are changed to non-default values, the corresponding rows in the table are highlighted in red.

For reference purposes, the data on this screen can be copied and pasted into other software, such as Microsoft Excel. It is not possible to paste data into this screen.

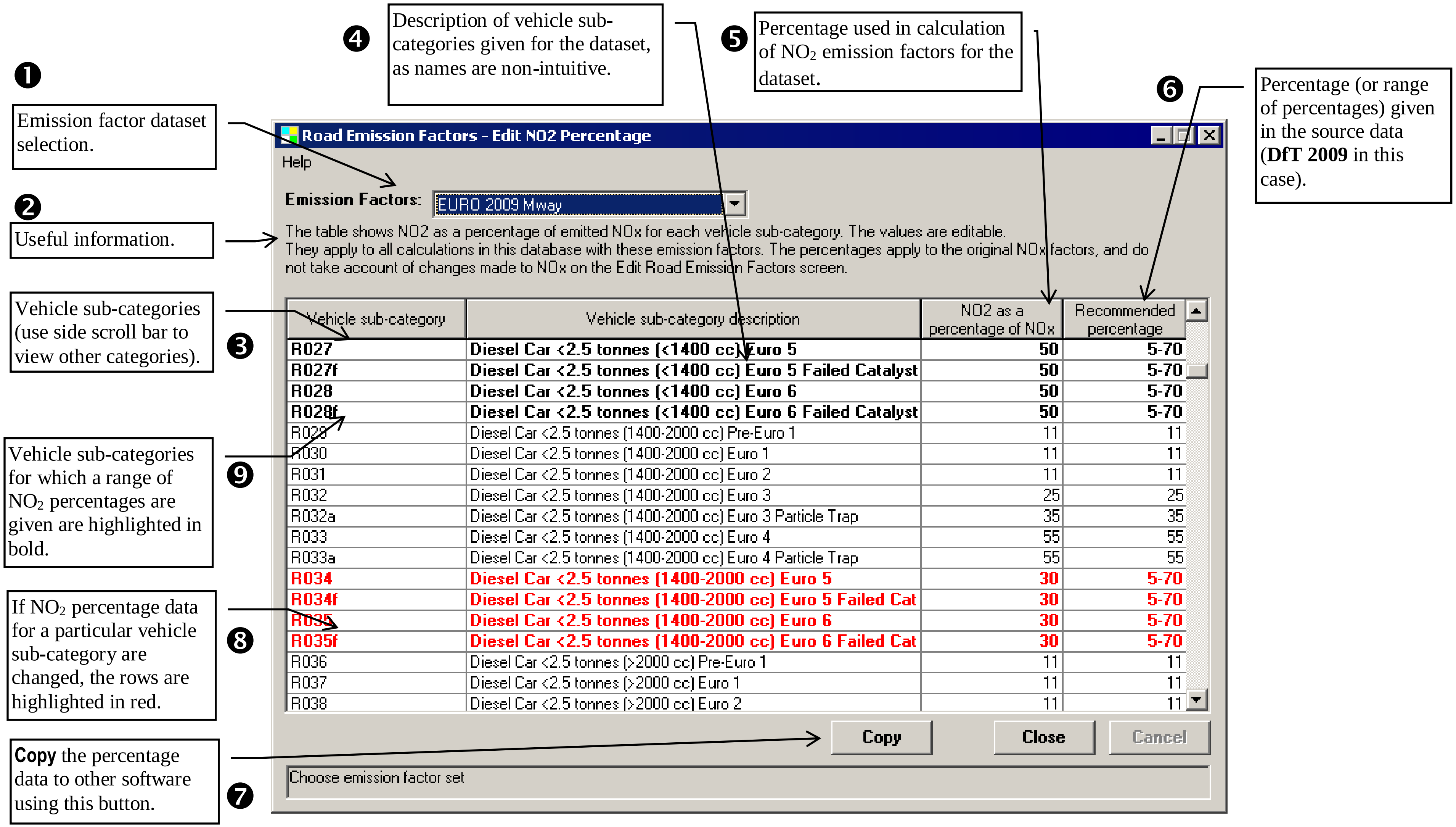


Figure 4.7 – **Road Emission Factors – Edit NO2 Percentage** screen (road sources).

4.3.3 Edit Road Emission Factors screen

Background

There are uncertainties regarding emissions of some pollutants from road traffic, particularly those that are unregulated. For example, PM_{10} and $PM_{2.5}$ emissions are clearly a proportion of the PM emissions, but the factors are different for the various vehicle types.

However, it may be the case that a user has access to additional information regarding emissions, and would like to alter the factors used in the EMIT calculations. For the sets of detailed road transport emission factor datasets, this can be done using the **Edit Road Emission Factors** screen described below.

Other examples where the user may like to edit the original emission factors are:

- If there is uncertainty regarding the SO_2 content of fuel.
- If there is uncertainty regarding the emissions from vehicles that have been retrofitted with new vehicle technologies, for example particulate traps.

Please refer to Appendix A for full details of how the underlying emission factors have been compiled in order to assess any requirements for adjusting the emission factors.

The **Edit Road Emission Factors** *screen*

Figure 4.8 shows the **Edit Road Emission Factors** screen. The data entered in this screen will be used in all calculations using the selected dataset. The following comments are displayed at the top of the screen:

You can specify a percentage of the original factors for each vehicle sub-category. You cannot alter the year-dependency or the speed dependency. The percentages apply to all calculations in this database with these emission factors. If you edit PM10, consider editing PM2.5. Similar considerations apply for NOx/NO2 and VOC/BENZENE/BUTADIENE/METHANE.

This reminds the user that:

- These factors apply globally to the emissions for a particular vehicle sub-category; there is currently no option to alter the year dependency or the speed dependency.
- When making edits to the emission factors using this screen, it is up to the user to ensure consistency between emissions. For example, if the user alters the NO_x emission factor for a particular pollutant, then a corresponding change should be made to the NO_2 emission factor in the **Road Emission Factors – Edit NO2 Percentage** screen.

The emission factor information is displayed in a table. The first and second columns give the vehicle sub-category name and description respectively. The third column is user-editable, and contains the percentage that will be applied to the original emission factor before being used by EMIT. By default, this is taken to be 100%.

If percentage data for a particular vehicle sub-category are changed from the recommended percentage, the corresponding rows in the table are highlighted in red.

For reference purposes, the data on this screen can be copied and pasted into other software, such as Microsoft Excel. Currently, it is not possible to paste data into this screen.

Note: NO_2 emission factors cannot be edited using this screen. The **Road Emission Factors – Edit NO2 Percentage** described in Section 4.3.2 above must be used to edit base NO_2 emission factors, in terms of a proportion of the base NO_x emission factors.

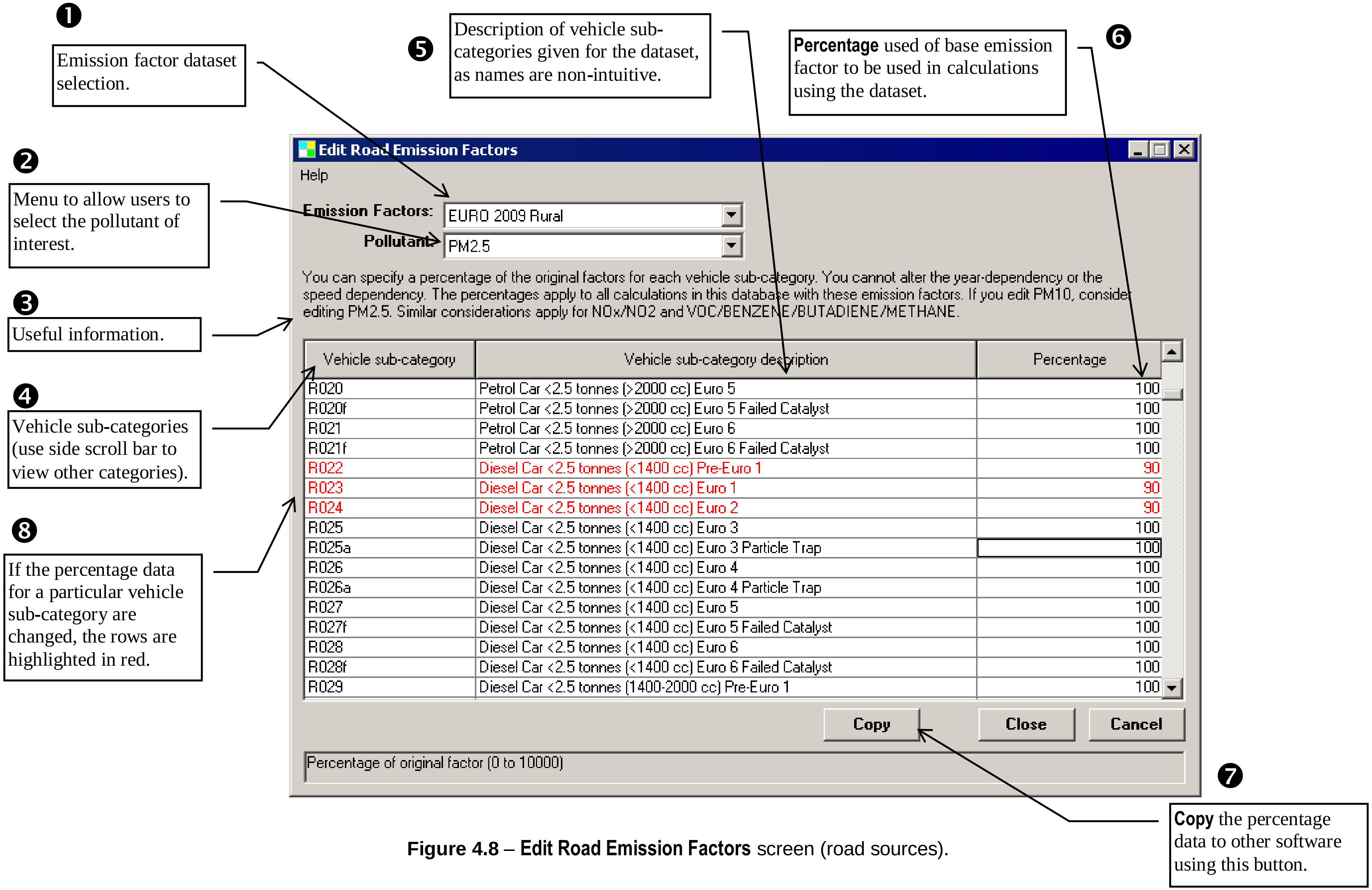


Figure 4.8 – **Edit Road Emission Factors** screen (road sources).

4.3.4 Traffic Apportionment screens

The **Traffic Apportionment** option consists of three sub-screens, the **Define Apportioned Pollutants** screen, the **Vehicle Categories** screen and the **Vehicle Category Membership** screen.

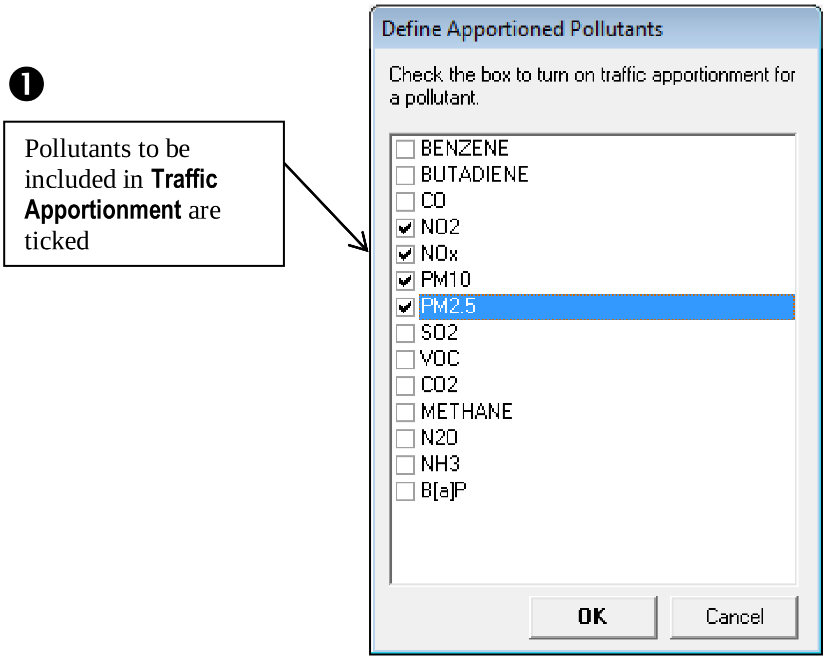


Figure 4.9 - The **Define Apportioned Pollutants** screen

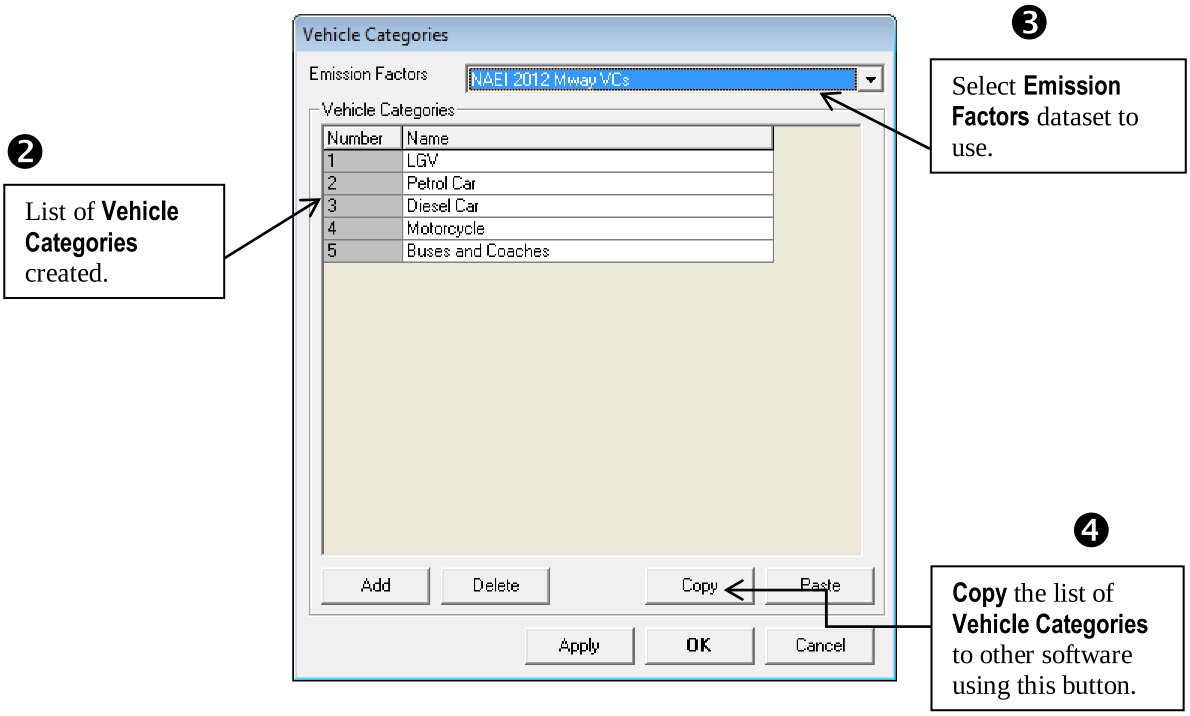


Figure 4.10 - The **Vehicle Categories** screen

❺ Select **Emission Factors** dataset to use.

❼ **Vehicle category** is chosen for each vehicle sub-category.

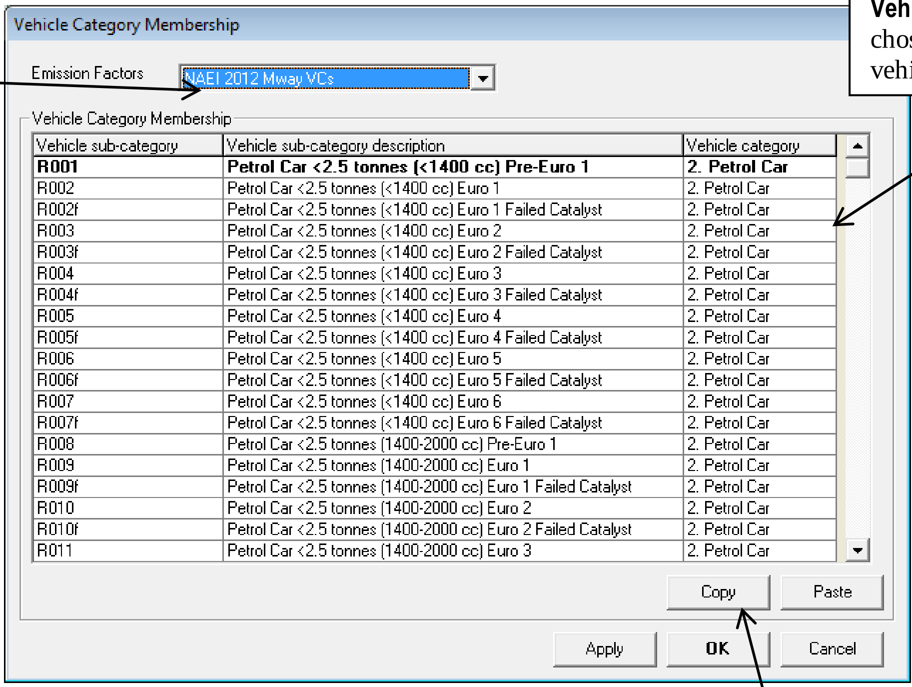


Figure 4.11 - The **Vehicle Category Membership** screen

❻ **Copy** / **Paste** the vehicle category membership to / from other software using these buttons.

For more information on **Traffic Apportionment** refer to Section 8.

4.3.5 Route Type screen

Another data screen used for transport sources is the **Route Type** screen shown in **Figure 4.12**. It is entered via **Data, Route Types, Roads** or **Rail.** The example shows the road route types. Unlike the sets of emission factors, route types may be edited and new ones defined for all datasets, to specify a particular mix of traffic for the user's road and rail sources. If required, the route type data can be copied and pasted into a spreadsheet package such as Microsoft Excel for editing. For further discussion of route types, please refer to Appendix A.

A route type must be associated with a particular set of emission factors, since the traffic is split up according to the same vehicle sub-categories used by the emission factors. In EMIT, the route type is the link between the fleet components, i.e. the breakdown of traffic count data into a small number of broader categories, and the emission factors. The two options for fleet component of road sources are:

Heavy/Light/Mcycle

- Heavy
- Light
- Motorcycle

LAEI Inventory (11)

- Motorcycles
- Cars
- Taxis
- Buses and coaches
- LGVs
- Rigid HGVs 2 axles
- Rigid HGVs 3 axles
- Rigid HGVs 4+ axles
- Artic HGVs 3&4 axles
- Artic HGVs 5 axles
- Artic HGVs 6+ axles

For rail sources there are 3 options and these are detailed in Appendix A.

EMIT comes with a number of pre-defined route types (see Appendix A); these may also be used as a template to define new ones. The user cannot edit or delete the pre-defined route types. All available route types for this EMIT database are listed in the **Route Type** drop-down list box on the left-hand side of the screen. The **Emission Factors** drop-down list box shows the associated emission factors. The final drop-down list box, **Fleet Components**, shows whether the traffic composition is divided into either 3 or 11 categories (2, 4 and 14 categories are allowed for rail sources). The **Year** label shows the year for which the fleet composition data applies. The **Emission Factors, Fleet Components** and **Year** boxes are not editable as these are properties of the selected route type.

The **New...** button allows you to define a new user-defined route type. Enter a name, which must be unique in the database, choose a template route type, choose a year for the route type, and click **OK**. The data from the template route type are copied to the new route type name. The **Delete...** button removes the current route type from the database and replaces all references to it with another route type. Pre-defined route types cannot be deleted.

The **Copy** and **Paste** buttons can be used to copy and paste the route types to/from other packages (such as Microsoft Excel) for editing, if required. Otherwise, the user-defined route types can be edited in the interface. Note that each column must add up to 100%, so changing one value means one or more others must also be changed to compensate. The **Adjust** button may be used to change one value in a column to give a column total of 100%, provided the adjusted value is positive.

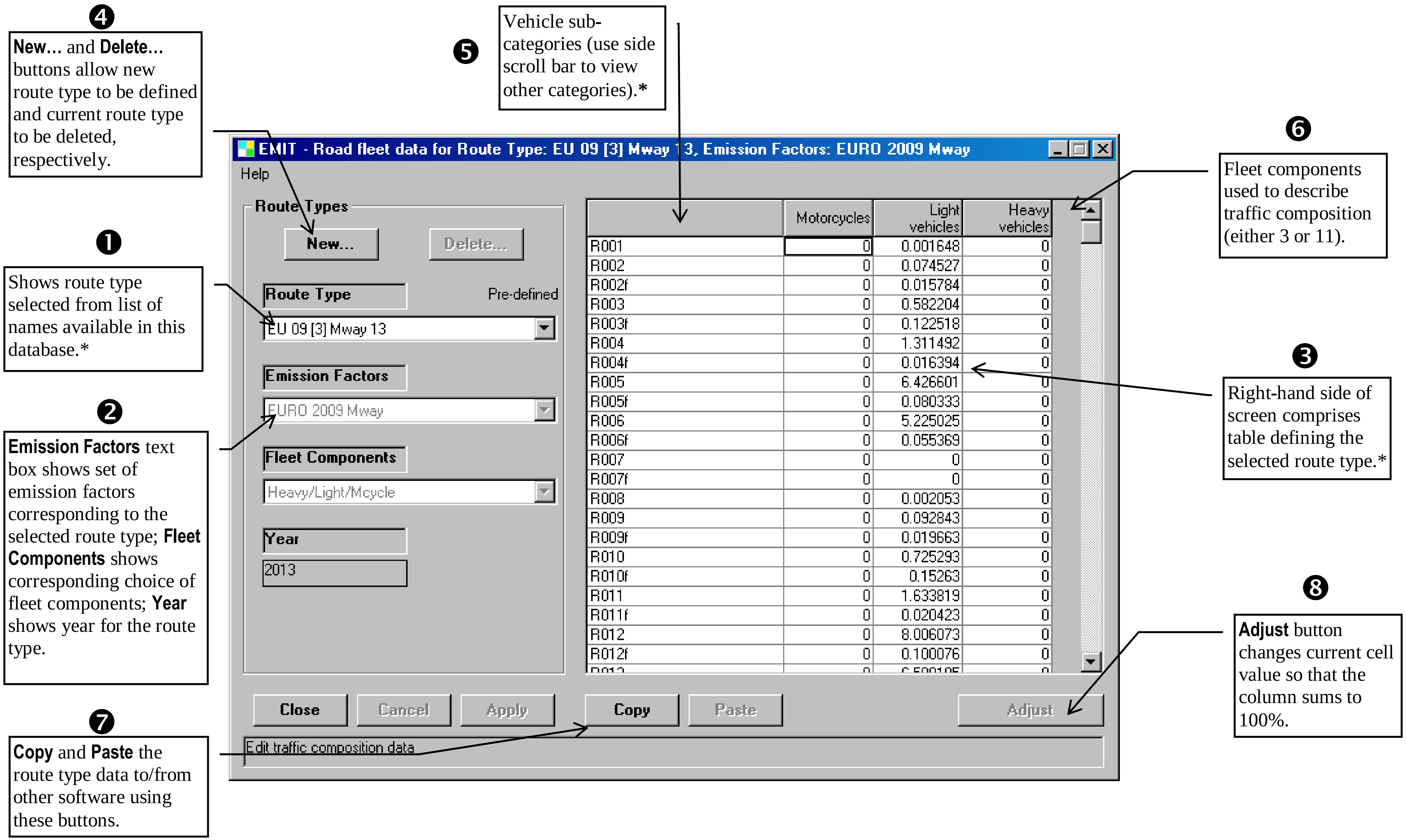


Figure 4.12 – Route type data screen (road sources). Features marked with an asterisk* are dependent on the choice of emission factors.

4.3.6 Region Type screen

The data screen used to define region types for use with the **SAP 2001** activity dataset is shown in **Figure 4.13**. This screen is activated via the **Data**, **Region Types** menu. Also, the **Region Type** applied to a specific source within a SAP group can be viewed by clicking on the **View region type...** button on the **Housing** tab of the appropriate source screen (Area and CandD sources only). When region types are viewed in this way, however, they are non-editable.

In order to create a new region type, click on the **New Region Type...** button in the top right hand corner of the screen. This activates the **New region type** screen where users can enter the name of a new region type (a maximum of 50 characters). The new region type will be based on the **Region Type** selected in the **Region Type** screen at the time when the **New Region Type...** button is clicked.

Unwanted region types can be deleted by clicking on the **Delete Region Type...** button, and in order to rename a **Region Type**, click on the **Rename Region Type...** button.

Any region types that are defined in the current EMIT database can be selected from the **Region Type** drop-down menu and edited as required. Click **Apply** to save any changes to the current **Region Type**; click **Cancel** to undo any unsaved changes, and **Close** to save changes and exit the **Region Type** screen.

Currently, all region types within the database are associated with **SAP 2001 Emission Factors.**

In order to create an appropriate **Region Type** for an area, there are 5 dwelling-related properties listed in the **Housing Details** section of the screen:

- Dwelling type
- Insulation (walls and roof)
- Insulation (doors and windows)
- Space and water heating
- Heating efficiency

For each of these properties, users should choose the appropriate option from the drop-down lists on the right-hand side of the table – 5 options are available in each case.

The final consideration when defining a **Region Type** is whether or not to include non-heating energy use in the CO_2 emission rate, such as energy use due to white goods and electronic equipment within the home. If this energy use is of interest, then the **Included** option should be chosen from the **Non-heating energy use** drop-down menu; otherwise, the **Not included** option should be selected.

The **Calculated Parameters** displayed on the **Region Type** screen are:

- **SAP Rating** (between 1 and 120)
- **Carbon Index** (between 0 and 10)
- **CO2 per dwelling (tonnes/year)**

These non-editable values are associated with the selected **Region Type**, although the **Non-heating energy use** option only affects the **CO2 per dwelling (tonnes/year)** emission rate, not the **SAP Rating** or the **Carbon Index**.

For further details of the **SAP 2001** dataset and how best to use region types when setting up an emission inventory, please refer to Section 12 of this User Guide.

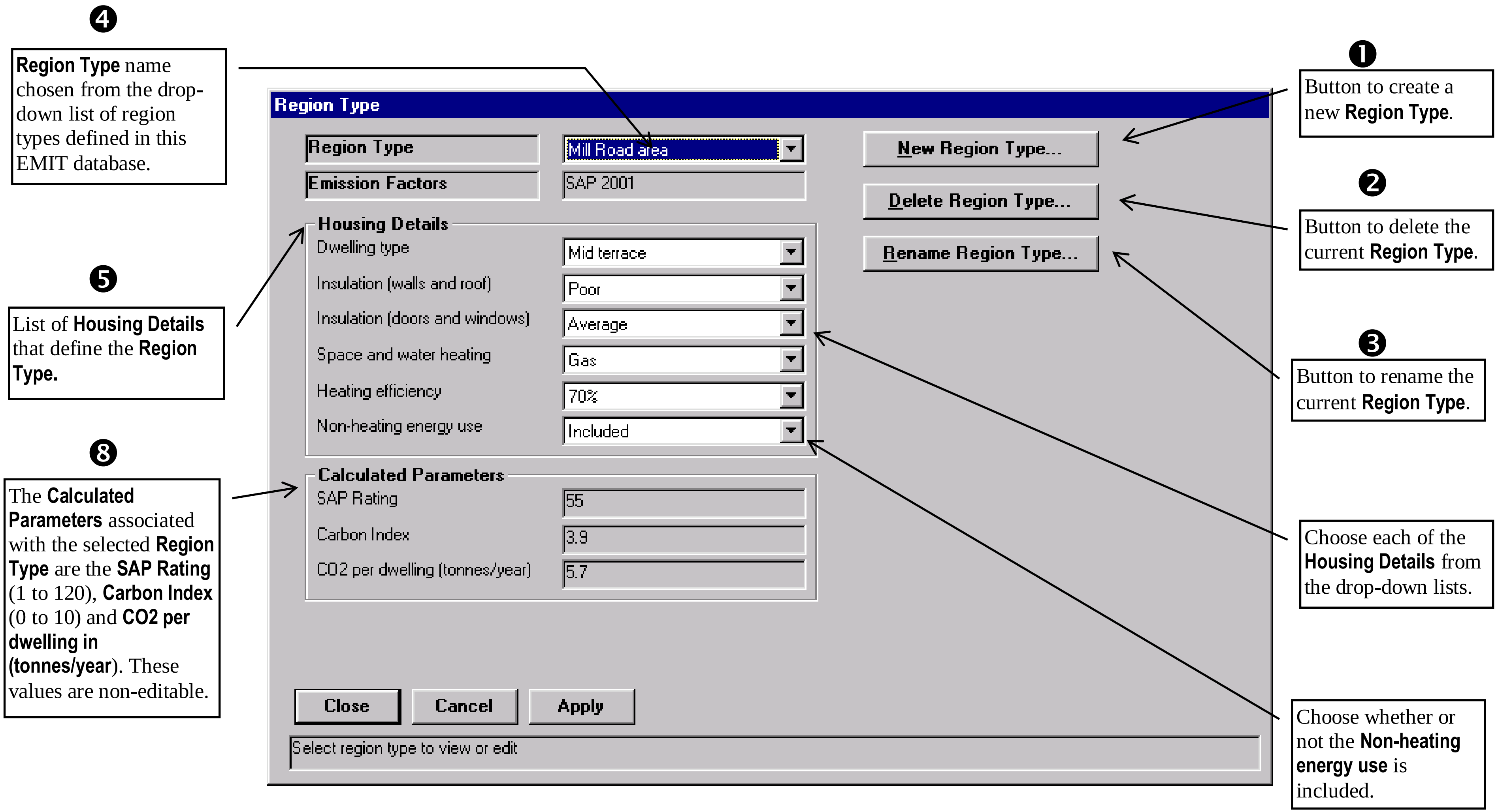


Figure 4.13 – Region type data screen (Area and CandD source groups only)

4.3.7 Group data screen

We saw in Section 4.2.2 that groups must be defined before they can be assigned to inventories, and the definition of new groups takes place here in the **Groups** screen, shown in **Figure 4.14**. You can enter this screen at any time from the **Data** menu (**Data, Groups**).

To create a new group click the **New...** button. This activates the **EMIT New Group** screen. A unique name for the **Group** must be entered, and a **Source Type**. The way in which the emissions for the group are going to be included in the database must then be chosen from:

- **Enter emissions manually**
- **Calculate with emission factors**
- **Calculate by scaling**

The remaining items that are displayed on the **EMIT New Group** screen depend on which of the above options has been selected.

If the user has chosen to **Enter emissions manually**, a **Greenhouse Gas Sector** and **Year** for the group much be selected from the drop down lists.

If the user has chosen to **Calculate with emission factors**, a set of **Emission Factors** must be chosen from the drop down list, and an appropriate **Year**. For the road and rail transport emission factor datasets, a **Route type** and a set of **Fleet Components** must also be chosen. Note that the greenhouse gas sectors associated with all emission factor datasets held within the EMIT database are pre-defined (for example, all the transport emission factor datasets are in the Energy sector).

If the user has chosen to **Calculate by scaling**, the **Scaling Parameters...** must be entered, in addition to the **Greenhouse Gas Sector** and **Year** for the group.

If the user intends to create a 3D grid for use in ADMS-Urban or CMAQ, the profiles will need to be included within the group definition. Selecting the **3D grid profiles...** opens a new screen in which to enter the species map, and vertical, diurnal and monthly profiles.

Note that the group type or (where appropriate) set of fleet components cannot be changed subsequently, although its name, year, route type, emission factors and 3D profiles can be changed using the **Modify Group...** button on the EMIT Inventory screen.

For examples of creating new groups, please refer to Section 5.

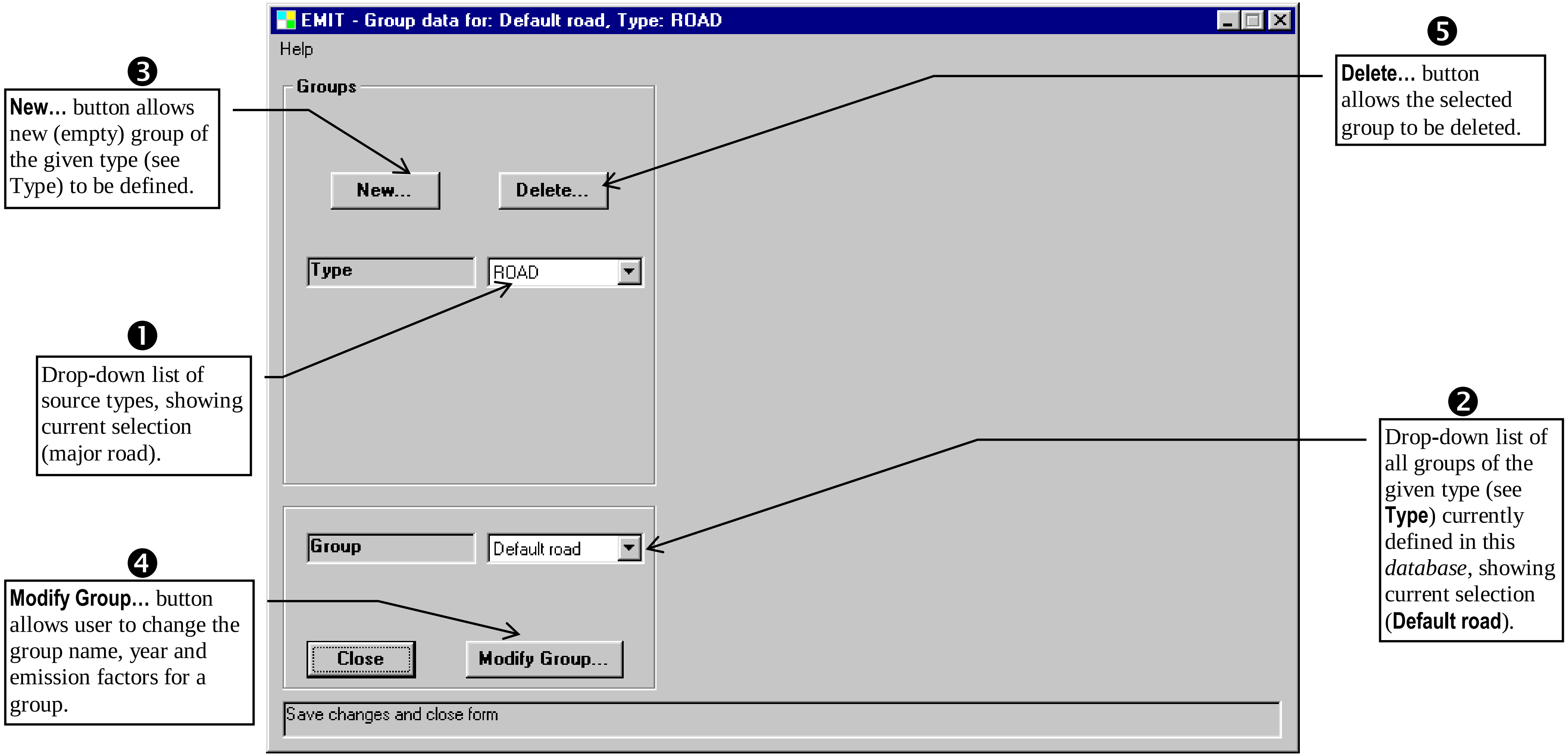


Figure 4.14 – Group data screen. This must be used to create new (empty) groups, which are subsequently populated using the **EMIT Group** screen.

4.3.8 Operators screen

EMIT assigns an operator to industrial sources (point and area sources), chosen from a drop-down list box on the relevant source screen. The **Operators** screen is used to manage this list of operators.

As shown in **Figure 4.15**, the right hand side of the **Operators** screen displays the data for the operator selected in the **Operator** drop-down list box, and these data items may therefore be edited as required. Click the **New...** button, to enter a new, unique operator name and associated data. If you click the **Delete...** button to delete the details for an operator, a screen appears asking you to select which other operator should be used to replace entries for the operator about to be deleted. Choose a replacement operator from the drop-down list.

Operator data are optional in EMIT, but a default is used for industrial sources if no user-specified values are assigned.

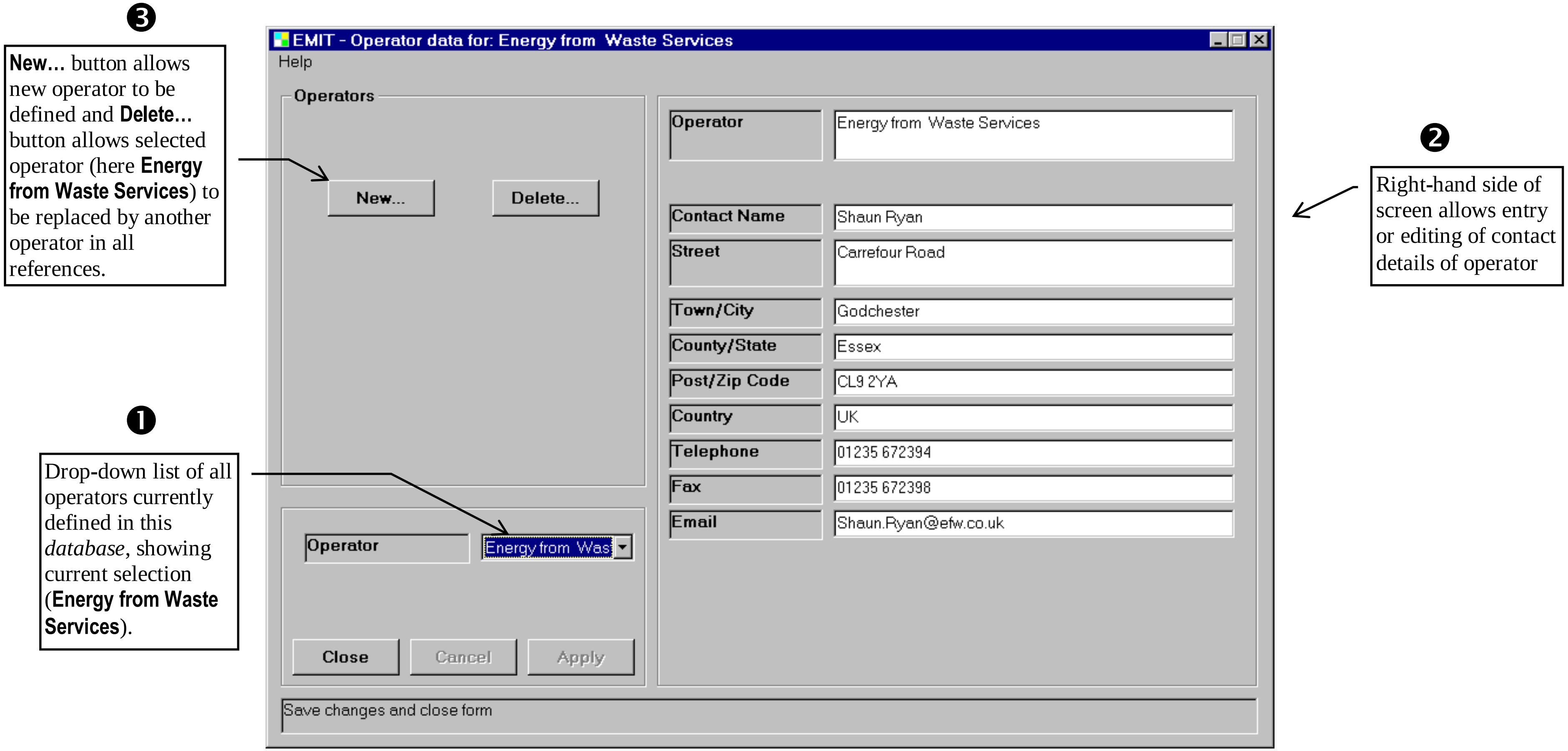


Figure 4.15 – Operators screen. This is used to define details of operators (used in source data screens for industrial sources).

SECTION 5 Setting up a new inventory

5.1 Introduction

Section 3 and Section 4 describe the EMIT database structure. In particular, **Figure 3.2** indicates how inventories are contained within a database, how groups are contained within inventories and how sources are contained within groups. Another way of looking at this is to think of the database in terms of a tree-like structure, as shown in the example given in **Figure 5.1** below. This figure shows an example inventory database, with 9 groups contained within the inventory.

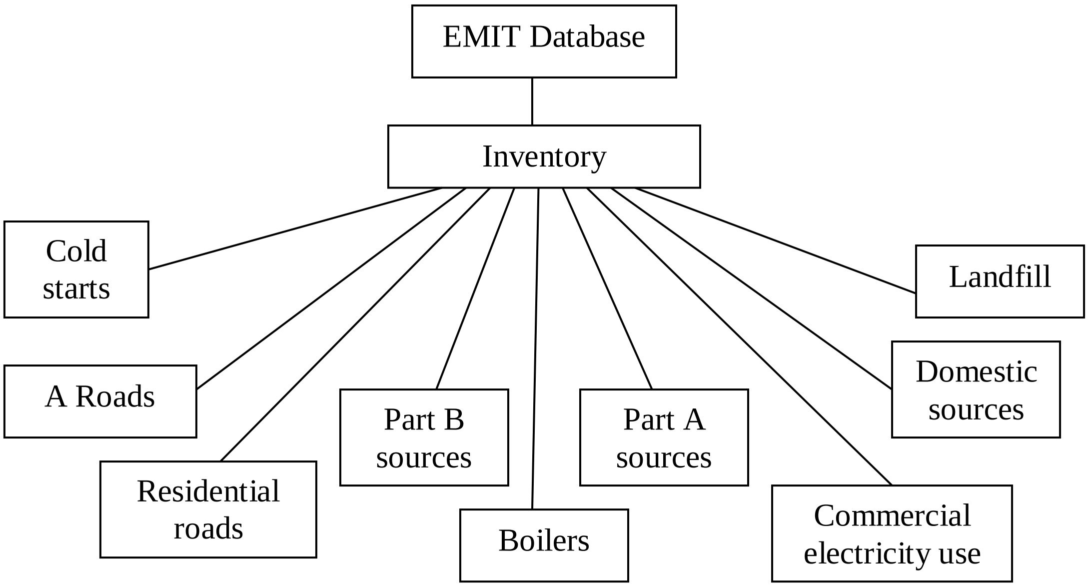


Figure 5.1 – EMIT has a tree-like structure: the figure shows an example EMIT database and emissions inventory, with one inventory containing 9 groups.

Within each group, EMIT holds emissions data for each source contained within that group. Emission rates for individual sources (in terms of tonnes per year or grams per second) may not be directly available, so EMIT provides ways to approximate emissions, for example, using fuel consumption or other data; alternatively, national emissions can be scaled to approximate emissions in a particular area. In EMIT, emissions can be calculated using:

- *activity data* such as traffic flows and fleet compositions for road traffic sources, the amount of product manufactured for industrial sources, or the number of dwellings (and housing types) to approximate domestic emissions, or
- *fuel consumption data* such as the amount of gas oil used for industrial sources, or the amount of electricity used in a residential area, or
- a *scaling* of a national emissions figure by an appropriate statistic such as population density.

Table 5.1 summarises the different calculation options available for the 8 group types. The 3 main column headings in this table – 'Manual Emissions', 'Activity Data' and 'Scaling' – describe the way in which the emissions are calculated, with the expressions in brackets –

Enter emissions manually, **Calculate with emission factors** and **Calculate by scaling** – describing the option chosen on the **EMIT New Group** screen (please see Section 5.3 for further details). Note that the 'Activity Data' column is subdivided into two further columns – SAP-based factors, and non-SAP factors. The SAP-based factors are used to estimate the CO_2 emissions from domestic properties and are only available for use for Area and CandD groups (for further details, please refer to Section 12); the non-SAP factors can be used with any group source type.

The example groups displayed in Figure 5.1 are summarised in **Table 5.2**. This table gives the information required to create these groups within the EMIT database – for further details, please refer to Section 5.3.

Group Source Type	Manual Emissions (Enter emissions manually)	Activity Data (Calculate with emission factors)		Scaling (Calculate by scaling)
		SAP - based factors	non-SAP factors	
Area	✓	✓	✓	✓
CandD	✓	✓	✓	✓
Line	✓		✓	
Major Roads	✓		✓	
Minor Roads	✓		✓	
Point	✓		✓	
Rail	✓		✓	
Volume	✓		✓	✓

Table 5.1 – Summary of Group options available in EMIT

Group Description	Source Type	Example Source Data	Emissions Calculation*	Example Activity Dataset (if applicable)	Greenhouse Gas Sector
Cold starts	CandD	Number of trips	**Calculate with emission factors**	NAEI	Energy
A Roads	Major road	Traffic flows, speeds, fleet data	**Calculate with emission factors**	EFT v10.1	Energy
Residential roads	Minor road	Annual vehicle km	**Calculate with emission factors**	EFT v10.1	Energy
Part B sources	Point	Fuel consumption data	**Calculate with emission factors**	UKEFD03 Energy	Energy
Boilers	Point	Fuel consumption data	**Calculate with emission factors**	UKGHG99 Fuels	Energy
Part A sources	Point	Emissions data	**Enter emissions manually**	n/a	Energy / Industrial Processes
Commercial electricity use	CandD	Number of kWh	**Calculate with emission factors**	Electricity-End Use	Energy
Domestic sources	CandD	Number of dwellings	**Calculate with emission factors**	SAP 2001	Energy
Landfill	Area	Population	**Calculate by scaling**	n/a	Waste

Table 5.2 – Groups contained within the example emissions inventory shown in **Figure 5.1**; as defined on the EMIT New Group screen – refer Section 5.3 for further details.

Important points to note:

- Emission factor datasets (column 5 in **Table 5.2**)

  When creating a new emissions inventory, or updating an old inventory, the most up-to-date emission factors should always be used. For road traffic (i.e. major and minor road source groups), the most up-to-date emission factor dataset held in the database is EFT v10.1 (equivalent to EFT v11.0). This dataset contains both exhaust and non-exhaust emission factors.

  For further information about this dataset, please refer to Appendix A.

- Greenhouse Gas (GHG) Sectors (column 6 in **Table 5.2**)

  When a group is created in EMIT, it is necessary to specify an associated greenhouse gas sector. This feature is of most use when compiling a greenhouse gas emissions inventory (see Section 11 for further details). If greenhouse gas totals are not of interest, then it is irrelevant which greenhouse gas sector is specified when groups are created.

Consider each of the example groups given in **Table 5.2**:

Cold starts

The emissions from cold starts can be estimated if the number of trips within an area is known, using appropriate emission factors. Emissions from cold starts are also categorized under the Energy GHG sector.

A Roads

The activity data available for calculating emissions from major roads are the traffic flows, traffic speeds, route types and fleet compositions. Associated exhaust and non-exhaust vehicle emission factors are included in the EMIT database, most of which are speed dependent (for further details of these factors, please refer to Appendix A). All traffic emissions fall into the Energy GHG emissions category.

Residential roads

As for major roads, minor road emissions are calculated using exhaust and non-exhaust vehicle emission factors held within the EMIT database; minor roads are also in the Energy GHG emissions category.

Part B sources and Boilers

Explicit emissions data from Part B sources and boilers may not be available. However, the amount of fuel consumed by a particular process is usually known. Associated fuel emission factors are held in the EMIT database (for further details please refer to Appendix C). These emissions are likely to be classified in the Energy GHG emissions sector.

Part A sources

In the UK, explicit emissions data are usually supplied by the Environment Agency for Part A sources. That is, emission rates for each source are given in units of tonnes of pollutant emitted per year. Emissions from Part A sources may be from both the fuel consumed to provide energy for the process, and emissions from the actual process itself. Therefore, Part A sources may be in either the Energy or Industrial processes GHG emissions sector or in both, as long as emissions are not double counted.

Commercial energy use

Total electricity consumption by commercial buildings may be known in terms of the number of kWh used per year. This value can be converted to a CO_2 emission rate by using an appropriate year-dependent emission factor. When considering electricity use, some thought must be given as to whether a ‘source of emissions’ or ‘end-user’ value is of interest i.e. will emissions be attributed to the power stations where the electricity is generated or to the end user of the electricity. For further details, please refer to the Greenhouse Gas emissions section of this manual – Section 11. Emissions from electricity are included in the Energy GHG sector.

Domestic sources

It is very unlikely that explicit emissions from every house in an area are known. An approximation of the emissions from domestic heating can be made by scaling the national emissions figure by the relative number of dwellings in an area. The appropriate GHG sector is Energy.

Alternatively, EMIT provides a way of making a better estimate of the CO_2 emissions from domestic heating, using a SAP-based emission factor dataset. This dataset allows users to investigate the effects of improved fuel type, housing insulation and heating efficiencies on CO_2 emissions and is particularly useful when looking at GHG emissions inventories. For further details, please refer to Section 11 of this User Guide.

Landfill sites

It is unlikely that emissions are known from particular landfill sites. In the absence of any other suitable data, national emissions figures may be scaled using population density values. The GHG emissions sector is Waste.

5.2 Before you start

Figure 5.2 shows a pie chart of the UK inland final energy consumption divided into 4 sectors: industry, domestic, transport and services. Examples of sources in each sector are given in this figure. When compiling an emissions inventory, a good starting point is to think about all the sources within these sectors, and about whether or not these emissions data should be included in your inventory.

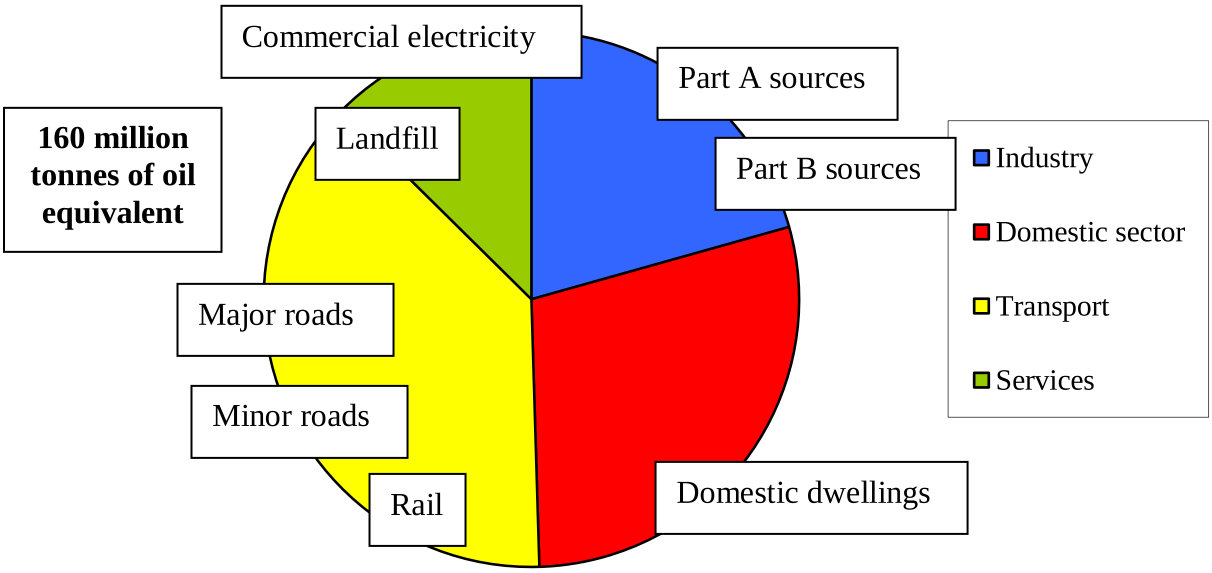


Figure 5.2 – Pie chart showing the UK inland energy consumption – final consumption only (data from UK Energy in Brief, UK ENERGY 2007)

It is important to give some thought to the emissions inventory structure. In particular, you need to decide:

- what groups will be contained within the inventory,
- whether the emissions data will be entered explicitly, and if not, how they will be calculated, and
- in which GHG emissions sector the group will be defined (if these emissions are of interest).

Prior to setting up an inventory, it is a good idea to make a list of all the different groups to be included in the inventory. It is convenient to summarise these data in a table, as in **Table 5.2**. The source type for each group should be decided upon i.e. major road, minor road, rail, commercial and domestic, industrial point, line, area or volume source, as in the second column of **Table 5.2**. Listing the emissions and/or activity data available for each group (as in the third column) allows you decide the type of each group. Column 4 gives the relevant option chosen in the **EMIT New Group** screen. If the emissions are to be calculated using activity data, an appropriate emission factor dataset must be chosen, as indicated in column 5 of **Table 5.2**. In order to be able to use the data to compile a GHG emissions inventory, the associated GHG sector should also be selected from the following (as in column 6): Energy, Industrial Processes, Agriculture, Waste, Land-use change and forestry, Solvent & other product use, and Other.

Having compiled this table, you are then in a position to create appropriate groups within EMIT. Section 5.3 below outlines how this can be done for some example group types.

Note on Greenhouse Gas Emissions

As mentioned in Section 5.1, industrial source emissions may fall into one of two GHG categories: Energy or Industrial Processes. Emissions or fuel consumption data supplied may not be separated into these two categories. If this is the case, it is advisable to refer to the appropriate guidance in order to decide which category is most appropriate (for example **Salway *et al* 2001** or **IPPC 1996**).

5.3 Creating New Groups

Section 5.1 gave some examples of the different group types available. This section details how these groups can be set up. Four examples will be given:

- Major roads,
- Part A sources,
- Boilers, and
- Landfill.

Note that a discussion of how to set up a domestic source group using the SAP-based CO_2 emission factors included within the EMIT database is described in Section 12.

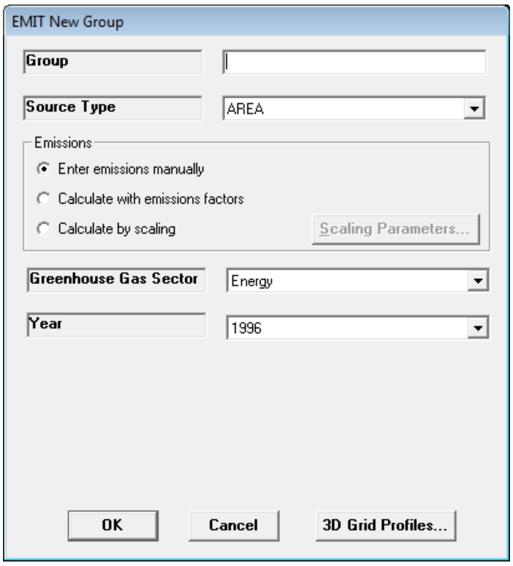


Figure 5.3 – The default **EMIT New Group** screen

5.3.1 A new Major roads group

From the **Data** menu, select the **Groups** option. Click on the **New** button to display the default **EMIT New Group** screen shown in **Figure 5.3**. Enter information into this screen in the following way:

Step 1 The group name is entered in the **Group** text box. A maximum of 20 characters are allowed. It is a good idea to include the source type in this name – in this case major roads – and also the year. **Figure 5.4** shows the **EMIT New Group** screen for a new major road group.

Step 2 The source type is then chosen from the **Source Type** list; in this case, the **ROAD** option is chosen.

Step 3 As discussed in Section 5.1, major road emissions are usually calculated using activity data (such as traffic flows and fleet compositions) combined with the appropriate emission factor dataset held in the EMIT database. Therefore, the button **Calculate with emission factors** should be selected.

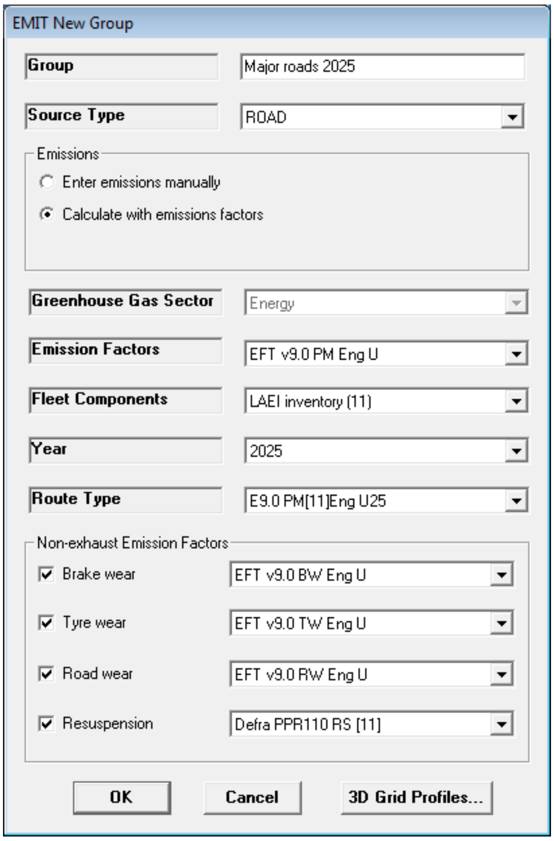


Figure 5.4 – Creating a major road group using the **EMIT New Group** screen

Step 4 When the **Calculate with emission factors** option is selected, the **Greenhouse Gas Sector** is greyed out as each emission factor dataset stored within the EMIT database has a pre-defined GHG sector associated with it.

Step 5 An exhaust emission factor dataset must be chosen from the **Emission Factors** list. For further details of the road traffic emission factors available within the EMIT database, please refer to Appendix A. In this example, the **EFT v9.0 PM Eng U** dataset has been chosen.

Step 6 The next step is to choose the number of fleet components for which the road traffic data are to be entered (once again, please refer to Appendix A for further details if required). In this case, the 11-component option has been selected from the list as the traffic count data for this group will be given as the number of Cars, taxis, LGV, buses, Rigid-HDVs (3 different axle types), Artic-HGVs (3 different axle types) and motorcycles.

Step 7 It is necessary to select an appropriate **Year** from the list available – in this case the year of the inventory is 2025, so this year has been selected.

Step 8 It is then necessary to select a **Route Type** from the list. In this case, the choice of year 2025 restricts the available route types to those available for that year. Refer to Appendix A for further details if required. **E9.0 PM[11]EngU25** has been chosen.

Step 9 When calculating emissions from road sources, estimates of non-exhaust emissions should be included if particulate emissions are of interest. Some of the exhaust emission factors selections discussed in the steps above automatically apply to the non-exhaust emission factors. Specifically:

i. the number of fleet components for which traffic data are entered is the same for both the exhaust and non-exhaust emission factor datasets, in this case the 11 category definition.

ii. the **Year** is the same for both the exhaust and non-exhaust emission factor datasets, in this case **2025**.

Step 10 If calculations of non-exhaust particulate emissions are required, a dataset should be selected for each of the four components from the lists available. The choice of fleet components restricts the available datasets to those with 11 fleet components. Please refer to Appendix A for further details if required.

In this example, the **EFT v 9.0** 11-component urban non-exhaust emission factors have been selected for brake wear, tyre wear and road wear, and one of the Defra re-suspension datasets.

Step 11 If you intend to create 3D gridded emissions, you also need to define the 3D grid profiles. This is covered in section 5.3.5.

Step 12 Click on **OK** to create the new EMIT group.

5.3.2 A new Part A source group

From the **Data** menu, select the **Groups** option. Click on the **New** button to display the default **EMIT New Group** screen shown in **Figure 5.3**. Enter information into this screen in the following way:

Step 1 The group name is entered in the **Group** text box. As for the major road source group, including the source type and year in the group name is a good idea. **Figure 5.5** shows the **EMIT New Group** screen for this new industrial point source group.

Step 2 The source type is then chosen from the **Source Type** list; in this case, the **POINT** option is chosen.

Step 3 As discussed in Section 5.1, in the UK, emissions from Part A sources are usually available from the Environment Agency. Therefore, the **Enter emissions manually** option should be selected.

Step 4 The appropriate **Greenhouse Gas Sector** must be chosen from the list. In the case of Part A sources, the GHG sector is likely to be either **Industrial process** or **Energy**.

Step 5 The **Year** 2020 is then chosen from the list, as this is the year of the inventory. As the emissions will be entered manually, the **Year** will just be used as a label – it will not affect the emission values.

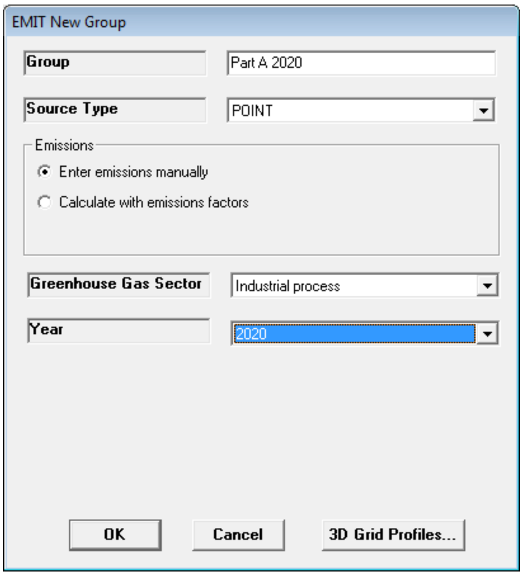


Figure 5.5 – Creating a Part A source group using the **EMIT New Group** screen

Step 6 If you intend to create 3D gridded emissions, you also need to define the 3D grid profiles. This is covered in section 5.3.5.

Step 7 Click on **OK** to create the new EMIT group.

5.3.3 A new Boilers group

From the **Data** menu, select the **Groups** option. Click on the **New** button to display the default **EMIT New Group** screen shown in **Figure 5.3**. Enter information into this screen in the following way:

Step 1 The group name is entered in the **Group** text box – in this case, the name given is ‘Boilers 2023’, as this includes the source type and the year; **Figure 5.6** shows the **EMIT New Group** screen.

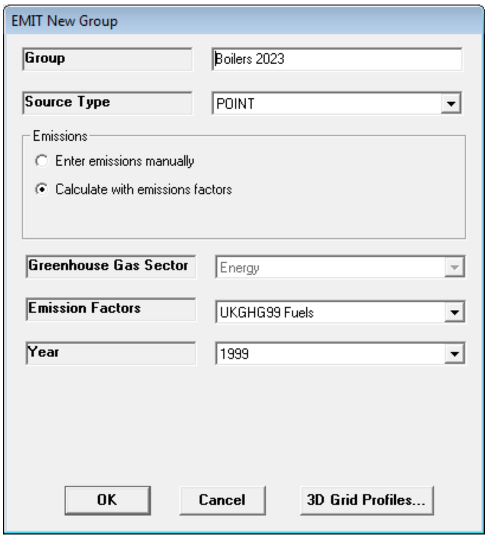


Figure 5.6 – Creating a boilers group using the **EMIT New Group** screen

Step 2 The **POINT** source type is then chosen from the **Source Type** list.

Step 3 As discussed in Section 5.1, emissions from boilers are unlikely to be known explicitly, but associated fuel consumption data may be available. If this is the case, emission factors contained within the EMIT database can be used to calculate emission rates. Therefore, the button **Calculate with emission factors** should be selected.

Step 4 When the **Calculate with emission factors** option is selected, the **Greenhouse Gas Sector** is greyed out as each emission factor dataset stored within the EMIT database is associated with a pre-defined GHG sector.

Step 5 An emission factor dataset must now be chosen from the **Emission Factors** list. For boilers, the **UKGHG99 Fuels**, **UKEFD03 Energy** or the **UKEFD07 Energy** datasets may be appropriate (for further details of the non transport emission factors available within the EMIT database, please refer to Appendix C). In this example, the **UKGHG99 Fuels** dataset has been chosen.

Step 6 For a number of the emission factor datasets held in EMIT, there is only one year available from the **Year** list. Such emissions datasets have an associated year (when they were published) and do not include any yearly variations; this is the case for the **UKGHG99 Fuels** dataset chosen here.

Step 7 If you intend to create 3D gridded emissions, you also need to define the 3D grid profiles. This is covered in section 5.3.5.

Step 8 Click on **OK** to create the new EMIT group.

5.3.4 A new Landfill group

From the **Data** menu, select the **Groups** option. Click on the **New** button to display the default **EMIT New Group** screen shown in **Figure 5.3**. Enter information into this screen in the following way:

Step 1 The group is named ‘Landfill 2020’, as this includes the source type and the year; **Figure 5.7** shows the **EMIT New Group** screen for the new landfill area group.

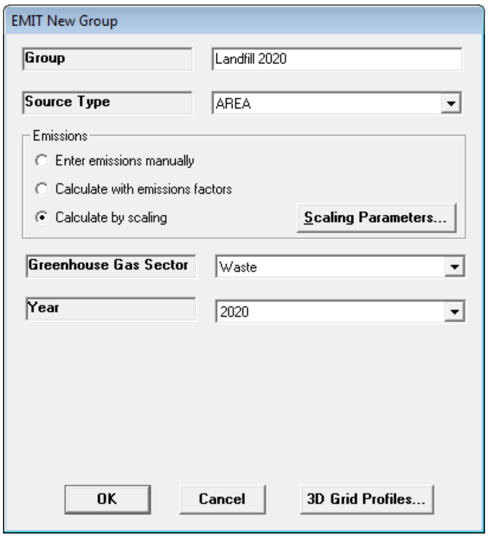


Figure 5.7 – Creating a landfill area group using the **EMIT New Group** screen

Step 2 The **AREA** option is chosen from the **Source Type** list.

Step 3 As discussed in Section 5.1, there may be some sources for which no emissions or associated activity data are available. In these cases, it is possible to scale a national emissions figure by an appropriate statistic. In this example, we are choosing to estimate the emissions from landfill sites by the population in the area. Therefore, the button **Calculate by scaling** has been selected in **Figure 5.7**.

Step 4 When the **Calculate by scaling** option is selected, the **Scaling Parameters...** button is enabled. Clicking on this button brings up the default **Scaling Parameters** screen on which the parameters that are to be used to estimate the landfill emissions are entered; Steps 5 to 11 below give example data entries (with the final version of the screen being given in **Figure 5.8**).

Step 5 The **Group** name is given automatically as the user has already entered this.

Step 6 The statistic that is being used to scale the national emissions figure must be entered into the **Name of Statistic** text box - in this case ‘Population’.

The national statistic value must then be entered into the **Reference Statistic** test box. In this case, this is the national population value, which for the UK in 2020 is approximately 68 million.

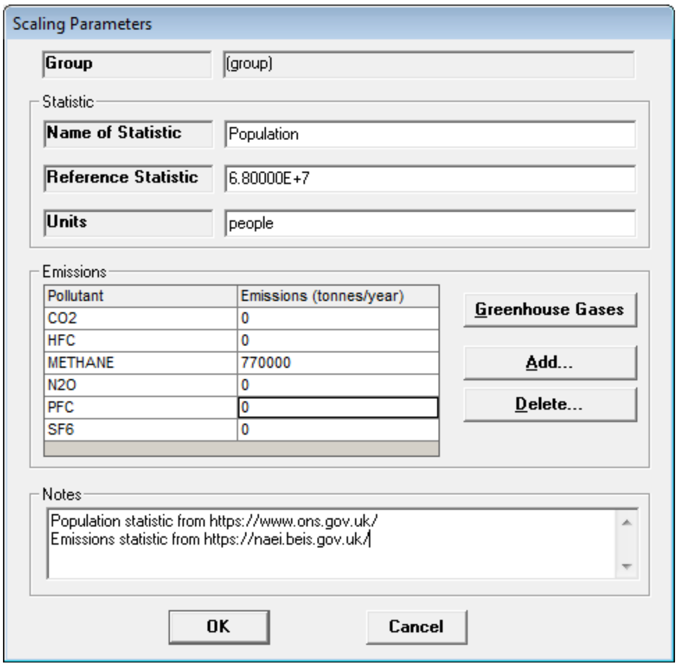


Figure 5.8 – Entering the national population and landfill data into the **Scaling Parameters** screen

Step 7 The units of the statistic should then be entered into **Units** text box – in this case ‘people’.

Step 8 The emission values are then entered into the **Emissions** section of the **Scaling Parameters** screen, as shown in **Figure 5.8** above. Pollutants can be entered one by one using the **Add...** button and choosing a pollutant from the list; alternatively, all GHG pollutants can be added by clicking on the **Greenhouse Gases** button. Pollutants can be deleted from the list by clicking on the **Delete...** button. Emissions are entered into the table in units of tonnes per year.

Step 9 Notes can be added to the **Notes** section of the **Scaling Parameters** screen. In this text box, it is a good idea to enter any relevant data, for example, the source of the statistics being used in the scaling calculations.

Step 10 Click on **OK** to close the **Scaling Parameters** screen**.**

Step 11 In the **EMIT New Group** screen, it is now necessary to choose an appropriate **Greenhouse Gas Sector** from the list. In this example, the GHG sector is **Waste**.

Step 12 It is necessary to select a **Year** from the list – in this case the year of the inventory is 2020, so this has been selected.

Step 13 If you intend to create 3D gridded emissions, you also need to define the 3D grid profiles. This is covered in section 5.3.5.

Step 14 Click on **OK** to create the new EMIT group.

5.3.5 3D grid profiles

It is usual to include a grid of emission totals in an air quality model, such as ADMS-Urban. EMIT allows the user to output the grid totals either on a 2D plane or in 3D. With a 2D plane the user will specify the depth of the grid sources when exporting from EMIT. With a 3D grid the emissions can be apportioned to a set of heights. The fraction of the emissions in each level should be set for each source group, this is known as the Vertical Profile. You should also define how the emissions vary by hour (Diurnal Profile) and month (Monthly Profile). The emissions can also be split into different species than those used in EMIT, for example emissions of VOC are made up of several species, this relationship is set in the Species Map.

From the **EMIT New Group** screen, select the **3D Grid Profiles...** option. This will show the screen shown in
Figure 5.9. Enter information into this screen in the following way:

Step 1 **Figure 5.9** shows the **Group Profiles** screen for a new group, Industry 2020, which has been defined as a CANDD group.

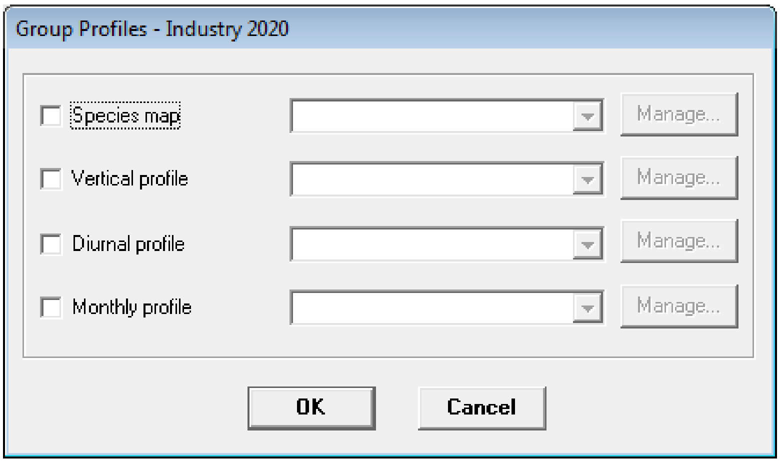


Figure 5.9 –The **Group Profiles** screen

Step 2 To enter a **Species map** for the group, tick the box beside **Species map** then select **Manage...** at the end of the line, to bring up the **Species Map** screen.

Figure 5.10 –The **Species Map** screen

Step 3 Select **Add**, then the **Edit** icon to start the **Speciation** screen.

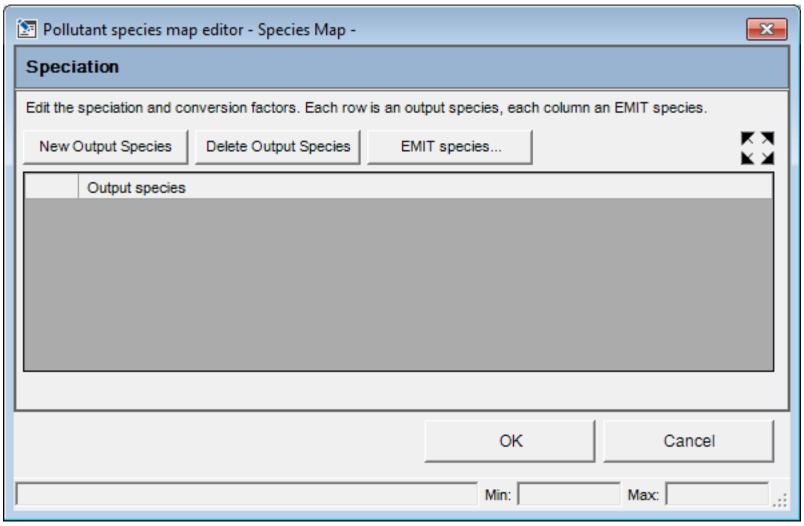


Figure 5.11 –The **Speciation** screen

Step 4 Select **EMIT species...** to start the **Edit EMIT species** screen. Then **New** to add a new entry to the screen. Repeat for all pollutants required, editing the pollutant names as you progress, which must exactly match the names of the pollutants in the rest of EMIT. Once all the pollutants have been added select **OK** to close the screen.

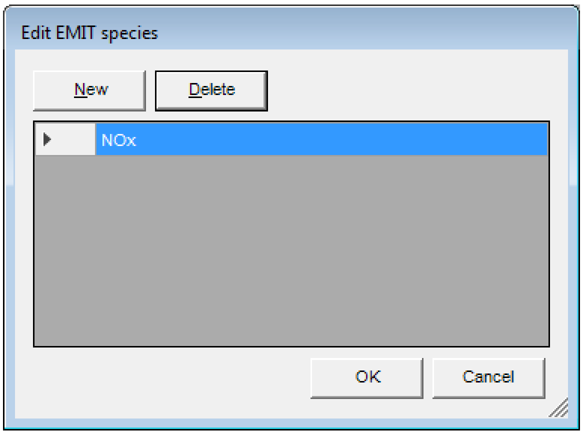


Figure 5.12 –The **Edit EMIT species** screen

Step 5 In the **Speciation** screen select New Output Species and repeat for all pollutants you need to be output from EMIT to your 3D grid. Note that these pollutant names need to match those in the chemical mechanism for the inventory. Individual species maps do not need to include all pollutants in the inventory, just the ones relevant to this group. You need to enter the conversion factor to convert the EMIT gridded emissions rates, which are in g/m^2/s to the output 3D gridded emission rates. If you intend to export a 3D grid to use in CMAQ, the emission rates for gaseous pollutants will need to be in moles/s and particulates in g/s, the conversion factors entered here need to reflect the change in emission units. If you are exporting a 3D grid to be used in ADMS-Urban the emission rates need to remain in g/m^2/s.

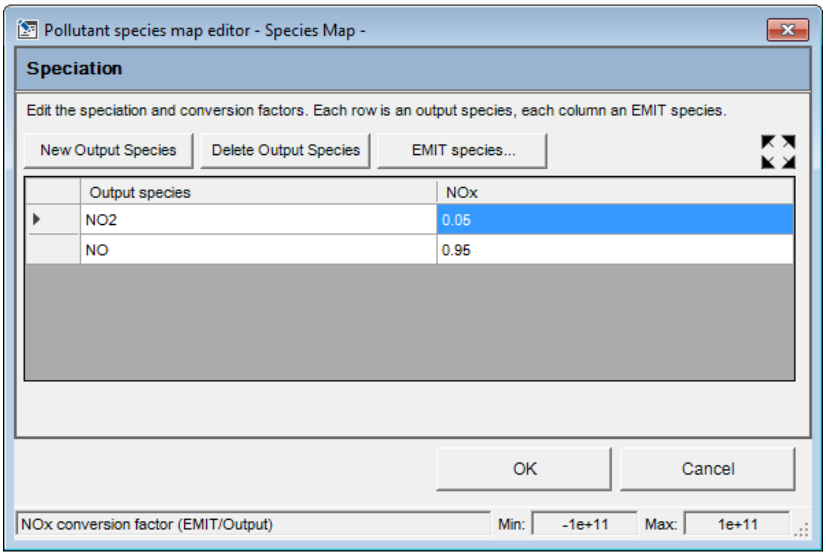


Figure 5.13 –The **Speciation** screen defining the relationship between EMIT and output species

Step 6 Once all EMIT and output pollutant species have been entered into the **Pollutant species map editor**, select **OK**. In the Edit EMIT species screen, give your newly created species map a name. Then select **OK** to return to the **Group profiles** screen.

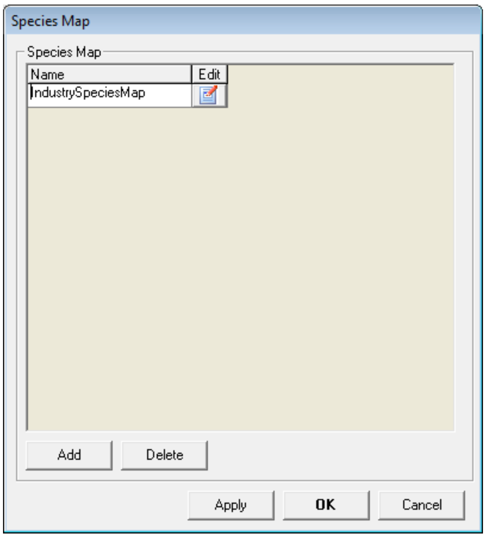


Figure 5.14 –The **Species Map** screen showing the name of the newly created species map

Step 7 In the **Group profiles** screen you can now select the name of your species map from the drop down list.

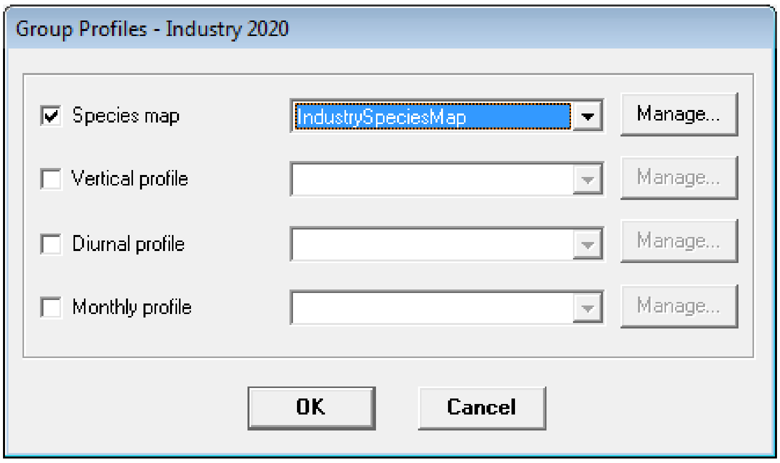


Figure 5.15 –The **Group profiles** screen showing the selected species map

Step 8 Staying in the **Group Profiles** screen, tick the box beside **Vertical profile** and select **Manage...** to start creating a vertical profile. In the **Vertical profile** screen, select **New**, then the edit icon to open the **Vertical Profile editor**. Select New repeatedly to have one fewer value than the number of vertical level boundaries you have defined in the **Inventory Properties**, then edit the values in the screen. In the example shown in **Figure 5.16** 10% of the emissions will be allocated between in the first layer, 50% in the second layer, 30% in the third layer and 10% in the top most layer. You can use the **Vertical Profile editor** to apply scaling or a unit conversion factor, as such the total of the values in the vertical profile do not need to add up to 1.

Once you are happy with the vertical profile data, select **OK** to return to the **Vertical Profile** screen, name your newly created vertical profile and press **OK** to return to the **Group Profiles** screen.

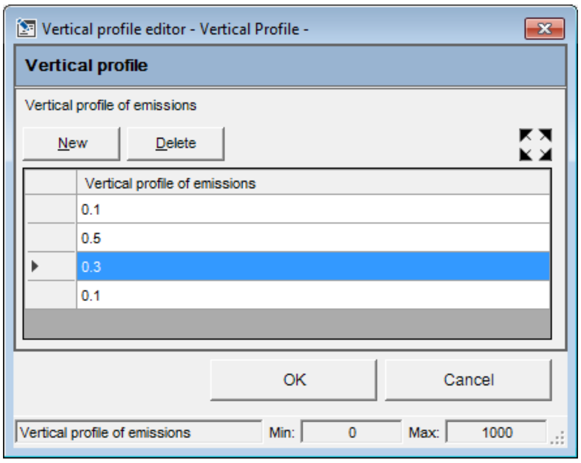


Figure 5.16 –The **Vertical profile** screen showing the vertical split of emissions

Step 9 Select the vertical Profile for your group from the drop down list.

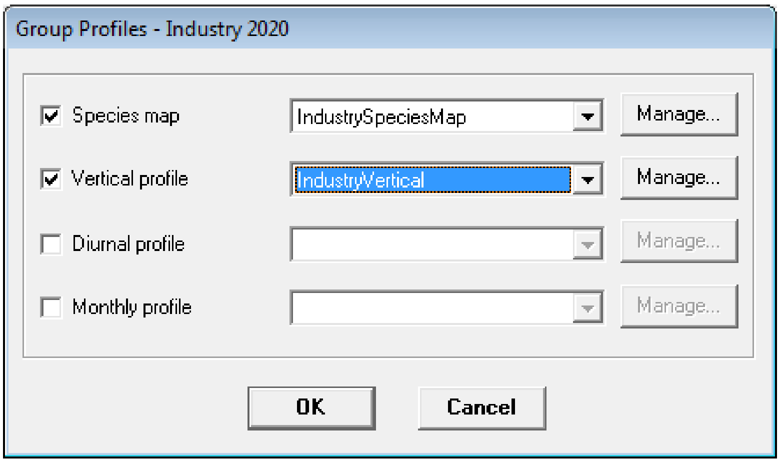
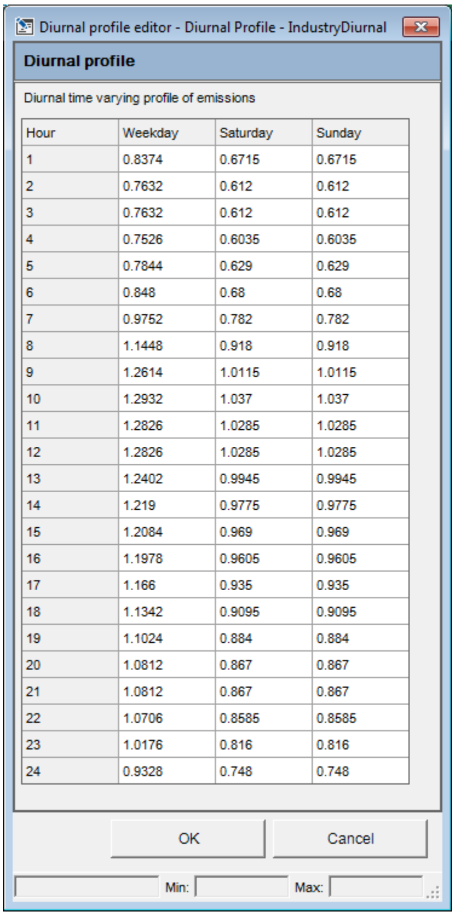


Figure 5.17 –The **Group profiles** screen showing the selected vertical profile

Step 10 Next, tick the selection box beside **Diurnal profile** and select **Manage...**to start the **Diurnal profile** screen. Select **Add**, then the edit icon to open the **Diurnal Profile editor**.

Step 11 Factors can be added for each hour of the day for weekdays, Saturdays and Sundays. Typically, the sum of five times the weekday factors plus the Saturday and Sunday factors would equal 168, the number of hours in a week.

*You can copy data from the **Diurnal profile editor** by right clicking your mouse within the editor and selecting **Copy All**, to paste data from an external source right click and select **Paste All**, remember to select all headers and columns.*



Hour	Weekday	Saturday	Sunday
1	0.8374	0.6715	0.6715
2	0.7632	0.612	0.612
3	0.7632	0.612	0.612
4	0.7526	0.6035	0.6035
5	0.7844	0.629	0.629
6	0.848	0.68	0.68
7	0.9752	0.782	0.782
8	1.1448	0.918	0.918
9	1.2614	1.0115	1.0115
10	1.2932	1.037	1.037
11	1.2826	1.0285	1.0285
12	1.2826	1.0285	1.0285
13	1.2402	0.9945	0.9945
14	1.219	0.9775	0.9775
15	1.2084	0.969	0.969
16	1.1978	0.9605	0.9605
17	1.166	0.935	0.935
18	1.1342	0.9095	0.9095
19	1.1024	0.884	0.884
20	1.0812	0.867	0.867
21	1.0812	0.867	0.867
22	1.0706	0.8585	0.8585
23	1.0176	0.816	0.816
24	0.9328	0.748	0.748

Figure 5.18 –The **Diurnal profile editor** screen

Step 12 Select **OK** to close the **Diurnal Profile editor**, name the newly created profile in the **Diurnal Profile** screen, and press **OK** to return to the **Group Profiles** screen. Select the diurnal profile for your group from those available in the drop down list.

Step 13 Finally, tick the selection box beside **Monthly profile** and select **Manage...**to start the **Monthly profile** screen. Select **Add**, then the edit icon to open the **Monthly Profile editor**.

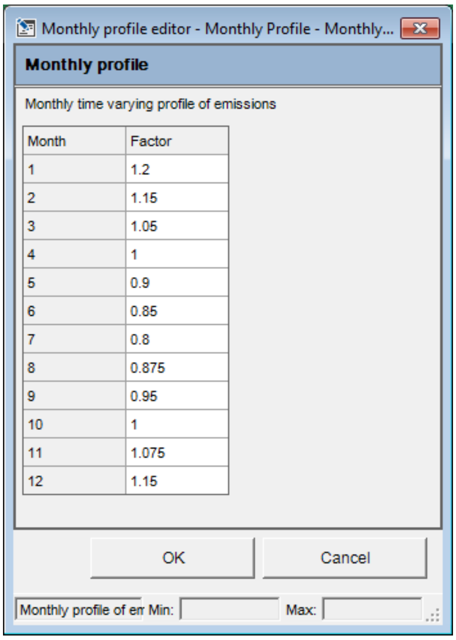


Figure 5.19 –The **Monthly profile editor** screen

Step 14 Enter your data for the monthly profiles, the sum of the factors would typically be 12.

Step 15 Select **OK** to close the **Monthly Profile editor**, name the newly created profile in the **Monthly Profile** screen, and press **OK** to return to the **Group Profiles** screen. Select the monthly profile for your group from those available in the drop down list.

Step 16 You should now have a group defined with all the profile data required for 3D grid calculations.

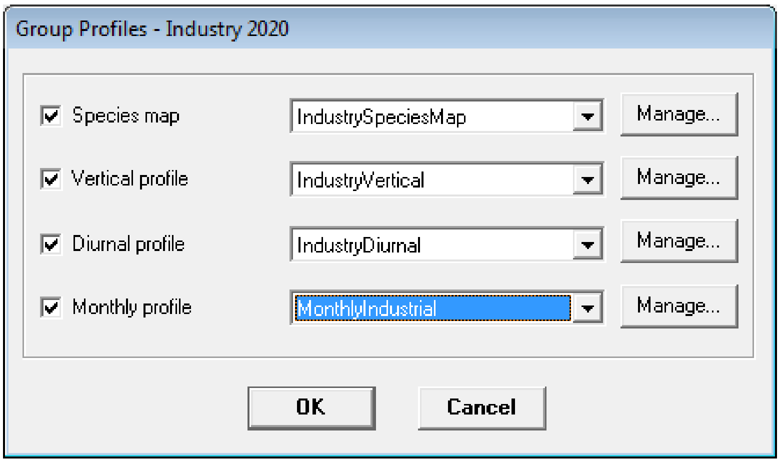


Figure 5.20 –The final **Group Profiles** screen for the new Industry 2020 group

SECTION 6 Importing data into EMIT using the Import Wizard

This section describes how to import data from ESRI shape files, MapInfo MIF files and comma separated (*.csv*) text files using the EMIT Import Wizard.

Section 6.2 describes the file types that can be imported into EMIT, and Section 6.3 gives details of the required format of the files. A few points to note prior to the importing of data into EMIT are given in Section 6.4. **Figures 6.2** to **6.5** show flow charts that outline the steps required to import data into EMIT for the different group types; these steps are described in Section 6.5. **Tables 6.2** to **6.11** at the end of the section give details of the format of and restrictions to the source data.

6.1 Introduction

Although small amounts of source data can be entered by hand via the interface, the principal means of importing large quantities of data into EMIT from user data files is using the EMIT Import Wizard. When the Import Wizard is launched, the user is asked a series of questions about the data and its destination. The wizard then attempts to read in the source data and assign it to the group designated by the user. The user must ensure that data are in one of the correct formats that are described later in this section and summarised in **Tables 6.2** to **6.11**. If the data are not in a correct format the Import Wizard will not attempt to import the data.

Example import files are located in the model installation directory under *Examples\Import*. This directory contains example files in the three different formats available for import:

- ESRI shape files (*SHP* subdirectory),
- MapInfo MIF files (*MIF* subdirectory) and
- Comma separated (.csv) text files (*CSV* subdirectory).

6.2 Input file types

The following types of commonly-encountered data file can be used as input files to the EMIT Import Wizard:

(a) ESRI shape files: *.shp* file extension

(b) MapInfo Interchange Format (MIF) files: *.mif* file extension

(c) Comma separated variable text files: *.csv* file extension

ESRI shape files are constructed using ArcGIS and *.mif* files are usually constructed from within MapInfo, although these are sometimes exported from other applications. *csv* files are simply text files with commas[1] used to separate columns of data, which may be constructed in a variety of ways, for example, using Microsoft Excel.

The EMIT .csv import format is different from the ADMS .spt format. EMIT can export data in the ADMS .spt format for use with ADMS-Urban. These ADMS .spt files cannot be re-imported into EMIT.

The instructions given in Section 6.3 below apply to all file types. For *.csv* files, there is a small amount of additional information about the source geometry that must be specified by the user in the files. The additional data manipulation required is outlined in (g) in Section 6.4 below.

6.3 Input file formats

For all file types, the data are arranged in table format, with columns corresponding to different source properties and each row corresponding to a separate source. All the data in a particular file will be imported into a single EMIT group, so all sources in the file must be of the same type i.e. major roads, point sources, and so on.

Obviously, the type of data available relates directly to the group into which the sources are imported. For example, a group set up to use manually defined emissions will require columns containing emissions data in the input file. Alternatively, a group set up to use one of the activity datasets in the EMIT database must contain one or more columns of activity data. For further details of the different group types, please refer to the ‘Setting up a new inventory’ chapter of this User Guide (Section 5), and Section 6.4 below.

The user must ensure that the data are in the correct format, with columns containing the correct type of data (text or numerical) in the correct units and, for numerical data, the data must lie within fixed ranges. Columns must have the correct headings (see **Tables 6.2** to **6.11** for further details).

Each column has a heading that describes its contents, and the EMIT Import Wizard uses these headings to identify the data contained in the file. Some column headings *must* be present in order for the Import Wizard to accept the input file, whereas others are optional.

Source properties

Tables 6.2 to **6.11** at the end of Section 0 summarise the headings that must be used for source property data. **Tables 6.2** to **6.9** (one for each source type) contain the following items:

- ‘**Column heading**’: the fixed column heading that is recognised in the input
- ‘**Data**’: a description of the meaning of the data field
- ‘**Units**’: indication of whether the data are text or numerical and, if numerical, gives the units of the data
- ‘**Restrictions**’: any restrictions on the legal values for the data. These restrictions

[1] Note that in some countries, where a comma is used as a decimal symbol, the delimiter in a *.csv* file is not a comma – it is usually a semi-colon. Users who make *.csv* files in Excel will not have to worry about this, as EMIT and Excel should use the same list separator character.

should be checked before import as sources with values outside these limits will not be imported

- '**Required**': 'yes' means the column is necessary for import, 'no' means that the column is optional
- '**Default**': if the column is optional (see above), then this column gives the default value to be used if the field is absent in the input table

Tables Table 6.10 and **6.11** give the vehicle component column headings for transport sources. These headings vary according to the chosen emissions dataset and route type**.**

Table 6.12 gives the options available to describe the road surface type (for use when the major road sources are to be used for noise mapping projects).

Emissions data

For all source types, it is possible to import emissions data directly. The emissions of each pollutant must be in separate columns and the units of the emissions must be the same for all the pollutants in a file.

The choice of column headings for emission data is not as restricted as the choice of the source data headings. If the Import Wizard does not recognise a column heading as a source parameter it attempts to interpret it as emissions data, using its stored list of pollutants and units. The user can then either accept or reject the suggestion supplied by the Wizard. Further details are given in Section 0 below.

Activity data

There are a number of different emission factor datasets included in EMIT that can be used to estimate emissions using activity data. For road, rail and shipping, the activity datasets are described in Appendix A; the airport activity datasets are described in Appendix B and the non-transport activity datasets are described in Appendix C. In addition, the **SAP 2001** emission factor dataset (for use with area and CandD sources) is described in Section 12.

For some of the activity datasets, the activity field names are pre-defined. These are summarised below. For the remaining datasets, columns containing activity data are matched to the activity options within the dataset during import, in a similar way to the pollutant method described above; users select an activity from a drop down list for each activity field selected.

- For the transport activity datasets, all the activity data columns are summarised in **Tables Table 6.10** and **6.11**.
- For the **SAP 2001** activity dataset, the heading for the column containing the dwelling data is NUMDWELL.
- For any group using statistics to scale a national emissions figure, the heading for the column containing the statistic is STAT.
- The aircraft data required in the import file is the thrust setting, the number of landings/take-offs per year and the time in mode. The column heading for each of these parameters will depend upon the aircraft/engine combination for each source. The correct field names are given in the relevant activity dataset spreadsheet supplied with EMIT, which can be found in the subdirectory *Data\ActivitySpreadsheets*, in the

Export sheet of the relevant Excel workbook. An example of an aircraft/engine combination from the *ICAO 20+ Other.xlsx* spreadsheet is given in **Table 6.1**. It can seen that to import data for the aircraft/engine combination shown the correct field names for the aircraft data would be THRD0001, LTOD0001 and TIMD0001.

Aircraft, engine, (UID), num of engines	THRUST_ FIELDNAME	LTO_ FIELDNAME	TIM_ FIELDNAME
3Xtrim 3X47 Ultra , LYC IO-360-A1B6 , (IO360) , 1	THRD0001	LTOD0001	TIMD0001

Table 6.1 – Example field names for aircraft import

6.4 Prior to import

This section outlines the steps that should be taken prior to importing any data into EMIT. Users are also advised to read Section 5 on how to set up an inventory.

Firstly, you need to decide into which database the sources will be imported – is it an existing database or a new one? If it is an existing database it is good practice to keep a back-up copy of the old database.

In your chosen database:

(a) Create a new inventory.

(b) Create appropriate groups for all source types to be imported (as outlined in Section 5).

(c) Add these groups to the appropriate inventory.

(d) Create new route types that may be needed for road and rail sources by selecting **Data**, **Route Types** and then **Road** or **Rail** from the menu bar.

(e) Create new region types that may be needed for domestic dwelling groups (using the **SAP 2001** dataset) by selecting **Data** and then **Region Types** from the menu bar.

(f) Set up a selection of Operators for the industrial sources by selecting **Data** and then **Operators** from the menu bar. If the user defines no operators, the default operator will be attached to each industrial source.

(g) The source location information that is automatically imported from ESRI shape files and MapInfo MIF files into EMIT has to be manipulated separately when source data are being imported via *.csv* files. The way this is done depends on the source type as described in 1 – 3 below.

1. Road/rail/line sources
2. Road, rail and line sources have a minimum of 2 (and maximum of 50) vertices. The vertices are listed after the other source information. The best way to see how this is done is to look at an example, as in **Figure 6.1**. The first set of data has 11 column headings: the first 8 are the headings given in the top section of **Table 6.2**, and the last 3 are the Heavy/Light/Mcycle fleet component headings given in **Table 6.10**.

   The second set of data in the file is the road vertex data. **Note that this data**

must be separated from the first set by a blank line. The three column headings for this data set are given in the bottom section of Table 6.2. The coordinates of each vertex are preceded by the source name. Note that if data are saved in *.csv* file format using Microsoft Excel, then additional commas will be added at the end of each line of data in this second dataset. These must be removed, for example using a 'Search and Replace' in Notepad.

3. Point sources

   The point source location data is entered in the same way as the other source properties with two columns headed X and Y; see **Table 6.5** for further details.

4. Area/CandD/volume sources

   Area, CandD and volume sources are polygons with between 3 and 50 sides inclusive. The location data for these sources are entered in terms of the coordinates of the source vertices in the following way:

   - One column headed NVERTEX gives the number of source vertices.
   - 2 × NVERTEX additional columns contain the source vertex information. These columns are labelled X1, Y1, X2, Y2, X3, Y3, … XN, YN, where N = NVERTEX.
   - Data entered in this way allows sources in the same *.csv* file to have differing numbers of vertices.

   Note that the sources must be convex.

   For example a file containing four-sided polygons would have columns X1, Y1, X2, Y2, X3, Y3, X4 and Y4, and the NVERTEX column would have the value 4 for every source.

   See **Tables 6.6, 6.7** and **6.9** for further details of these source types.

5. Minor road sources

   Minor road sources are rectangular in shape, and the coordinates of the vertices must be multiples of 1000m. The location data for these sources are entered in terms of the coordinates of the bottom left hand coordinate of the source (MIN_X, MIN_Y) and the top right hand coordinate of the source (MAX_X, MAX_Y). These data are entered similarly to the data for the point sources; see **Table 6.4** for further details.

6. Airport sources

   Airport sources may be line/area/volume or point sources, and the relevant rules for the chosen source type, given above, should be applied.

6.5 Step-by-step through the Wizard screens

The EMIT Import Wizard presents the user with a sequence of screens; these depend on:

- the group type, and
- the source type.

The different group and source type options are defined in **Table 5.1** in Section 5. Flow schemes representing the import of files into EMIT are given in **Figures 6.2** to **6.5**; that is:

Figure 6.2 gives the steps needed to import manually defined emissions data *for all source groups.*

Figure 6.3 gives the steps needed to import activity data *for all source groups*.

Figure 6.4 gives the steps needed to import SAP dwelling data for *area and CandD source groups only*.

Figure 6.5 gives the steps needed to import statistics data for scaling groups *for area, volume and CandD source groups only*.

In these figures, the steps outside the dashed box are the same for each figure; the steps within the dashed box vary from figure to figure.

Exiting the Wizard during import

The import process can be stopped at any time prior to the final screen by clicking **Cancel**. If this is done, then no data will have been transferred to EMIT.

Error messages

There is a range of error messages that may be displayed during the import process. Some of these are given in the step-by-step instructions below. Any additional ones that may appear will be self-explanatory.

```
ROADNAME, DESCRIPT, NOTES1, KEYWORDS, WIDTH, HEIGHT, CANYON, SPEED, HEAVY, LIGHT, MCYCLE
Road 1, A1, 2001 location, main, 20, 20, 0, 60, 417, 4176, 0
Road 2, London Road, 2001 location, main, 20, 0, 0, 60, 1112, 8864, 245
Road 3, Silver Street, 2001 location, main, 10, 0, 10, 40, 17, 648, 25
Road 4, Oswald Terrace, 2001 location, main, 10, 0, 0, 30, 1, 256, 24

ROADNAME, X, Y
Road 1, 449161, 528000
Road 1, 449173, 528334
Road 1, 449173, 528334
Road 1, 449173, 528334
Road 2, 449000, 528229
Road 2, 449173, 528334
Road 3, 449173, 528334
Road 3, 449743, 528668
Road 4, 449743, 528668
Road 4, 450000, 528919
```

Figure 6.1 – Example *.csv* file for input of road sources. Note that source names cannot contain apostrophes.

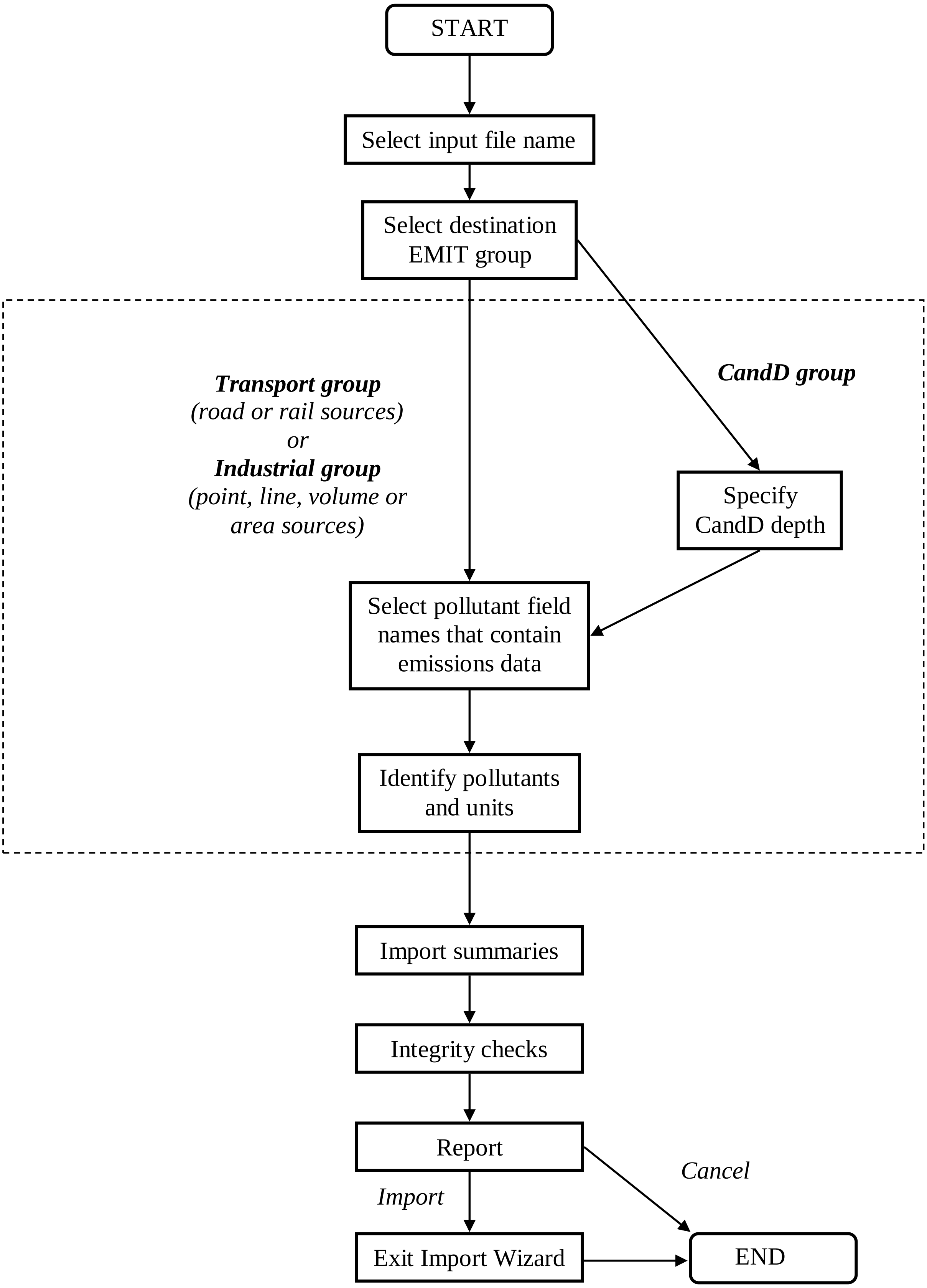


Figure 6.2 – Flow chart showing how to import **manually defined emissions data** into EMIT using the Import Wizard. Instructions outside the dashed box are in common with **Figures 6.3** to **6.5**.

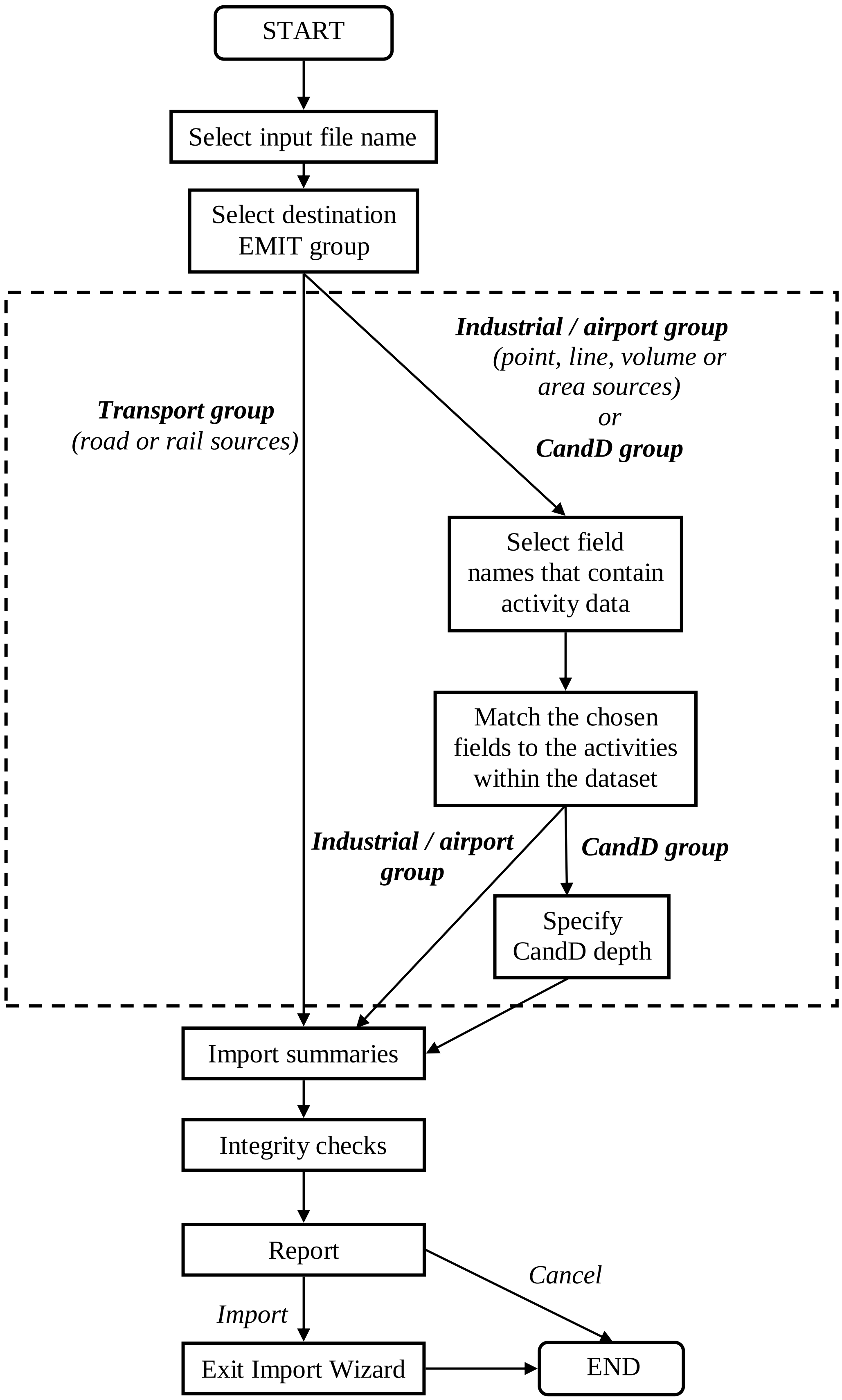


Figure 6.3 – Flow chart showing how to import **activity data** into EMIT using the Import Wizard. Instructions outside the dashed box are in common with **Figures 6.2**, **6.4** and **6.5**.

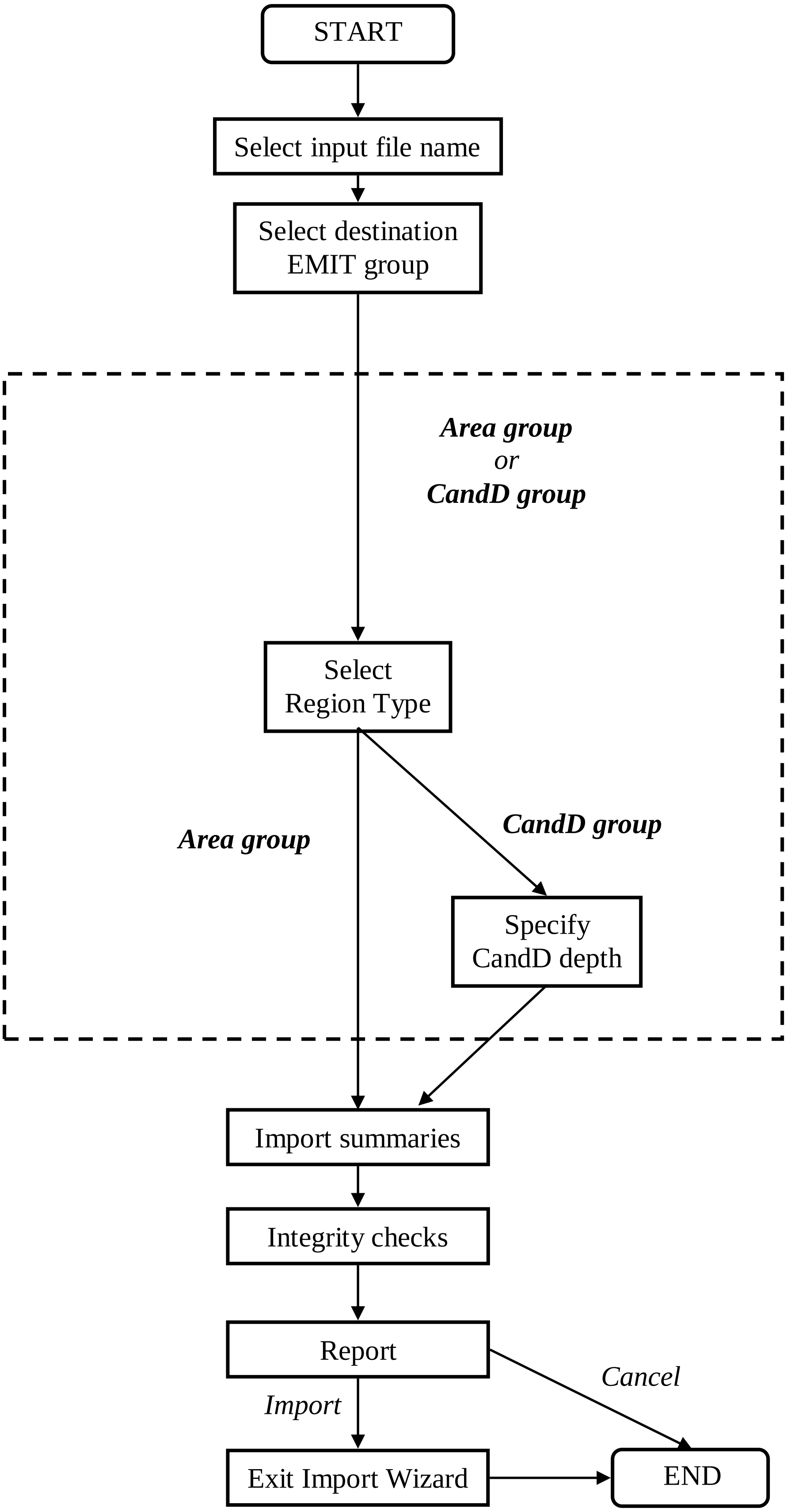


Figure 6.4 – Flow chart showing how to import data into **SAP groups** in EMIT using the Import Wizard (*Area and CandD sources only*). Instructions outside the dashed box are in common with **Figures 6.2**, **6.4** and **6.5**.

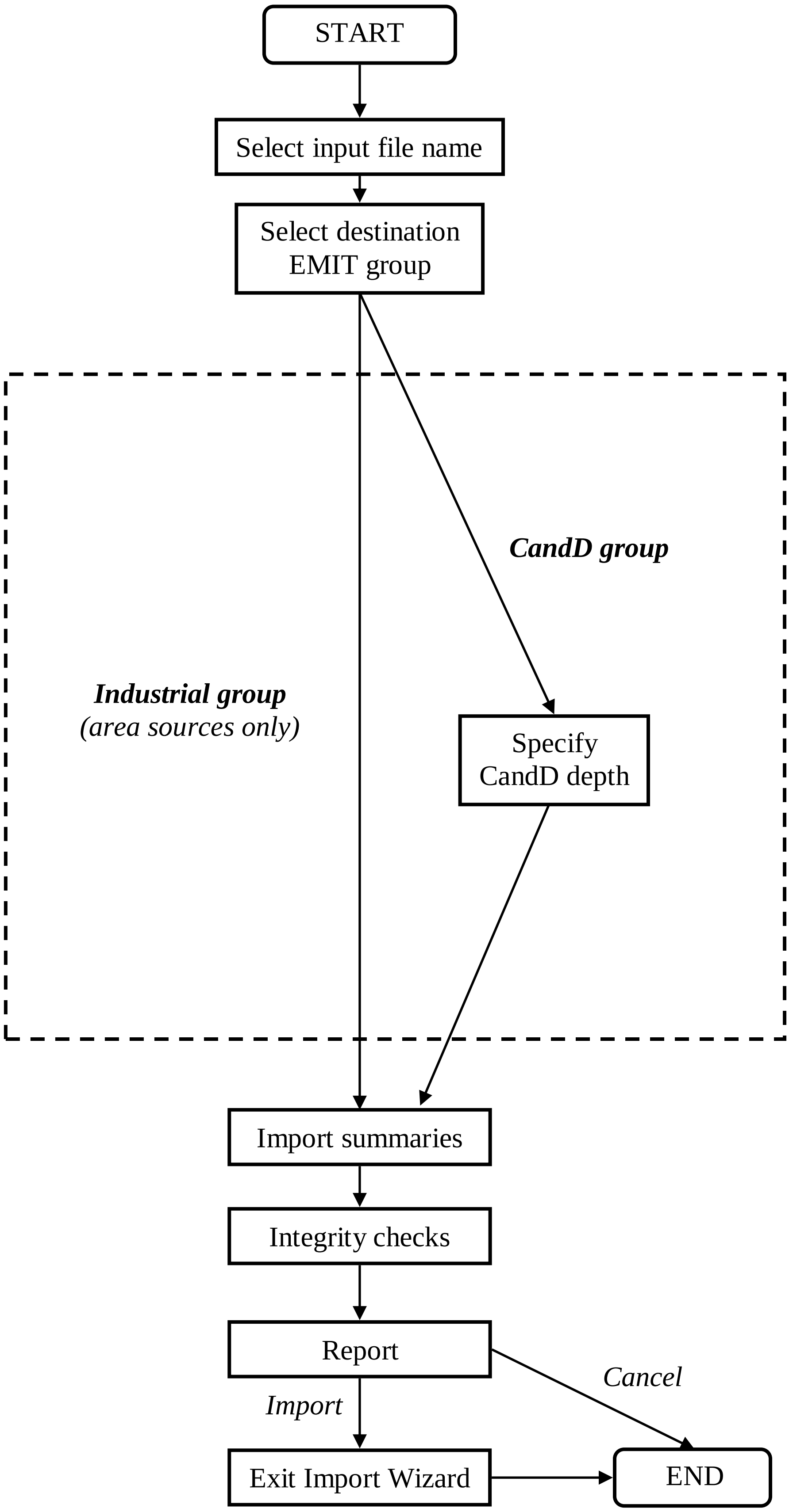


Figure 6.5 – Flow chart showing how to import data into **Scaling groups** in EMIT using the Import Wizard (*area, volume and CandD sources only*). Instructions outside the dashed box are in common with **Figures 6.2** to **6.4**.

The rest of this section follows the steps required to import source data into EMIT.

Step 1 **Launch the Import Wizard**

With the chosen EMIT database open in EMIT, launch the EMIT Import Wizard by clicking the menu option **File**, followed by **Import Data**, as shown in **Figure 6.6** below.

Step 2 **Specify path name of file from which data will be imported**

Enter the full path name of the input file in the text box under **File name** or use the **Browse...** button and navigate to the correct file, as shown in **Figure 6.7**. The source type of the data in the input file will be detected by EMIT from the field headings. Only one source type of the eight available can be imported at any one time.

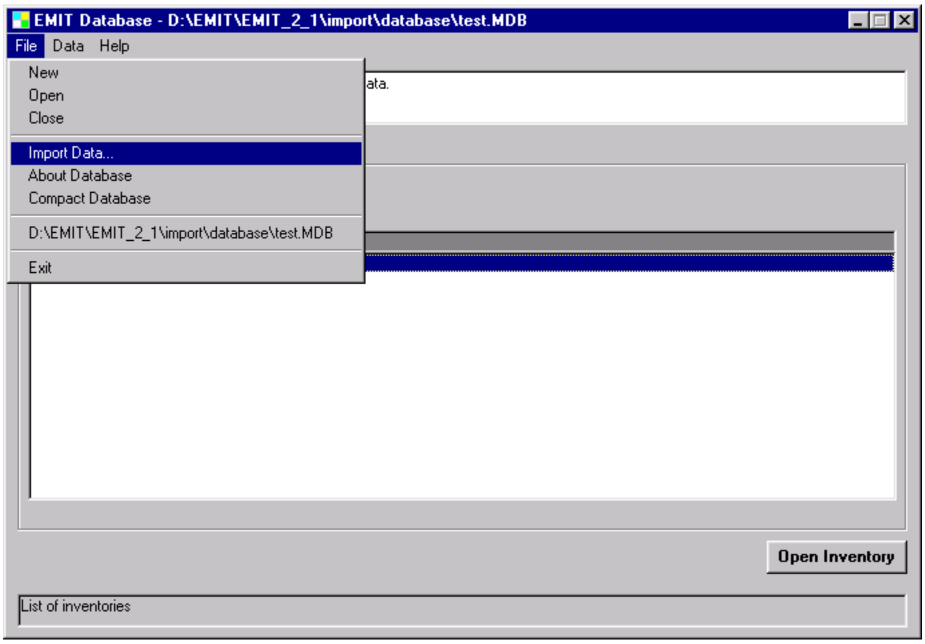


Figure 6.6 – Menu option **File**, **Import Data**.

Click on **Next>** and a screen will then appear that displays a progress bar indicating the time needed for the EMIT Import Wizard to read in the data from the input file. If the input file is a comma-separated variable (*.csv*) text file, the screen will simply inform the user that the process may take some time.

If the input file does not contain all the required fields, for example, if it is missing the SPEED field (required when importing data into an activity road source group), an error message will be given detailing the missing fields. If this happens, the user is advised to exit the Import Wizard, by clicking **OK** to return to the **Input File Name** screen shown above and then clicking on **Cancel**. The file chosen for import should then be checked to make sure it contains all the correct column headings.

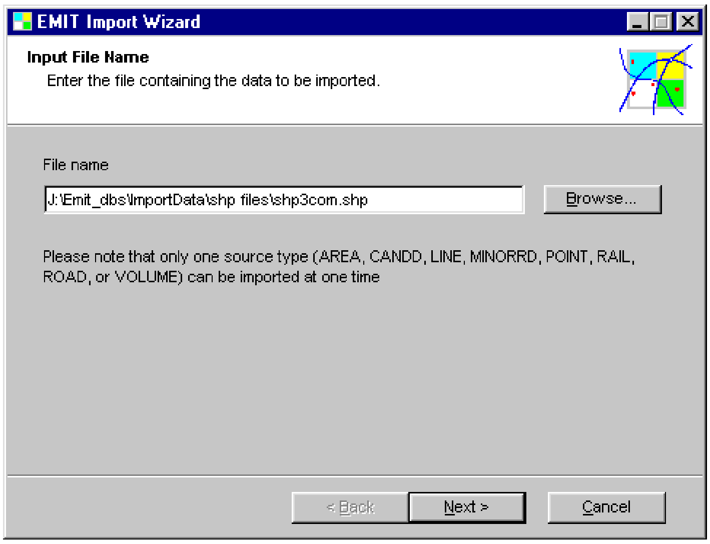


Figure 6.7 – The **Input File Name** screen for entering the path of the data file to be imported.

Once the input file has been read and the Wizard has checked that the required fields are present, the next screen is automatically displayed (see **Figure 6.8**). This screen differs slightly depending on the target group type of the source: point, line, volume, area and CandD groups only have the **Group** name, **Emission Factors** and **Year** displayed, whereas for roads, rail and minor road groups the **Fleet Components** are additionally listed. Note that for groups created to hold manually defined emissions data, no **Emission Factors** or **Fleet Components** are listed.

Note that in the case of industrial (point, line, volume and area) sources, the 'OPERATOR' column is optional. If this column of data is not present in the file, then a default operator is assigned to all sources. However, if this column of data is included in the file, then every source must be assigned to one of the operators already defined in the EMIT database. See Section 4.3.8 to see how to set up new Operators.

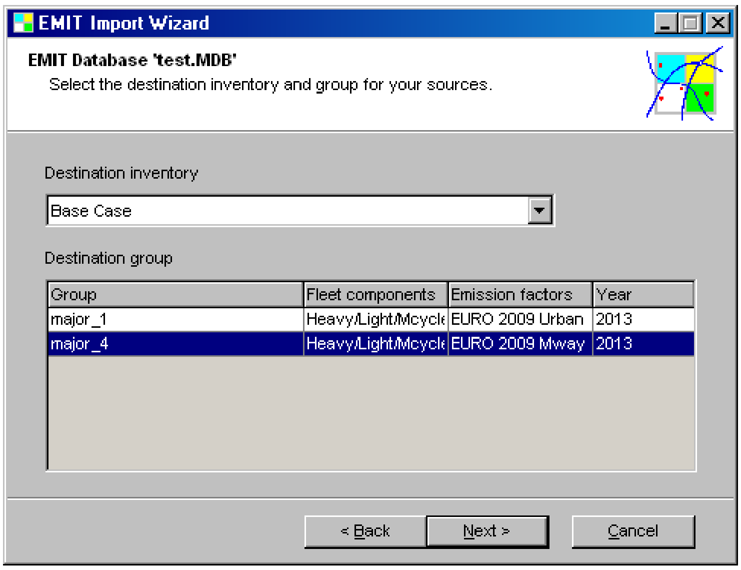


Figure 6.8 – The **EMIT Database** screen for selecting the inventory into which the data will be imported.

Step 3 **Specify the destination inventory and group**

The screen shown in **Figure 6.8** is used to select the **Destination inventory** and **Group** into which the data from the input file are to be imported. The user selects the inventory from the drop-down list, which contains all the inventories in the currently loaded EMIT database. Once an inventory has been selected, the table in the lower half of the screen displays the groups within that inventory of the correct source type. As mentioned above, the **Fleet components** column in the table only applies to traffic sources; if the source is not a traffic source then this column is omitted. A suitable group should be selected at this stage.

The next few steps in the import process differ depending on the group type and the source type. Please refer to the steps outlined within the dashed boxes in **Figures 6.2** to **6.5** for further details.

Some notes on particular issues to be aware of for the different group and source type options are given below.

The import steps common to all group and source type options are continued in Steps 4-7, starting on page 101.

*For groups with manually defined emissions (as shown in **Figure 6.2**)*

When manually defined emissions data are imported, after being prompted to enter the depth of the CandD source (if necessary), the user is presented with a list of any column headings in the input file that have not been already associated with a recognised field, that is, those that are *not* in **Tables 6.2** to **6.9**.

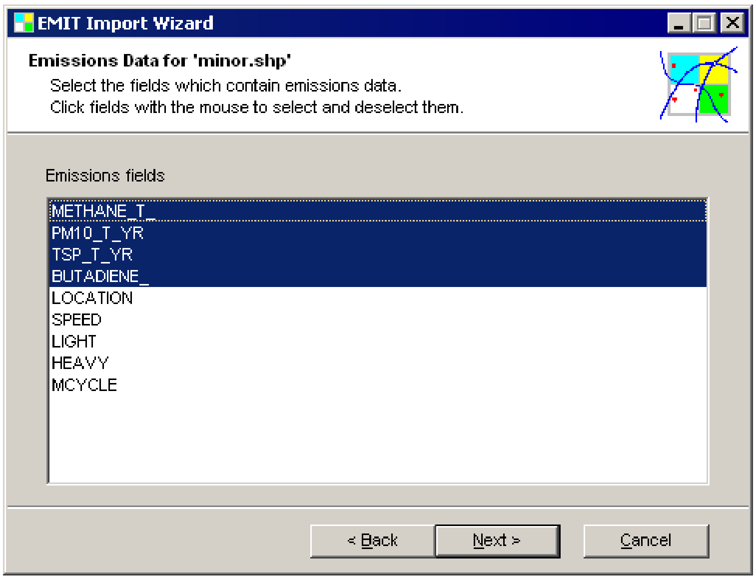


Figure 6.9 – The **Emissions data** screen: choosing emissions fields to be imported.

Any column headings that start with recognisable pollutant names will be automatically highlighted. For example, “Benzene_g_s”, “BENZENE” and “benzene_data” would all be recognised as emissions fields and highlighted. Highlighted fields will be automatically moved to the top of the list. Clicking with the mouse allows more fields to be selected or those already highlighted to be deselected.

Figure 6.9 shows an example screen where 5 of the columns in the file have been recognised as possible pollutants. Note that in this example, an ESRI shape file, only the first 10 characters in the column name are read, whereas for other formats, such as MIF files, more than 10 characters can be read. The user should check each column that has been highlighted to make sure that it is required for import of emissions data.

Once the emissions fields have been selected, and the user has clicked on **Next>**, the selected fields are listed in a table, and the user must match a pollutant to each field name. If the **Emissions field** name contains the name of a pollutant, the Wizard will make a guess at which pollutant should appear in the **Pollutant** column. For example, for “PM10_T_YR” in **Figure 6.10**, the Wizard has, correctly, deduced that the pollutant is particulate matter, PM_{10}, which therefore appears in the **Pollutant** column. If no matching pollutant can be deduced, or the guess is incorrect, the user can select a pollutant from the drop-down list in the **Pollutant** column.

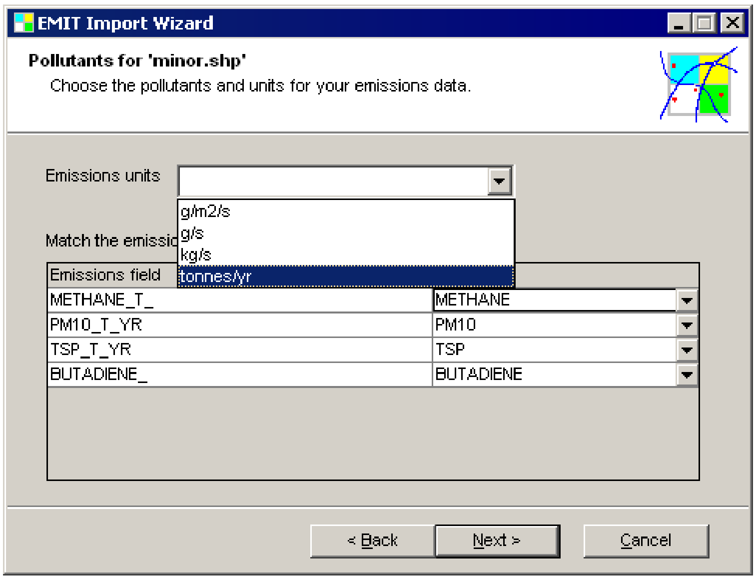


Figure 6.10 – The **Pollutants** screen for assigning column names to pollutants in the database, and selecting the emissions unit for all pollutants to be imported.

All pollutant emissions must be specified in the same units that are selected using the Emissions units drop-down list box, as shown in **Figure 6.10**. This list shows only those units that apply to the current source type. In the case shown of a minor road source, the units could be $g/m^2/s$, g/s, kg/s or tonnes/yr.

*For groups set up using Activity Data (as shown in **Figure 6.3**)*

The method for importing traffic activity data (i.e. road, rail and minor road data) into EMIT differs from that used to import point, line, volume, area and CandD activity source data. This is because there are a fixed, relatively small number of traffic ‘activities’ (i.e. traffic counts) that are of interest; conversely, there is an almost unlimited selection of activity datasets that could be included within the EMIT dataset to estimate emissions from point, area, line, volume and CandD source (for further details, please refer to Appendix C).

When traffic activity groups are created, a fleet component set is assigned to the group. Road source groups have the choice of two fleet component sets and rail source groups have a choice of three fleet component sets; these are summarised in **Tables 6.8** and **6.9**. The appropriate fields must be present in the import file; if the wrong column headings are present, an error message will be displayed.

During the import of activity data for point, area, line, volume and CandD sources, the user must first select the fields that contain activity data. For example, **Figure 6.11** shows the selection of three column headings that contain fuel consumption data.

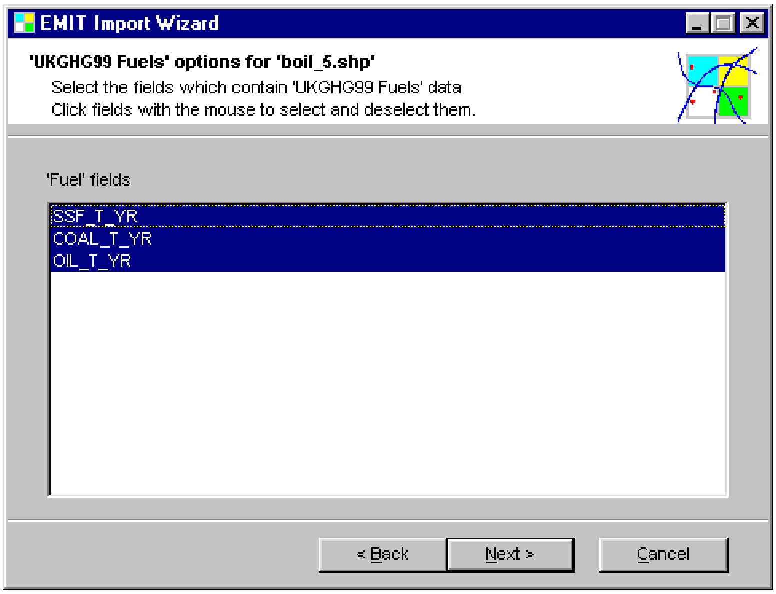


Figure 6.11 – Selecting the activity data fields during the import of point, area, line, volume and CandD activity source data

The next step is to assign an activity to each of the chosen fields; this is done by selecting an activity from the drop down list, as shown in **Figure 6.12**. Sometimes, it may not be entirely clear which activity should be chosen. In these cases, it is a good idea to:

- refer back to where the activity data came from in order to be sure what data you are working with, and then
- look at the activity emission factor dataset spreadsheets held in the *Data/ActivitySpreadsheets* sub directory of the installation directory. In most cases, these spreadsheets give fuller explanations of the activity names that will help you choose the correct activity from the drop down list.

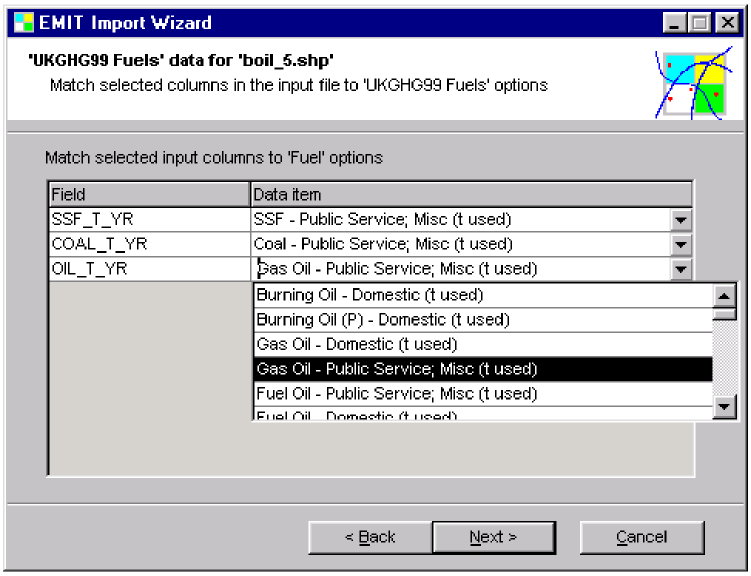


Figure 6.12 – Matching the activities (as defined within the EMIT database) to the chosen activity fields

*For groups set up to use the SAP emission factors (as shown in **Figure 6.4**)*

The import of dwelling data to be used with the SAP based emission factor dataset is straightforward. The dwelling data (i.e. the number of dwellings in each source) included in the import file must be in a column headed NUMDWELL; the Import Wizard automatically recognises this column.

A **Region Type** must be selected during the import process. This **Region Type**, selected from a drop down list of all region types defined in the database, will be applied to all sources imported into the chosen group. For further details of groups containing emissions from domestic properties, please refer to Section 12 of this User Guide.

Note that only area and CandD source groups can use the SAP-based emission factor dataset.

*For groups set up using Scaling Parameters (as shown in **Figure 6.5**)*

The import of local statistical data (used to scale national emissions data using a national statistics value) is also straightforward. The statistics data included in the import file must be in a column headed STAT; the Import Wizard automatically recognises this column.

Note that only area and CandD source groups can be set up as scaling source groups.

Step 4 **Import summary**

The Import Wizard then conducts a series of checks and summarises the status of all the fields in the file to be imported. The status may be Missing, Redundant or Imported.

Missing fields

The column headings of optional fields that were not included in the input file are listed, for example the NOTES, KEYWORDS, DESCRIPT and OPHOURS columns shown in **Figure 6.13**. This screen does not appear if there are no missing fields. Missing fields will be filled with the default values given in **Tables 6.2** to **6.7**.

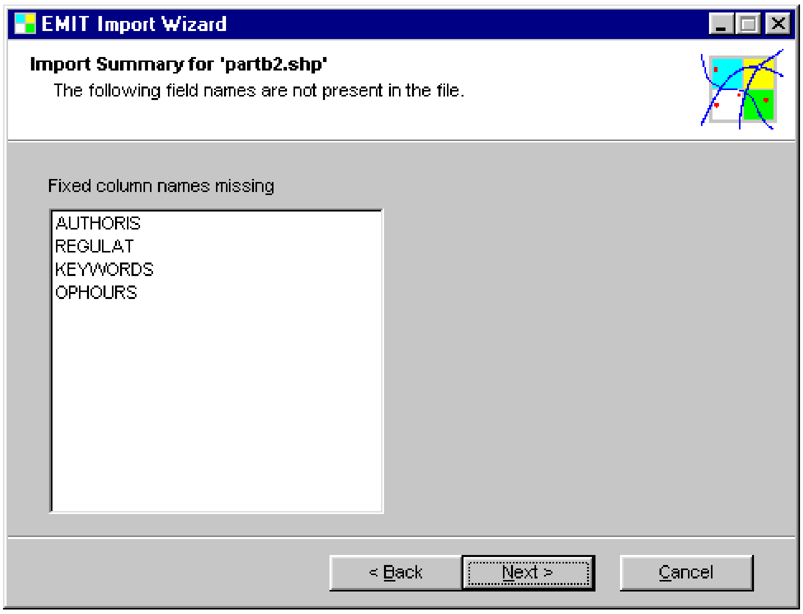


Figure 6.13 – The **Import Summary** screen for missing optional fields.

Redundant fields

The column headings of fields that were neither the fixed field names given in **Tables 6.2** to **6.11** nor pollutant field names, and are therefore to be ignored are then listed (**Figure 6.14**). This screen does not appear if there are no redundant fields.

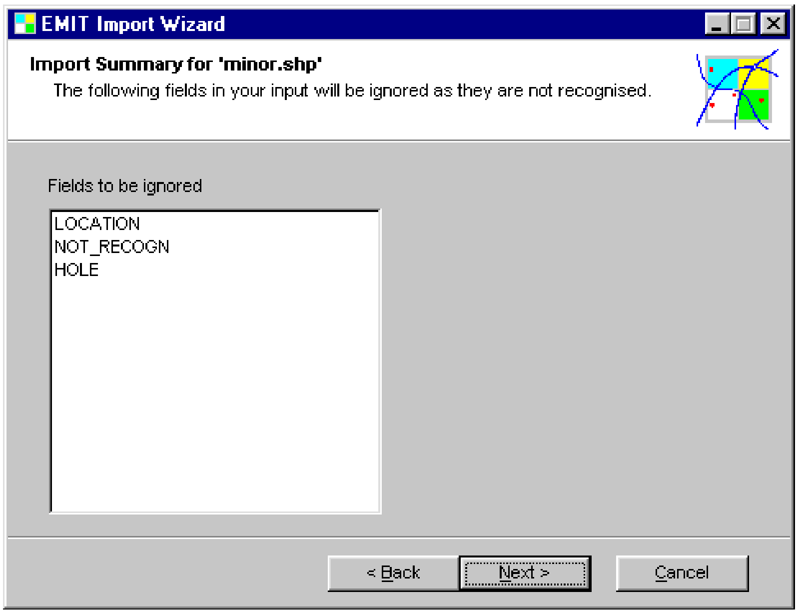


Figure 6.14 – The **Import Summary** screen for redundant fields.

Imported fields

The column headings of fields that are to be imported are then listed (**Figure 6.15**).

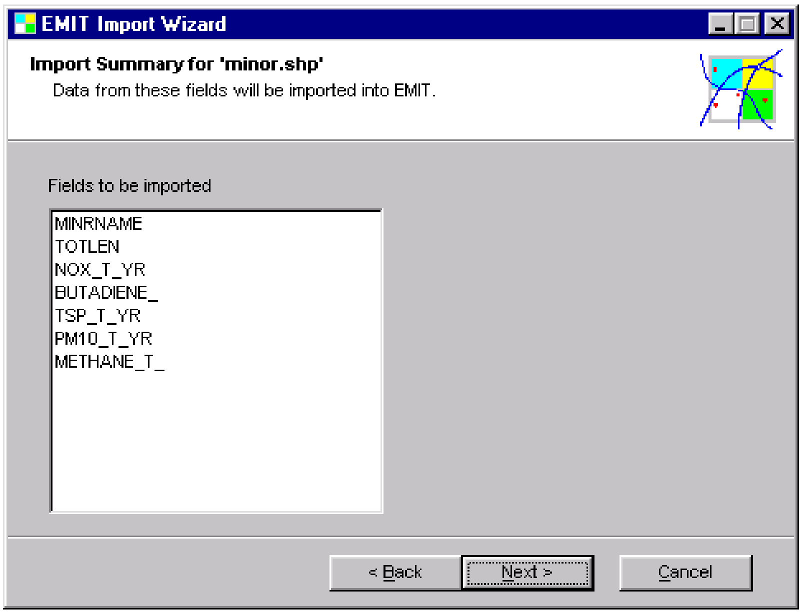


Figure 6.15 – The **Import Summary** screen for fields to be imported.

Step 5 Carry out integrity checks on data

The screen shown in **Figure 6.16** is the next to appear. This simply informs the user that the Wizard will carry out various checks on the data, such as whether there are duplicate data items. On clicking **Next>** the integrity checks begin and a progress bar is displayed.

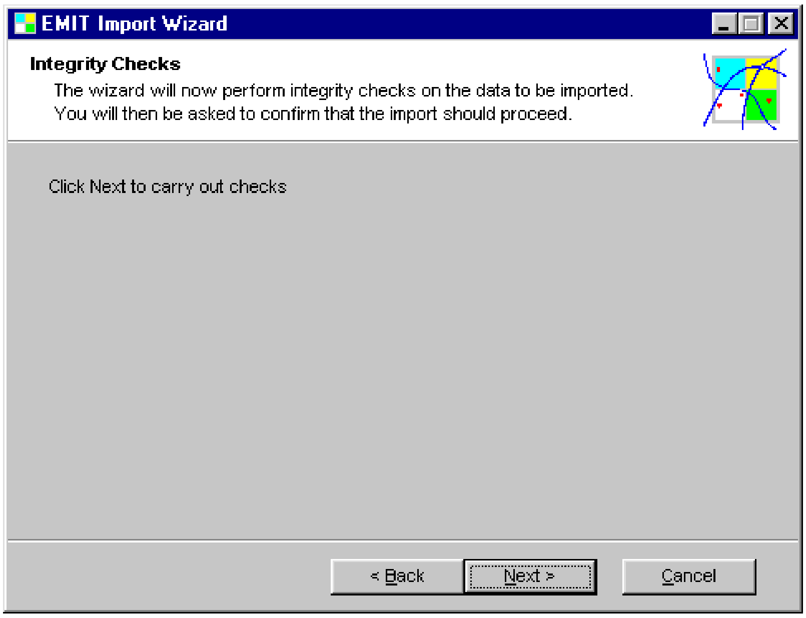


Figure 6.16 – The **Integrity Checks** screen.

Step 6 Report on integrity checks

There are three types of integrity checks carried out by the Import Wizard:

- Checking validity of individual sources.
- Checking the full set of sources to be imported.

- Checking for compatibility with the target group in the EMIT database.

These checks are outlined below. Please refer to **Tables 6.2** to **6.9** for further details of valid source properties.

Checking validity of individual sources

The Wizard checks all source properties and emissions individually to make sure the entries are valid. For example:

- A valid (up to 20 character), non-empty source name must be entered.
- Numerical values are checked to see whether they lie within the valid ranges.
- No 'type mismatches' are allowed, that is, no text in a numerical data field, and vice versa.
- Source geometry is checked for errors. Note that minor road sources must be rectangular in shape, with corner co-ordinates that are multiples of 1000m. Area, CandD and volume sources must be convex polygons with 3 to 50 sides. Road, rail and line sources are limited to 50 vertices.

Checking the full set of sources

Next, the full set of sources is considered with respect to each other. Problems that may come to light at this stage include:

- Duplicate source names cannot be imported. These may arise from the truncation of long source names to 20 characters.

Checking for compatibility with the target group in the EMIT database

Finally, the Wizard checks that the sources selected for import do not conflict with those already present in the EMIT database. The following problems may arise:

- Any source selected for import that has the same name as a source already present in the EMIT database cannot be imported.
- For industrial (point, line, volume and area) sources, if an OPERATOR column has been defined in the import file, then those sources with an operator name not present in the EMIT database cannot be imported.

When the checks have been completed, a report is displayed showing the findings, **Figure 6.17**. The user can save this report by clicking the **Save Report** button. The report contains the following sections:

- Error Summary
- Integrity Checks Report
- Details

If one or more of the sources have been rejected, then the user can choose whether to import just the valid sources by clicking **Import Now**, or to **Cancel** the import altogether. The best option may be to **Cancel** the import and go back and recheck the input data file.

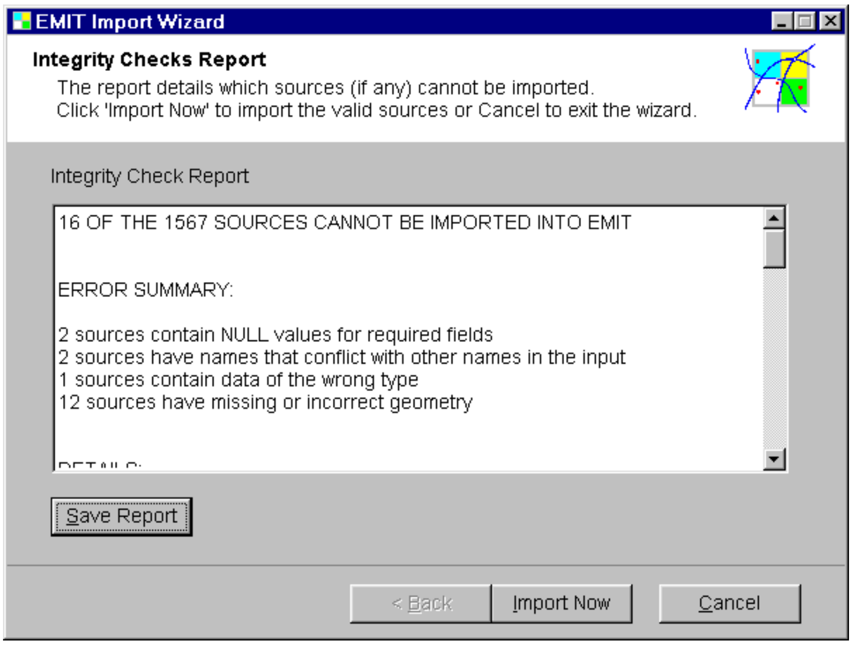


Figure 6.17 – The **Integrity Checks Report** screen, see Step 6.

Step 7 **Import data.**

If the user has chosen **Import Now** on the previous screen, the Wizard now imports the valid sources. The process is very fast. The final screen is shown in **Figure 6.18**.

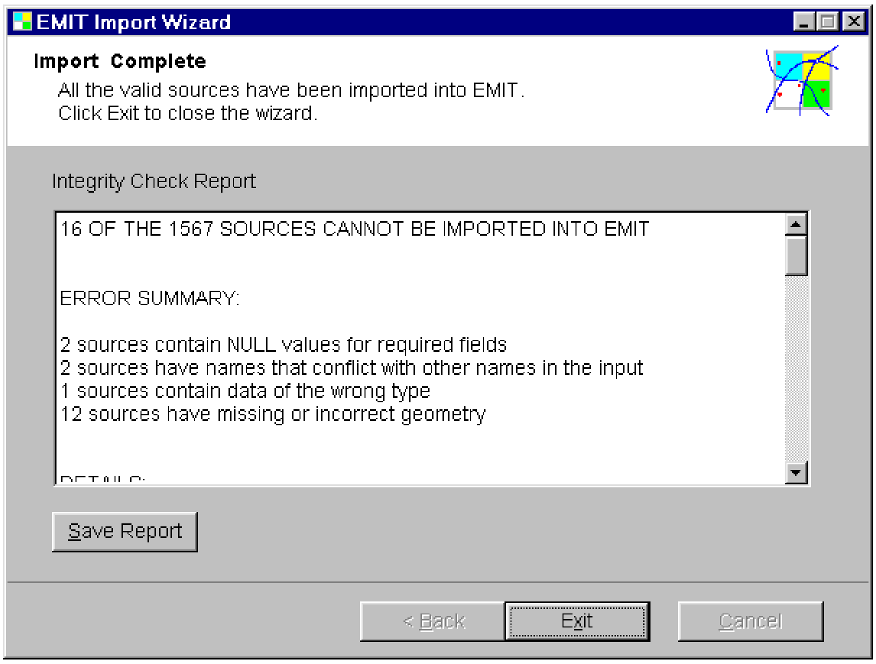


Figure 6.18 – The **Import Complete** screen.

After the import process has been completed, click **Exit** to close the EMIT Import Wizard.

Column heading	Data	Units	Restrictions	Required	Default
ROAD SOURCES					
ROADNAME	Unique name of source	*text*	20 characters maximum. Source names cannot contain apostrophes.	yes	-
DESCRIPT	Description of source	*text*	200 characters maximum	no	blank
NOTES	Notes on this source	*text*	32,000 characters maximum	no	blank
KEYWORDS	Searchable keywords	*text*	32,000 characters maximum	no	blank
WIDTH	Road source width	m	5 – 100m	yes	-
HEIGHT	Height of road above ground	m	0 – 2000m	yes	-
CANYON	Canyon height	m	0 – 100m	yes	-
SPEED	Average speed	km/hr	Must be in the range supported by the dataset, given in A.7. Speed is rounded to the nearest valid value in the target dataset.	yes	-
GRADIENT	Gradient of road	-	0 – 50%	no	0
ROADSURF	Road surface type	*text*	Choose from one of the options given in Table 6.12	no	No Correction
TEXDEPTH	Road surface texture depth	mm	0 – 100mm	no	0
CSV FILES ONLY (data following the above)					
ROADNAME$^{\Delta}$	Unique name of source	*text*	20 characters maximum	yes	-
X	X-location of source vertex	m	-9,999,000 – 9,999,999m	yes	-
Y	Y-location of source vertex	m	-9,999,000 – 9,999,999m	yes	-

Table 6.2 – EMIT Import Wizard column headings: major road sources. The data under the heading "CSV FILES ONLY" must be included in *.csv* files for import immediately below the columns of source data (please refer to **Figure 6.1** for an example *.csv* file).

Column heading	Data	Units	Restrictions	Required	Default
RAIL SOURCES					
RAILNAME	Unique name of source	*text*	20 characters maximum. Source names cannot contain apostrophes.	Yes	-
DESCRIPT	Description of source	*text*	200 characters maximum	No	blank
NOTES	Notes for this source	*text*	32,000 characters maximum	No	blank
KEYWORDS	Searchable keywords	*text*	32,000 characters maximum	No	blank
WIDTH	Rail source width	m	5 – 100m	Yes	-
HEIGHT	Height of railway above the ground	m	0 – 2000m	Yes	-
CSV FILES ONLY (data following the above)					
RAILNAME $^{\Delta}$	Unique name of source	*text*	20 characters maximum	Yes	-
X	X-location of source vertex	m	-9,999,000 – 9,999,999m	Yes	-
Y	Y-location of source vertex	m	-9,999,000 – 9,999,999m	Yes	-

Table 6.3 – EMIT Import Wizard column headings: rail sources. The data under the heading “CSV FILES ONLY” must be included in *.csv* files for import immediately below the columns of source data (please refer to **Figure 6.1** for an example *.csv* file).

Column heading	Data	Units	Restrictions	Required	Default
MINOR ROAD SOURCES					
MINRNAME	Unique name of source	*text*	20 characters maximum. Source names cannot contain apostrophes.	yes	-
MIN_X*	X-coordinate of bottom left hand corner of source	m	-9,999,000 – 9,999,000m	yes*	-
MAX_X*	X-coordinate of top right hand corner of source	m	-9,999,000 – 9,999,000m	yes*	-
MIN_Y*	Y-coordinate of bottom left hand corner of source	m	-9,999,000 – 9,999,000m	yes*	-
MAX_Y*	Y-coordinate of top right hand corner of source	m	-9,999,000 – 9,999,000m	yes*	-
DESCRIPT	Description of source	*text*	200 characters maximum	no	blank
NOTES	Notes for this source	*text*	32,000 characters maximum	no	blank
KEYWORDS	Searchable keywords	*text*	32,000 characters maximum	no	blank
SPEED	Average speed	km/hr	Must be in the range supported by the dataset, given in A.7 Speed is rounded to the nearest valid value in the target dataset.	yes	-
TOTLEN	Total length of road within this $1km^2$. This value is stored for reference but is not used in EMIT's emissions calculations.	m	$0 – 1.0 \times 10^7$ m	yes	-

Table 6.4 – EMIT Import Wizard column headings: minor road sources (* for *.csv* files only).

Column heading	Data	Units	Restrictions	Required	Default
POINT SOURCES					
PTNAME	Unique name of source	*text*	20 characters maximum; must be unique; ource names cannot contain apostrophes.	yes	-
X*	X-location of source	m	-9,999,000 – 9,999,999m	yes*	-
Y*	Y-location of source	m	-9,999,000 – 9,999,999m	yes*	-
NOTES	Notes for this source	*text*	32,000 characters maximum	no	blank
KEYWORDS	Searchable keywords	*text*	32,000 characters maximum	no	blank
DIAMETER	Stack internal diameter height at exit	m	0.1 – 100m	yes	-
EXITVEL	Exit velocity	m/s	0 – 1000m/s	yes	-
EXITTEMP	Exit temperature	°C	-100 – 5000°C	yes	-
HEIGHT	Height of stack exit above local ground level	m	0 – 2000m	yes	-
AUTHORIS	Authorisation code	*text*	20 characters maximum	no	blank
REGULAT	Appropriate regulator	*text*	20 characters maximum	no	blank
OPERATOR	Operator for the source, e.g. company owning chimney	*text*	the operator must be defined in EMIT	no	default operator+
OPWEEKS	Operating weeks per year§	weeks	0 – 52 weeks	no	52
OPHOURS	Operating hours per week§	hours	0 – 168 hours	no	168

Table 6.5 – EMIT Import Wizard column headings: point sources.

* For *.csv* files only.
+ The 'default operator' is the operator pre-loaded in a new EMIT database. This can be altered by the user, see Section 4.3.8 for further details.
§ Can be stored but is not currently used by EMIT.

Column heading	Data	Units	Restrictions	Required	Default
AREA SOURCES					
AREANAME	Unique name of source	*text*	20 characters maximum; must be unique; cannot contain apostrophes.	yes	-
X1*	X-coordinate of first corner of source	m	-9,999,000 – 9,999,999m	yes*	-
Y1*	Y-coordinate of first corner of source	m	-9,999,000 – 9,999,999m	yes*	-
X2*	X-coordinate of second corner of source	m	-9,999,000 – 9,999,999m	yes*	-
Y2*	Y-coordinate of second corner of source	m	-9,999,000 – 9,999,999m	yes*	-
X3*	X-coordinate of third corner of source	m	-9,999,000 – 9,999,999m	yes*	-
Y3*	Y-coordinate of third corner of source	m	-9,999,000 – 9,999,999m	yes*	-
etc*					
NVERTEX*	Number of source vertices	-	3 – 50	yes*	-
NOTES	Notes for this source	*text*	32,000 characters maximum	no	blank
KEYWORDS	Searchable keywords	*text*	32,000 characters maximum	no	blank
EXITVEL	Exit velocity	m/s	0 – 1000m/s	yes	-
EXITTEMP	Exit temperature	°C	-100 – 5000°C	yes	-
HEIGHT	Height of release above local ground level	m	0 – 2000m	yes	-
AUTHORIS	Authorisation code	*text*	20 characters maximum	no	blank
REGULAT	Appropriate regulator	*text*	20 characters maximum	no	blank
OPERATOR	Operator for the source, e.g. company owning chimney	*text*	the operator must be defined in EMIT	no	default operator+
OPWEEKS	Operating weeks per year§	weeks	0 – 52 weeks	no	52
OPHOURS	Operating hours per week§	hours	0 – 168 hours	no	168
STAT	Statistic used for scaling emissions++	-	-	no	-
NUMDWELL	Number of dwellings**	-	must not be a negative value	no	-

Table 6.6 – EMIT Import Wizard column headings: area sources

* For *.csv* files only; the CSV file should include as many pairs of X- and Y-coordinate columns as are needed to describe all sources within the file. The largest number possible is 50 pairs of columns: X1, Y1, X2, Y2, X3, Y3, X4, Y4, … X50, Y50.

\+ The 'default operator' is the operator pre-loaded in a new EMIT database. This can be altered by the user, see Section 4.3.8 for further details.

§ Can be stored but is not currently used by EMIT.

++ For import into 'scaling' groups only.

** For import into SAP groups only.

Column heading	Data	Units	Restrictions	Required	Default
CANDD SOURCES					
CDNAME	Unique name of source	*text*	20 characters maximum; must be unique; cannot contain apostrophes.	yes	-
X1*	X-coordinate of first corner of source	m	-9,999,000 – 9,999,999m	yes*	-
Y1*	Y-coordinate of first corner of source	m	-9,999,000 – 9,999,999m	yes*	-
X2*	X-coordinate of second corner of source	m	-9,999,000 – 9,999,999m	yes*	-
Y2*	Y-coordinate of second corner of source	m	-9,999,000 – 9,999,999m	yes*	-
X3*	X-coordinate of third corner of source	m	-9,999,000 – 9,999,999m	yes*	-
Y3*	Y-coordinate of third corner of source	m	-9,999,000 – 9,999,999m	yes*	-
etc*					
NVERTEX*	Number of vertices (corners) for the source	-	3 – 50	yes*	-
NOTES	Notes for this source	*text*	32,000 characters maximum	no	blank
KEYWORDS	Searchable keywords	*text*	32,000 characters maximum	no	blank
STAT	Statistic used for scaling emissions++	-	-	no	-
NUMDWELL	Number of dwellings**	-	must not be a negative value	no	-

Table 6.7 – EMIT Import Wizard column headings: CandD sources

* for *.csv* files only; the CSV file should include as many pairs of X- and Y-coordinate columns as are needed to describe all sources within the file. The largest number possible is 50 pairs of columns: X1, Y1, X2, Y2, X3, Y3, X4, Y4, … X50, Y50.

++ for import into 'scaling' groups only.

** for import into SAP groups only.

Column heading	Data	Units	Restrictions	Required	Default
LINE SOURCES					
LINENAME	Unique name of source	*text*	20 characters maximum; must be unique; must not contain apostrophes	yes	-
NOTES	Notes for this source	*text*	32,000 characters maximum	no	blank
KEYWORDS	Searchable keywords	*text*	32,000 characters maximum	no	blank
EXITVEL	Exit velocity	m/s	0 – 1000m/s	yes	-
EXITTEMP	Exit temperature	°C	-100 – 5000°C	yes	-
HEIGHT	Height of source above local ground level	m	0 – 2000m	yes	-
WIDTH	Width of line source	m	0 – 100m	yes	-
AUTHORIS	Authorisation code	*text*	20 characters maximum	no	blank
REGULAT	Appropriate regulator	*text*	20 characters maximum	no	blank
OPERATOR	Operator for the source, e.g. company owning chimney	*text*	the operator must be defined in EMIT	no	default operator[+]
CSV FILES ONLY (data following the above)					
LINENAME [Δ]	Unique name of source	*text*	20 characters maximum	yes	-
X	X-location of source vertex	m	-9,999,000 – 9,999,999m	yes	-
Y	Y-location of source vertex	m	-9,999,000 – 9,999,999m	yes	-

Table 6.8 – EMIT Import Wizard column headings: line sources. The data under the heading "CSV FILES ONLY" must be included in *.csv* files for import immediately below the columns of source data (please refer to **Figure 6.1** for an example *.csv* file).

[+] The 'default operator' is the operator pre-loaded in a new EMIT database. This can be altered by the user, see Section 4.3.8 for further details.

Column heading	Data	Units	Restrictions	Required	Default
VOLUME SOURCES					
VOLNAME	Unique name of source	*text*	20 characters maximum; must be unique; cannot contain apostrophes	yes	-
X1*	X-coordinate of first corner of source	m	-9,999,000 – 9,999,999m	yes*	-
Y1*	Y-coordinate of first corner of source	m	-9,999,000 – 9,999,999m	yes*	-
X2*	X-coordinate of second corner of source	m	-9,999,000 – 9,999,999m	yes*	-
Y2*	Y-coordinate of second corner of source	m	-9,999,000 – 9,999,999m	yes*	-
X3*	X-coordinate of third corner of source	m	-9,999,000 – 9,999,999m	yes*	-
Y3*	Y-coordinate of third corner of source	m	-9,999,000 – 9,999,999m	yes*	-
etc*					
NVERTEX*	Number of vertices (corners) for the source	-	3 – 50	yes*	-
NOTES	Notes for this source	*text*	32,000 characters maximum	no	blank
KEYWORDS	Searchable keywords	*text*	32,000 characters maximum	no	blank
HEIGHT	Elevation of centre of source above local ground level	m	0 – 2000m	yes	-
DEPTH	Depth of source	m	0 – 1000m	yes	-
AUTHORIS	Authorisation code	*text*	20 characters maximum	no	blank
REGULAT	Appropriate regulator	*text*	20 characters maximum	no	blank
OPERATOR	Operator for the source, e.g. company owning chimney	*text*	the operator must be defined in EMIT	no	default operator+
STAT	Statistic used for scaling emissions++	-	-	no	-

Table 6.9 – EMIT Import Wizard column headings: volume sources

* For *.csv* files only; the CSV file should include as many pairs of X- and Y-coordinate columns as are needed to describe all sources within the file. The largest number possible is 50 pairs of columns: X1, Y1, X2, Y2, X3, Y3, X4, Y4, … X50, Y50.
+The 'default operator' is the operator pre-loaded in a new EMIT database. This can be altered by the user, see Section 4.3.8 for further details.
++ Tor import into 'scaling' groups only.

Fleet Component set name	Fleet component	Column heading
ROAD SOURCES and MINOR ROAD SOURCES		
Heavy/Light/Mcycle	Motorcycles	MCYCLE
Heavy/Light/Mcycle	Light vehicles	LIGHT
Heavy/Light/Mcycle	Heavy vehicles	HEAVY
GLA inventory (11)	Motorcycles	MCYCLE
GLA inventory (11)	Cars	CAR
GLA inventory (11)	Taxis	TAXI
GLA inventory (11)	LGVs	LGV
GLA inventory (11)	Buses and coaches	BUS
GLA inventory (11)	Rigid HGVs 2 axles	RHGV_2X
GLA inventory (11)	Rigid HGVs 3 axles	RHGV_3X
GLA inventory (11)	Rigid HGVs 4+ axles	RHGV_4X
GLA inventory (11)	Artic HGVs 3&4 axles	AHGV_34X
GLA inventory (11)	Artic HGVs 5 axles	AHGV_5X
GLA inventory (11)	Artic HGVs 6 axles	AHGV_6X

Table 6.10 – EMIT Import Wizard column headings: the two sets of fleet component headings for road and minor road sources.

Note: for roads, the composition is in terms of daily traffic flow, and each component must be less than or equal to 2.4 million vehicles; for minor roads, the composition is in terms of vehicle kilometres per year, and each component must be less than or equal to 10 million.

Fleet Component set name	Fleet component	Column heading
RAIL SOURCES		
Freight/Passenger	Freight	HEAVY
Freight/Passenger	Passenger	LIGHT
UKEFD 2001 (14)	Cl 37 Freight 1 loco	C37F_1L
UKEFD 2001 (14)	Cl 37 Freight 2 loco	C37F_2L
UKEFD 2001 (14)	Cl 47 Freight	C47F
UKEFD 2001 (14)	Cl 47 Passenger	C47P
UKEFD 2001 (14)	Cl 56 Freight	C56F
UKEFD 2001 (14)	Cl 58 Freight	C58F
UKEFD 2001 (14)	Cl 60 Freight	C60F
UKEFD 2001 (14)	Cl 66 Freight	C66F
UKEFD 2001 (14)	Electric per train	ELECTRIC
UKEFD 2001 (14)	Heritage DMU (2 car)	HERITAGE
UKEFD 2001 (14)	IC125 per power car	IC125
UKEFD 2001 (14)	Pacer DMU per car	PACER
UKEFD 2001 (14)	Sprinter DMU per car	SPRINTER
UKEFD 2001 (14)	Turbo DMU per car	TURBO
UK Diesel 2001 (4)	IC125 per train	IC125
UK Diesel 2001 (4)	Regional per train	REGIONAL
UK Diesel 2001 (4)	Freight per train	FREIGHT
UK Diesel 2001 (4)	Electric per train	ELECTRIC

Table 6.11 – EMIT Import Wizard column headings: the three fleet component set headings for rail sources.

Note: for rail, the composition is in terms of daily traffic flow, and each component must be less than or equal to 1 million vehicles.

Road Surface Type	Import text
No correction	NO_CORR
Impervious concrete	IMP_CONC
Impervious bituminous	IMP_BITUM
Pervious	PERVIOUS

Table 6.12 – EMIT Import Wizard road surface type options for import, as defined in **CRTN 1998**.

SECTION 7 Viewing and manipulating data using the EMIT Mapper

This section describes the use of the EMIT Mapper for displaying and manipulating the data held in EMIT. Section 7.1 is an introductory section, which can also be used for reference as it contains a list of all the available menu options and tools. Section 7.2 explains which tools are useful when an EMIT database is being viewed with the Mapper and contains an example. Section 7.3 discusses how the EMIT Mapper can be used to manipulate source data, also with an example. The examples given in the Traffic Management section of the manual (Section 10) also demonstrate use of the EMIT Mapper, in particular the selection and **Change Group** tools. Section 7.4 is a 'Troubleshooting' reference section. This is the first place to look if you have questions when using the EMIT Mapper.

7.1 Introduction to the EMIT Mapper

EMIT contains an integrated visualisation and manipulation utility called the EMIT Mapper. It allows source data not only to be displayed graphically but also manipulated. New sources may be added and existing sources may be moved between groups. The geometry of a source may be changed directly, perhaps by using background map data as a guide. Additionally, sources may be edited via their EMIT source data screens. The map created in the EMIT Mapper can be copied and pasted into other packages such as Microsoft Word.

The EMIT Mapper is launched by clicking on the icon or, alternatively, from the Start Menu. Note that the edit mode of the Mapper, when Mapper tools are used to change EMIT data, cannot be used when the EMIT interface is running. This prevents simultaneous changes being made with the Mapper and the interface.

The EMIT Mapper window is shown in **Figure 7.1**. The main features of the interface are annotated. The options available from the menu bar are described in Section 7.1.1, and the EMIT Mapper tools available on the tool bar are discussed in Section 7.1.2. The remaining parts of the interface, the **Database Explorer**, **Map View** and **Selections** windows, are described in Sections 7.1.3, 7.1.4 and 7.1.5, respectively.

The relative size of the **Database Explorer**, **Map View** and **Selections** windows can be changed by clicking and dragging the separators above the relevant window, and below the EMIT Mapper toolbar indicated on **Figure 7.1**.

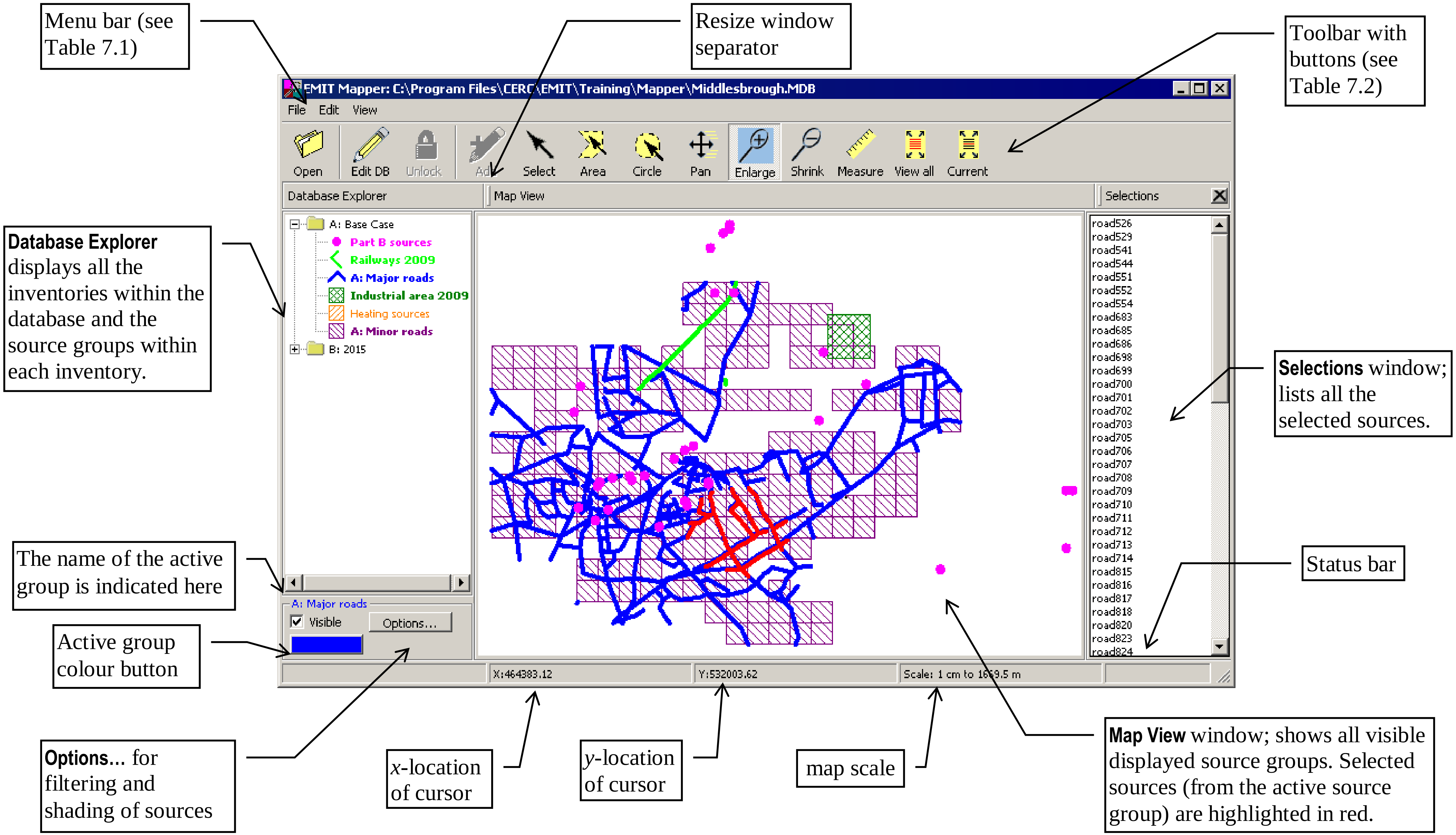


Figure 7.1 – The EMIT Mapper interface

7.1.1 The menu bar

There are three main menus: **File**, **Edit** and **View**. The **File** menu options allow the opening of database files, the import of background image files, and gives the user the option to **Exit** the EMIT Mapper. The **Edit** menu options are concerned with the manipulation of source data, and are only enabled when the **Edit DB** (edit database) button is depressed (down) and one or more sources are selected. The **View** menu options allow the user to change the display: for example, background images such as TIFF files can be switched on and off. In addition, the **View** menu gives the options to copy the **Map View** to the clipboard, or save the map to a file. The menu options are summarised in **Table 7.1**.

Menu	Option	Use
File	**Open EMIT Database…**	Allows the user to browse for an EMIT database to open.
	Load Image…	Loads a background image file (TIFF, JPEG, CompuServe GIF and BMP formats accepted).
	Exit	Exits the EMIT Mapper.
Edit*	**Change Group…**	Allows the user to move selected sources from the active group into another group of the same type. The sources are deleted from the original group.
	Delete	Deletes the selected sources. The sources are permanently removed from the database.
	Delete Vertex	Deletes the selected vertex.
View	**Show Source List**	Makes the **Selections** window visible/invisible.
	Show North Arrow	Makes the north arrow visible/invisible.
	Show Images	Makes any background images visible/invisible.
	Save Map View…	Allows the user to save the sources and images currently displayed in the **Map View** as a BMP file.
	**Save Map View (high resolution)… ** **	As above, except the **Map View** is saved to a higher resolution.
	Copy Map View…	Allows the user to copy the sources and images currently displayed in the **Map View** to the clipboard, for pasting into other packages such as Microsoft Word.
	**Copy Map View (high resolution)… ** **	As above, except the **Map View** is copied to a higher resolution.
	Refresh Map	Refreshes the contents of the **Map View** window, for instance after editing data in the EMIT interface. Note that if new groups or inventories have been added in the EMIT interface these will not be displayed unless the database is reopened in the Mapper.

***** The **Edit** menu commands are only available when the **Edit DB** button is on.

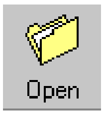
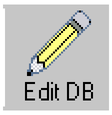
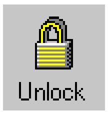
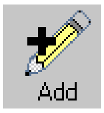
****** The 'high resolution' maps contain significantly more data than the standard maps; these actions therefore require more computer memory and may be slow if running on a minimum specification PC.

Table 7.1 – Menu options in EMIT Mapper.

7.1.2 EMIT Mapper Toolbar

The toolbar contains buttons allowing manipulation of the source data and controlling the display and selection of sources. The EMIT Mapper tools are summarised in **Table 7.2**. Sections 7.2.1 and 7.3.1 give examples of how these tools are used to view and manipulate data respectively.

As the cursor is moved across the tool bar, tooltips appear explaining the function of each button. Right clicking on the toolbar allows the user to turn on or off the text that appears on the buttons of the toolbar.

Mapper Tool	Map Cursor	Use when activated
	n/a	Allows the user to browse for an EMIT database to open. (It has the same effect as the menu option **File**, **Open EMIT Database...**)
	n/a	Enable/disable editing tools. When the **Edit DB** button is down (depressed) data can be changed: sources can be created, deleted and moved between groups; the **Unlock** and **Add** tools are available; and source screens can be displayed.
	n/a	Only available when the **Edit DB** button is down (depressed). When the button is down (depressed) the source geometry is 'unlocked' i.e. can be edited using the Mapper. The selected source can be moved, and for road, rail, line, CandD, volume and area sources, the geometry can be altered by moving, adding or deleting vertices. Users are advised to keep the source geometry locked except when correcting source positions to avoid accidentally moving sources.
	+	Only available when the **Edit DB** button is down (depressed). When this button is down, clicking in the **Map View** window adds a new source to the active group in the location clicked. Point sources are added with a single click. Area, CandD and volume sources are added by clicking at each vertex and right-clicking at the final vertex. Road, rail and line sources are also added through a single click for each vertex, and a right-click at the final vertex. In each case, the EMIT source screen is then displayed for the user to complete the source parameters.

Select		The cursor changes to a small box in which part of the source to be selected must be placed. A single click on the source selects it and displays the source name in the **Selections** window. Selected sources are shown in red. When **Edit DB** is on, double clicking on a source displays the EMIT source form for that source. When both **Edit DB** and **Unlock** are on, clicking on a source causes the vertices to be highlighted and the source can be moved or its geometry edited.
Area		This button allows the selection of sources within a specified polygon. A left click on the mouse defines the vertices of a closed polygon; a right click signals the last vertex. Sources contained wholly or mainly within the polygon are selected.
Circle		This button allows the selection of sources within a specified circle. It operates in a similar way to the **Area** tool. Click and drag the mouse to define the circle. Release the mouse button to complete the selection.
Pan		Allows the user to move the map around within the **Map View** window, allowing different parts to be viewed. The map remains at the same scale.
Enlarge		This tool allows the user to 'zoom in' on the **Map View** window. A single mouse click within the **Map View** window causes a magnified display of the region clicked. You can also click and drag the mouse to zoom to a particular rectangle.
Shrink		When the cursor is positioned within the **Map View** window a mouse click causes the display centred at the click to be shrunk ('zooming out').
Measure		This tool can be used to measure distances in the **Map View** window. The first click on the left mouse button indicates the starting point of a line to be measured; subsequent clicks define vertices on the line, and a right mouse click indicates the end of a line. The total length of the line in metres is given in the status bar.
View all	n/a	This button 'zooms' the **Map View** window to show all sources in the currently visible groups.
Current	n/a	This button 'zooms' the **Map View** window to show all sources in the currently selected group.

Table 7.2 – EMIT Mapper tools available on the toolbar.

7.1.3 Database Explorer

The **Database Explorer** window is on the far left of the EMIT Mapper interface (see **Figure 7.1**).

This window displays the contents of the current EMIT database, using a format very similar to the directory tree structure shown in Windows Explorer. Inventories are indicated by folder icons and can be opened by clicking with the left mouse button to show the source groups they contain. The display incorporates a key indicating the colours and shading used to display each source group in the **Map View** window.

Clicking on a source group within the **Database Explorer** window causes that group to be displayed. This is also indicated by the group name being displayed in bold. Additionally, clicking on a group in the **Database Explorer** window causes that group to become the active group, and its name, together with the colour used to display it in the **Map View** window, are shown in the box beneath the **Database Explorer** window. Note that if a group is shared between two or more inventories it will only be displayed once, so the **Database Explorer** shows the same colour and shading key for all instances of that group.

Clicking on the coloured button, which displays the **Color** dialogue box, **Figure 7.2**, allows the colour in which the sources are displayed to be changed.

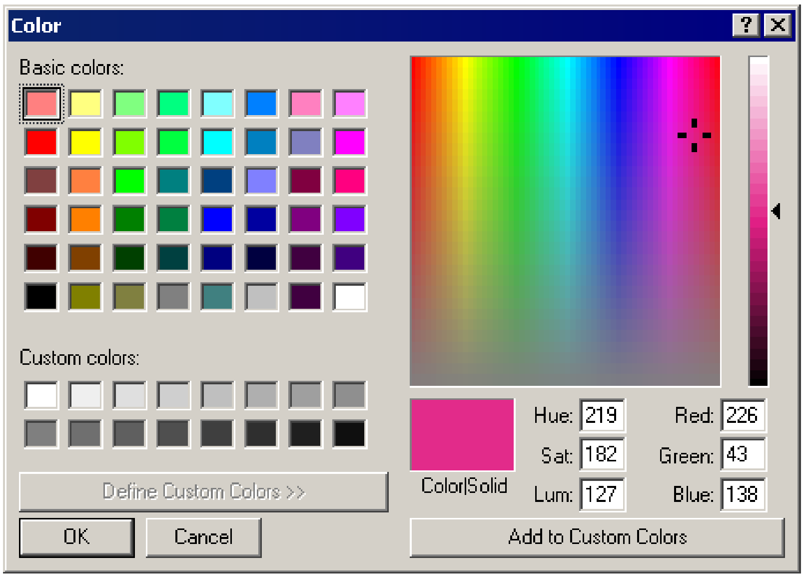


Figure 7.2 – Colour palette dialogue box.

The **Visible** check box may be used to show or hide the active group and in this way the user can control what appears in the **Map View** window.

Clicking on the **Options...** button gives a dialogue box, **Figure 7.3**, which allows the user to display the active sources in terms of their emissions of each pollutant. Firstly, sources can be *filtered* such that only those with emissions above and below certain limits will be displayed in the **Map View** window. Secondly, sources can be *shaded* in different colours, depending on their emissions. This is a useful tool that can be used for investigating where emissions are highest or as a rapid visual check to pinpoint errors that may have occurred during the compilation of the emissions inventory.

The units used to scale the shading of source by emission are given in **Table 7.3**.

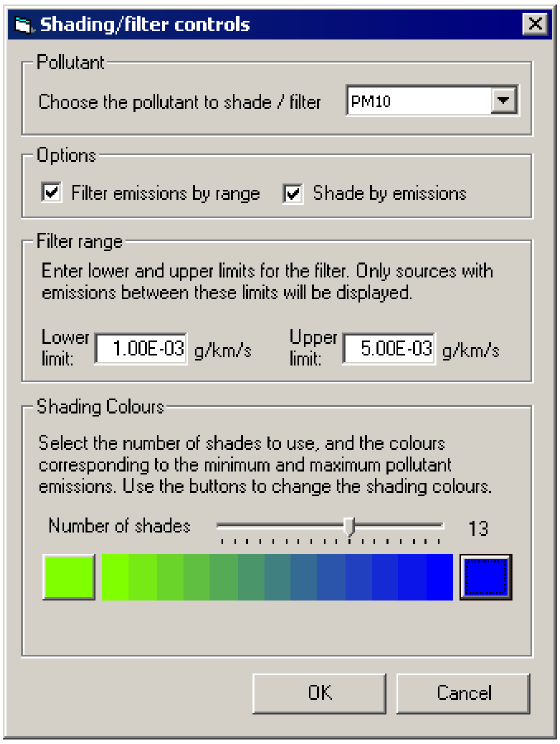


Figure 7.3 – The filtering and shading dialogue box.

Units	Source type
g/km/s	major road, rail
g/m/s	line
g/s	point
$g/m^2/s$	area
$g/m^3/s$	volume
tonnes/year	minor road, CandD

Table 7.3 – Units used for shading sources by emission.

7.1.4 Map View window

The **Map View** window is in the centre of the EMIT Mapper interface. This window shows all visible sources i.e. sources within groups shown in bold. A background image is displayed if one has been loaded. The selection tools may be used in the **Map View** window to edit sources and the pan and zoom tools are used to view different areas. The location of the cursor in the **Map View** window is given on the status bar (in metres).

Copying and Saving the Map View

It is possible to copy all the components in the **Map View** to the clipboard by selecting the **View** menu and choosing either **Copy Map View** or **Copy Map View (high resolution)**; the image can then be pasted into another package such as Microsoft Word. Similarly, the **Save Map View** and **Save Map View (high resolution)** can be used to save the **Map View** to a bitmap (BMP) file.

Users may also wish to copy or save the map (not including the background image), the legend or the north arrow separately. The map can be copied (or saved to a file) by right clicking in the **Map View**; this action activates the list of options shown in **Figure 7.4**. The **Copy map to clipboard** command can be used to copy and paste the map into another package as a Windows metafile (WMF file); the **Save map to file...** can be used to save the map as a BMP or a WMF file.

Figure 7.4 – The list of options enabled by right clicking in the **Map View**.

Note that the format of the plot created using the three options:

- **Copy Map View** (from the **View** menu),
- **Copy Map View (high resolution)** (from the **View** menu), and
- **Copy map to clipboard** (by right clicking in the **Map View**)

are all slightly different in terms of resolution and formats; similarly, the corresponding save commands all create slightly different files. Users are advised to spend a bit of time investigating the different formats in order to decide which is most suitable for their purpose.

Editing, copying and pasting the legend

Right clicking on the legend in the **Map View** allows users to edit, copy or save the legend: the option list shown in **Figure 7.5** is displayed. The legend can be edited in the following ways:

- the legend can be resized (using the **Resize legend box** command), and
- the legend font can be changed (using the **Change legend font...** command).

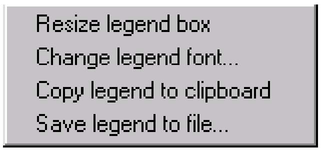


Figure 7.5 – The list of options enabled by right clicking in the map legend (before editing the size of the legend).

After the legend box has been resized, the **Stop resizing legend box** option can be selected from the list of options activated by right clicking on the legend (options shown in **Figure 7.6**). Alternatively, clicking with the left mouse button anywhere in the **Map View** *away* from the legend deactivates the **Resize legend box** command.

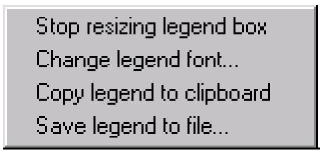


Figure 7.6 – The list of options enabled by right clicking in the map legend (after editing the size of the legend).

The **Copy legend to clipboard** and **Save legend to file...** commands shown in **Figure 7.5** behave in a corresponding way to the **Copy map to clipboard** and **Save map to file...** commands described above.

Finally, the legend can be moved around the **Map View** by ‘clicking’ (using the left mouse button) and ‘dragging’, as required.

Adding a north arrow to the Map View

It is sometimes useful to include a north arrow on a map. This can be done by selecting the **View** menu and choosing the **Show North Arrow** option. By default, the north arrow is displayed in the top left hand corner of the **Map View**. Using the left mouse button, the north arrow can be dragged to any location in the **Map View**; right clicking on the north arrow activates the option list shown in **Figure 7.7**.

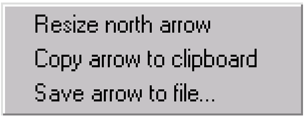


Figure 7.7 – The list of options enabled by right clicking in the north arrow (before editing the size of the arrow)

The **Resize north arrow** command is analogous to the **Resize legend box** command described above, with the option to **Stop resizing north arrow** corresponding to the **Stop resizing legend box**. Similarly, the **Copy arrow to clipboard** and **Save arrow to file...** commands work in the same way as the **Copy map to clipboard** and **Save map to file...** options discussed above.

7.1.5 Selections window

This window lists all the sources from the active source group that are currently selected. Selected sources are displayed in red in the **Map View** window.

7.2 Viewing data using the EMIT Mapper

This section shows, by way of a worked example, how the EMIT Mapper can be used to view emissions data within the EMIT database. When viewing data in the EMIT Mapper, if the **Edit DB** button is not down, the EMIT interface can also be open. The example given below demonstrates how data held in an EMIT database can be viewed using the EMIT Mapper, and shows an investigation which results in the editing of source data via the EMIT interface. The layout of the map is changed, and then the final map is saved to a file.

This worked example is based on an emissions inventory for the Middlesbrough area, using ‘dummy’ data to illustrate the Mapper; it is not a genuine emissions inventory for Middlesbrough. Users can follow this example by using the *Middlesbrough.mdb* database installed in the following location in the installation directory:

Examples\Mapper\Middlesbrough.mdb

7.2.1 Example: Viewing data in the EMIT Mapper, locating an erroneous source and saving the map to a file

Step 1 Double click on the EMIT Mapper icon, , to launch the EMIT Mapper.

Step 2 Use Windows Explorer to copy the *Middlesbrough.mdb* database from your installation directory to another location on your computer; in the following steps you will edit the database, and it is preferable not to modify the master copy in the installation directory.

Step 3 Click on the **Open** button on the toolbar and browse for the new copy of *the Middlesbrough.mdb* database, as shown in **Figure 7.8**.

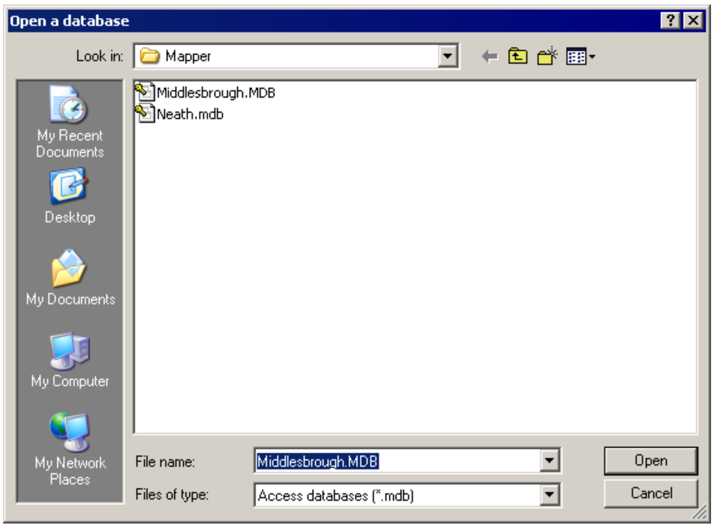


Figure 7.8 – Selecting an EMIT database to open.

Step 4 In the **Database Explorer** window, double click on the ‘B: Future Year’ folder icon to display the groups within this inventory, as in **Figure 7.9**.

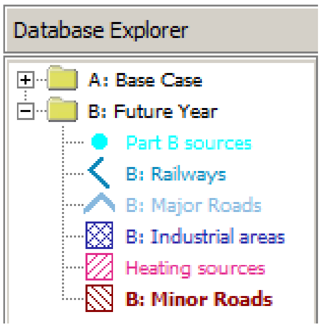


Figure 7.9 – Viewing the groups within an inventory in the **Database Explorer** window.

Step 5 Click once on ‘Part B sources’ to display the point sources in the **Map View** window. The area underneath the **Database Explorer** window shows this group to be the active source group. The **Visible** box is ticked and the coloured button is the same colour as that given in the key for Part B sources (light blue in this case). The text for this source group appears bold in the **Database Explorer** window because the group is visible.

Step 6 Click on all the other source types in turn: ‘B: Railways’, ‘B: Major roads’, ‘B: Industrial Areas’, ‘Heating sources’ and ‘B: Minor roads’. As an exercise, change the colours for all groups in the ‘B: Future Year’ inventory so the **Map View** window looks like that shown in **Figure 7.10**.

Note that it is a good idea to avoid using red as a group colour as selected sources are highlighted in red.

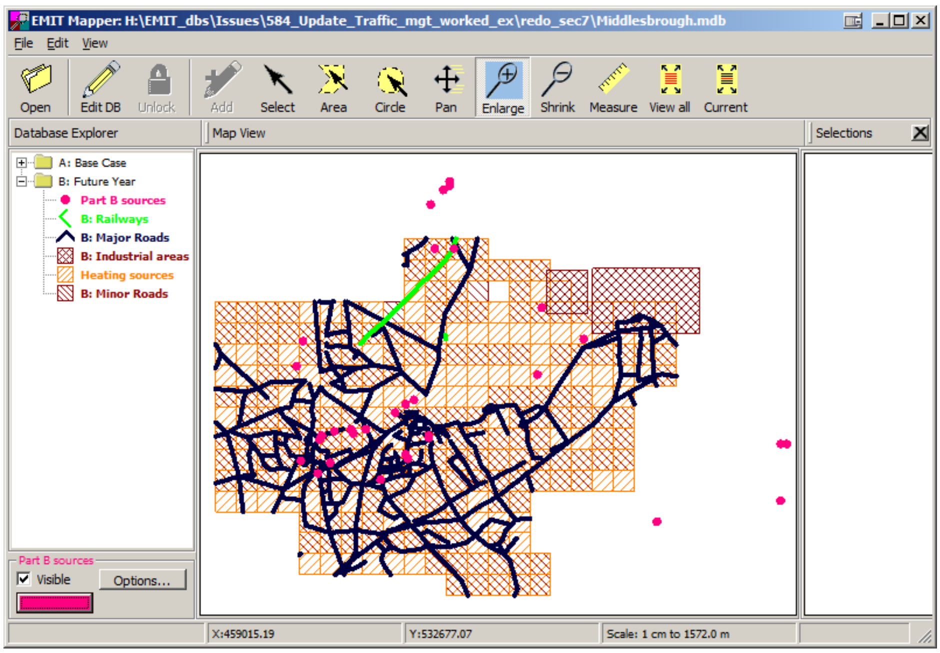


Figure 7.10 – The **Map View** window showing all sources from all groups in the B: Future Year inventory.

Step 7 The following instructions will help to make users familiar with some of the viewing tools available on the EMIT Mapper toolbar.

- Use the  button to zoom in on the central area of the map, and then click on the  button to again view all sources.

- Make the ‘B: Industrial Area’ group active and use the  button to zoom in on the sources in this group.
- Use the measuring tool  to find the total distance in the East-West and North-South directions that the ‘B: Industrial Area’ covers; distances are shown in metres in the bottom left hand corner of the **Database Explorer** window, as shown in **Figure 7.11**.

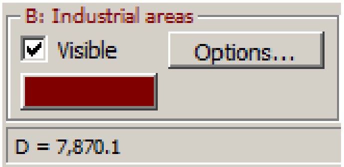


Figure 7.11 – The results of the measuring tool

Step 8 Consider the road sources in the ‘B: Major roads’ group. In order to concentrate on this group, it is a good idea to ‘hide’ all the other sources. This can be done by un-checking the **Visible** box for the five other groups.

It is sometimes useful to view sources shaded by emission. For instance this can highlight errors in compiling or entering emissions data. After making the ‘B: Major road’ sources active, click on the **Options...** button in the bottom of the **Database Explorer** screen (as shown in **Figure 7.3**). Then:

- In the **Pollutant** section, choose PM10 as the pollutant.
- In the **Options** section, tick the **Shade by emissions** check box.
- In the **Shading colours** section, select green as the minimum colour, and blue as the maximum colour, and choose 12 shades.
- Click on **OK**.

The **Map View** window should now look as in **Figure 7.12** below.

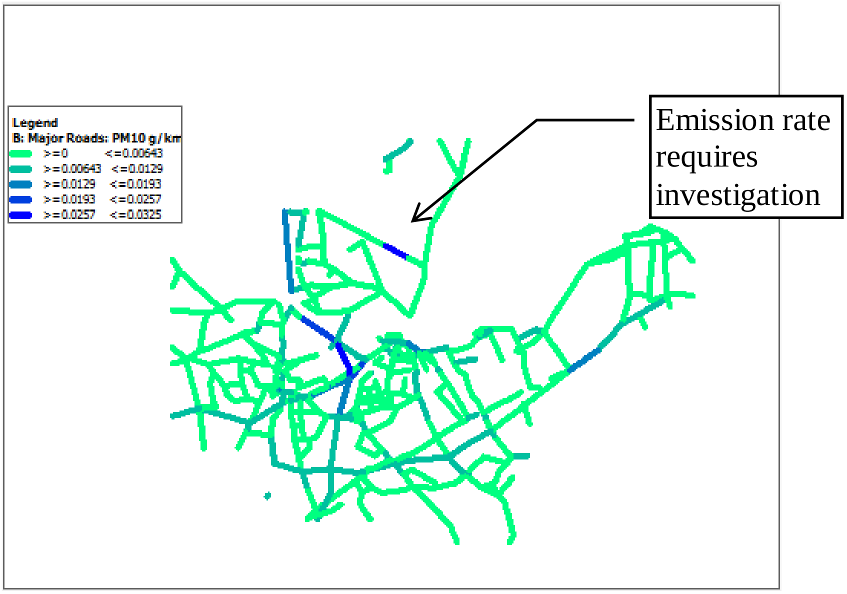


Figure 7.12 – Major roads scaled by PM_{10} emissions showing an irregularity.

Step 9 In this view, roads with higher emissions are indicated in blue. Zooming in on the central area, it is easy to see some roads with relatively high traffic flows. This is to be expected. However, towards the top of the view, there is one segment of road coloured in blue indicating high emissions, with the roads either side of it coloured bright green indicating low emissions. This seems unreasonably high, as one would generally expect traffic flows, and consequently emissions, to vary gradually down a road, in the absence of some particular local circumstance.

In order to investigate this:

- Zoom in on this area and select this source using the Select tool.
- Record the source name (C1_road67) and also record the names of the sources either side of this segment (C1_road65 and C1_road69).
- Open the Middlesbrough database in the EMIT interface. Note that it is possible to launch the EMIT interface since the **Edit DB** button is not on, so the database is not being edited with the Mapper.
- Locate the three sources and look at the **Number of vehicles/day** travelling down each segment (on the **Traffic** tab of the EMIT source screen). In particular, compare the number of **Heavy vehicles** on each segment. Note that there are 144 heavy vehicles/day on road segments C1_road65 and C1_road69, whereas there are 14400 heavy vehicles/day on road segment C1_road67. This is likely to be a typographical error, and should be checked. For this example let's suppose we have checked the data and found it to be incorrect. Correct the value to 144.

Step 10 After correcting the error in the EMIT database, recalculate the emissions for the whole 'B: Future Year' inventory using the **Calculate** button on the EMIT **Inventory** screen. Select **Refresh Map** from the **View** menu of the EMIT Mapper. The emissions on this road will now be more plausible i.e. the blue segment of the road turns green.

Step 11 In the final three steps, we will rearrange the Map View slightly, and then export the map as a bitmap file so that it can be included in a document.

First, use the 

button to make the major roads fill the whole of the **Map View**. The legend should then be moved from the left hand side of the screen down to the bottom right hand corner of the screen, by 'clicking and dragging'. By right clicking on the legend, and selecting **Change legend font...**, change the legend font from 8pt Tahoma to 10pt Times New Roman; click on **OK**. This action has caused the legend to be 'too big for its box', so the legend now needs to be resized. This is done by again right clicking on the legend, and this time selecting the **Resize legend box** command. The cursor can now be used to drag the sides or corners of the legend box – do this so that all the information included in the legend can be seen. Finally, right click again on the legend to deactivate the legend resizing option (by selecting **Stop resizing legend box**).

Step 12 From the **View** menu, select **Show North Arrow** – this command creates a north arrow box in the top left hand corner of the screen. Click and drag the north arrow down to the right hand side of the screen so that it is displayed just above the legend.

The **Map View** is now ready to be exported to a file.

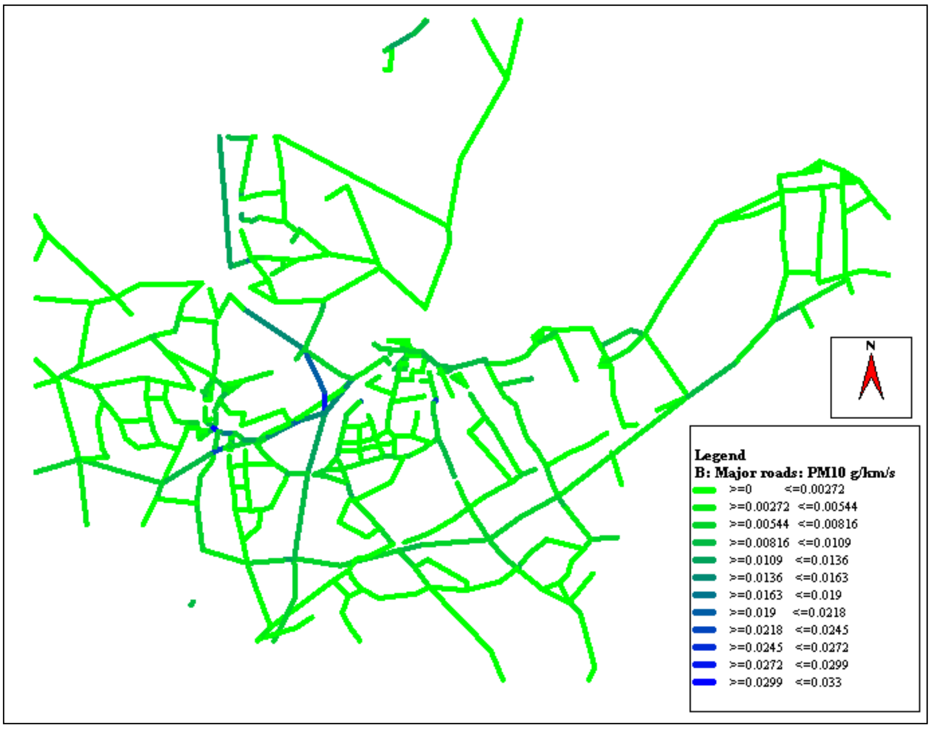


Figure 7.13 – Major roads scaled by PM_{10} emissions in g/km/s

Step 13 From the **View** menu, select **Save Map View**. Save the map as MajorRoadEmissions.bmp in a suitable location on your computer. Then open Microsoft Word (or the corresponding word processing package on your computer) and import the saved file into a new document. You should find that your picture looks something like **Figure 7.13**.

Although this is a simple example, it demonstrates how errors or strange trends in emissions inventories can be found using the EMIT Mapper to display sources shaded by emission. It is often useful to do this for industrial sources where mistakes may have been made in converting emissions units.

7.3 Manipulating data using the EMIT Mapper

This section demonstrates the data manipulation functions of the EMIT Mapper. When the Mapper is running in 'edit mode', i.e. the **Edit DB** button is on and the Mapper is being used to edit the EMIT database directly, the EMIT interface must be closed.

Section 7.3.1 gives a worked example, which takes the user through some of the data manipulation tools available, such as adding and deleting sources, and demonstrates how the location of a road source held in the database can be changed. Users can follow this example by using the *Neath.mdb* database and the Ordnance Survey image file *Ss79r.bmp*. Both are installed in the folder *Examples\Mapper* under the installation directory.

7.3.1 Example: Using the EMIT Mapper editing tools, adding sources, deleting sources, and changing the location of a road

Step 1 Start the EMIT Mapper, and open the *Neath.mdb* database. Click on the 'Part A sources' and the 'Major road' sources so that they are visible in the **Map View** window.

Step 2 Go to the **File** menu and select the **Load Image** option. Browse to locate the Ordnance survey tile, *Ss79r.bmp*. The image location is entered via the dialogue box shown in **Figure 7.14**. The coordinates of the south west corner of this tile are (271000,194000), and the dimensions are 5km by 5km. Clicking **OK** loads this tile to the view. This may take a few seconds.

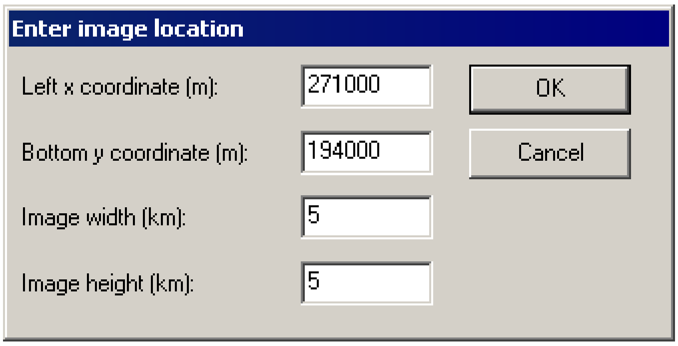


Figure 7.14 – **Enter image location** dialogue box with the coordinates and dimensions of the Neath Ordnance Survey tile, *Ss79r.bmp*.

After zooming in slightly on the map area, the **Map View** window should now look like that shown in **Figure 7.15**.

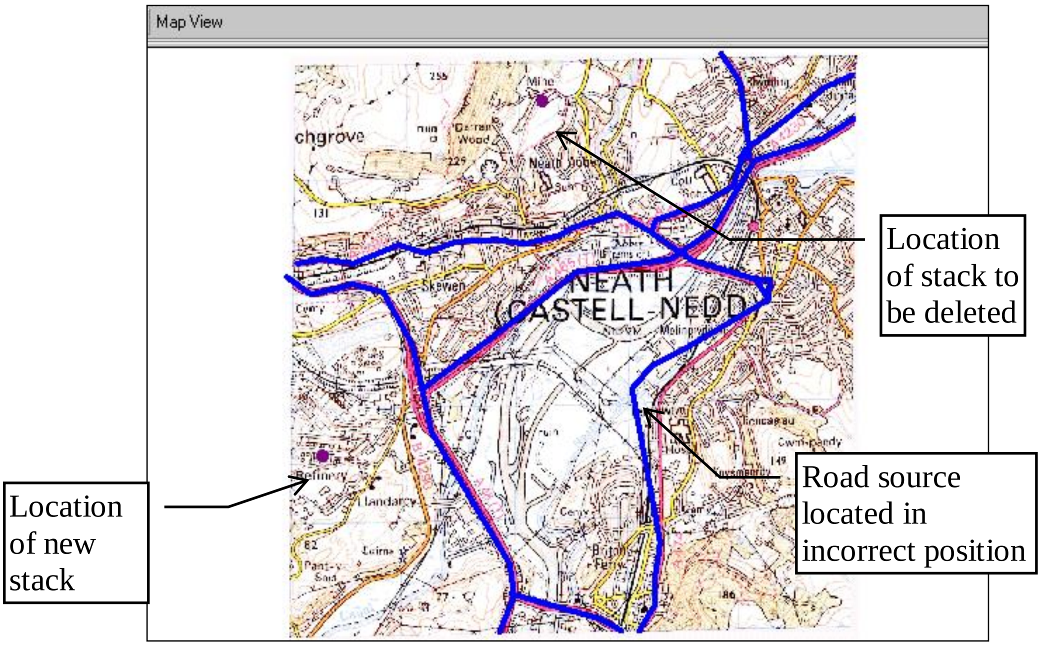


Figure 7.15 – Road and industrial sources displayed in the **Map View** window.

Step 3 A new stack has been built in the region to the west of the A48(T) road, so the EMIT database must be updated accordingly:

- First, make the Part A sources group active and zoom in on the ‘Refinery’ source in this group (using the  button).
- Click on the  button to enable the  and  editing buttons.
- Click on the  button and then click in the **Map View** window at the location of the new stack indicated by the arrow in **Figure 7.15**. This is at approximately (271380,195947), the location being displayed in the status bar at the bottom of the EMIT Mapper screen. After a short delay, the EMIT source data screen will be displayed. Fill in the source details, for example, call the source ‘Boiler stack’, with an emission rate of 1g/s of CO_2, and fill in the date in the Notes field. Close the EMIT source screen.

The new source has now been added to the EMIT database. All other source types (major road, minor road, rail, area, line, volume and CandD sources) can be added in the same way.

Step 4 Imagine that an industrial source, say, ‘Mining works’ is not operating this year and we want to remove it from the inventory for the year:

- Still in edit mode, zoom in on the ‘Mining works’ stack. Double click on the source with the  tool active to bring up the EMIT source screen in order to check that the correct source has been selected. It is important to do this as sources are deleted permanently from the database. Close the EMIT source screen.
- With the source still selected and the source name listed in the

Selections window, choose the **Delete** option from the **Edit** menu. A dialogue box confirming that the source is to be deleted will appear, and clicking on **Yes** will delete the source.

This source has now been deleted from the EMIT database.

Step 5 The geometry of the A474 road to the east of the view has not been entered correctly (see **Figure 7.15**). The EMIT Mapper can be used to edit the vertices of this road:

- Still in edit mode, make the 'Major roads' source group active and zoom in on the A474 road. Click on the 

button to allow editing of source geometry.
- Using the 

tool, single click on the road source. With the **Unlock** tool active (down), the **Select** tool not only highlights the source in red, and lists the source name in the **Selections** window, but also indicates each vertex of the selected source by a red box. This is shown in **Figure 7.16**.
- **Select** one of the three vertices of the road that is not in the correct position by clicking once on the corner of the red box containing the chosen vertex. This highlights the selected vertex in blue (as shown in **Figure 7.16**). Drag the vertex to the road location as indicated by the map. Repeat this exercise for the other two points.
- Choose the **Refresh Map** option from the **View** menu, and click on **View All** to see the result of the vertex editing.

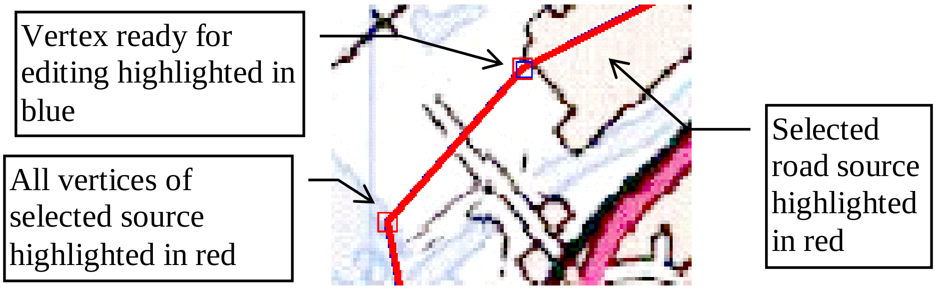


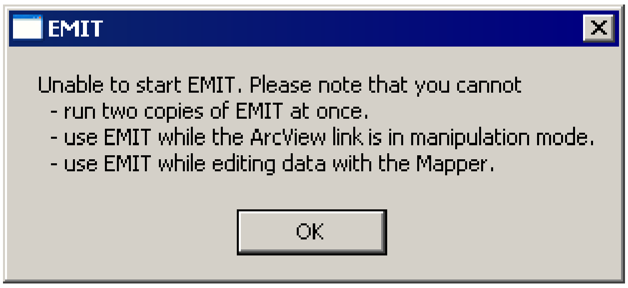
Figure 7.16 – A road source ready for editing

This road source is now in the correct position. The same steps should be followed to alter the geometry of rail and area sources or to move any type of source.

7.4 Troubleshooting

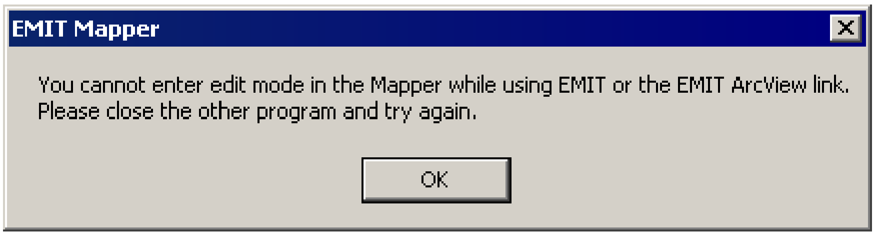
This section lists some warning messages that may be displayed / problems that may be encountered whilst using the EMIT Mapper. Explanations for the messages and solutions to the problems are given.

Question 1 When I try to open the EMIT interface, the following error message appears:



Solution 1 It is not possible to open the EMIT interface when the **Edit DB** button in the EMIT Mapper is down (depressed). Click the button to turn **Edit DB** off before trying to restart the EMIT interface.

Question 2 When I try to manipulate data by clicking the **Edit DB** button, the following error message appears:



Solution 2 It is not possible to use the EMIT Mapper's data manipulation tools while the EMIT interface is running. Close the EMIT interface before trying again to use the EMIT Mapper's manipulation tools.

Question 3 My new source isn't being displayed in the Map View window when I have scaled my sources by emission.

Solution 3 Only sources with calculated emissions will be displayed when sources are shown shaded by emissions. That is, if a new source has been added to the EMIT database (either directly into the interface, graphically via the EMIT Mapper or imported using the EMIT Import Wizard) then it will not be displayed unless its emissions have been calculated using the **Calculate** button in the EMIT interface on the **EMIT Inventory** screen (for the whole inventory) or on one of the EMIT source screens (for each source). Alternatively, the source may have no emissions of the chosen pollutant.

Question 4 When I load an image file, it does not load correctly - the background is just one or two large blocks of colour.

Solution 4 You need to check that you have entered the coordinates of the image file correctly. First, exit the EMIT Mapper, then restart the Mapper and re-open the database of interest. Then, reload the image making sure that the bottom left hand coordinates are entered in m, and the image width and height are entered in km. Also, check that the coordinates of your sources in EMIT correspond to the same area as your image file.

Question 5 I want to copy my map into a Word document but when I right click with the mouse in the **Map View**, I don't get the **Copy map to clipboard / Save map to file...** options.

Solution 5 If the **Add** 

, **Area** 

or **Measure** 

tools are being used, the **Copy map to clipboard / Save map to file...** options are not available. This is because in these modes, a right click activates some other function. In order to copy the map to the clipboard, deactivate the appropriate function (for example, by clicking on the **Select** 

button) and then right click on the **Map View** to give the drop down list, as shown in **Figure 7.4**.

Question 6 When I try to load my black and white image into the EMIT Mapper, I get the following error message:

Solution 6 Black and white images cannot be loaded as background images to the **Map View**. First they need to be converted to 'colour' images. This process, often referred to as *increasing the colour depth* of an image, can be performed in many image manipulation packages, for example Paint Shop Pro. In this particular package, you must open the image, and then from the **Colors** menu, choose **Increase Color Depth**, and select either 8bit or 24bit (since the original image was black and white, 8bit colour is adequate).

The new version of the image file will be larger than the original, but it can now be loaded into the EMIT Mapper.

SECTION 8 Output from EMIT

An emissions inventory provides information on emissions for all pollutants for which data are held, for individual sources, combinations of sources, or entire inventories. Both the total emissions for the inventory area and the distribution of emissions across the inventory area are of interest. EMIT calculates emissions totals for all pollutants for which emissions are specified. In EMIT, inventory totals are broken down according to group and onto grid squares. Greenhouse gas (GHG) inventory totals are also given, both in terms of actual emission and in terms of Global Warming Potential (GWP); the GHG totals are further categorised by GHG sector. For further details of GHG inventories, please refer to Section 11. Emission totals can be copied and pasted into other software packages such as Microsoft Excel. The way in which EMIT presents emission totals is described in Section 8.1.

All source parameters and associated emissions can be exported from EMIT as ESRI shape files on a group-by-group basis. This is particularly useful if the data are to be used in other environmental assessments, for example, noise-mapping projects. This export feature is described in Section 8.2.

EMIT also has the facility to export group and inventory emissions data to *.csv* and database format suitable for use with other packages and for importing data into the ADMS-Urban air quality model. This is discussed in Section 8.3.

8.1 Calculation of emission rates

In this section we discuss how EMIT calculates total emissions. The process begins with emission rates for individual sources and then proceeds to the inventory totals by suitable aggregation of the individual source values. This section describes how the sources are aggregated, how NO_X and NO_2 emissions are calculated for use in ADMS-Urban, how to view the emissions data and how to recalculate emissions after changes have been made to the source data.

8.1.1 Individual source emissions

As outlined in Section 3, source emissions held in EMIT are either:

- User defined;
- Calculated by using activity data and a pre-defined emission factor dataset held within the EMIT database; or
- Calculated by the scaling of a national emissions value by a local statistic.

Different groups are set up to hold the different source types. Further details are given in earlier sections of this user guide (see, for example, Section 5). On all source screens, an **Emissions** tab displays the emissions for that source. In addition, for sources whose emissions have been calculated by EMIT (i.e. not user defined), there is a **Recalculate** button on the source screen; this button can be used to recalculate the emissions for that source if any of the source parameters have been changed.

8.1.2 Inventory totals

Inventory total emissions are calculated for each grid cell included in the inventory coverage area, which may include some, all or none of the inventory sources. The user enters the inventory coverage area on the **Inventory Properties** screen (**Figure 8.1**), which is opened by selecting the **Inventory Properties...** button on the inventory screen.

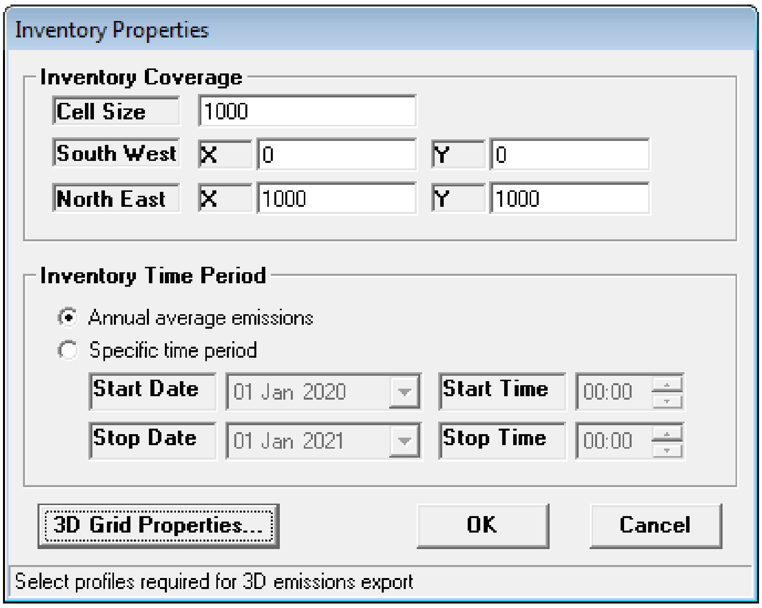


Figure 8.1 – The Inventory Properties screen.

The **Cell Size** must be entered to the nearest metre and the **X** and **Y** coordinates of the **South West** and **North East** corners of the inventory area must be entered in metres to the nearest 1000m. Note that if the difference between the maximum coordinate and the minimum coordinate is an exact whole multiple of the cell size, the calculated inventory totals grid cells will extend past the maximum coordinate by an entire row or column. For example, with the coverage area shown in **Figure 8.1**, the inventory totals grid cells will extend to 2000 in x and y.

The user has the choice of calculating the emissions as an annual average or for a specific time period, with the default being as an annual average. If the user selects the **Specific time period** option, they can then enter a date and time range over which to calculate the emissions. When a time period has been specified the value in tonnes will be calculated from the tonnes/year value by multiplying by the number of hours in the period and dividing by the number of hours in a year. The number of hours in the period will be calculated accounting for leap years. However, the divisor will be fixed at 8760. As an example, suppose an inventory had total PM_{10} emissions of 1000 tonnes/year with no time period specified. If a time period 1 Jan 2009 to 1 Jan 2010 was specified, the total PM_{10} would be shown as 1000 tonnes. If a time period 1 Jan 2008 to 1 Jan 2009 was specified, the total PM_{10} would be shown as 1002.7 tonnes. In this case leave the default option of Annual average emissions.

When creating 3D grid data for CMAQ[1], the output files will only be generated for the time period specified in this section. It is assumed in this User Guide that users of CMAQ are familiar with the model and the required format of the model's input files.

[1] https://www.epa.gov/cmaq

If you are creating 3D grid data for either ADMS-Urban or CMAQ you will need to complete the **3D Grid Properties...** data accessed from the **Inventory Properties** screen.

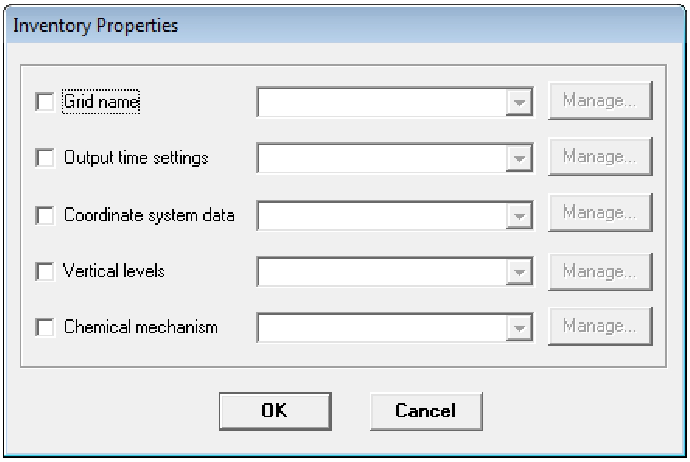


Figure 8.2 – The **3D Inventory Properties** screen.

Firstly, you will need to give the 3D grid a name. This is created by ticking the box beside **Grid name**, then selecting **Manage...** In the **Grid name definition** screen select **Add** and give your grid a definition name. Then select the icon beside Edit. Enter the **Grid name** in the **Grid name editor**, select OK to return to the **Grid name definition** screen.

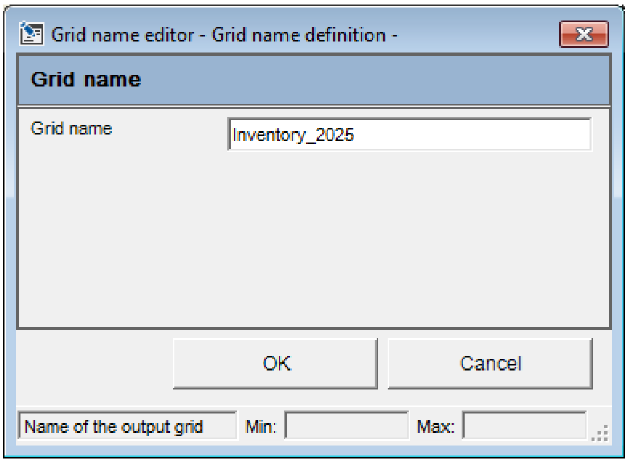


Figure 8.3 – The **Grid name editor** screen.

Next, define your Output time settings. This is done by ticking the box beside **Output time settings**, then selecting **Manage...** In the **Output time definition** screen select **Add** and give your time settings a name. Then select the icon beside Edit. In the **Time settings editor**, you can use the settings to output a set of files each with a set number of hours in. Enter the number of hours per output file, the time difference between output time and local time (for example CMAQ requires GMT time), and the number of hours of overlap between output files. The overlap is not relevant to ADMS-Urban modelling, but CMAQ often uses an overlap. Select OK to return to the **Grid name definition** screen.

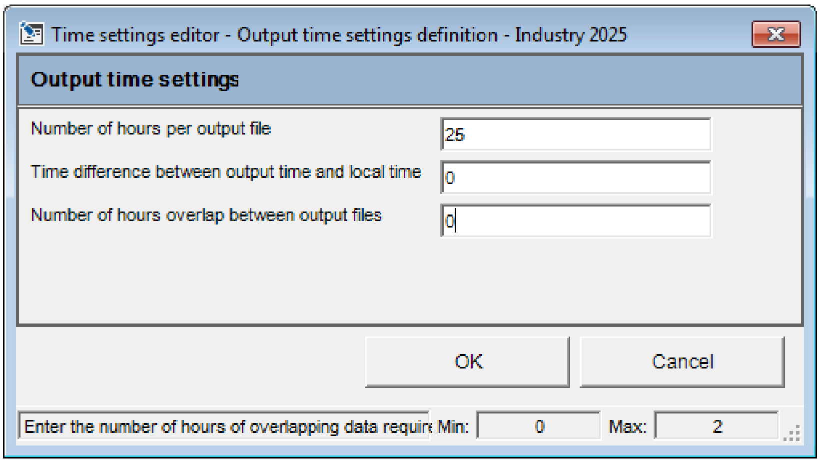


Figure 8.4 – The **Time settings editor** screen.

Click **OK** to leave the **Time settings editor**, and select the time settings to use from the drop down list in the 3D **Inventory Properties** screen.

Next enter the coordinate system definition for your inventory by ticking the box beside **Coordinate system data**, and selecting **Manage...** at the end of the row. In the **Coordinate system data definition** screen select **Add** and give your coordinate system a name. Then select the icon beside Edit. In the **Coordinate Conversion Definition Editor**. You need to enter the full details of the coordinate system you will be modelling in.

In the **Spheroid datum information** section three choices are available, a pre-defined sphere datum, a pre-defined spheroidal datum, or you can define your own datum.

A sphere is based on a circle, while a spheroid (or ellipsoid) is based on an ellipse. A spheroid, or ellipsoid, is a sphere flattened at the poles. The shape of an ellipse is defined by two radii. The longer radius is called the semimajor axis, and the shorter radius is called the semiminor axis.

The pre-defined datum **Sphere (CMAQ/EMEP)** matches that used in the mesoscale meteorological model WRF, so is often used in CMAQ. The alternative pre-defined datum is the **WGS84 spheroid**.

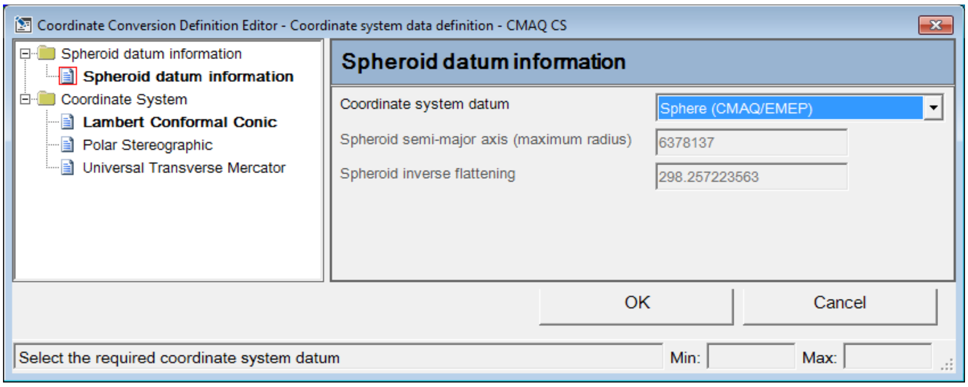


Figure 8.5 – The **Coordinate Conversion Definition Editor** screen.

You then need to define the projection for your coordinate system. The available options are the Lambert Conformal Conic, the Polar Stereographic and the Universal Transverse Mercator projections. Choose the correct projection and fill in the relevant details. **Figure 8.6** shows an example of a projection definition used for a CMAQ 3D grid project.

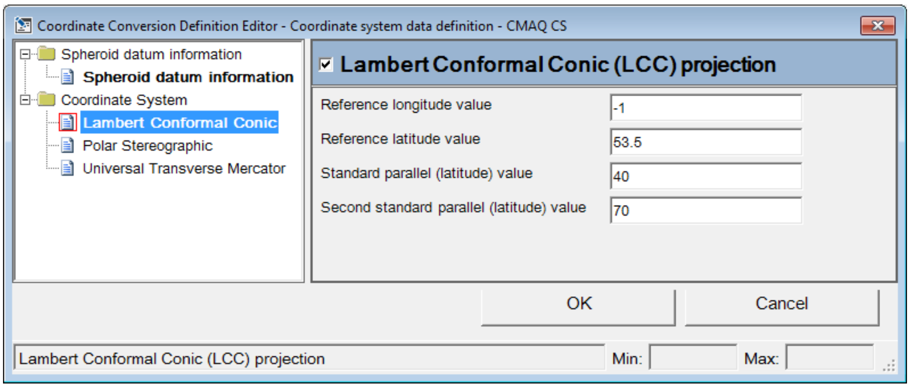


Figure 8.6 – The **Lambert Conformal Conic projection** screen.

Once you are happy with your coordinate system definition, click **OK** return to the **Inventory Properties** screen and select your newly defined coordinate system definition from the drop down list.

The next set of properties you need to define for the 3D grid are the vertical levels. In the **Inventory Properties** screen tick the box beside **Vertical levels**, and select **Manage...** at the end of the row to open up the **Vertical levels definition** screen. Select **Add**, then enter a name for the profile you are about to create and click the edit icon to open the **Vertical layer heights** editor. It is possible to define your vertical levels as a set of sigma values, for use in CMAQ, or you can enter height values in metres for use in ADMS-Urban. The number of vertical layers you enter should include one more value than the number of layers defined for each group in the inventory.

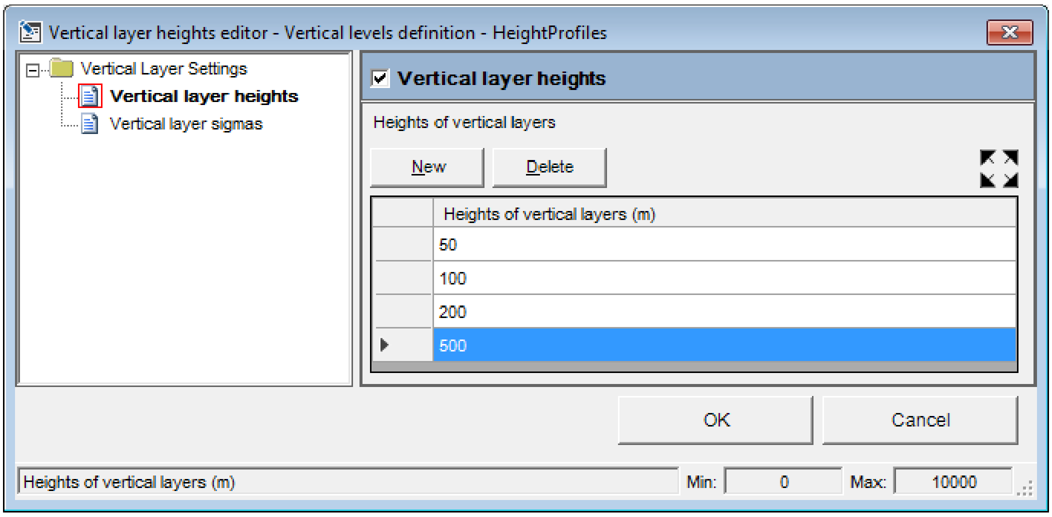


Figure 8.7 – The **Vertical layer heights editor** screen showing entered heights of vertical layers.

The heights you enter are the values at the boundaries of each layer, so in the example shown in **Figure 8.7** the first layer will be between 50 and 100 m, the second 100 to 200 m etc.

If you are using CMAQ, you can enter vertical layer sigma values, with 0 representing the top of the region and 1 representing ground level. You also need to enter the atmospheric pressure at the top of the model (i.e. when the sigma value is 0).

Once you have entered your vertical layer settings, press **OK** to return to the **Vertical levels definition** screen and return to the **Inventory Properties** screen by selecting **OK** again. Choose the vertical levels settings to use from the drop down list.

The final set of properties to enter for the emissions inventory defines the output pollutants and their units. This is known as the chemical mechanism. From the **Inventory Properties** screen, tick the box beside **Chemical mechanism** and select **Manage...** at the end of the row to enter the **Chemical mechanism definition** screen. Select **Add**, enter a name for your settings, then press the edit icon to enter the **Chemical mechanism editor**. The pollutants in this editor need to cover all the output pollutants you define for each of the individual groups contained in the inventory. Typically, CMAQ output will require gaseous pollutants in moles/sec and particulate emissions in g/s. 3D output grids for ADMS-Urban should be in g/s for all pollutants.

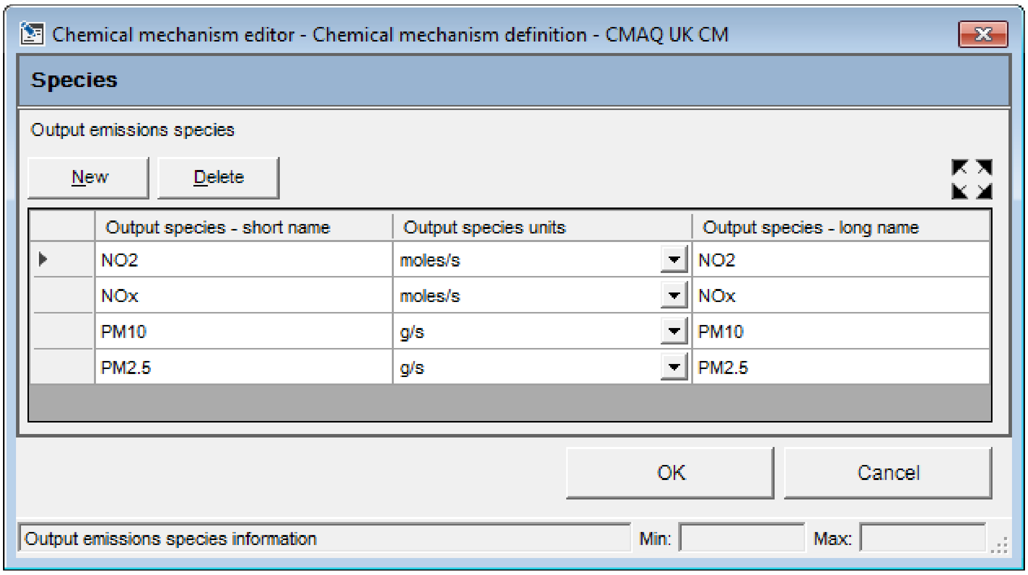


Figure 8.8 – The **Chemical mechanism editor** screen

Once you have entered your definitions, press **OK** to return to the **Chemical mechanism definition** screen, and return to the **Inventory Properties** screen by selecting **OK** again. Choose the chemical mechanism to use from the drop down list.

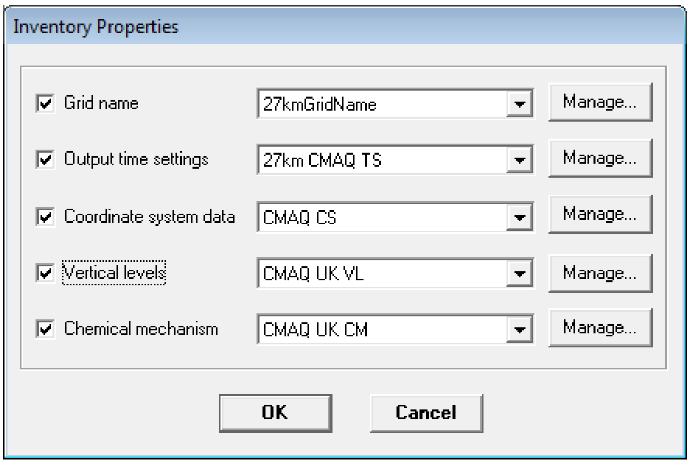


Figure 8.9 – The **Chemical mechanism editor** screen

Once you have completed the 3D properties for your inventory, return to the **Inventory**

Properties screen by clicking **OK**. Press **OK** again to close the **Inventory Properties** screen.

Click **Calculate** on the inventory screen to calculate the total emissions. EMIT will recalculate the emissions from all sources contained in the inventory, taking account of changes to source parameters, in order to calculate the inventory totals.

In general, there will be a mixture of different source types within any given grid square, and some sources may extend across more than one grid square. The procedure for allocating the emissions from a source to the grid square or squares within which it is located is described in **Table 8.1**.

Source type	Source location	Treatment
Major road/Rail/Line	Source contained entirely within one grid square	Emissions allocated to the containing grid square
	Source crosses more than one grid square	Emissions are divided between grid squares crossed in proportion to the length of the source lying within each grid square
	Source lies on the edge of a grid square	All emissions are allocated to the most northern and eastern grid square
Point	Point source inside grid square	Emissions allocated to the containing grid square
	Point source lies on the edge of a grid square	All emissions are allocated to the most northern and eastern grid square
	Point source lies on the vertex of a grid square	All emissions are allocated to the north-eastern grid square
Area/Volume/ Minor roads/ CandD	Source contained entirely within one grid square	Emissions allocated to the containing grid square
	Source covers more than one grid square	Emissions are divided between grid squares covered in proportion to the area of the source lying within each grid square

Table 8.1 – Treatment of source types in grid totals calculation.

8.1.3 Calculation of NO_x and NO_2 emissions

The **Aggregate for export to ADMS-Urban** box on the **Inventory** screen must be checked if users want to export NO_X and NO_2 emission data to ADMS-Urban. This is necessary because the chemistry option in ADMS-Urban requires the emissions of both NO_X and NO_2, and if one is not present, an estimate is made. The **Aggregate for export to ADMS-Urban** option ensures that EMIT makes compatible estimates of NO_X and NO_2 emission rates before exporting emission values. The EMIT export process insists that NO_X and NO_2 are exported together; if the selection box for one is checked, the other is automatically checked.

When the **Aggregate for export to ADMS-Urban** box is checked the following assumptions are made:

i. if NO_2 emissions are specified for a source but no emissions of NO_X are specified, the NO_X emissions are taken to be 100% NO_2, i.e. the emissions totals will include a mass emission of NO_X equal to the source's mass emission of NO_2.

ii. if NO_X emissions are specified but no emissions of NO_2 are specified, the NO_X emissions will be treated as "NO_X as NO_2". The percentage by volume of the NO_X emission assumed to be NO_2 is dependent on the source type, with the default percentages summarised in **Table 8.2**. Details of how to change these default values are given below.

It is important to use an appropriate percentage of NO_x that is NO_2 in the emissions calculations, particularly for road sources. The percentage is year dependent, and may vary with different emissions scenarios.

---

iii. if both NO_2 and NO_X emissions data are specified for a source, EMIT will simply add the emission rates of NO_X and NO_2 to the inventory totals of NO_X and NO_2 respectively. The NO_X is treated as "NO_X as NO_2" (no adjustment is made).

Source type	Default percentage (by volume) of NO_x that is NO_2 assumed in the absence of explicitly defined NO_2 emissions
Major roads/Minor roads	17.1
Point/Area/Line/Volume/CandD/Rail	5.0

Table 8.2 – Default percentage (by volume) of NO_x that is NO_2 assumed in the absence of explicitly defined NO_2 emissions for the different source types in EMIT.

If both NO_2 and NO_X emissions data are available for a source, it is recommended that both are explicitly entered into EMIT i.e. case (iii). In practice, situation (iii) is likely to be most common for traffic sources, since the emission factors include NO_X and NO_2.

If the **Aggregate for export to ADMS-Urban** box is not checked EMIT will add the mass emission rates of NO_X and NO_2 that have been specified or imported by the user to the inventory totals of NO_X and NO_2 respectively. *No assumptions* will be made about the proportion of NO_X that is NO_2 for sources that contain NO_X only. Similarly, if a source only emits NO_2 no value for the emission of NO_X will be assumed.

Changing the default percentage of NO_x that is NO_2

If NO_X emissions are specified but no emissions of NO_2 are supplied, the percentage by volume of the NO_X emission assumed to be NO_2 is dependent on the source type, with the default percentages being given in **Table 8.2**. These defaults can be changed by editing the *EMITLocal.INI* file, which is located in the EMIT installation directory. An example *EMITLocal.INI* file is shown below.

```
[UserInterface]
UserGuide=C:\CERC\EMIT\Documents\EMIT User Guide.pdf
[fNO2]
AREA=5
CANDD=5
```

```
LINE=5
MINORRD=17.1
POINT=5
RAIL=5
ROAD=17.1
VOLUME=5
```

The percentage of NO_x that is NO_2 can be changed for each source type by editing the number located after the equals sign in the `[fNO2]` section of the *EMITLocal.INI* file. The file should then be saved in its current location i.e. the EMIT installation directory.

Care should be exercised when editing the *EMITLocal.INI* file. Users are advised not to edit any other parts of the file.

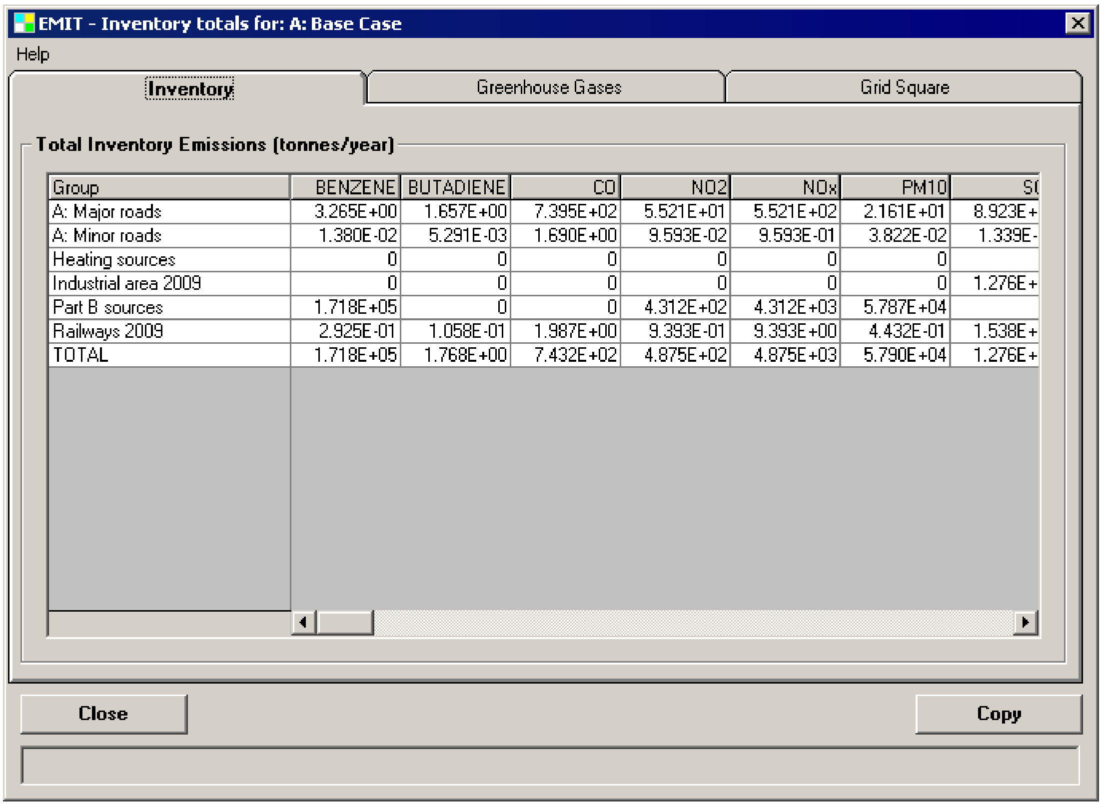
8.1.4 Viewing numerical output

The inventory total emissions are displayed using the **View Totals** button on the **EMIT Inventory** screen. The **Inventory totals** screen has three tabs; these are summarised in **Table 8.3**. On each tab, in addition to an overall value, emission totals are given for each group.

Tab Name	Description
Inventory	All pollutant totals for the entire inventory coverage area
Greenhouse Gases	GHG pollutant totals for the entire inventory coverage area, either in terms of actual pollutant or in terms of Global Warming Potential (GWP). Groups are also categorised by GHG sector.
Grid Square	All pollutant emissions for each grid square within the inventory area

Table 8.3 – Summary of options available on the **Inventory totals** screen

Figure 8.10 shows the **Inventory** tab. This contains a table showing the total emission rate for each pollutant being considered and for each group in the inventory. If the inventory has a specific time period, the total emissions for the time period are shown in tonnes. Otherwise annual average emissions are shown, in tonnes/year. Use the lower scroll bar to view the data for all pollutants.



Group	BENZENE	BUTADIENE	CO	NO2	NOx	PM10	S(
A: Major roads	3.265E+00	1.657E+00	7.395E+02	5.521E+01	5.521E+02	2.161E+01	8.923E+
A: Minor roads	1.380E-02	5.291E-03	1.690E+00	9.593E-02	9.593E-01	3.822E-02	1.339E-
Heating sources	0	0	0	0	0	0	
Industrial area 2009	0	0	0	0	0	0	1.276E+
Part B sources	1.718E+05	0	0	4.312E+02	4.312E+03	5.787E+04	
Railways 2009	2.925E-01	1.058E-01	1.987E+00	9.393E-01	9.393E+00	4.432E-01	1.538E+
TOTAL	1.718E+05	1.768E+00	7.432E+02	4.875E+02	4.875E+03	5.790E+04	1.276E+

Figure 8.10 – **Inventory totals** screen, showing the **Inventory** tab.

Figure 8.11 shows the **Greenhouse Gases** tab. This screen gives a table of the inventory totals for the 6 greenhouse gases (CO_2, methane, N_2O, SF_6, PFC and HFC). If the inventory has a specific time period, the emissions for the period are shown in ktonnes. Otherwise annual average emissions are shown in ktonnes per year. Emission totals are given for each group, and are additionally categorised in terms of their GHG sector. There are two choices for the inventory totals: the **Carbon dioxide as Carbon** button displays the totals for each pollutant as given on the **Inventory** tab, except that the carbon dioxide emissions are given in terms of carbon rather than CO_2, and the **Global Warming Potential** button displays totals in terms of the pollutants' GWP. For further details of how to use EMIT to calculate a GHG emissions inventory, please refer to Section 11.

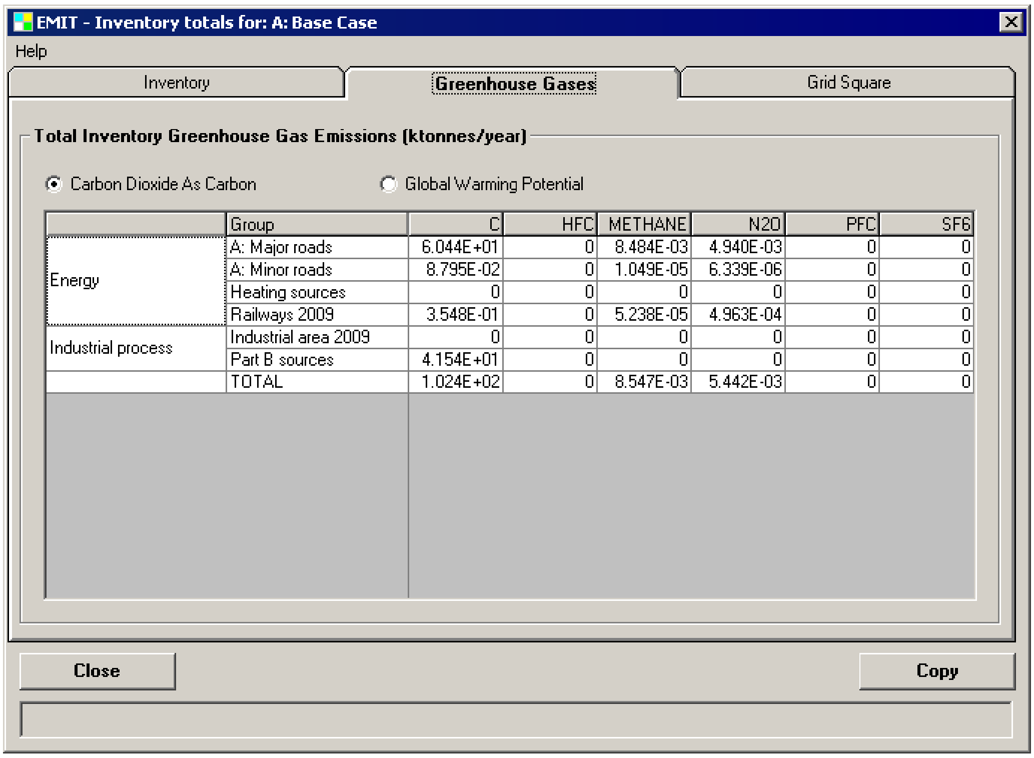


Figure 8.11 – **Inventory totals** screen, showing the **Greenhouse Gases** tab.

Figure 8.12 shows the **Grid Square** tab. This screen displays a table showing the total emission rates for each pollutant and group for a particular grid square. The drop-down list boxes at the top of the tab are used to select the grid square of interest within the inventory coverage area.

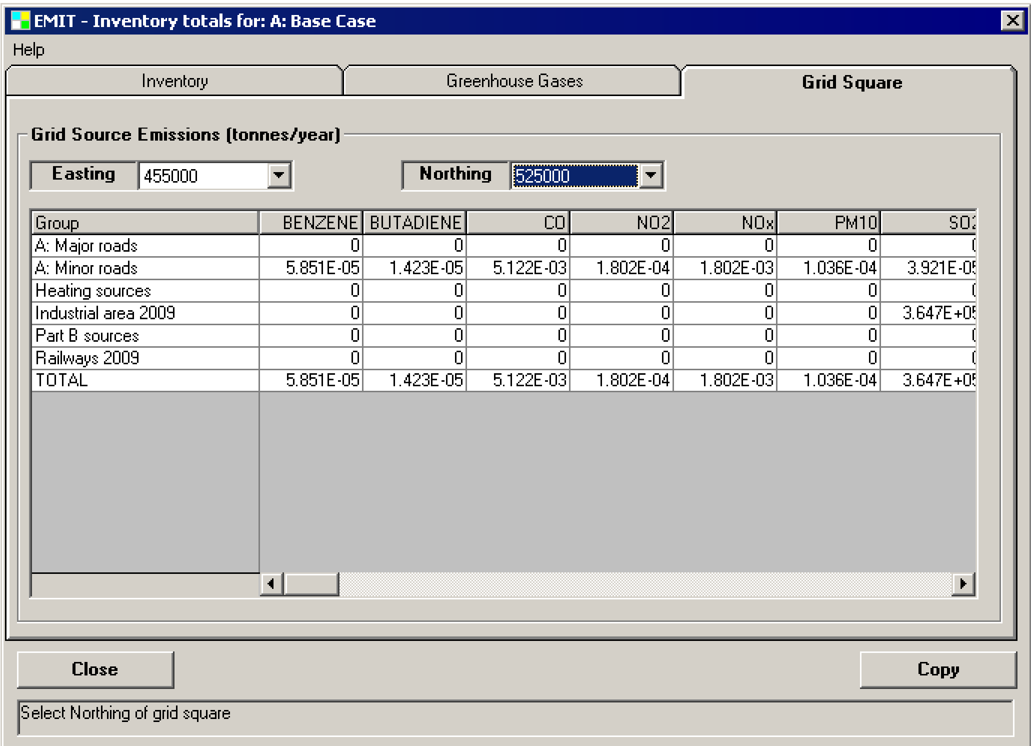


Figure 8.12 – **Inventory totals** screen, showing the **Grid Square** tab.

Copying and Pasting emission totals

The data displayed in each of the 3 inventory screens shown in **Figures 9.2** to **9.4** can be copied and pasted into other packages, such as Microsoft Word or Excel. This is done by clicking on the **Copy** button in the bottom right hand corner of each screen.

8.1.5 Recalculation of emission totals

When source data are changed in EMIT, it is then necessary to recalculate the group and inventory emission totals as well. The EMIT interface contains features that have been included to assist the user in keeping track of changes and when there is a need to recalculate emission rates. All source emission rates are recalculated automatically by EMIT when inventory totals are calculated.

Individual source

For source emissions that are calculated using either activity data or a scaling, you can recalculate the emission rates for the source by clicking **Apply** and then the **Recalculate** button on the **Emissions** tab of the **Source** screen. You may wish to do this to see the immediate effect of changes to the data.

Inventory

This is the level at which the totals for the inventory are recalculated using the **Calculate** button on the **Inventory** screen. If data have changed since the last calculation, a message appears on the inventory screen (in the **Inventory Totals** section) stating that the **Inventory totals are out of date**. The date and time of the previous calculation are shown in the **Last recalculated on** box.

There is also information in the **Groups** table of the **Inventory** screen. The **Changed** column will display a **Y** if the data have been changed since last recalculation. The **Recalc** column is not used.

If the user changes the inventory time period, they will not need to rerun the inventory calculation. The totals to be shown on the totals screen can be calculated from the values stored in the database. If the user changes the inventory coverage or cell size, they will need to rerun the inventory calculation.

8.2 Exporting emissions to ESRI shape files

The source parameters and emissions data stored in EMIT can be exported to ESRI shape files. This is done on a group-by-group basis by clicking on the **Export Group...** button on the **Inventory** screen. When this is done, the list shown in **Figure 8.13** is displayed, and the third option, **To Shape File...**, should be chosen.

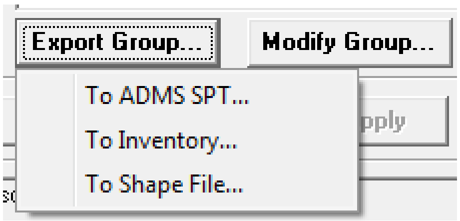


Figure 8.13 – The options listed when clicking on the **Export Group...** button in the **Inventory** screen.

Note that the **To ADMS SPT...** and **To Inventory...** options are only enabled for Major road, Point, Area, Line and Volume source groups (refer to Section 8.3 below).

The user is then prompted to browse to a location where the shape file is to be saved, and to give a name to the file. The newly created shape file can then be used either to display source parameters or emissions in ArcGIS or MapInfo, or it can be imported into another software package, such as a noise mapping program; ESRI shape files are a standard format for the transfer of such data.

Which data are exported?

ESRI shape files are made up of a number of files; there are at least three: the *.shp, .shx* and *.dbf* files. The *.shp* and *.shx* files hold the location information, and the *.dbf* file holds the associated source data in tabular form. Note that the *.dbf* file can be opened in Microsoft Excel for reference purposes.

For each source for each ESRI shape file, the data that are exported can be summarised in the following way:

(a) Source location data (for example, the (x,y) coordinates of all the point sources in a group)

These data are exported to the *.shp* and *.shx* files.

(b) Source parameters (for example, the source name, stack height, diameter, CandD source depths, notes, keywords)

These data are exported to the *.dbf* file. Each parameter has a separate field (column) in the file. **Tables 6.1** to **6.10** in the Importing Data into EMIT section of this User Guide summarize the source parameters that are exported for each source type. In addition, for CandD sources, the source depth is exported to a field with heading CDDEPTH.

Note that the road surface and texture depth parameters required for noise mapping projects are also exported.

(c) Activity or statistical data (for example, traffic flows, amount of fuel consumed, number of houses, statistics used for scaling)

If the emissions have been calculated using either activity data (and an emission factor dataset held in the EMIT database), or statistical data (for scaling national emissions figures), then these data are exported to the *.dbf* file. There are four options:

- **Road, rail and minor road activity groups** – the activity data here are the traffic flow data summarised in Table 6.2 and Table 6.3 in SECTION 6. In addition, the **Route Type**, emission factor dataset and year are exported (with field names ROUTETYPE, EMFACTORS and YEAR respectively).
- **Point, area, line, volume and CandD activity groups** – the field names for the activity data for these groups are 8-character references. In order to associate a reference to a particular activity, users must look up the reference in the appropriate emission factor spreadsheet (in the installation directory: C:\Program Files\CERC\EMIT\Data\ActivitySpreadsheets).

  The name of the activity dataset and year are also exported to the file (with field names EMFACTORS and YEAR respectively).
- **Domestic dwelling (SAP 2001) groups** – here the activity data are just the number of dwellings in each source; these data are exported into a column labelled NUMDWELL. The **Region Type**, emission factor dataset name and the group year are also exported (as REGIONTYPE, EMFACTORS and YEAR respectively).
- **Statistical groups** – the activity data here are the statistics that have been used to scale the national emissions figure; the data are exported into a column labelled STAT. In addition, the YEAR is exported as a separate field.

(d) Emissions

The emission data are also exported to the *.dbf* file. The units in which the emissions are exported are as follows:

- Road and rail source groups: g/km/s
- Line source groups: g/m/s
- Point source groups: g/s
- Minor road, area and CandD source groups: g/m^2/s
- Volume source groups: g/m^3/s

In most cases, the column headings are a combination of the pollutant name and the unit, for example CO_G_KM_S and VOC_G_M2_S. However, in cases where the pollutant name / unit combination is too long, the pollutant unit is omitted (for example, Benzene and Butadiene).

8.3 Exporting emissions to ADMS-Urban

EMIT can export emissions data to a database in ADMS-Urban emissions inventory format or to ADMS *.spt* format files, for further processing using other packages, or for import into ADMS-Urban for air quality modelling. Major roads, point, line, volume and area source groups, and inventory totals can be exported from the EMIT database to an ADMS-Urban database or ADMS **.spt* format file using the methods described below.

The ADMS .spt format is different from the EMIT .csv format. Emissions data in the ADMS .spt format cannot be imported into EMIT.

Here is a comparison of the two export formats:

The ADMS *.spt* format can be read in Microsoft Excel or other packages. Advanced users could use Excel or another package to view or edit the emissions data before importing them into ADMS-Urban. Such users should consult the detailed description of the ADMS *.spt* format in Section The ADMS *.spt* File Format8.3.5.

An emissions inventory database is a single file. The ADMS *.spt* format uses multiple files, as described in Section 8.3.5.

It is possible to export multiple EMIT groups to the same emissions inventory database file. By contrast it is not possible to export multiple EMIT groups to the same ADMS *.spt* file.

The emissions inventory database format is supported in ADMS-Urban and ADMS-Roads versions 3.1, 3.2 and 3.4, but it is being phased out in preference to using *.spt* format files.

8.3.1 Exporting Groups To Inventory

Groups of major road, point, line, volume or area sources can be exported. To export minor road or CandD gridded emissions for a single group, create an inventory containing only that single group and export the inventory totals.

To export emissions data for a group, highlight the group to be exported from the list given on the **Inventory** screen and then click **Export Group**. Select **To Inventory...** from the options given (as shown in **Figure 8.13**). The dialogue box shown in **Figure 8.14** is then displayed. Use **Browse** to find the location of an emissions inventory database or create a new one with the **New** button. Select some or all of the pollutants in the group for export using the **All pollutants** and **Select pollutants** radio buttons. If just some of the pollutants are to be exported check the boxes beside the names of the pollutants you wish to export. Because of the special relationship between NO_X and NO_2, these pollutants can only be exported as a pair; if the box beside one is checked the other is automatically also checked. Click on the **Export** button to export the emissions data.

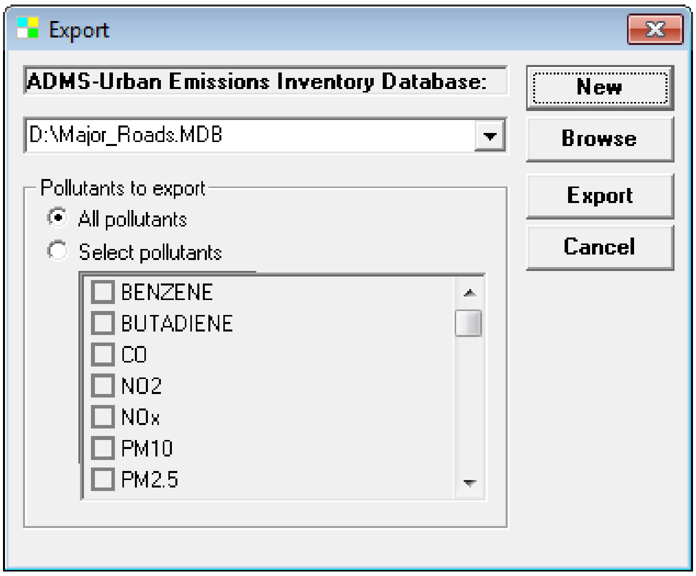


Figure 8.14 – Dialogue box for exporting major road, point or area groups to an Emissions Inventory database.

If one or more of the sources to be exported are already present in the ADMS-Urban inventory database, then the warning message given in **Figure 8.15** will be displayed. Clicking on **OK** exits the export procedure. No sources will have been exported. In order to avoid this warning message, users must rename the sources in the EMIT database, remove the duplicate sources from the ADMS-Urban emissions inventory, or export the sources to a new (empty) database.

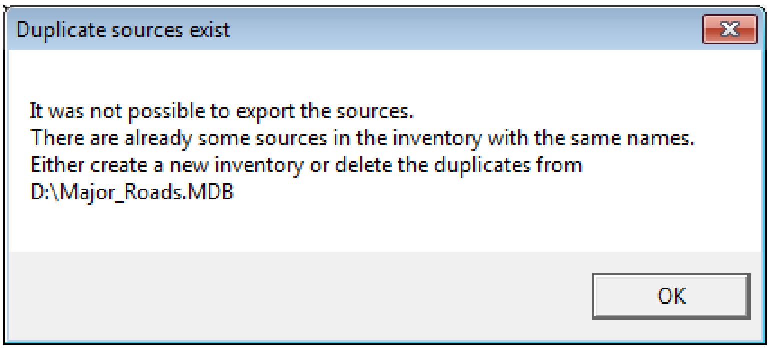


Figure 8.15 – Warning message displayed when one or more sources are already present in the ADMS-Urban emissions inventory.

8.3.2 Exporting Totals To Inventory

Users of ADMS-Urban will probably need to use this option to export the inventory total emissions to be used as a 2D grid source in the air quality model. See the ADMS-Urban User Guide for further details on the use of grid sources.

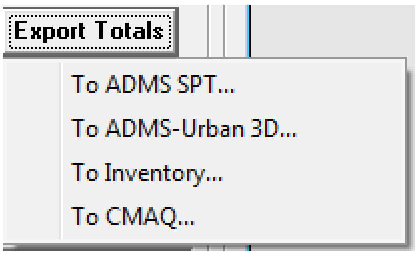


Figure 8.16 – Options available when selecting **Export Totals**

To export the gridded total 2D emissions for an inventory, click the **Export Totals** button on the **Inventory** screen and select **To Inventory...** The procedure is similar to that for exporting groups described in the previous section. After selecting the output format, the dialogue box shown in **Figure 8.17** is displayed. The user locates the existing database or creates a new database and selects some or all of the pollutants for export. NO_X and NO_2 are only available if their totals have been aggregated using the **Aggregate for export to ADMS-Urban** option, see Section 8.1. Because of the special relationship between NO_X and NO_2, these pollutants can only be exported as a pair; if the box beside one is checked the other is automatically also checked. Click on the **Export** button to export the emissions data.

The user must specify a value for the grid depth in the **Grid Depth** text box. If the data are to be used in ADMS-Urban, then the value for this parameter requires a considered choice, and the user is referred to the *ADMS-Urban User Guide*, otherwise its value can be left as the default provided.

Click on the **Export** button and the process is completed with the export of the selected grid totals data to the specified emissions inventory database. If a grid square has zero emission rates for all the exported pollutants, no data for that grid square will be exported.

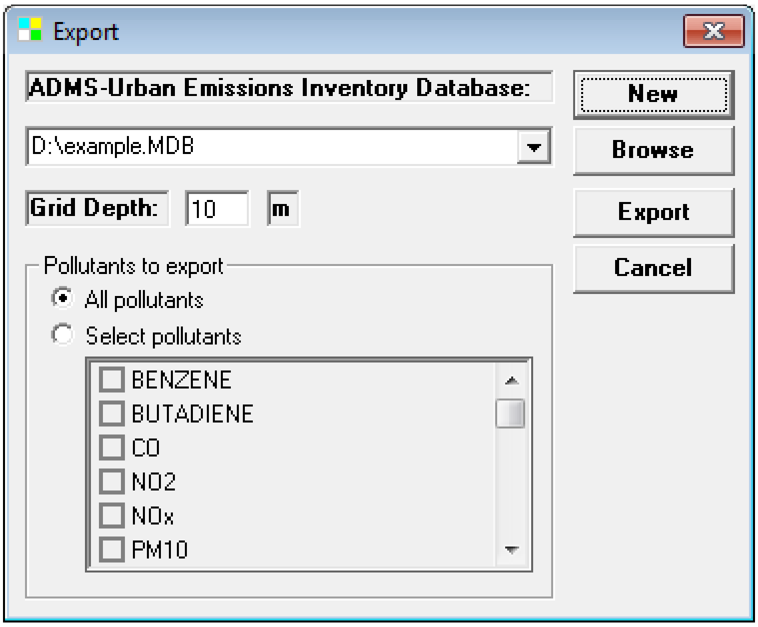


Figure 8.17 – Dialogue box for exporting grid totals to an Emissions Inventory database.

As for the export of groups described in Section 8.3.1, the warning message given in **Figure 8.15** is displayed if one or more grid cells with the same name are already present in the ADMS-Urban emissions inventory.

8.3.3 Exporting Groups To *.spt* Format

Groups of major road, point, line, volume or area sources can be exported. To export minor road or CandD gridded emissions for a single group, create an inventory containing only that single group and export the inventory totals.

To export emissions data for a group, highlight the group to be exported from the list given on the **Inventory** screen and then click **Export Group**. Select **To ADMS SPT…** from the options given. The dialogue box shown in **Figure 8.18** is then displayed. Use **Browse** to choose the location for the *.csv* file.

If you choose the location of an existing .csv file, it will be overwritten and the previous file contents will be discarded.

Select some or all of the pollutants in the group for export using the **All pollutants**, **All pollutants except greenhouse gases**, and **Select pollutants** radio buttons.

If the **All pollutants except greenhouse gases** button is selected, EMIT will not export emissions of greenhouse gas pollutants (CO2, METHANE, N20, HFC, PFC, and SF6). This is usually the best selection when exporting to ADMS-Urban or ADMS-Roads for air quality modelling.

If just some of the pollutants are to be exported check the boxes beside the names of the pollutants you wish to export. Because of the special relationship between NO_X and NO_2, these pollutants can only be exported as a pair; if the box beside one is checked the other is automatically also checked.

Click on the **Export** button to export the emissions data.

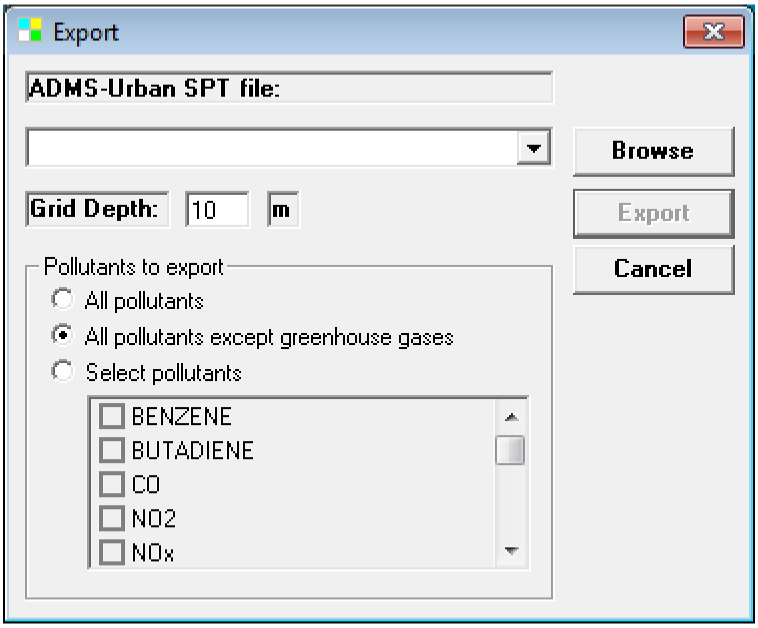


Figure 8.18 - Dialogue box for exporting major road, point or area groups to an ADMS *.spt* file.

8.3.4 Exporting Totals To *.spt* Format

Users of ADMS-Urban will probably need to use this option to export the inventory total emissions to be used as a 2D grid source in the air quality model. Refer to the

ADMS-Urban User Guide for further details on the use of grid sources.

To export the 2D gridded total emissions for an inventory, click the **Export Totals** button on the **Inventory** screen, and select **To ADMS SPT…** from the options given. The procedure is similar to that for exporting groups described in the previous section. After selecting **To ADMS SPT…**, the dialogue box shown in **Figure 8.10** is displayed. The user specifies the location for the *.spt* file and selects some or all of the pollutants for export. NO_x and NO_2 are only available if their totals have been aggregated using the **Aggregate for export to ADMS-Urban** option. Because of the special relationship between NO_X and NO_2, these pollutants can only be exported as a pair; if the box beside one is checked the other is automatically also checked. Click on the **Export** button to export the emissions data.

If you choose the location of an existing .spt file, it will be overwritten and the previous file contents will be discarded.

The user must specify a value for the 2D grid depth in the **Grid Depth** text box. If the data are to be used in ADMS-Urban, then the value for this parameter requires a considered choice, and the user is referred to the ADMS-Urban User Guide, otherwise its value can be left as the default provided.

Click on the **Export** button and the process is completed with the export of the selected grid totals data to the specified *.spt* file. If a grid square has zero emission rates for all the exported pollutants, no data for that grid square will be exported.

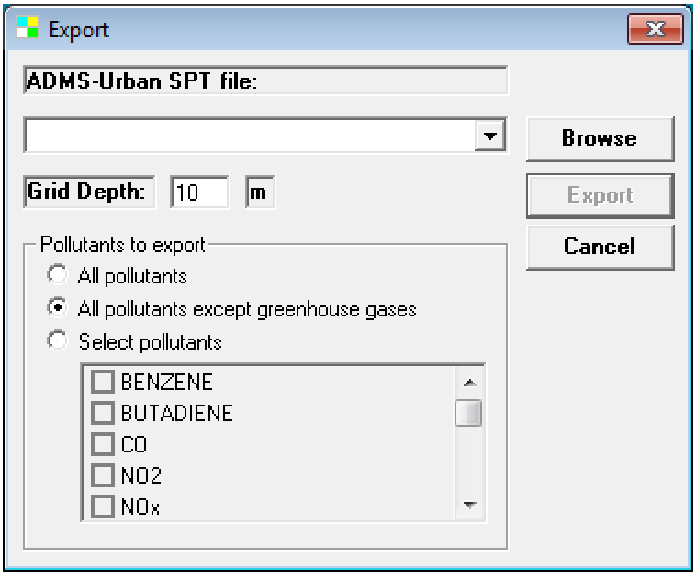


Figure 8.19 - Dialogue box for exporting grid totals to an ADMS *.spt* file.

8.3.5 The ADMS *.spt* File Format

This section describes the ADMS *.spt* file format for advanced users who might want to view or edit the files after they have been exported from EMIT. The file format is also described in the ADMS-Urban and ADMS-Roads User Guides.

EMIT creates a set of three comma-separated files when exporting to ADMS *.spt* format:

- the *.spt* file contains the main properties of the sources including the efflux parameters and the source type.
- the *.eit* file contains the emissions for the sources.
- the *.vgt* file contains the vertex information for any line, area, volume, road or grid sources.

The *.eit* and *.vgt* files must be in the same directory and have the same name as the *.spt* file with which they are being used.

Each of the files contains a version number on the first line. For the *.spt* file the traffic dataset to be used is entered on the next line in the form:

Traffic dataset name, <Traffic dataset name>

There is then a header line followed by the data for each source.

For all other files, after the version number there is a header line followed by the source data. Every data column must be present in the input file, in the correct order. Details of the information required to be entered in the *.spt*, *.eit* and *.vgt* files are given in **Table 8.4**, **Table 8.5** and **Table 8.6** respectively.

Data	Description
`Source description`	Description of the source, for information. This column may be left blank.
`Source name`	Source name.
`Specific heat capacity (J/kg/K)`	Specific heat capacity of the release in Joules per kilogram per Kelvin.
`Molecular mass (g)`	Molecular mass of the release in grams.
`Temperature or density?`	Will the release temperature or density be specified. Enter the keyword `temperature` or `density`.
`Temperature (degrees C) / Density (kg/m3)`	Temperature or density of the release in appropriate units.
`Actual or NTP?`	Is the efflux specified at the temperature or at NTP? Enter the keyword `Actual` or `NTP`.
`Efflux type keyword`	There are 2 options for specifying the efflux. Enter the keyword `velocity` or `volume`.

`Velocity (m/s)`
`Volume flux (m3/s)`
`Momentum flux (m4/s2)`
`Mass flux (kg/s)`
	Efflux in appropriate units.

`Heat release rate (MW)`	This is not used.
`Source Type`	Enter `Point`, `Line`, `Area`, `Volume`, `Road` or `Grid`.
`Height (m)`	Height of the source, in metres.
`Diameter (m)`	Diameter of the source, in metres.
`X (m)`	X coordinate of the source, in metres. Only used for point sources.
`Y (m)`	Y coordinate of the source, in metres. Only used for point sources.

`Line width (m)`
`Road width (m)`
`Volume depth (m)`
`Grid depth (m)`
	Width of a line/road source, or vertical extent of a volume/grid source, in metres.

`Canyon height (m)`	Height of canyon for road sources, in metres.
`Angle 1 (deg)`	This is not used.
`Angle 2 (deg)`	This is not used.
`Mixing ratio (kg/kg)`	This is not used.
`Traffic flows used`	Enter keyword `Yes` or `No` to indicate if traffic flows are used to calculated the emissions. Only used for road sources.
`Traffic flow year`	Year for the traffic flows.
`Traffic flow road type`	Road type for traffic flows.
`Comments`	Further comments may be added here.

Table 8.4 - Data contained in the *.spt* file

Data	Description
`Source name`	Source name.
`Pollutant name`	Pollutant name.
`Emission rate`	Emission rate of the pollutant in g/s for point sources, g/m/s for line sources, g/m^2/s for area sources, g/m^3/s for volume sources, g/km/s for road sources and g/m^2/s for grid sources.

Table 8.5 - Data contained in the *.eit* file

Data	Description
`Source name`	Source name.
`Vertex number`	Sequential number of the vertex for this source.
`X (m)`	X coordinate of the vertex, in metres.
`Y (m)`	Y coordinate of the vertex, in metres.

Table 8.6 - Data contained in the *.vgt* file

8.3.6 The ADMS-Urban 3D File Format

Users of ADMS-Urban will need to use this option to export the inventory total emissions to be used as a 3D grid source in the air quality model. See the ADMS-Urban user guide for more details of modelling with a 3D grid.

The ADMS-Urban 3D files are in NetCDF format (*.nc*); a set of *.nc* files, each of the length specified in the **Output time settings**, will be created covering the time period specified in the **Inventory Properties** screen. To create the output files, select the **To ADMS-Urban 3D...** option from the **Export Totals** dropdown list to start the **3D export** screen.

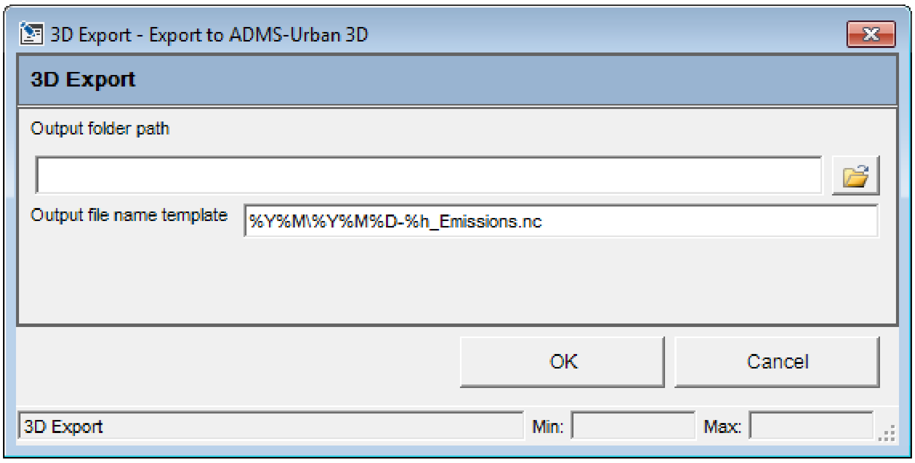


Figure 8.20 - Dialogue box for exporting grid totals to an ADMS-Urban 3D grid file.

Enter the output folder and the file name template for the output *.nc* files you require. This template allows each output file to be named to include the date and time of the start of the time period in the file. This is necessary when creating multiple emissions files that each cover a subset of the total time period. It is possible to specify each part of the date to be updated in the filenames with placeholders for year (%Y), month (%M), day of the month (%D) and hour of the day (%h). Note that these placeholders are case sensitive. Select **OK** to create the output files.

8.3.7 The CMAQ File Format

Users of CMAQ will need to use this option to export the inventory total emissions to be used as a 3D grid source in the air quality model. See the CMAQ user guide for more details.

The CMAQ 3D files are in NetCDF format; a set of *.nc* files, each of the length specified in the **Output time settings**, will be created covering the time period specified in the **Inventory Properties** screen. To create the output files, select the **To CMAQ**... option from the **Export Totals** dropdown list to start the **3D export** screen. Enter the output folder and the file name template for the output *.nc* files you require. This template allows each output file to be named to include the date and time of the start of the time period in the file. This is necessary when creating multiple emissions files that each cover a subset of the total time period. It is possible to specify each part of the date to be updated in the filenames with placeholders for year (%Y), month (%M), day of the month (%D) and hour of the day (%h). Note that these placeholders are case sensitive. Select **OK** to create the output files.

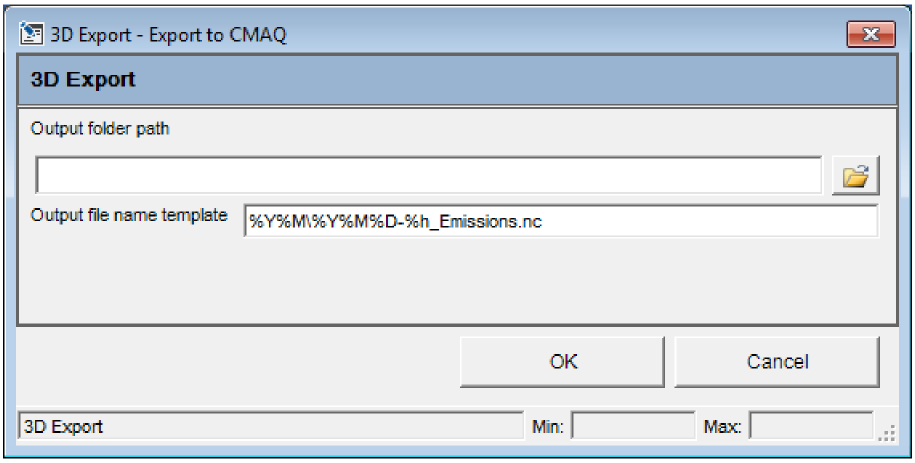


Figure 8.21 - Dialogue box for exporting grid totals to CMAQ 3D grid files.

SECTION 9 Traffic Apportionment

EMIT allows the user to apportion road traffic emissions for any given pollutant, to determine the contributions from different types of vehicle. The apportioned emissions can also be exported to ADMS-Urban for dispersion modelling; this allows apportionment of calculated concentrations due to the different categories, as well as emissions. The apportioned concentrations take account of non-linear affects from vehicle-induced turbulence.

9.1 Introduction

In order to use Traffic Apportionment, a road group in the EMIT inventory should be created using one of the available emission factor datasets for use with Traffic Apportionment.

EMIT also allows non-exhaust emissions from road traffic to be apportioned into the following categories:

- Brake wear
- Tyre wear
- Road wear
- Resuspension

For more information on creating and setting up groups in EMIT see Section 5.

The Traffic Apportionment option creates special pollutant names e.g. “NOx_VC01”, “NOx_VC02” in addition to the overall emissions with the usual name e.g. “NOx”. The extra component on the pollutant name represents the vehicle category number, for example vehicle category 1 is represented by VC1, see Section 9.3 for more details of vehicle category numbers. Non-exhaust emissions use names such as “NOx_BW”, “NOx_TW”, “NOx_RW”, “NOx_RES”, where BW represents Brake Wear, TW tyre wear, RW road wear and RES resuspension. These special pollutants and the emissions are visible throughout EMIT in the same way as the normal pollutants.

All the extra required information for Traffic Apportionment is entered on three separate screens, accessed by selecting **Data** followed by **Traffic Apportionment** on the inventory screen, as shown in **Figure 9.1**.

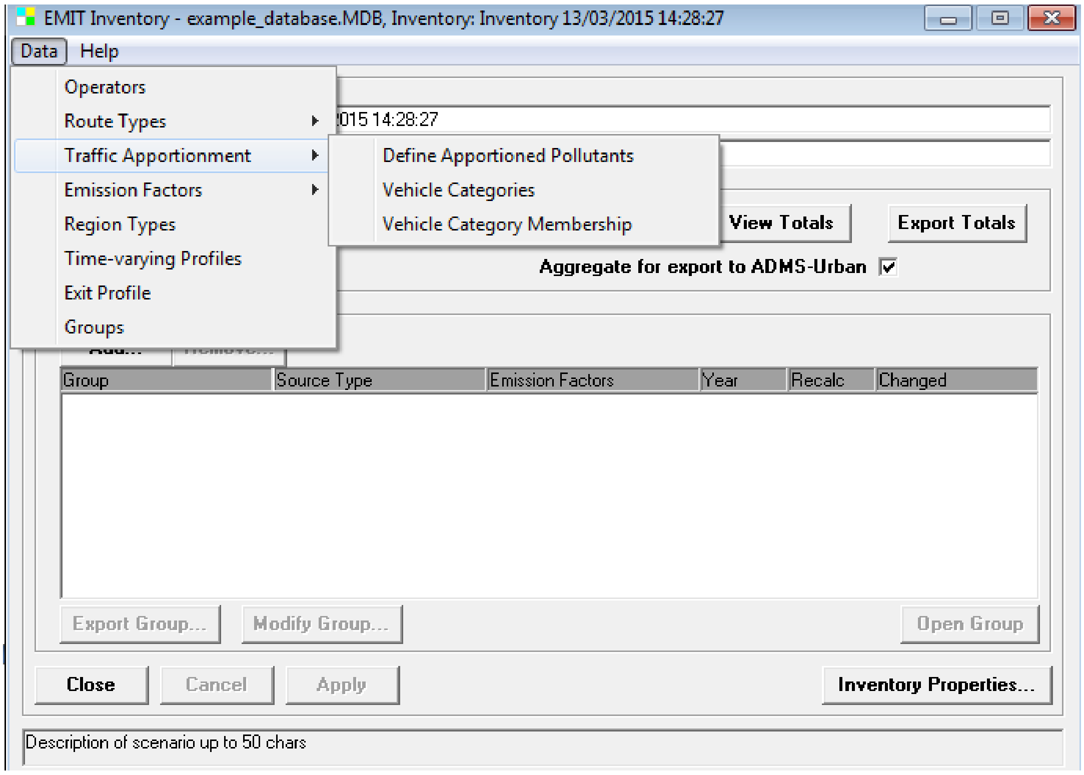


Figure 9.1 - Traffic Apportionment menu

9.2 Define Apportioned Pollutants screen

By selecting **Define Apportioned Pollutants** from the **Traffic Apportionment** menu, the user can choose which of the available pollutants to use with traffic apportionment. **Figure 9.2** shows the **Define Apportioned Pollutants** screen with the pollutants NO_2, NO_x, PM_{10} and $PM_{2.5}$ selected to use with Traffic Apportionment.

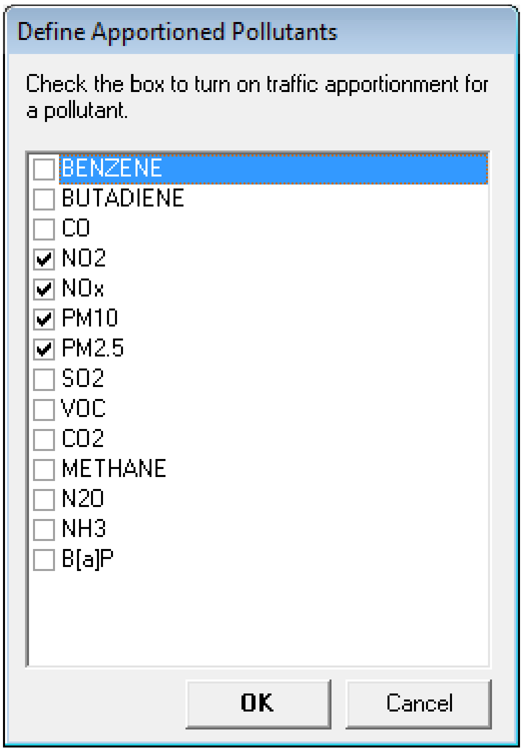


Figure 9.2 - Define Apportioned Pollutants screen

9.3 Vehicle Categories screen

On selecting **Vehicle Categories** from the **Traffic Apportionment** menu the user can define up to twenty vehicle categories for traffic apportionment. EMIT contains the default vehicle categories:

- Motorcycles
- Petrol cars
- Diesel cars
- Other cars
- LGVs
- Buses and Coaches
- Rigid HGVs
- Articulated HGVs

The user can modify these categories or create new ones, for example apportioning emissions by EURO class or by vehicle size. **Figure 9.3** shows the **Vehicle Categories** screen, with the default categories, plus an extra user defined category Low Emissions Vehicles.

Before editing the **Vehicle Categories** table the user should first select the correct Emissions Factors dataset to use from the top of the screen; this should match the emission factors dataset used in the definition of the road group.

To enter a new category into the **Vehicle Categories** table, the user should then press the **Add** button at the bottom of the screen, which adds a new row for data at the bottom of the Vehicle Categories list. The user can then edit the name of the category into the new row under the **Name** heading; the number of the vehicle category will be entered automatically and cannot be edited. Vehicle categories can be deleted by selecting the category and pressing the **Delete** button at the bottom of the screen. If an entry is deleted then the category numbers will change so that they are still in ascending order starting at 1: the names will remain unaltered. The numbers are used in the names of the special pollutants for the apportioned emissions e.g. “NOx_VC01”.

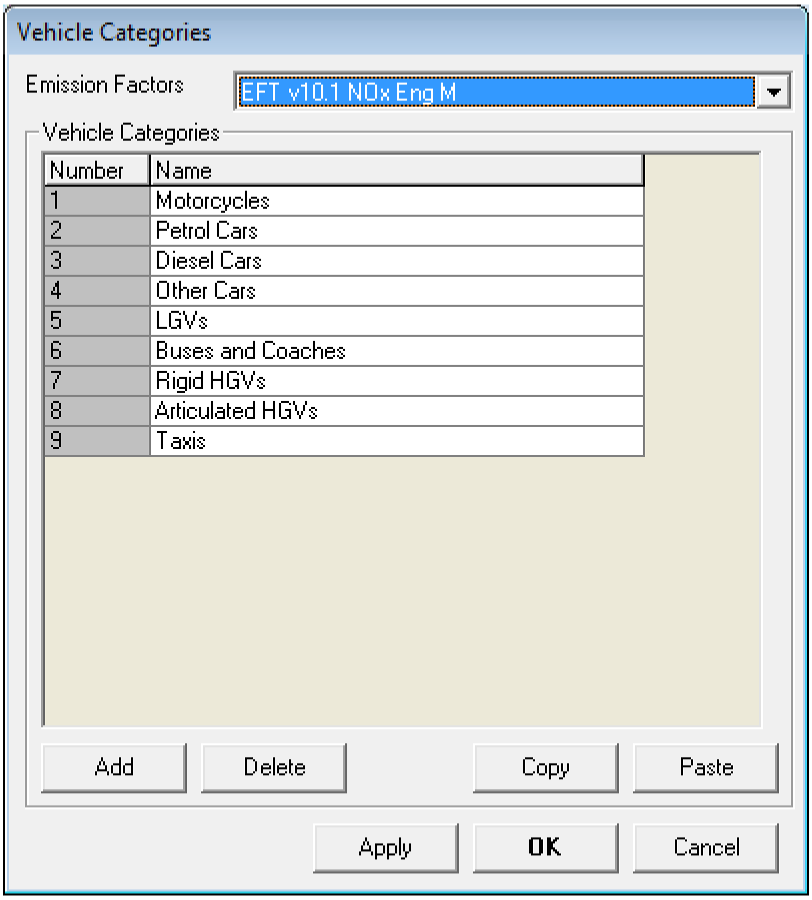


Figure 9.3 – The **Vehicle Categories** screen

The list can be copied and pasted into other software packages. The user can also create the list of vehicle categories in a separate package, such as Microsoft Excel, and then paste the list into the **Vehicle Categories** table. The data to be pasted into EMIT must include the column headings, i.e., **Number** and **Name**. If there are more rows in the existing table than in the data being pasted into the table, the extra rows of data will remain in the table, unaltered. The user will receive a message to this effect, as shown in **Figure 9.4**.

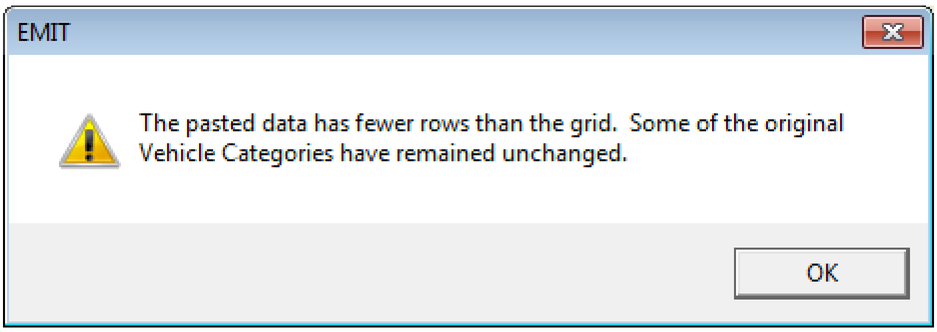


Figure 9.4 - Warning message received when fewer than existing entries are pasted into the **Vehicle Categories** table

If there are more rows of data being pasted into the table than currently exist, the existing data will be replaced by the new data. Extra rows will automatically be created to store the new data.

Data being pasted must have valid values in the first column, containing the vehicle category number: the values must be in ascending order starting with the value 1. If the user tries to paste a list of vehicle categories and numbers into the screen with the numbers out of order, an error will be given, as shown in **Figure 9.5**, and the values will not be pasted into the table.

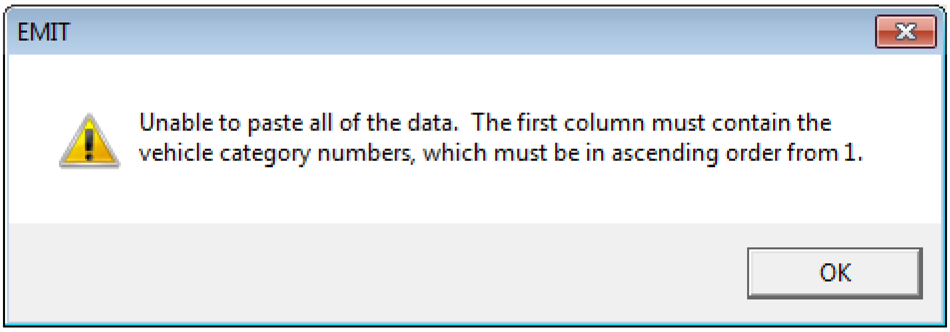


Figure 9.5 – Error received on pasting vehicle categories in non-ascending order

If the user tries to paste more than the maximum allowed number of vehicle categories (twenty), the error message shown in **Figure 9.6** will be given, and EMIT will not paste the data into the **Vehicle Categories** table.

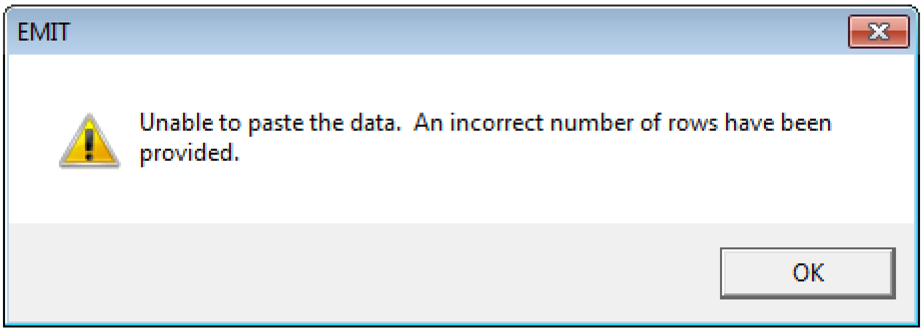
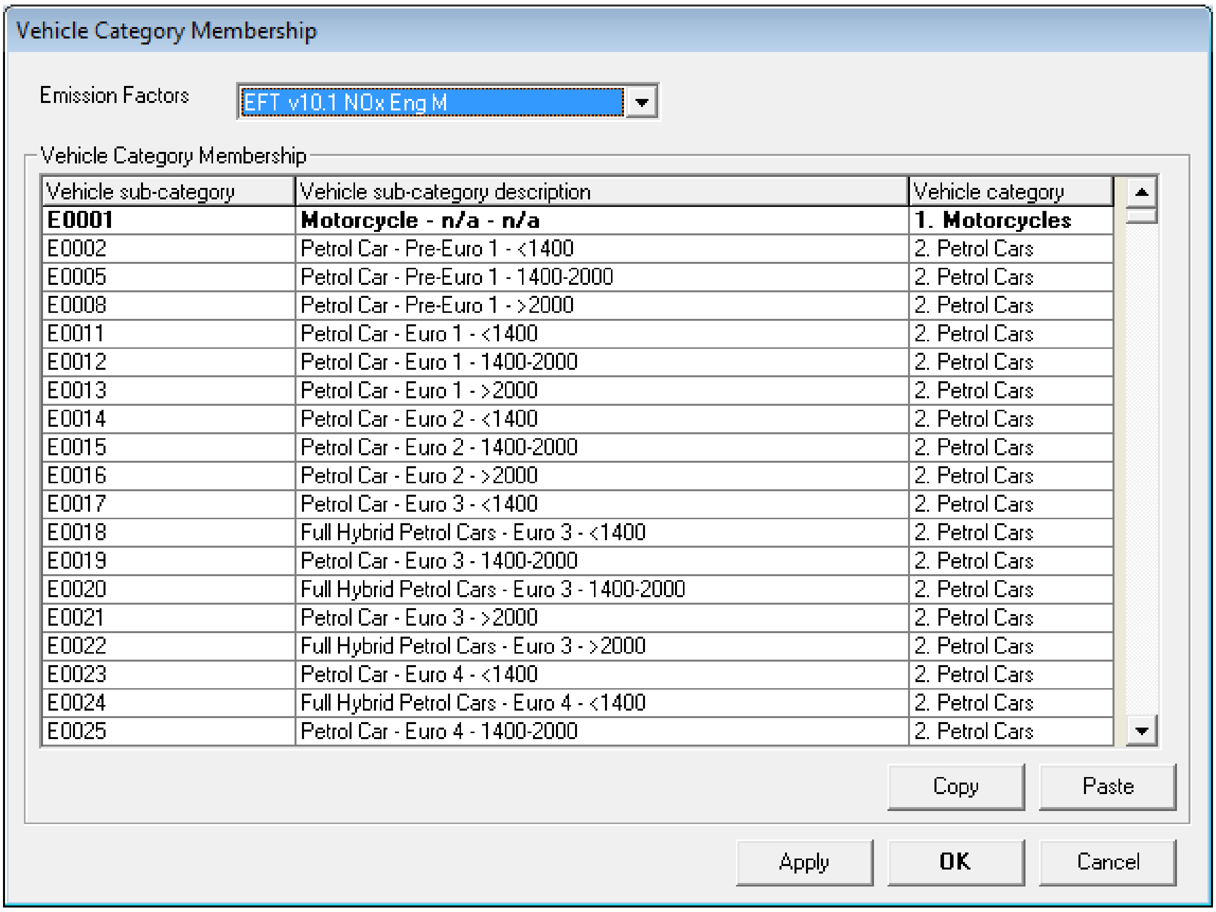


Figure 9.6 – Error received on pasting more than twenty vehicle categories into the **Vehicle Categories** table

9.4 Vehicle Category Membership screen

The final screen of data required for Traffic Apportionment is the **Vehicle Category Membership** screen. This screen allows full control of the vehicle sub-categories within each vehicle category.

On selecting **Vehicle Category Membership** from the **Traffic Apportionment** menu, the **Vehicle Category Membership** screen is opened, as shown in **Figure 9.7**.



Vehicle sub-category	Vehicle sub-category description	Vehicle category
E0001	**Motorcycle - n/a - n/a**	**1. Motorcycles**
E0002	Petrol Car - Pre-Euro 1 - <1400	2. Petrol Cars
E0005	Petrol Car - Pre-Euro 1 - 1400-2000	2. Petrol Cars
E0008	Petrol Car - Pre-Euro 1 - >2000	2. Petrol Cars
E0011	Petrol Car - Euro 1 - <1400	2. Petrol Cars
E0012	Petrol Car - Euro 1 - 1400-2000	2. Petrol Cars
E0013	Petrol Car - Euro 1 - >2000	2. Petrol Cars
E0014	Petrol Car - Euro 2 - <1400	2. Petrol Cars
E0015	Petrol Car - Euro 2 - 1400-2000	2. Petrol Cars
E0016	Petrol Car - Euro 2 - >2000	2. Petrol Cars
E0017	Petrol Car - Euro 3 - <1400	2. Petrol Cars
E0018	Full Hybrid Petrol Cars - Euro 3 - <1400	2. Petrol Cars
E0019	Petrol Car - Euro 3 - 1400-2000	2. Petrol Cars
E0020	Full Hybrid Petrol Cars - Euro 3 - 1400-2000	2. Petrol Cars
E0021	Petrol Car - Euro 3 - >2000	2. Petrol Cars
E0022	Full Hybrid Petrol Cars - Euro 3 - >2000	2. Petrol Cars
E0023	Petrol Car - Euro 4 - <1400	2. Petrol Cars
E0024	Full Hybrid Petrol Cars - Euro 4 - <1400	2. Petrol Cars
E0025	Petrol Car - Euro 4 - 1400-2000	2. Petrol Cars

Figure 9.7 - The **Vehicle Category Membership** screen

The user should first ensure that the correct emission factors for the road group are selected from the drop down list at the top of the screen.

The **Vehicle Category Membership** table contains three columns; the Vehicle sub-category; the Vehicle sub-category description; and the Vehicle category. The vehicle categories available can be selected by hand from a drop down list, for each Vehicle sub-category. The table can be edited by hand in the **Vehicle Category Membership** table, or the table can be copied into a third-party package for editing, such as Microsoft Excel, and then pasted back into the **Vehicle Category Membership** table.

When pasting data into the **Vehicle Category Membership** table, the user must include the headings. All the vehicle sub-categories need to be pasted together as a complete set and the Vehicle categories must have already been defined in the **Vehicle Category** table.

If the user tries to paste the list of data into the **Vehicle Category Membership** table using a vehicle category which has not been previously defined in the **Vehicle Category** table, an error will be received, as shown in **Figure 9.8**, and the data will not be copied into the **Vehicle Category Membership** table.

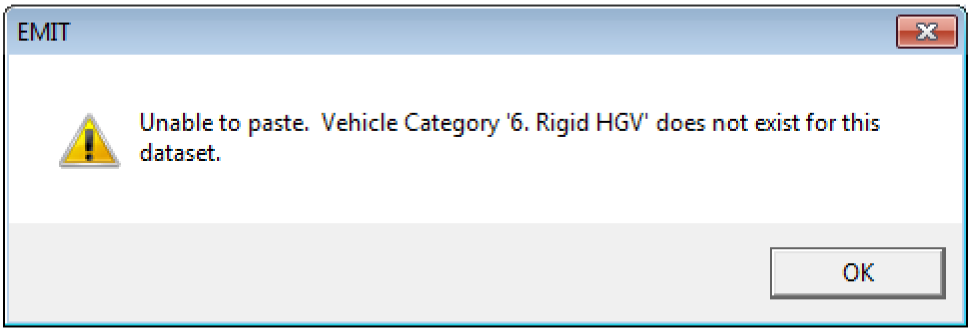


Figure 9.8 - An example error given when pasting an undefined vehicle category into the membership table

If the user tries to paste an incomplete list of data into the **Vehicle Category Membership** table, an error will be received, as shown in **Figure 9.9**, and the data will not be copied into the **Vehicle Category Membership** table.

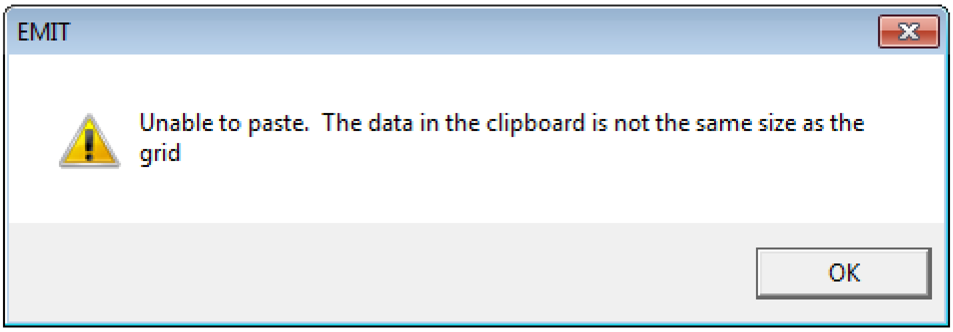


Figure 9.9 – Error given when pasting an incomplete list of data into the membership table

9.5 Example Output

The special pollutants and their emission rates created during traffic apportionment are visible throughout EMIT in the same way as the normal pollutants. Figure 9.10 shows the source screen for a road source, with the emission rates for some of the special pollutants visible. For this example there are two vehicle category groups defined. Emissions rates from the two vehicle category groups use the extension to the pollutants name _VC01 and _VC02. The emission rates due to the non-exhaust components are also given for particulates, using the extensions _BW for break wear, _RS for resuspension, _RW for road wear and _TW for tyre wear.

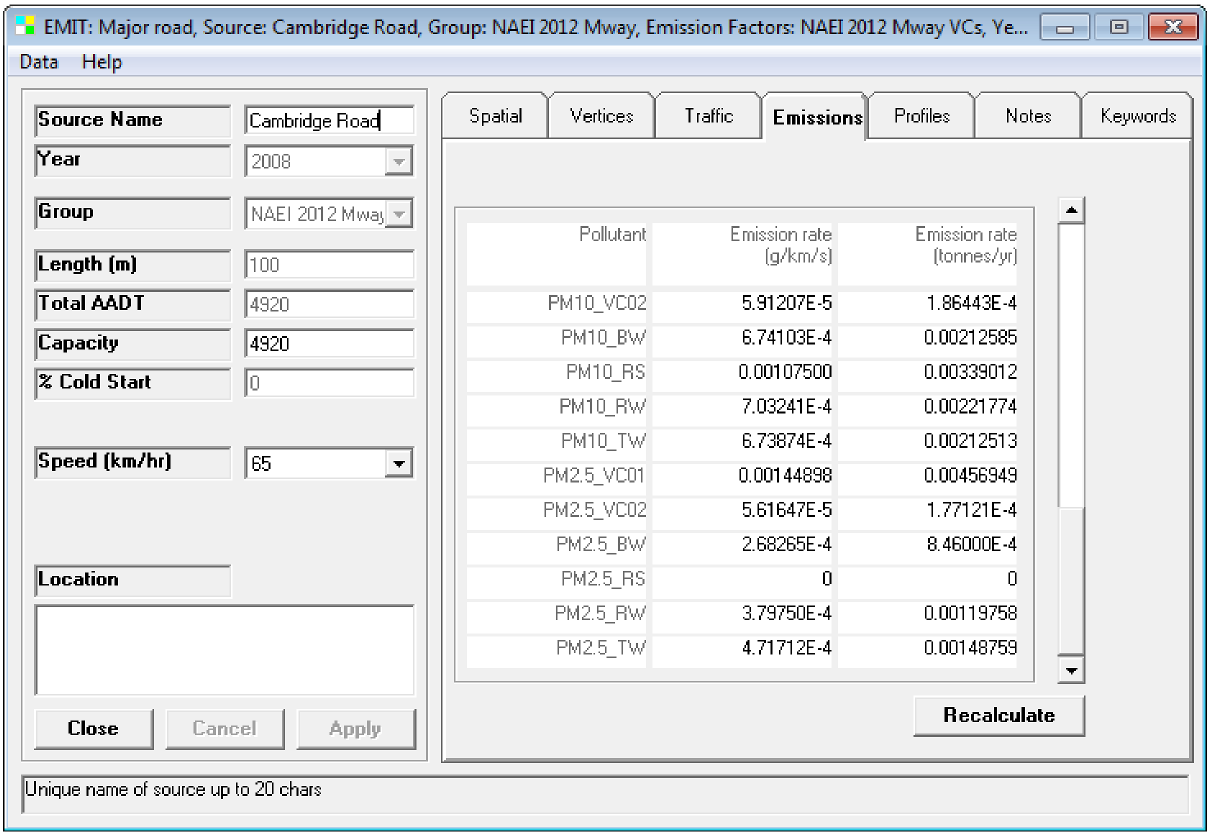


Figure 9.10 – Source screen showing special pollutants added during Traffic Apportionment

Figure 9.11 shows the Inventory Totals screen for an example group which uses traffic apportionment. The totals can be seen for each of the separate vehicle category groups by scrolling to the left of the totals screen. The special pollutants are given after the totals for all the standard pollutants.

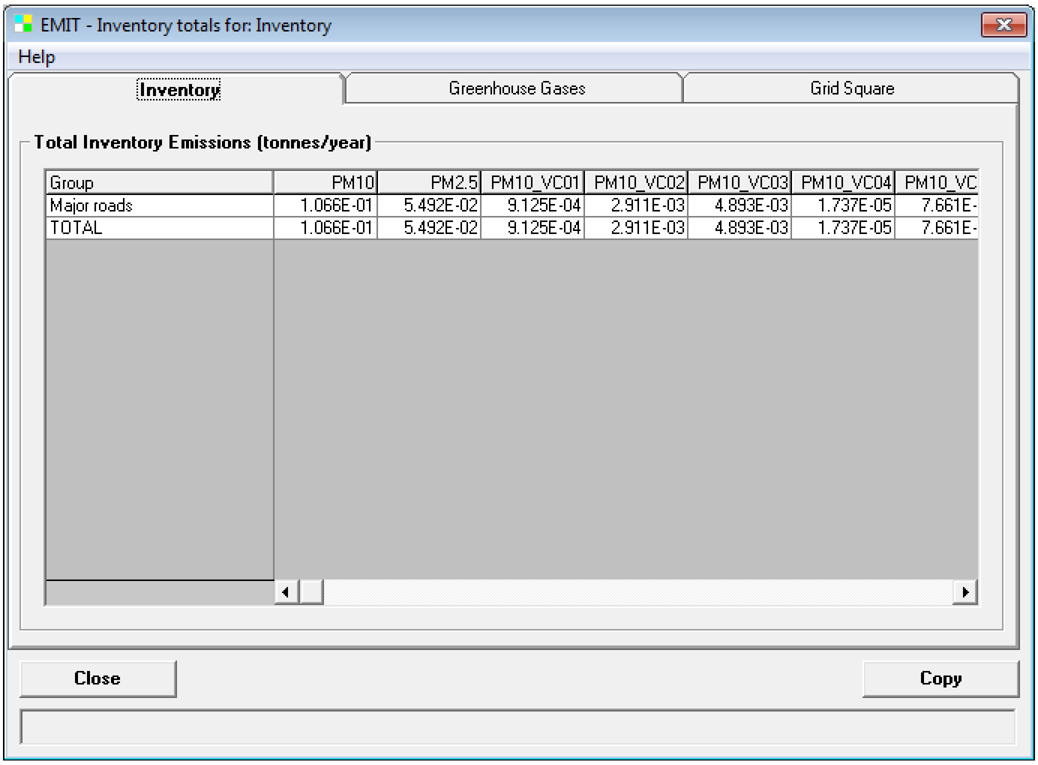


Figure 9.11 – Totals screen showing special pollutants added during Traffic Apportionment

9.6 Exporting Emissions Data into ADMS-Urban

There are a few points to consider when modelling the emissions from the special pollutants created during Traffic Apportionment in ADMS-Urban.

A default input file for ADMS-Urban will not contain the special pollutant names. Therefore before importing the emission rates due to the special pollutants it will be necessary to add their names to the ADMS-Urban pollutant palette.

ADMS-Urban version 5 has a limit on the number of pollutants which can be modelled at one time. This limit is 80 pollutants. Therefore it may be necessary to either limit the pollutants being imported into ADMS-Urban to only those of interest – for example Benzene and Butadiene may be included in the ADMS-Urban inventory, but results of modelling these pollutants may not be relevant to the study. If the study has included a number of vehicle categories, then the limit of 80 pollutants may be reached even when importing only the pollutants of interest. In this case it may be necessary to split the study up into a number of separate ADMS-Urban runs. It should be noted that in order for ADMS-Urban to include the effects of traffic-produced turbulence, at least one of the standard pollutants NOx, PM10 or VOC should be included in each model run.

The chemistry module should not be used in ADMS-Urban when modelling traffic apportionment. For the chemistry module to be correct the total emission rates of NO2 would need to be modelled and the chemistry module will not recognise the special pollutant names which make up the emissions from the individual vehicle categories.

SECTION 10 Traffic management

This section describes how EMIT can be used to calculate the change in emissions due to various traffic management schemes. Section 10.1 introduces the use of EMIT to assess traffic management schemes. Section 10.2 discusses some possible schemes that users may want to consider. In Section 10.3 two example investigations of traffic management schemes are demonstrated, step by step: a simple speed restriction area and a Low Emission Zone (LEZ).

10.1 Introduction

When local authorities develop air quality action plans, an important aspect is estimating the emissions consequences of traffic management schemes. EMIT has been specifically designed to help with this task. **Figure 10.1** is a schematic diagram showing an approach for investigating the effectiveness of traffic management schemes. You may want to consider the effect on emissions of

- proposed traffic management schemes,
- the introduction of cleaner technology with time, and
- both of these together.

Steps 1 to 4 below outline how EMIT can be used to investigate the effect of traffic management schemes.

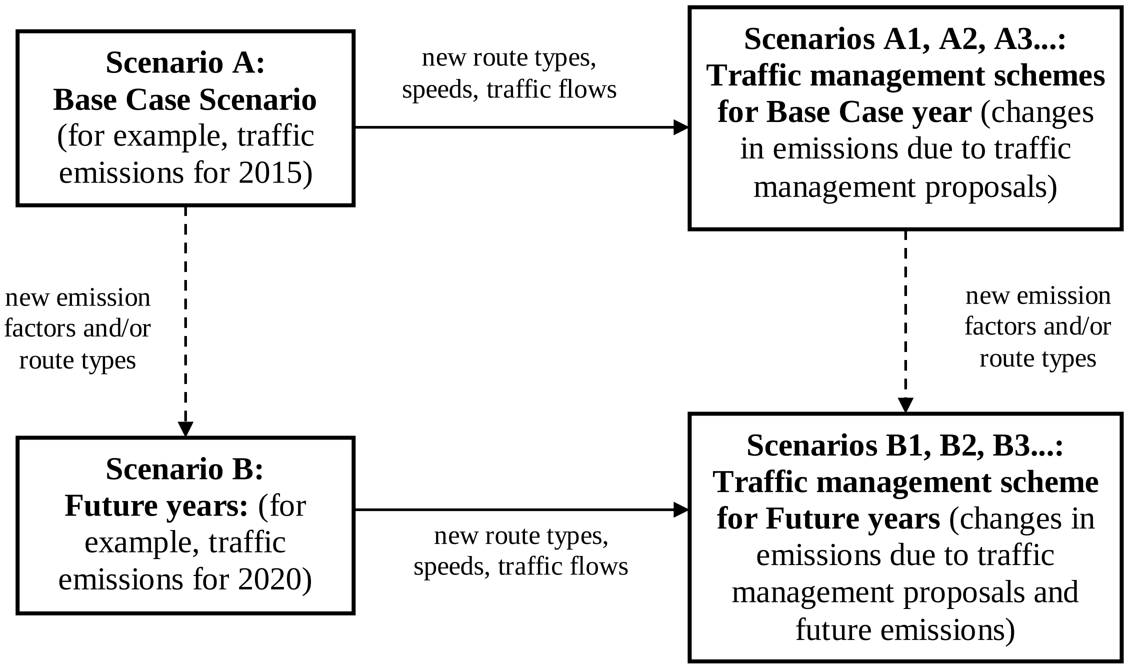


Figure 10.1 – Different scenarios that may be considered during the investigation of a traffic management scheme.

Step 1 Scenario A

Firstly, EMIT is used to set up an emissions inventory for a specific year, the Base Case year (Scenario A). This inventory may contain emissions due to a variety of sources: industrial, commercial and domestic, road or rail, but in this section we are only going to be concerned with changes in the emissions from road traffic.

Step 2 Scenario B

Next, an inventory is set up to look at the emissions totals for future years in the absence of any traffic management schemes (Scenario B). We then add corresponding groups to the new inventory for all the groups present in the Base Case year inventory.

Any groups whose emissions do not change between the Base Case and the future year should be added directly to the future inventory, to be shared between the two inventories. For instance industrial source emissions may not change year on year, in which case the industrial groups could be shared between Scenario A and Scenario B.

Any groups whose emissions do change between the Base Case and the future year must be included as follows. New groups must be created for inclusion in Scenario B and the sources copied to those groups. Then the emissions of the copied groups should be changed. This is done using the **Modify Group** option in the **EMIT Inventory** screen, as shown in **Figure 10.2**.

---

*When updating the group **Year**, it is important to check that the **Route type** is for the corresponding year.*

It should be noted that when creating a new emissions inventory, or updating an old inventory, the most up-to-date emission factors should always be used. For road traffic, the most up-to-date emission factor datasets held in the database are:

- **EFT v10.1** for NOx and PM,
- **COPERT v5.5** for other pollutants

For further information about any of these datasets, please refer to Appendix A.

Note that for this simple example an old dataset has been used, which is no longer available in EMIT. It has been assumed that the traffic numbers and split between light and heavy vehicles and are not forecast to change in the future year. Such changes can be accounted for by editing the AADT values with the **Multiple Source Edit** screen if necessary. In general, if there is no increase in traffic numbers and no change in the split between light and heavy vehicles, the emissions totals for Scenario B will be less than those for the Base Case year, due to the introduction of cleaner technology.

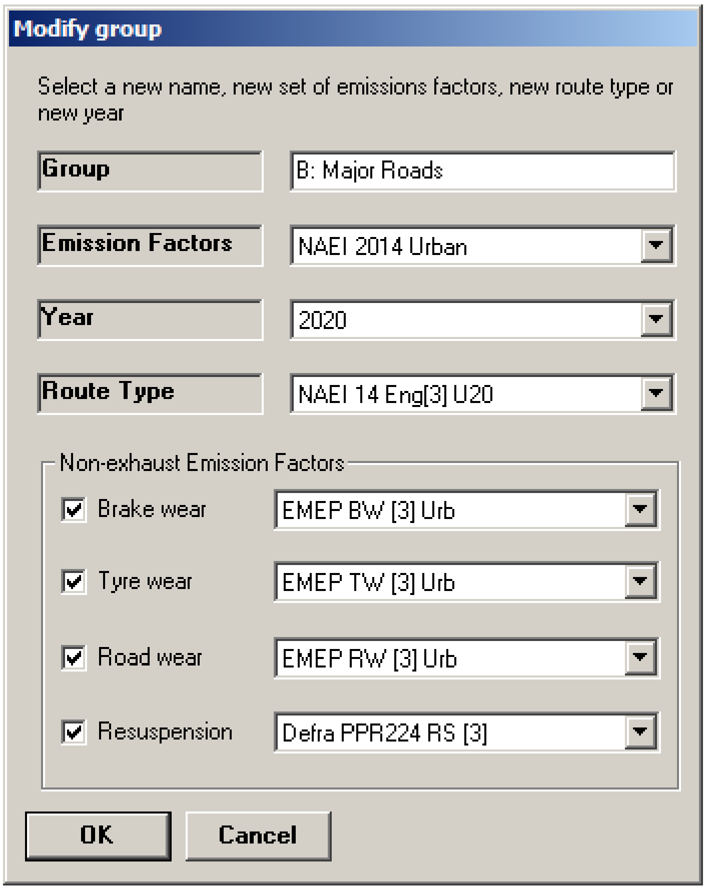


Figure 10.2 – Changing the year in the **Modify Group** screen.

Step 3 Scenarios A1, A2, A3...

To consider the effect of traffic management schemes on the current situation (Base Case), further inventories are set up containing copies of the sources for the Base Case year, and then the sources edited to represent changes due to the schemes. Section 10.2 outlines some possible schemes, and two specific examples are given in Section 10.3.

The emissions totals with traffic management may be greater or smaller than those for the Base Case. If the aim is to improve air quality we will be looking for reductions in the total emissions or at least a spatial redistribution of emissions. EMIT users can rapidly assess different schemes by modelling a range of scenarios and hence obtain an indication of the likely impact on air quality.

Step 4 Scenarios B1, B2, B3...

The longer-term impact of traffic management schemes is assessed by creating additional scenarios in EMIT to calculate the future emissions with the schemes in place. These scenarios include copies of the sources from the Base Case traffic management scheme scenarios (A1, A2, A3...) with emission factors and/or route types for future years as described in Step 2 above. The emissions from these scenarios are likely to be used as input to an urban air dispersion model (such as ADMS-Urban) for comparisons with Air Quality Standards. We could compare Scenario B with these scenarios to distinguish between specific emissions reductions due to the traffic management schemes and the general reduction due to the increased presence of newer, cleaner vehicles in the future years.

10.2 Possible Schemes, and their implementation in EMIT

Work on assessing the consequences of traffic management schemes has been carried out as part of the UK DfT's TRAMAQ (Traffic Management and Air Quality) project UG 218. The TRAMAQ State of the Art Review (TRAMAQ, 2002) contains a review of traffic management schemes and classifies their impact in the following way:

(a) Schemes affecting vehicle/driver behaviour e.g. speed limits, road humps

(b) Schemes affecting traffic numbers, routes and patterns e.g. new routes, new roads, car sharing, and

(c) Schemes affecting traffic composition, modes and technology e.g. Low Emission Zones (LEZ), restriction of HGVs

In practice, many measures will have a combination of these effects. For instance an LEZ – Scheme (c) – may lead to an increase in vehicle numbers on surrounding roads i.e. Scheme (b). Many schemes can be modelled in EMIT using a combination of new route types and editing of source parameters, such as speeds and traffic flows. The following three sections describe how EMIT can be used to model these three effects.

10.2.1 Vehicle/driver behaviour

Speed limits can be modelled in EMIT by modifying the speeds for selected sources with the **Multiple Source Edit** screen (**Figure 10.2**). *Road humps* are likely to reduce the average speed of traffic and this can be modelled in the same way. Road humps also disturb the traffic flow, resulting in more acceleration and deceleration, but this cannot currently be modelled in EMIT as no suitable parameterisation of the effect on emissions is available. Similarly, *road narrowing*, introduction of *traffic islands* and new *road markings* can both reduce average speeds and alter the traffic flow, probably making it smoother i.e. less acceleration and braking.

Other measures that affect vehicle/driver behaviour include *parking availability*, the introduction of *speed cameras*, and *co-ordinated signalling*. Assessment of these management schemes could be assessed with EMIT provided suitable traffic data is available, for instance from a traffic model.

10.2.2 Traffic numbers, routes and patterns

The introduction of a *pedestrianised* area decreases traffic flows on some roads, but may increase it on others. This can be modelled in EMIT by changing the **Number of vehicles/day** on the **Traffic** tab of the **EMIT Source** screen for the relevant sources. In addition, it may be necessary to re-import new data from a traffic model.

A *Low Emission Zone (LEZ)* may force certain vehicles to change their routes, affecting traffic numbers and patterns and changing the traffic composition both inside and outside the LEZ. *Car-sharing*, *congestion charging* and *freight management* similarly affect both traffic numbers and traffic composition.

10.2.3 Traffic composition, modes and technology

The introduction of a *Low Emission Zone (LEZ)* will change the traffic composition, by excluding vehicles that do not conform to certain emissions standards from the LEZ area. An *LEZ* can be introduced in EMIT by defining new route types that exclude the banned vehicles and applying them to the roads within the *LEZ*. Further details and an example of an *LEZ* are given in Section 10.3.2.

Home Zones are residential areas where measures are introduced to improve conditions for pedestrians and cyclists and in turn reduce the numbers of motor vehicles. These can also be modelled by the introduction of suitable route types and amendment of AADT and speed values.

Bus lanes and *High Occupancy Vehicle (HOV) Lanes* can be investigated by consideration of different route types for different lanes on a road.

10.3 Traffic Management Examples

Sections 10.3.1 and 10.3.2 present example investigations of traffic management schemes using EMIT. In both cases we consider only emissions from the major and minor roads. Users can follow this example by using the *Middlesbrough.mdb* database – the same example database used in Section 7. The database uses ‘dummy’ data to illustrate the use of EMIT; it is not a genuine emissions inventory for Middlesbrough. It is installed in the following location in the installation directory:

Examples\Mapper\Middlesbrough.mdb

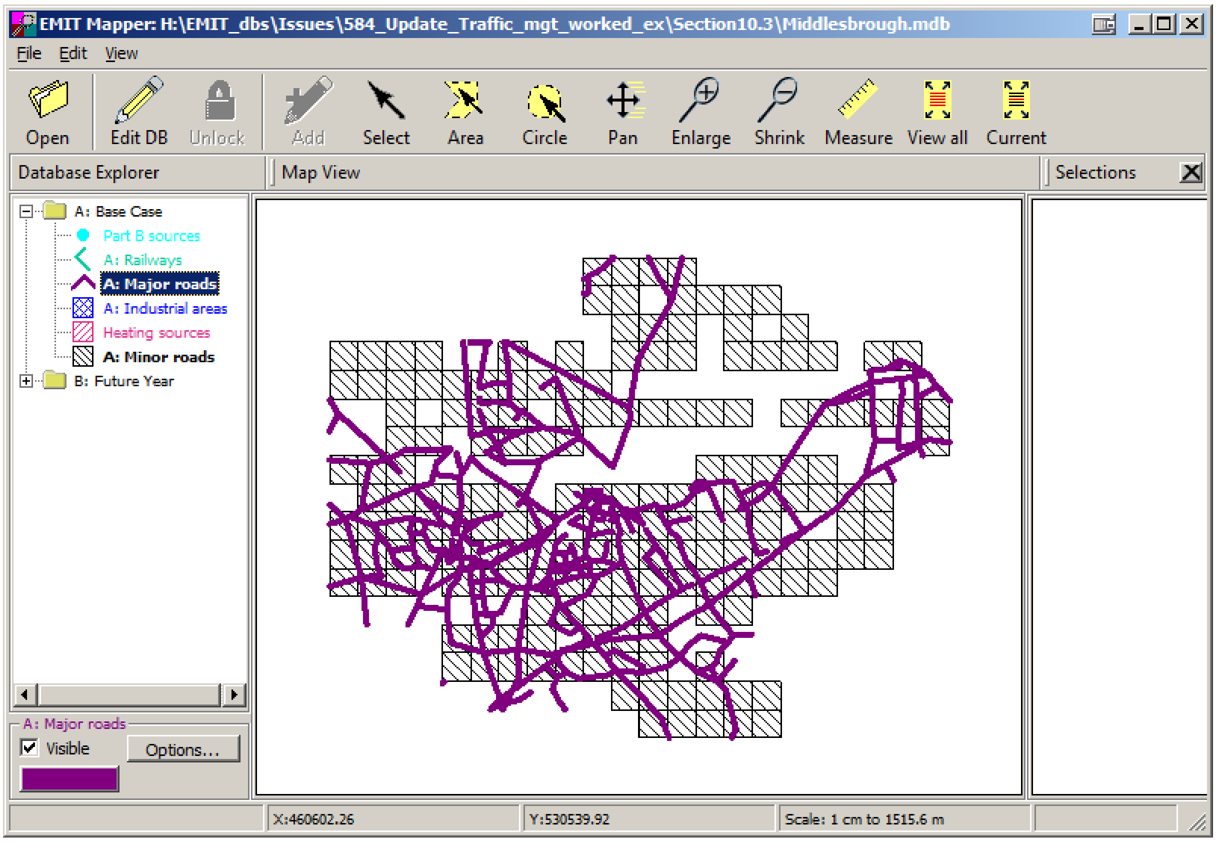


Figure 10.3 – Base Case major and minor road sources displayed in the Mapper.

Step 1 Scenario A

The example database contains two scenarios, ‘A: Base Case’ and ‘B: Future Year’. **Figure 10.3** shows the Base Case (Scenario A) displayed in the EMIT Mapper. The major roads and the minor roads (groups ‘A: Major roads’ and ‘A: Minor roads’, respectively) both use the same emission factor dataset, **NAEI 2014 Urban**[1]. Both groups also have the same route type, ‘NAEI 14 Eng[3] U15’, which represents the fleet composition for the Base Case year, 2015, in an urban area in England.

The totals are calculated and viewed using the **View Totals** button. Total emissions for the Base Case scenario are given in the first row of **Table 10.1**.

[1] The NAEI 2014 dataset is no longer available in EMIT

Step 2 Scenario B

The second scenario, 'B: Future Year', contains the emissions in a later year than the Base Case, 2020. There are two groups 'B: Major roads' and 'B: Minor roads'. As the groups use the **NAEI 2014 Urban** emission factors, both the route type and the group year have been changed from Scenario A to calculate the emissions in the future year (2020). The route type is 'NAEI 14 Eng[3] U20'. The totals for Scenario B are given in the fourth row of **Table 10.1**. Compared with Scenario A, emissions totals have reduced dramatically, being approximately reduced by 71% for NO_x and 17% for PM_{10}. These reductions are due to predicted changes in the fleet in the future year: the predictions are taken from the UK National Atmospheric Emissions Inventory (**UK NAEI 2014**).

Scenario	NO_x tonnes/yr			PM_{10} tonnes/yr		
	Major roads	Minor roads	Total roads	Major roads	Minor roads	Total roads
A: Base Case	595	1.00	596	44.5	0.065	44.6
A1: Base Case + speed restrictions	547	0.99	548	44.3	0.07	44.4
A2: Base Case + LEZ	584	0.99	585	43.8	0.06	43.9
B: Future Year	346	0.55	347	39.1	0.06	39.2
B1: Future Year + speed restrictions	316	0.55	316	39.5	0.06	39.5
B2: Future Year + LEZ	338	0.54	338	38.8	0.06	38.9

Table 10.1 – Inventory totals for Scenarios A, A1, A2, B, B1 and B2.

10.3.1 The effect of *speed restrictions* on emissions totals

Step 3 Scenario A1

The next step is to consider the effect of the speed restrictions on the Base Case scenario totals. We will create a new inventory, 'A1: Base Case + speed restrictions'. In the EMIT interface, the maximum and minimum coordinates for the new inventory are entered in the **Inventory Coverage** boxes on the **EMIT Inventory** screen. The values should be copied from those for Scenario A.

Four new groups are set up in the database: 'A1: Major roads', 'A1: Minor roads', 'A1: Go slow (major roads)', 'A1: Go slow (Minor roads)'. As the groups use the **NAEI 2014 Urban** emission factors, both the route type and the group year are set to calculate the emissions in the Base Case year (2015). The route type is 'NAEI 14 Eng[3] U15'. The **EMIT Inventory** screen displayed in **Figure 10.4** shows these groups.

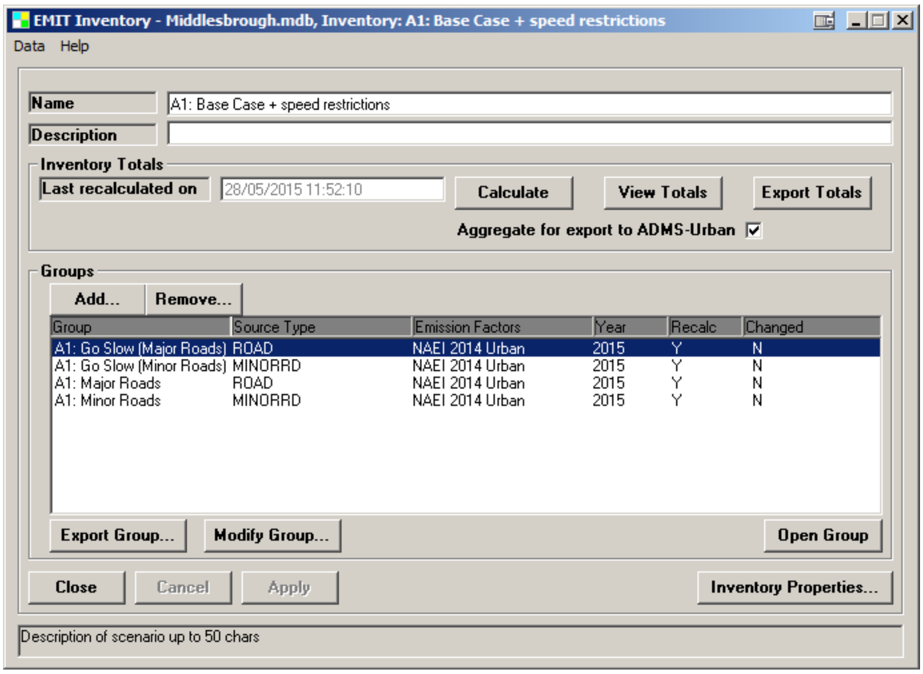


Figure 10.4 – **EMIT Inventory** screen for Scenario A1: Base Case + speed restrictions.

The sources from the Base case scenario groups 'A: Major roads' and 'A: Minor roads' are copied to the 'A1: Major roads' and 'A1: Minor roads' groups respectively. **Figure 10.5** shows a step in copying the major roads: the **Select All** button has been clicked to select all the sources in the 'A: Major roads' group; the user is about to click the **Copy** button.

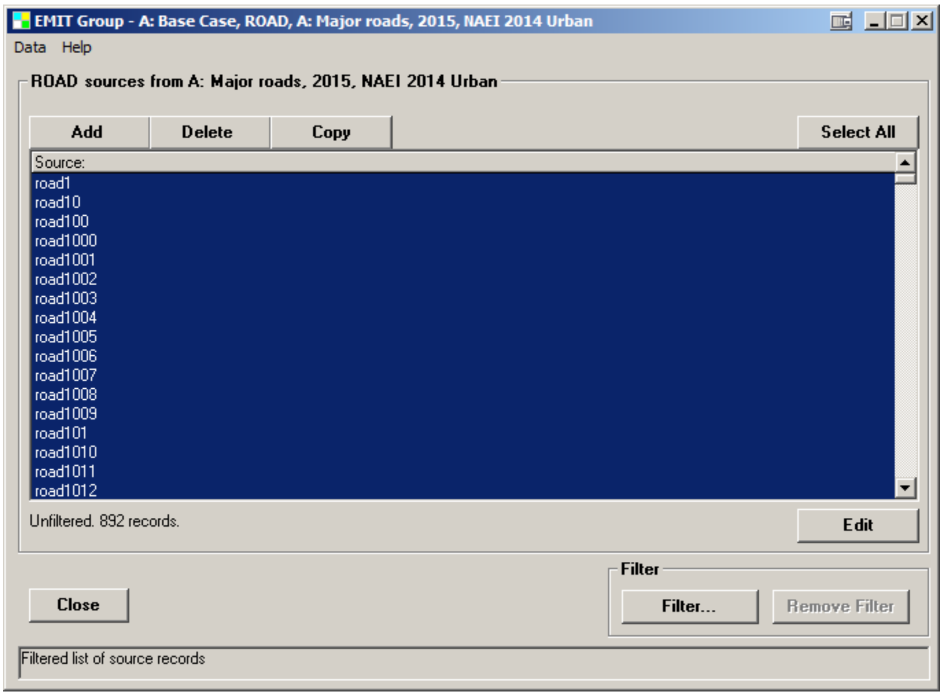


Figure 10.5 – Copying Scenario A major roads to Scenario A1

The major roads to which the speed restrictions will be applied are moved to the group 'A1: Go Slow (Major roads)', and the minor roads are moved to the group 'A1: Go Slow (Minor roads)'. This is most easily done in the

Mapper. Detailed instructions for carrying out this operation are below.

Using the Mapper, select the group ‘A1: Major roads’ in the **Database Explorer**. Click the **Edit DB** button. The next step is to choose the roads to which the speed restriction will apply. For example, the roads shown in red in **Figure 10.6**; since this is only an exercise to demonstrate the use of EMIT, it does not matter if you do not select exactly the same sources as shown in the figure. First choose the **Area** tool, and then click with the left mouse button to draw a polygon containing the sources; click with the right mouse button to close the polygon and select the sources within the polygon. Selected sources will be shown in red.

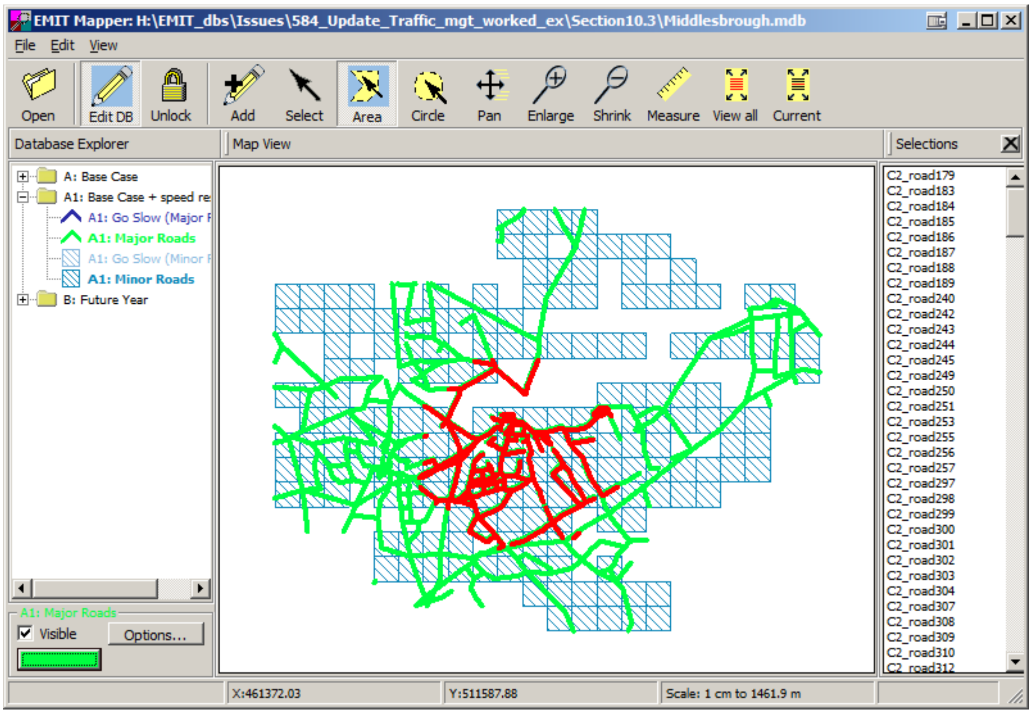


Figure 10.6 – Selecting major roads to which speed restrictions will apply

The selected roads can now be moved to the ‘A1: Go Slow (Major roads)’ group, by clicking on the **Change Group** option from the Mapper’s **Edit** menu.

Minor roads in the same area are selected and moved to the ‘A1: Go Slow (Minor roads)’ group using a similar process. **Figure 10.7** shows the result, as displayed in the Mapper, with the major and minor roads in the speed restriction area displayed in dark blue and purple respectively.

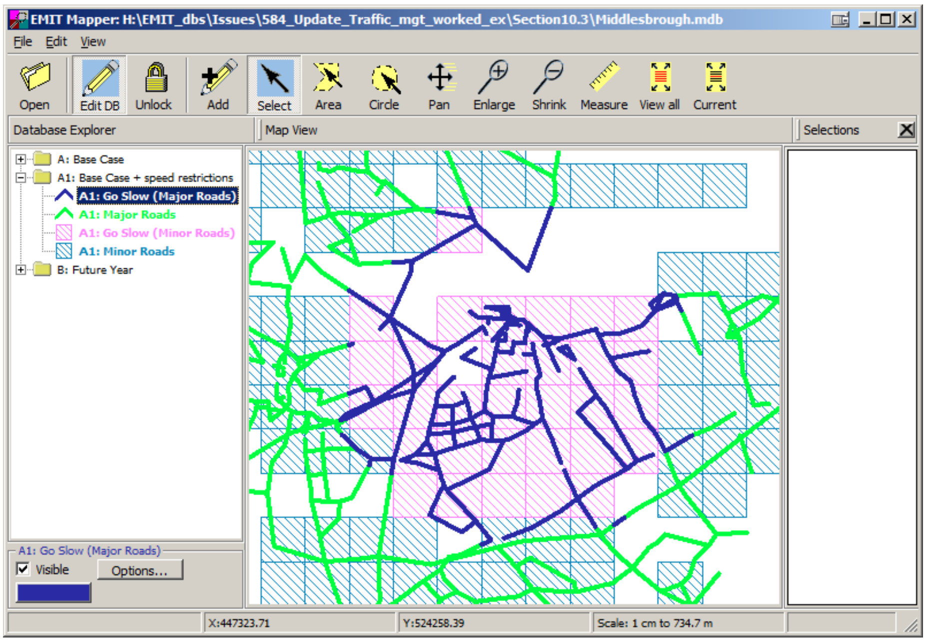


Figure 10.7 – Major (dark blue) and minor (purple) road sources in the 'Go Slow' area of the city viewed using the Mapper.

Next we return to the EMIT interface, and apply the speed restrictions. This is straightforward to do by selecting all the sources in the group, and then using the **Multiple Source Edit** screen (shown in **Figure 10.8**). In this example, the speeds on the major roads are to be reduced to 50km/hr and the speeds on the minor roads to 30km/hr.

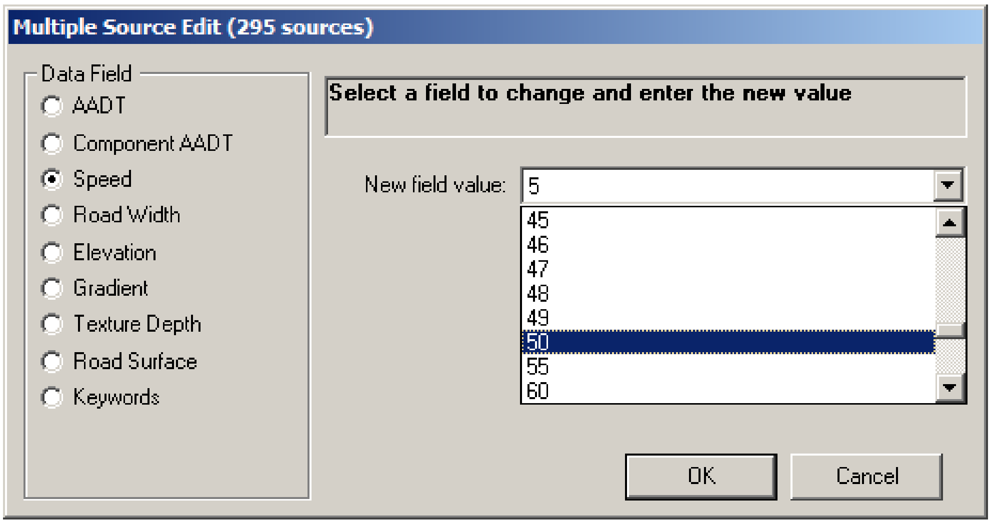


Figure 10.8 – **Multiple Source Edit** screen for Scenario A1: Base Case + speed restrictions.

Once the speed restrictions have been applied, the Inventory totals are recalculated. The new totals for NO_x and PM_{10} are given in **Table 10.1**. The results show a slight decrease in total NO_x emissions and very little change in PM_{10} emissions due to these speed restrictions.

Step 4 Scenario B1

To consider the effect of the speed restrictions on the future (2020) scenario totals, a fourth inventory is created. This is called 'B1: Future Year + speed restrictions' and it contains four new groups:

- B1: Major roads
- B1: Minor roads
- B1: Go Slow (Major roads) and
- B1: Go Slow (Minor roads)

Sources are then copied across from the groups in scenario A1 to the corresponding groups in scenario B1, i.e.:

A1: Major roads	→	B1: Major roads
A1: Minor roads	→	B1: Minor roads
A1: Go Slow (Major roads)	→	B1: Go Slow (Major roads)
A1: Go Slow (Minor roads)	→	B1: Go Slow (Minor roads)

Copying the sources from scenario A1 saves a significant amount of time. There is no need to select the sources to which the speed restriction applies, since this selection has already been made for the A1 scenario and the sources moved to the appropriate group. Similarly there is no need to apply the speed restriction, since this has already been done for the A1 scenario.

In order to calculate the future impact of the speed restrictions investigated in Step 3, all the groups in the inventory must be modified to use the year 2020 and the 'NAEI 14 Eng[3] U20' route type. Emissions totals are then recalculated and these are given in **Table 10.1**. In this case, total NO_x emissions decrease slightly and total PM_{10} emissions *increase* slightly in comparison to scenario B. Users should be aware that speed restrictions may not always decrease emissions; for some vehicles for some pollutants they can decrease with speed for lower speeds, and then increase again at higher speeds.

10.3.2 The effect of a *Low Emission Zone (LEZ)* on emissions totals

The method used to investigate the change in emissions totals due to the introduction of an LEZ is very similar to that given in Section 10.3.1 above. Consequently some details have been omitted here, such as the creation of new inventories and groups and copying sources between groups.

Step 5 Scenario A2

In order to investigate the effect of an LEZ on the Base Case emissions, a new inventory is created, 'A2: Base Case + LEZ' containing four new groups:

- A2: Major roads
- A2: Minor roads
- A2: LEZ (Major roads), and
- A2: LEZ (Minor roads)

The major and minor road sources from the Base Case scenario, A, are copied across to groups 'A2: Major roads' and 'A2: Minor roads' respectively.

The next step is to set up an LEZ route type for the Base Case year. For this fictional example, we shall consider the exclusion of all pre-EURO, Euro 1/I, Euro 2/II and Euro 3/III vehicles in the Base Case year from a certain area (see Appendix A for further explanation of the Euro categories). A new route type is created by selecting **Data** from the EMIT menu bar, then **Route types**, **Road** and **New...**. **Figure 10.9** shows the **New Route Type** screen. In this case the new route type will be created by editing the 'NAEI 14 Eng[3] U15' route type (**Copy data from...**).

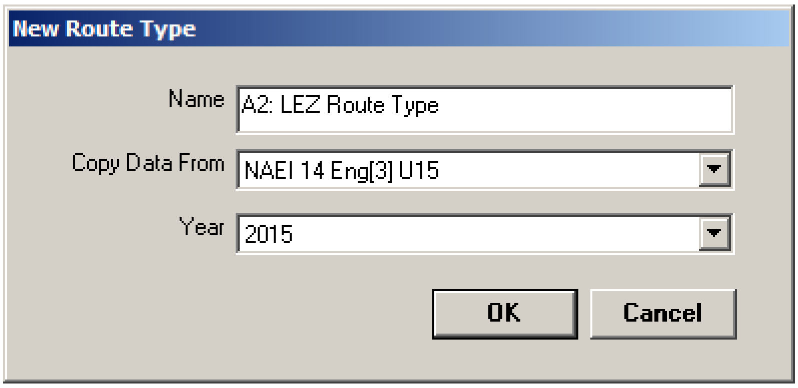


Figure 10.9 – Creating a new route type 'A2: LEZ Route Type', using data from the 'NAEI 14 Eng[3] U15' route type.

The route type data can be edited in a spreadsheet package such as Microsoft Excel, and data can be copied and pasted between EMIT and the spreadsheet package using the **Copy** and **Paste** buttons on the EMIT route type screen. For this example the contributions from pre-EURO, Euro 1/I, Euro 2/II and Euro 3/III vehicles have been removed, and the total composition made up to 100% by keeping the relative proportions of the remaining vehicles constant.

The EMIT interface is then closed, and the sources are viewed in the Mapper. An area is selected within which to apply the LEZ route type. As in the previous example (Section 10.3.1), the selected major and minor road sources are moved into new groups, 'A2: LEZ (Major roads)' and

'A2: LEZ (Minor roads)'. The Mapper is then closed and EMIT is restarted to open the database. The new route type is applied to the two LEZ groups, using the **Modify Group...** button on the **Groups** screen, and emission totals for this inventory are calculated. The new inventory totals are given in **Table 10.1**. Emission totals have been slightly reduced by the introduction of a LEZ: a reduction of 2% is achieved for NO_x and 1% for PM_{10}.

Step 6 Scenario B2

Firstly, another new route type must be defined to represent an LEZ in the future year 2020. In this future year, the LEZ will be tightened; EURO 4/IV vehicles will now be excluded in addition to the pre-EURO, Euro 1/I, Euro 2/II and Euro 3/III vehicles. This route type is named 'B2: LEZ route type'. The roads from Inventory A2 are copied into appropriate groups in a new inventory named 'B2: Future Year + LEZ', as in Step 4 in Section 10.3.1 above. The 'NAEI 14 Eng[3] U20' and 'B2: LEZ route type' route types are applied to the non-LEZ and LEZ groups respectively. Emission totals are recalculated and are given in **Table 10.1**.

In the future year, the decrease in emissions due to the implementation of the LEZ is again 2% for NO_x and 1% for PM_{10}.

An alternative LEZ could be created by the exclusion of all heavy vehicles. A simple approach would be to use the **Multiple Source Edit** screen, shown in **Figure 10.10**, to set the percentage of heavy vehicles within the LEZ to be zero. Also, users may like to investigate the introduction of an increased number of hybrid cars – this would involve the creation of a new route type, as described above.

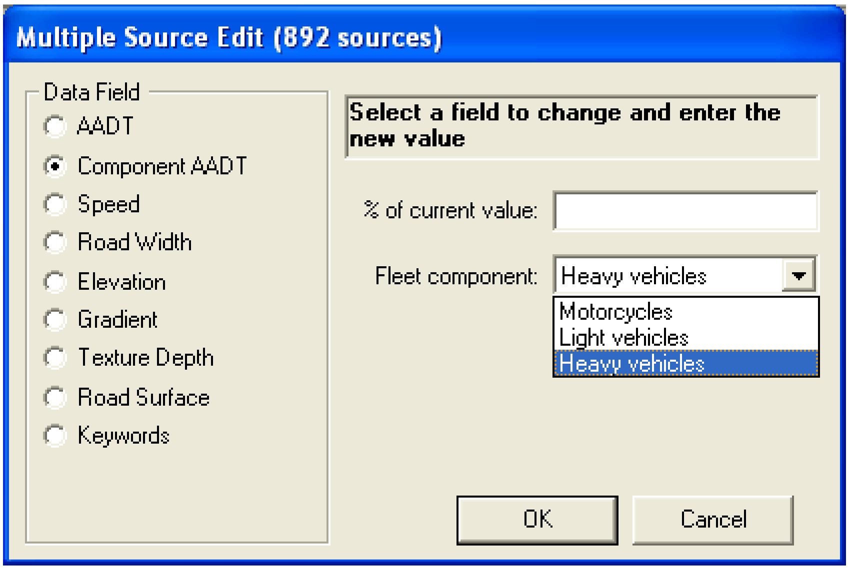


Figure 10.10 – Changing the % of HGVs to be zero in order to represent an LEZ (using the **Multiple Source Edit** screen).

In this example a relatively simple approach has been taken to the modelling of an LEZ. Other factors that could be taken into account include the increased traffic flow in the non-LEZ area by vehicles that do not meet the required standards and a possible corresponding decreased flow of traffic inside the LEZ.

SECTION 11 Greenhouse Gas (GHG) emissions

This section describes how EMIT can be used to calculate and store greenhouse gas (GHG) emissions to compile a greenhouse gas inventory. Section 11.1 gives a brief introduction to how GHG emissions are calculated by EMIT. Sections 11.2 and 11.3 give details of how EMIT can be used to compile a GHG inventory using the 'bottom-up' and 'top-down' approaches respectively; and an example GHG inventory is compiled in Section 11.4.

11.1 Introduction

The 6 greenhouse gases usually considered in GHG emissions inventories are:

- carbon dioxide (CO_2)
- methane (CH_4)
- nitrous oxide (N_2O)
- hydrofluorocarbons (HFC)
- perfluorocarbons (PFC)
- sulphur hexafluoride (SF_6)

All of these pollutants can be stored in EMIT.

There are many different sources of greenhouse gas emissions, for example energy production, industrial processes, agriculture and waste. A comprehensive categorisation of GHG sources is given in the IPCC Revised 1996 Guidelines for National Greenhouse Gas Inventories (IPCC, 1996). For the UK, Ricardo-AEA has calculated greenhouse gas emission totals, and these are reported in the UK Greenhouse Gas Inventory, 1990 to 1999 (Salway *et al.*, 2001).

The UK Greenhouse Gas Inventory divides emission totals into 7 GHG categories (or sectors):

- Energy
- Industrial Processes
- Solvent and other product use
- Agriculture
- Land-use change and forestry
- Waste
- Other

In EMIT, each group must have one of these GHG sectors associated with it. For further details of how these categories are assigned, please refer to Section 5 of this User Guide. When GHG totals are displayed in EMIT, they are listed both in terms of groups and GHG sectors (see Section 11.1.3 below).

Greenhouse gas emissions can be reported as tonnes of each gas emitted per year or, as the gases have different impacts for global warming (Global Warming Potential, GWP, with CO_2 emissions expressed as Carbon), the mass of each non-CO_2 gas can be converted into the equivalent tonnes of CO_2 using the scaling factors listed in **Table 11.1**. For example, the scaling factor for methane, CH_4, is 21, which means that 1 tonne of CH_4 has the same global warming potential as 21 tonnes of CO_2. Further details are given in Section 11 of the UK Greenhouse Gas Inventory, 1990 to 1999 (Salway *et al.*, 2001). In EMIT, emission totals are given explicitly, as well as in terms of GWP.

Pollutant	GWP
CO_2	1
CH_4	21
N_2O	310
HFC	140-11700
PFC	6500-7000
SF_6	23900

Table 11.1 – Global Warming Potentials (GWP) of Greenhouse Gases on a 100-year horizon.

In compiling a greenhouse gas inventory it is important to be clear about whether the emissions are to be attributed to the **source of emissions** or to the **end-user**. For instance, a power station will emit quantities of greenhouse gases. If the emissions due to electricity generation are attributed to that plant, that is a **source of emissions** approach, whereas, if the emissions are attributed to users of electricity, according to the amount of electricity used, that is an **end-user** approach. Different approaches will be suitable for different purposes, but it is important to be aware of which approach is being used.

There are two main approaches adopted for the compilation of a greenhouse gas emissions inventory. These are:

- a ‘bottom-up’ approach; and
- a ‘top-down’ approach.

These methods are briefly described below, with further details and brief examples using EMIT given in Sections 11.2 and 11.3. In practice a greenhouse gas inventory may be compiled using a combination of both methods.

11.1.1 The ‘bottom-up’ approach

In this approach, emissions from individual sources are calculated and summed. This is the more accurate way of calculating GHG emissions, and in particular the spatial distribution of emissions, if accurate data and emission factors are known. At its simplest, emissions from industrial sources, say, may be known from measurements or from the public register and these emissions can be entered explicitly into EMIT.

If the emissions are not known explicitly, an emission factor must be used. Then the emission, E, of pollutant in tonnes/year, is equal to the product of the activity, A (unit activity)/year and the emission factor, e_f in tonnes of pollutant/unit activity i.e.

$$E = Ae_f \tag{11.1}$$

Examples of this approach are the calculation of GHG emissions from road and rail sources in EMIT, where the activity is the number of vehicles or number of locomotive carriages and the emission factors are the stored transport datasets, for example the '**EFT v10.1**' datasets, and **UKEFD 2001** (for further details of the transport datasets, please refer to Appendix A). Also, calculation of emissions from industrial point, line, volume and area, and CandD sources using the non-transport activity datasets detailed in Appendix C is also a 'bottom-up' approach. Examples of activity data for these sources include the amount of fuel or electricity consumed, and the amount of product produced.

The 'bottom-up' approach to the calculation of GHG emissions requires detailed source data. The emissions calculated are spatially varying and are usually more accurate than those obtained using a 'top-down' approach.

Use of emission factors to calculate emission rates for transport and explicitly defined emissions for industrial sources is a 'bottom-up' **source of emissions** approach. However, for a CandD source the emissions due to electricity consumption correspond to a 'bottom-up' **end-user** approach.

11.1.2 The 'top-down' approach

This is basically a scaling approach. The UK Greenhouse Gas Inventory, 1990 to 1999 (Salway *et al.*, 2001) and the Digest of United Kingdom Energy Statistics (**DECC 2012**), supply important information on a national or other large scale which can be used to estimate 'local' GHG emissions, E_{local}. The following algorithm is used

$$E_{local} = E_{UK} \frac{STAT_{local}}{STAT_{UK}}, \tag{11.2}$$

in which E_{UK} are the emissions for the whole of the UK or other large area and $STAT_{local}$ and $STAT_{UK}$ are respectively the local and large-scale 'statistics' of some kind. The UK 'statistic' may be obtained from the DECC (**DECC 2012**) or the national UK statistics web site (**National Statistics**). The 'statistic' is some value that may be taken as an indicator of the emission required, for instance population or car ownership.

This top-down approach is used for the calculation of GHG emissions from sources about which less is known, for example emissions due to electricity usage or from landfill sites. It is less accurate than the 'bottom-up' approach and depends on the suitability of the scaling statistic chosen. The spatial resolution of emissions obtained is limited by the resolution of the statistic used.

The statistic chosen will determine whether the approach is a **source of emissions** or an **end-user** approach. For instance for landfill, if the statistic is population, the approach is 'top-down' **end-user** as it assumes that everyone in the country contributes equally to emissions from landfill. However, if the volume of a landfill site is used, the approach is a 'top-down' **source of emissions** approach as it attributes the emissions to the site itself, and people from outside the local area will use the site.

11.1.3 Viewing GHG emission inventory totals

Once the GHG emissions have been calculated, the emissions totals can be viewed by clicking on **View Totals** on the **Inventory** screen. Clicking on the **Greenhouse Gases** tab displays the Greenhouse gas totals, both in terms of tonnes of each gas emitted per year or Global Warming Potential (GWP). **Figure 11.1** shows the **Greenhouse Gases** screen, with totals given in terms of GWP. The units are kilotonnes per year, unless the inventory has a time period specified, in which case they are kilotonnes for the period.

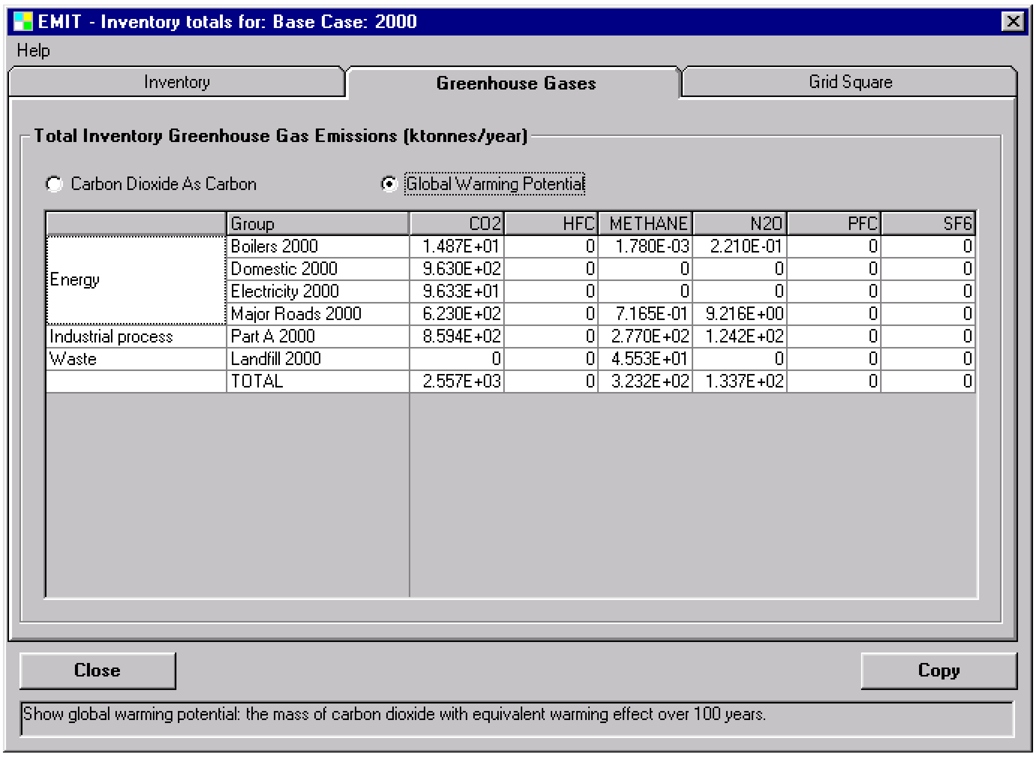


Figure 11.1 – Greenhouse Gas totals in the **Inventory totals** screen

The emissions are given in terms of totals for each group, with a total emission for each pollutant in the **TOTAL** row. In addition, the groups are each categorised into one of the seven GHG sectors, which is shown in the left hand column.

Note **Table 11.1** shows that PFC and HFC have a range of GWP factors. In EMIT, the factor for PFC is taken to be the midpoint in the available range i.e. 6750, and the factor for HFC is taken to be the maximum in the range i.e. 11700; in this latter case, any HFC value presented in terms of GWP is preceded by a less-than sign (<). Users are therefore advised to treat HFC GWP values calculated in EMIT as screening figures indicating whether the HFC contribution needs more careful treatment, rather than exact values.

As for all inventory totals calculated in EMIT (as described in Section 9), results can be copied and pasted into other software, such as Microsoft Excel, using the **Copy** button.

11.2 Using the 'bottom–up' approach

EMIT can be used to compile GHG emissions inventories using the 'bottom-up' approach. In this section we discuss the some different source types in turn, giving examples of sources of GHG emissions, and how they can be represented in EMIT using the 'bottom-up' approach.

- Road sources

  The three greenhouse gases emitted by road sources are CO_2, methane and N_2O.

  The calculation performed by EMIT when the user has imported traffic flows and route types is given in detail in Section A.7 of Appendix A. For example, for a road with the following features:

  – Length = 0.179km

  – Traffic: 95 motorcycles, 8688 light vehicles, 434 heavy vehicles per day

  – Speed = 15km/hr

  – Route type = "EFT v6.0 Urban Eng"

  – Emission factors: **EFT v6.0.1**; year=2015; 246g/vehicle/km CO_2 for rural light vehicles at 15km/hr; 1231g/vehicle/km CO_2 for rural heavy vehicles at 15km/hr

  EMIT performs the following calculation:

$$E = [(95 + 8688) \times 246 + 434 \times 1231] \times 0.179 \times 365 \times \frac{1}{10^6} \qquad \textbf{(11.3)}$$

$$= 1.76 \times 10^2 \text{ tonnes of } CO_2 \text{ per year}$$

  Here we can see that Equation (11.3) fits into the general format of Equation (11.1), i.e. the calculation performed by EMIT automatically is a 'bottom-up' approach. The spatial variation of the GHG emissions is on a road-by-road basis.

- Minor road sources

  Minor road sources use the same emission factors as the major road sources, but are defined using the number of vehicles in terms of vehicle km/year within the area rather than number of vehicles per day and length of the road link. For a minor road source defined by the following parameters:

  – Traffic in 1km^2: 50 motorcycles km/year, 4090 light vehicle km/year, 352 heavy vehicle km/year

  – Speed = 15km/hr

  – Route type = "EFT v6.0 Urban Eng"

  – Emission factors: **EFT v6.0.1**; year=2015; 246g/vehicle/km CO_2 for rural light vehicles at 15km/hr; 1231g/vehicle/km CO_2 for rural heavy vehicles at 15km/hr

  EMIT performs the following calculation:

$$E = [(50 + 4090) \times 246 + 352 \times 1231] \times \frac{1}{10^6} \tag{11.4}$$

$$= 1.45 \text{ tonnes of } CO_2 \text{ per year}$$

Again we can see that Equation (11.4) fits into the general format of Equation (11.1), i.e. the calculation performed by EMIT is a 'bottom-up' approach, with the spatial variation being on a km by km basis.

- Rail sources

  Two of the rail emission factor datasets contain GHG emission factors for CO_2, methane and N_2O: **UKEFD 2001** and **UK Diesel 2001**. The calculations for rail emissions taking into account number of trains, carriages or locomotive cars, train type, emission factors and length of rail track, are similar to those for major roads, except that the rail emission factors are not speed dependent.

- Point sources

  GHG emissions from point sources may be known explicitly. Alternatively, emissions can be calculated using available activity data and one of the non-transport datasets described in Appendix C. Emission factors are given for CO_2, PFC, methane and N_2O, although not all pollutants are included in all datasets. For example, emissions from a boiler may be calculated in the following way:

  – Fuel consumption: 5 tonnes of gas oil per year

  – Use: a council building

  – Emission factors: 'Gas Oil – Public Service; Misc (t used)' chosen from the **UKGHG99 Fuels** dataset (a factor of 3142 kg of CO_2 per tonne of gas oil consumed)

  EMIT performs the following calculation:

$$E = 5 \times 3.142 \tag{11.5}$$

$$= 15.7 \text{ tonnes of } CO_2 \text{ per year}$$

  This is 'bottom-up' approach to the compilation of GHG emissions.

- Area, line and volume sources

  Area, line and volume source emissions can be calculated in the same way as point source emissions.

- Commercial and domestic (CandD) sources

  CandD source emissions can vary from grid square to grid square. If these emissions have been calculated directly, then they can be referred to as 'bottom-up' sources.

  For example, consider domestic energy use. Section 12 describes how CO_2 emissions from domestic energy use can be approximated using a methodology based on the Government's Standard Assessment Procedure for Energy Rating of Dwellings (SAP

2001). The SAP-based EMIT calculation depends on the following information:

– Number of dwellings in an area,
– House type (i.e. detached, semi-detached, terraced and so on),
– Fuel type,
– Level of insulation, and
– Efficiency of the heating system.

Note that all the non-transport emission factor datasets described in Appendix C can be used for CandD source emissions.

11.3 Using the 'top–down' approach

EMIT can be used to compile GHG emissions inventories using the 'top-down' approach. This approach is suitable if little data are available on the sources and the emissions.

The way this is done is to set up a 'scaling' group in EMIT; this has been demonstrated in the landfill group example given in Section 5.3.4.

In this section we consider some different source types and explain how their greenhouse gas emissions might be estimated using this 'top-down' approach. Examples of the statistics that may be used in the scaling of the UK emissions are given.

- Road sources

  Suitable statistics may be population or number of vehicles registered locally. However, both statistics may be inaccurate for areas with a lot of through traffic, for example from major motorways.

- Minor road sources

  The same statistics that can be used to scale major road emissions can be used to scale minor road emissions. These statistics may be more appropriate for minor road emissions than major road emissions, as journeys made on minor roads, such as 'the school run', are likely to be made by people who live locally, and whose cars are registered locally.

- Rail sources

  The number of trains starting or arriving at local stations, obtained from the relevant passenger timetable or freight operating company, could be used to scale UK rail emissions.

- Point sources

  The number or capacity of industrial works in an area, categorised into industry type, could be used to estimate emissions. The area of land in industrial usage might also be a suitable statistic.

- Area and volume sources

  The surface area or volume of a landfill site or the capacity of a sewage works could be used to scale UK emissions.

- Commercial and domestic (CandD) sources

  Emissions due to the generation of electricity can be scaled by population or the number of electricity customers. Some energy consumption figures may be available on a postcode area basis to give some spatial disaggregation of greenhouse gas emissions.

11.4 An example Greenhouse Gas Emissions Inventory

As an example, a GHG emissions inventory for the Calderdale area shown in **Figure 11.2** will be created for the year 2000. The groups to be considered are those shown in **Figure 11.3**. Users should refer to Section 5 in order to learn more about how to set up an inventory.

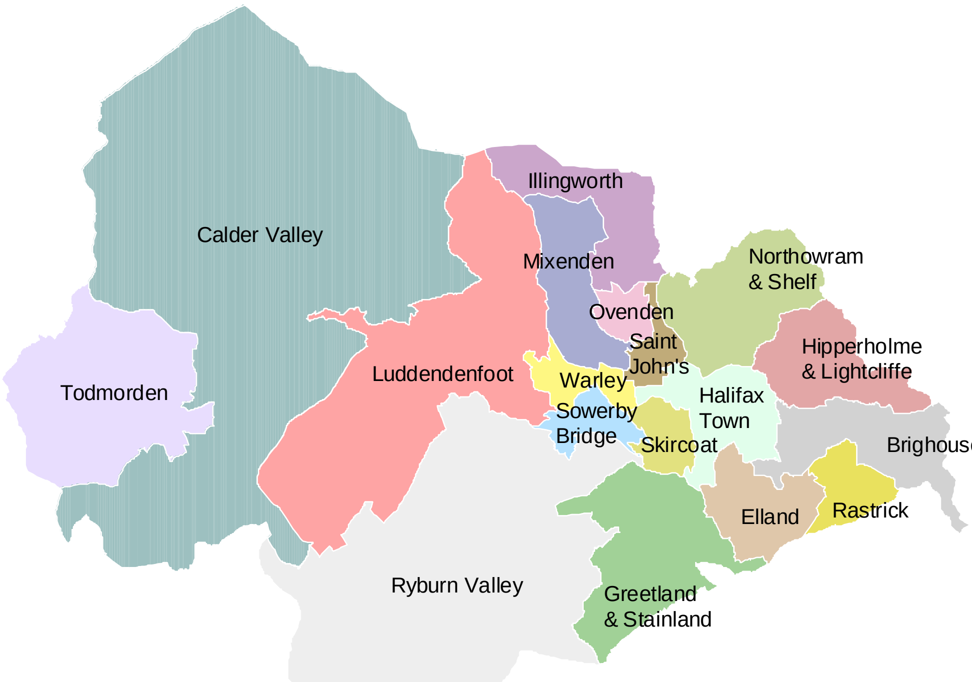


Figure 11.2 – The Calderdale area showing the different wards

Table 11.2 summarises the groups to be considered within this emissions inventory. In the following sections, each group is taken in turn, and the source/activity data are described, and details are given of any manipulations required.

Section 11.4.1 describes the results from this example, and shows how they are presented in EMIT. This section also discusses alternative ways of presenting results. Section 11.4.2 gives some ideas of different scenarios that can be investigated using EMIT.

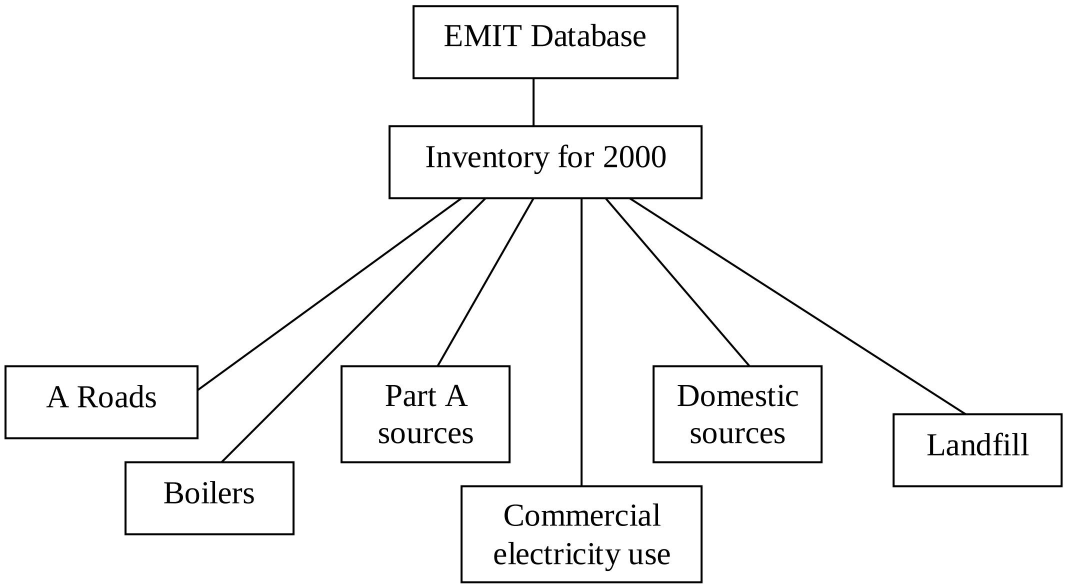


Figure 11.3 – An example GHG emissions inventory for Calderdale showing 6 groups

A roads

The activity data available here are the traffic flows in terms of average daily light and heavy vehicle counts, average traffic speeds and road widths; no additional fleet composition data are available. Using these data to calculate emissions is a 'bottom-up' approach.

A road traffic emission dataset must be chosen. For further details of all the road traffic datasets available, please refer to Appendix A. It is always best to use the most up-to-date emission factors available; in this example, the **EURO SCALED 03**[1] dataset has been used. As no local fleet composition data are available, one of the standard route types will be used – Calderdale is a fairly rural area, so the route type **SCALED 03 Rural 00**[2] is suitable.

A new major roads group should be created; for further details of how to do this, please refer to Section 5. The activity data can then be imported into EMIT using the EMIT Import Wizard – please refer to Section 6 for details of how this is done.

Part A sources

Explicit emissions from Part A sources are supplied by the Environment Agency. Additional source information such as source height, source diameter, exit velocities and temperatures are also of interest if the data are to be used for local air quality modelling, but default values can be entered if it is only GHG emissions that are of interest. Entering these explicit emissions data is a 'bottom-up' approach to creating a GHG emissions inventory.

An industrial point source group must be created (as outlined in Section 5), and the emissions imported into this group using the Import Wizard.

[1] **EURO SCALED 03** is a redundant dataset no longer contained within the EMIT database.
[2] **SCALED 03 Rural 00** is a redundant route type no longer contained within the EMIT database.

Boilers

The available activity data for the boilers in the Calderdale area are fuel consumption values. These data need to be converted to emission rates using an appropriate dataset. One suitable dataset is the **UKGHG99 Fuels** dataset, which gives the emission rates from fuel use for liquid, solid (including coal) and gaseous fuels from the UK Greenhouse Gas emissions inventory (Salway *et al.* 2001). Using these data to calculate emissions is a 'bottom-up' approach.

A new industrial point source group must be created and the activity data imported. As for the groups described above, please refer to Section 5 and Section 6 for further details of how to do this.

Group Description	Source Type	Available Source Data	Emissions Calculation*	Example Activity Dataset (if applicable)	Greenhouse Gas Sector
A Roads	Major road	Traffic flows, speeds, fleet data	**Calculate with emission factors**	EURO SCALED 03	Energy
Part A sources	Point	Emissions data	**Enter emissions manually**	n/a	Energy / Industrial Processes
Boilers	Point	Fuel consumption data	**Calculate with emission factors**	UKGHG99 Fuels	Energy
Commercial electricity use	CandD	Number of kWh	**Calculate with emission factors**	Electricity-End Use	Energy
Landfill	Area	Population	**Calculate by scaling**	n/a	Waste
Domestic sources	CandD	Number of dwellings	**Calculate with emission factors**	SAP 2001	Energy

*as defined on the **EMIT New Group** screen

Table 11.2 – Groups contained within the example Calderdale GHG Emissions Inventory shown in **Figure 11.3**

Commercial electricity use

Figure 11.4 shows the annual commercial electricity usage in Calderdale on a 1km^2 grid. These data can be imported into EMIT as CandD sources, and the **Electricity-End Use** emission factor dataset can be used to convert the electricity consumption values into CO_2 emissions. Calculating emissions from electricity in this way is a 'bottom-up', **end-user** approach.

Such detailed electricity consumption data may not be available. If this is the case, a 'top-down' approach to calculating emissions is an option, using a scaling of the UK emissions from commercial buildings by, say, local population statistics. This would be similar to the way in which the landfill emissions are calculated below.

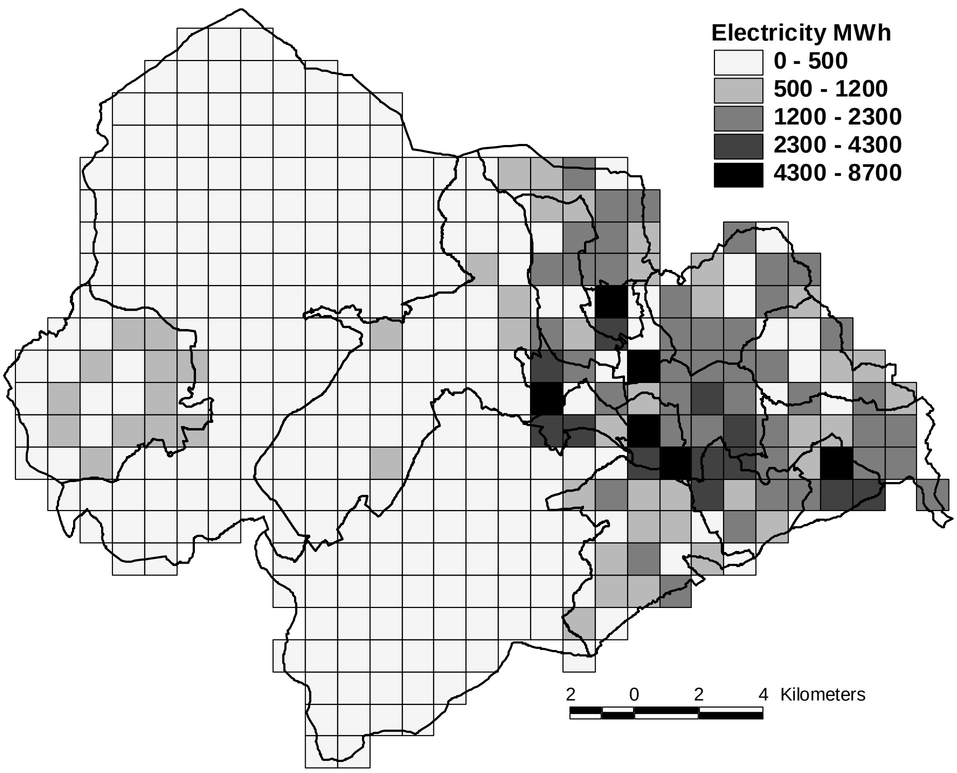


Figure 11.4 – Annual commercial energy use in Calderdale in MWh on a 1km^2 grid

Landfill

A 'top-down' approach can approximate the emissions from landfill. In this case, population data are used to scale UK emissions from landfill sites. Comparing to equation (11.2) in Section 11.1.2, the available data are:

E_{UK} = UK emissions from landfill, 660000 tonnes of methane per year in 2000

$STAT_{UK}$ = Total UK population in 2000, approximately 59 million

$STAT_{local}$ = Calderdale population data

In this case, population data are known only on a ward-by-ward basis. Therefore, it was decided to make a gridded area source to represent the population over the whole area. This was done in a GIS package and the results are shown in **Figure 11.5**. It is interesting to compare **Figures 11.4** and **11.5** as we see that the high electricity energy use parts of the region are those that are most densely populated, as expected.

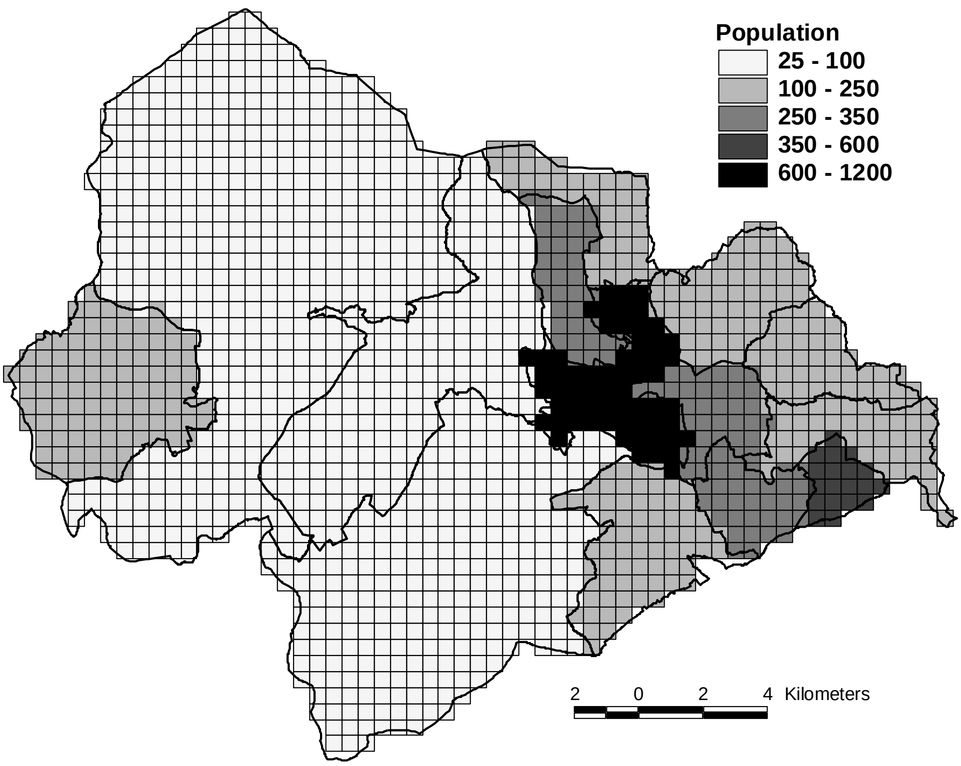


Figure 11.5 – Population in Calderdale shown on a 0.25km^2 grid

Section 5 outlines how to set up this landfill source group using population as a scaling parameter. The population data can then be imported using the EMIT Import Wizard. Note that when calculating emissions using a scaling, on import, the column containing the scaling data – in this case population – should be headed 'STAT' (as indicated in Table 6.5 and Table 6.6 in Section 6).

Domestic sources

The number of dwellings in each ward is known; also, the type of housing in different areas is known. Therefore, the CO_2 emissions can be approximated using the SAP-based emission factor dataset contained within the EMIT database, **SAP 2001**.

The way to create a domestic sources group in EMIT using these factors is described in Section 12.

11.4.1 Results

Figure 11.1 shows the emissions totals for this example displayed in EMIT in terms of Global Warming Potential (GWP). These data can be displayed in a number of ways. For example, **Figure 11.6** shows 3 pie charts of the total GHG emissions in terms of GWP created in Microsoft Excel:

(a) All group totals,

(b) Energy sectors as defined in the UK Energy in Brief document (UK ENERGY

2001), and

(c) GHG sectors as defined in the UK Greenhouse Gas Emissions Inventory (Salway *et al*. 2001).

For the 'base case' it is often a good idea to view the emission totals in this way as it shows where the majority of the GHG emissions are coming from. This allows decision makers to target the correct sectors when considering emission-reduction scenarios.

By comparing **Figure 11.6** (b) to the energy sector pie chart for the UK shown in **Figure 5.2** in Section 5, we see that for Calderdale, industry has a significantly higher contribution than the UK average. This is expected, as Calderdale is a relatively rural area with significant industry[3]. So in this area, considering ways of reducing emissions from industry are likely to bring down totals more than, say, targeting the emissions from the services sector, although there will be other relevant considerations such as cost and ownership.

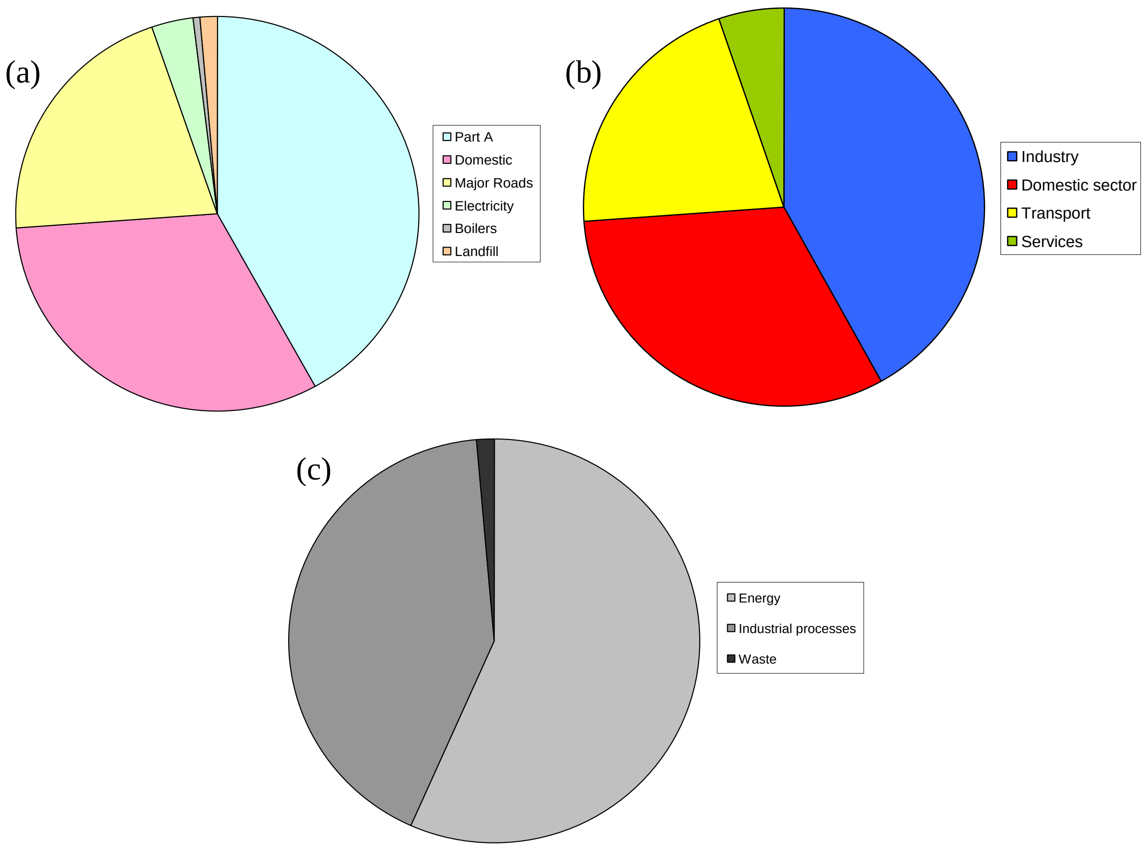


Figure 11.6 – Pie charts created in Microsoft Excel showing GHG Emission Inventory totals in terms of Global Warming Potential: (a) all group totals (b) energy sectors as defined in the UK Energy in Brief document (UK ENERGY 2001) and (c) GHG sectors as defined in the UK Greenhouse Gas Emissions Inventory (Salway *et al*. 2001)

[3] Note that this inventory has been set up as an example. Not all emissions have been included and some values have been altered for demonstration purposes.

11.4.2 Different Scenarios

Once a base case GHG Emissions Inventory has been compiled, a number of different emission-reduction scenarios may be considered. For example:

- Emissions from traffic can be reduced by restricting certain high-CO_2 producing vehicles from some parts of urban areas i.e. introducing a Low Emission Zone with respect to Carbon emissions. This can be modelled in EMIT by applying new route types to certain areas, as described in the Traffic Management chapter of this user guide, Section 10.

- Emissions from industry need to be considered directly. For example, the Part A source emissions can be viewed in the EMIT Mapper and scaled by CO_2 emissions, as shown in **Figure 11.7**. Here we see that there is one source that has significantly higher CO_2 emissions than any of the other sources. Selecting this source, it is possible to look at the emissions, and perhaps consider ways of reducing the emissions by encouraging the use of new technologies.

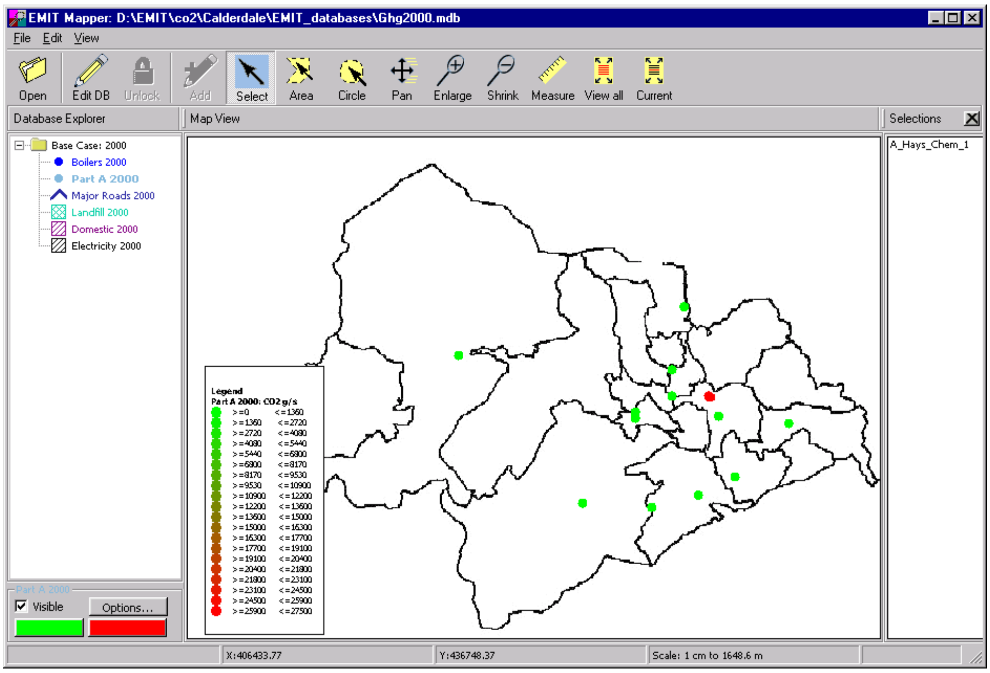


Figure 11.7 – CO_2 emissions from Part A sources, scaled by emission

- It is possible to investigate reduction in emissions from domestic sources by applying different region types to the dwellings in the area, as described in Section 12.

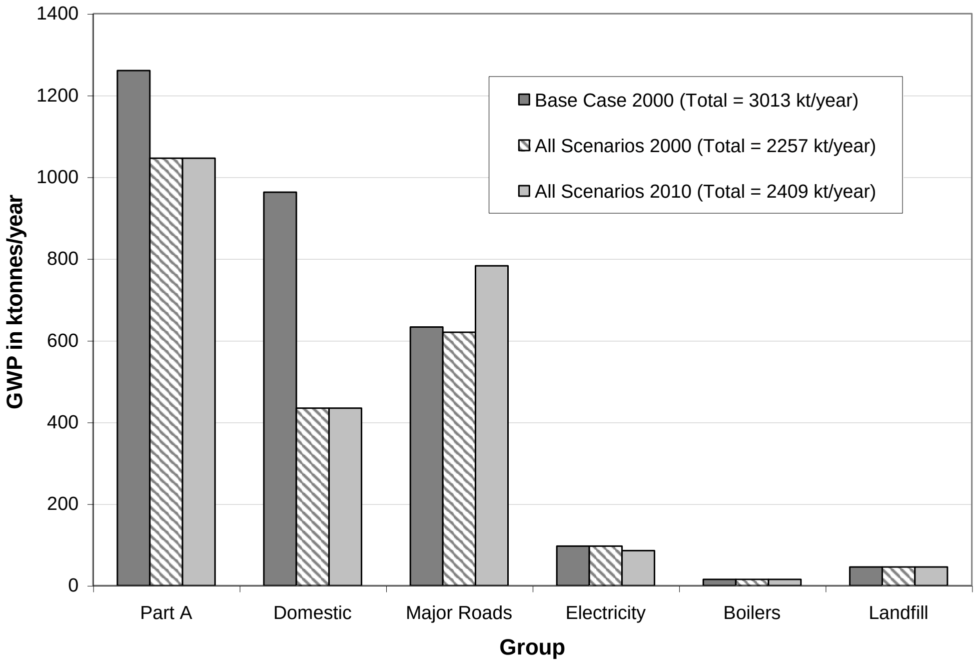


Figure 11.8 – Example GHG scenarios investigated using EMIT

Figure 11.8 shows a bar chart of GHG totals calculated in EMIT, then copied into and manipulated in Microsoft Excel. Here, the Base Case 2000 results are those compiled in Section 11.4.1. The All Scenarios 2000 results are from considering the different emission reduction scenarios described above, specifically:

- A low-CO_2 zone was created in the central part of the region.
- Emissions from the most polluting Part A source were reduced by 25% due to improved technologies being applied.
- The domestic emissions were reduced by significantly improving the insulation and heating efficiency in all housing. In addition, all properties using electricity for heating were converted to gas.

These measures reduce the CO_2 emissions by approximately 25% in 2000. For this scenario, the most significant reduction in emissions is from the improvement in domestic property energy use.

It is also important to consider the scenario for future years, as some emissions are predicted to change with time; specifically, in this example:

- Emissions from electricity production decrease slightly.
- Emissions from traffic increase significantly – this is a combination of a slight reduction in CO_2 emissions due to improved vehicle technologies outweighed by a significant increase in traffic flows (an annual increase of 2.5% has been assumed).

Comparing the All Scenarios 2010 total with the Base Case 2000 total, we see that there is a 20% reduction in CO_2 emissions.

SECTION 12 Emissions from domestic properties

This section describes how EMIT can be used to estimate the CO_2 emissions from domestic properties using a methodology based on the UK Government's Standard Assessment Procedure for Energy Rating of Dwellings (SAP 2001). This EMIT feature is of particular use when compiling Greenhouse Gas (GHG) emissions inventories.

Section 12.1 gives an introduction to the method used to create the emission values. The full methodology is described in Section 12.2, and maximum and minimum values for the various house types are given. Section 12.3 explains how to set up a group using the SAP emission factors held in EMIT. An example of how EMIT can be used to calculate the CO_2 emissions from domestic properties in an area is given, and this section also demonstrates how to investigate the effects of energy-reduction scenarios.

12.1 Introduction

The UK Government's Standard Assessment Procedure for Energy Rating of Dwellings (hereafter referred to as SAP) is a relatively complicated methodology used to estimate the energy efficiency of domestic properties in terms of over 100 different variables. For a particular dwelling, the SAP calculations combine to give:

- A **SAP Rating**, which is a number between 1 and 120 that gives an indication of the energy efficiency of a particular house (1 is not energy efficient, 120 is energy efficient). Fuel costs are included in the calculation of this rating;
- A **Carbon Factor (CF)**, which is defined as:

  $$\mathbf{CF} = \mathbf{CO_2}/(\mathrm{TFA} + 45.0),$$

  where $\mathbf{CO_2}$ is the emissions in kg/year, and TFA is the total floor area. The units of CF are kg of CO_2/m^2/year; and

- A **Carbon Index (CI)**, which is defined as:

  $$\mathbf{CI} = 17.7 - 9.0 \log_{10} (\mathrm{CF})$$

  where the **CI** ranges from 0 (bad) to 10 (good) and is rounded to 1 decimal place. If the result of the calculation is less than 0 the rating is quoted as 0; if it is greater than 10, the rating is quoted as 10.

In terms of compiling a GHG emission inventory, it is the CO_2 emission value that is of use, but the other indicators are also of interest. In particular, an increasing number of Local Authorities are compiling housing stock condition surveys in terms of the SAP values of properties in their areas. Two important points to be aware of when thinking about SAP values and CO_2 emission values are:

- SAP rating of a property is dependent on the energy efficiency of a property AND the fuel price but NOT on the CO_2 emission rate of the fuel; and

- The CO_2 emission rate of a property is dependent on the energy efficiency of a property AND the CO_2 emission rate of the fuel but NOT on the fuel price.

Therefore, a low SAP rating for a property may not be particularly good with respect to CO_2 emissions if the emission rate of the fuel used is high. A good example of this is a property that uses coal for space and water heating. Coal is an inefficient way of heating and has an 'average' emission rate (with respect to gas and electricity); this combination leads to quite a high CO_2 emission rate for the property. However, coal is cheap and so the SAP rating would not necessarily be that high.

The SAP methodology has been simplified so that users can define dwellings in terms of 5 variables; these are summarised in **Table 12.1**. For each of the variables, a number of assumptions have been made. Some examples of these assumptions are given below.

(a) House Type

There are 5 house types to choose from (given in **Table 12.1**). The main differences between the house types are based on the house dimensions i.e. the detached house is assumed to be larger than the semi-detached which is assumed to be larger than the mid terrace and so on. In addition, the larger houses are taken to have a larger hot water storage volume.

(b) Insulation (walls and roof)

The walls and roof insulation varies between 'Very Poor' and 'Very Good'. Parameters that have been used to vary the insulation include the U-values of the walls and roof, and whether or not the property has a sealed or unsealed suspended wooden floor.

(c) Insulation (doors and windows)

The doors and windows insulation varies between 'Very Poor' and 'Very Good'. Parameters that have been used to vary the insulation include the percentage of doors and windows draught-stripped, and whether or not the property has a draught lobby. Whether or not the windows are single, double or triple glazed was also taken into account.

Category	**Ranges:**					
House Type	Detached	Semi detached	Mid terrace	Ground floor flat	Bungalow	
Insulation (walls and roof)	Very poor	Poor	Average	Good	Very good	
Insulation (doors and windows)	Very poor	Poor	Average	Good	Very good	
Space and water heating (type)	Gas	Electric	Solid fuel	Oil	Other	
Space and water heating (efficiency)	50%	60%	70%	80%	90%	100%

Table 12.1 – Summary of variable ranges used to define dwelling properties in EMIT.

(d) Space and water heating (type)

It is assumed that the fuel used for space heating is the same as that used for water heating. There are 5 heating types considered (given in **Table 12.1**). Many of the variables in the SAP calculation are co-dependent on the type of fuel used for the heating *and* the heating efficiency. These are mentioned in section (e) below. Parameters that are independent of the heating efficiency, but dependent on the space and water heating type include the fuel costs and the CO_2 emission factors.

Here, the 'Other' parameters have been chosen to be approximately average.

(e) Space and water heating (efficiency)

The space and water heating efficiency varies between 50% and 100%. As mentioned above, the efficiency of the heating system is dependent on the fuel type. For example, the efficiency of a gas water heater varies between 55% and 85%, whereas for an electric heater, the efficiency varies between 85% and 100%. Other variables that are dependent on the heating efficiency but independent of the fuel type include the hot water storage loss factor and the primary circuit loss.

These five variables can be divided into two categories: the 'house/fuel type' category ((a) and (d)) and the 'insulation/efficiency' category ((b), (c) and (e)). It is usually the variables included in the insulation/efficiency category that would be changed in order to investigate a reduction in housing energy use, although changing to a more efficient/less polluting fuel may be an option to consider.

There are also a number of other inputs into the SAP calculation that are assumed to be the same for all dwellings. For example, all properties are assumed to have one flue, and two fans or passive vents; also it is assumed that all properties are of masonry construction.

Non-heating energy use

According to the DTI's Energy Use Indicators document (**ENERGY 2001**), in the year 2000

"82% of the energy used in households is for space or water heating".

This means that approximately 18% of the energy use in households is *not* for space and water heating. This additional energy is used for cooking, lighting and other household appliances. In most cases, when compiling a GHG emissions inventory, total household energy use is of interest. Therefore, an approximation has been made as to the amount of non-heating energy that is used for each house type, and this value can be included in the EMIT CO_2 emission calculations if required.

Note that:

- All non-heating energy use is assumed to be electrical. This gives a conservative estimate with respect to the CO_2 emission rate because the emission rate for electricity in terms of kg of CO_2 per GJ of energy is larger than all other forms of delivered energy. Obviously, a number of houses use gas for cooking, but the percentage of energy use from cooking is approximately 6% (less than one third of the total non-heating energy use); and
- The non-heating energy use is independent of three out of the 5 variables (a) to (e)

listed above; that is, the non-heating energy use is independent of the quality of the insulation, or the heating efficiency.

Further details of the way in which the non-heating energy use contribution to the emission rate is calculated are given in Section 12.2 below.

Source of emissions and end-user approaches

When compiling any emissions inventory, for each set of sources, it is important to be aware of whether a **source of emissions** approach or an **end-user** approach is being applied. For example, this becomes an issue when electricity generation and consumption are being considered. **Figure 12.1** gives an example bar chart showing energy usage in an area where some properties use gas for space and water heating, some use electricity and some use oil. The white sections of the bars show the energy usage for space and water heating, and the additional non-heating energy usage is shown in grey (this latter contribution is approximately 18% of the total in each case, as discussed in the previous section).

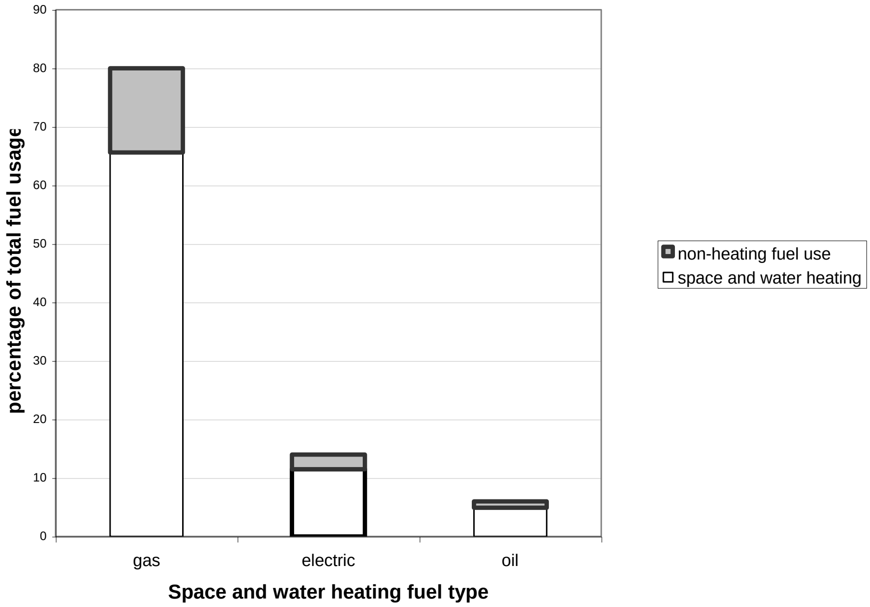


Figure 12.1 – Example bar chart showing energy usage in an area where some properties use gas for space and water heating, some use electricity and some use oil (white section of bars), with the additional non-heating energy usage shown in grey; contributions with thick black outlines indicate electrical energy.

In **Figure 12.1**, contributions shown with thick black outlines indicate electrical energy usage. If an **end-user** approach is being applied, this electrical usage must be taken into account when calculating the emissions from domestic dwellings. If a **source of emissions** approach is being used, the emissions from the power station providing the electricity have already been included in the inventory, so in order to avoid double counting emissions, the electrical energy usage emissions should not be included.

12.2 Methodology

As can be seen from **Table 12.1**, there are a number of different combinations of variables used to define the housing characteristics; in fact, there are 5 x 5 x 5 x 5 x 6 = 3750 different combinations. For each combination, the CO_2 emission rate has been calculated for a single dwelling, and this value is held in the EMIT database. In addition, for reference, the associated SAP and Carbon Indices are included in the EMIT database, and displayed in the EMIT interface for each SAP source. The total CO_2 emission rate is then calculated by multiplying the number of dwellings in an area by the CO_2 emission factor for the chosen property type.

A full list of all the SAP Ratings, Carbon Indices and CO_2 emission factors in the form of a Microsoft Excel spreadsheet, *SAP 2001.xls*, has been supplied in the EMIT installation directory, in the subdirectory *Data\ActivityDatasets*.

Table 12.2 summarises the range of SAP Ratings, Carbon Factors, Carbon Indices and the CO_2 emission factors with and without the non-heating energy use for all combinations of house/fuel type. The minimum, maximum and average values are given in this table.

Table 12.3 gives the same information as **Table 12.2** only averaged over fuel types whilst **Table 12.4** gives the same data averaged over house types. Note that in **Tables 12.3** and **12.4** the 'average' values are not applicable to an average or typical house. This is because they assume an equal contribution from all fuel types / house types respectively, which is not the case in practice. However, these averaged values do show the trends in the data and are therefore of interest. For example:

- **Table 12.3** shows that the SAP Ratings, Carbon Factor and Carbon Indices do not vary a great deal for the different house types – this is expected as these values are supposed to be "*independent of dwelling size for a given built form*" (please refer page 10 of **SAP 2001**).
- **Table 12.3** shows that the CO_2 emission factor ranges vary significantly with house type as expected, with the average emissions varying as follows:

  Ground floor flat < Mid terrace < Bungalow < Semi detached < Detached

  with the order between the bungalow and the semi detached houses probably being due to the relative sizes chosen.

House Type	Fuel Type	SAP Ratings			Carbon Factor			Carbon Index			Emission Factor (non-heating energy use not included)			Emission Factor (non-heating energy use included)		
		Min SAP	Max SAP	Average SAP	Min CF	Max CF	Average CF	Min CI	Max CI	Average CI	Min CO_2	Max CO_2	Average CO_2	Min CO_2	Max CO_2	Average CO_2
Detached	Gas	22	120	69	6.6	75.8	28.6	0.8	10.0	5.2	1228	14019	5295	3184	15975	7251
Detached	Electricity	9	110	53	10.4	102.3	43.2	0.0	8.5	3.5	1925	18931	7995	3398	20403	9467
Detached	Solid fuel	1	120	54	11.2	174.8	58.3	0.0	8.3	2.7	2064	32331	10780	4755	35022	13471
Detached	Oil	29	120	70	8.8	78.4	35.4	0.7	9.2	4.2	1628	14506	6546	3455	16333	8373
Detached	Other	1	120	56	5.4	194.9	41.0	0.0	10.0	4.6	996	36064	7582	3305	38372	9891
Semi detached	Gas	22	115	66	7.3	75.6	29.6	0.8	10.0	5.0	1052	10964	4291	2660	12572	5899
Semi detached	Electricity	8	106	50	11.1	102.8	44.5	0.0	8.3	3.4	1606	14913	6446	2813	16119	7652
Semi detached	Solid fuel	1	120	53	11.9	172.9	59.6	0.0	8.0	2.6	1725	25064	8641	3927	27267	10843
Semi detached	Oil	29	120	70	9.4	78.4	36.4	0.7	8.9	4.1	1367	11366	5275	2864	12863	6772
Semi detached	Other	1	120	54	5.8	192.4	41.9	0.0	10.0	4.5	846	27905	6070	2736	29794	7960
Mid terrace	Gas	23	112	66	7.6	73.4	29.5	0.9	9.8	5.0	954	9169	3681	2354	10569	5081
Mid terrace	Electricity	8	103	49	11.4	99.8	44.0	0.0	8.2	3.4	1429	12470	5499	2475	13515	6545
Mid terrace	Solid fuel	1	120	54	12.3	167.5	58.9	0.0	7.9	2.5	1536	20938	7368	3445	22847	9278
Mid terrace	Oil	31	120	70	9.8	75.9	36.0	0.8	8.8	4.1	1223	9484	4506	2523	10784	5806
Mid terrace	Other	1	118	54	6.1	186.8	41.4	0.0	10.0	4.4	763	23351	5177	2402	24990	6817
Ground floor flat	Gas	34	107	69	7.9	56.3	25.6	1.9	9.6	5.4	676	4785	2176	1498	5607	2999
Ground floor flat	Electricity	21	110	57	10.9	73.9	36.5	0.9	8.4	4.0	925	6283	3100	1525	6883	3700
Ground floor flat	Solid fuel	18	120	65	11.7	109.3	46.0	0.0	8.1	3.2	994	9288	3909	2056	10350	4971
Ground floor flat	Oil	43	120	80	9.4	59.9	30.5	1.7	8.9	4.6	799	5092	2595	1552	5845	3348
Ground floor flat	Other	1	116	61	6.2	109.6	31.2	0.0	10.0	5.1	526	9317	2654	1436	10227	3563
Bungalow	Gas	14	112	61	7.5	90.4	33.8	0.1	9.8	4.6	862	10393	3893	2274	11805	5305
Bungalow	Electricity	1	109	46	11.0	128.6	51.4	0.0	8.3	3.0	1263	14783	5916	2320	15841	6973
Bungalow	Solid fuel	1	120	50	11.8	212.4	68.6	0.0	8.1	2.3	1356	24426	7893	3289	26359	9826
Bungalow	Oil	21	120	66	9.4	93.6	41.5	0.0	9.0	3.7	1079	10769	4773	2391	12081	6085
Bungalow	Other	1	119	50	6.0	243.0	48.6	0.0	10.0	4.2	685	27947	5585	2341	29603	7241

Table 12.2 – SAP, Carbon Factor (kg of CO_2/m^2/year), Carbon Index and CO_2 emission factor (kg of CO_2 per year) ranges and average values.

House Type	SAP Ratings			Carbon Factor			Carbon Index			Emission Factor (non-heating energy use not included)			Emission Factor (non-heating energy use included)		
	Min SAP	Max SAP	Average SAP	Min CF	Max CF	Average CF	Min CI	Max CI	Average CI	Min CO_2	Max CO_2	Average CO_2	Min CO_2	Max CO_2	Average CO_2
Detached	12	118	60	8.5	125.2	41.3	0.3	9.2	4.0	1568	23170	7640	3619	25221	9691
Semi detached	12	116	59	9.1	124.4	42.4	0.3	9.0	3.9	1319	18042	6144	3000	19723	7825
Mid terrace	13	115	58	9.4	120.7	42.0	0.3	8.9	3.9	1181	15082	5246	2640	16541	6705
Ground floor flat	23	114	66	9.2	81.8	34.0	0.9	9.0	4.5	784	6953	2887	1613	7782	3716
Bungalow	8	116	55	9.1	153.6	48.8	0.0	9.0	3.5	1049	17664	5612	2523	19138	7086

Table 12.3 – SAP, Carbon Factor (kg of CO_2/m^2/year), Carbon Index and CO_2 emission factor (kg of CO_2 per year) ranges and values averaged over fuel types.

Fuel Type	SAP Ratings			Carbon Factor			Carbon Index			Emission Factor (non-heating energy use not included)			Emission Factor (non-heating energy use included)		
	Min SAP	Max SAP	Average SAP	Min CF	Max CF	Average CF	Min CI	Max CI	Average CI	Min CO_2	Max CO_2	Average CO_2	Min CO_2	Max CO_2	Average CO_2
Gas	23	113	66	7.4	74.3	29.4	0.9	9.8	5.0	954	9866	3867	2394	11306	5307
Electricity	9	108	51	11.0	101.5	43.9	0.2	8.3	3.4	1430	13476	5791	2506	14552	6867
Solid fuel	4	120	55	11.8	167.4	58.3	0.0	8.1	2.7	1535	22409	7718	3494	24369	9678
Oil	30	120	71	9.4	77.2	36.0	0.8	9.0	4.1	1219	10243	4739	2557	11581	6077
Other	1	119	55	5.9	185.4	40.8	0.0	10.0	4.6	763	24916	5414	2444	26597	7094

Table 12.4 – SAP, Carbon Factor (kg of CO_2/m^2/year), Carbon Index and CO_2 emission factor (kg of CO_2 per year) ranges and values averaged over house types.

- Following on from the previous point, it is interesting to note that the relative volumes of the houses are as follows:
  - detached: $350\ m^3$
  - semi detached: $250\ m^3$
  - mid terrace: $200\ m^3$
  - ground floor flat: $100\ m^3$
  - bungalow: $175\ m^3$

  This demonstrates the effect of building type on CO_2 emissions – the mid terrace house has a bigger volume than the bungalow, but has lower average emissions.

- The fuel dependent averages given in **Table 12.4** vary much more than the house dependent values given in **Table 12.3**.
- The average SAP ratings which include a cost element as well as an energy efficiency element are ordered as follows:

  BEST oil > gas > other = solid fuel > electricity WORST

  The following points explain the overall pattern here:

  - Oil is relatively cheap and is an efficient way of heating;
  - Gas is also relatively cheap but has quite a large standing charge and although gas heating can be efficient, it can also be relatively inefficient (compared to oil);
  - Solid fuel is very inefficient, but is cheap; and
  - Electricity is efficient but very expensive relative to the other fuels, especially on peak.
- The average CO_2 emissions take a different order, because the CO_2 emissions are based only on the energy use and emission factors, and not on fuel price, as discussed in Section 12.1 above. Excluding non-heating sources, the CO_2 emissions take the following order:

  BEST gas < oil < other < electricity < solid fuel WORST

  and including non-heating sources:

  BEST gas < oil < electricity < other < solid fuel WORST

  The following points explain the overall pattern here:

  - Gas a low emission factor (54 kg CO_2/GJ) and is also relatively efficient;
  - Oil, despite being more efficient than gas, has an almost 40% higher emission factor (75 kg CO_2/GJ);
  - Electricity, although also quite efficient, has a 113% higher emission rate than gas; and
  - Coal (on which the solid fuel calculations were based) has a moderate emission

rate (81 kg CO_2/GJ) but is very inefficient.

Non-heating energy use

As discussed in the Introduction, EMIT allows emissions from non-heating sources to be included in the total CO_2 emission rate, if required. The methodology used to calculate these values is discussed in this section.

The SAP calculations only predict CO_2 emissions due to space and water heating, and the remaining household energy use is unrelated to three of the five variables ((a) to (e)) described in the Introduction. That is, the non-heating energy use is unrelated to the quality of the insulation, (b) and (c), or the heating efficiency, (e).

A space and water heating energy use value, E_H, has been evaluated for each of the 25 combinations of house type / fuel types listed in **Table 12.2**. Assuming that 82% of household energy use is for this heating, the non-heating energy use value can then be calculated by:

$$18 \times E_H / 82 \text{ GJ per year.}$$

This energy requirement is assumed to be supplied by electricity. This gives a conservative estimate with respect to the CO_2 emission rate because the emission rate for electricity in terms of kg of CO_2 per GJ of energy is larger than all other forms of delivered energy. Therefore, the appropriate emission factor (from Table 15 of **SAP 2001**) is 115 kg of CO_2 per GJ. So the additional CO_2 contribution from non-heating household energy use is:

$$18 \times 115 \times E_H / 82 \text{ kg of } CO_2 \text{ per year.}$$

When defining the **Region Type**, users can decide whether or not they want to include the CO_2 emissions due to non-heating energy sources in their calculations (for further details, please refer to Section 12.3.2 below).

12.3 Setting up a domestic dwellings group in EMIT

This section describes how to set up a domestic dwellings group in EMIT and import the activity data (i.e. the number of dwellings in an area) into a database. The concept of a **Region Type** is also introduced.

12.3.1 Creating a group using the SAP based CO2 emission factors

First, it is necessary to create a group that will use the SAP emission factors described in Sections 12.1 and 12.2 above. This is done in the usual way (as outlined in Section 5). Figure 12.2 shows the **EMIT New Group** screen. SAP groups can be set up as either CandD or area sources.

The option **Calculate with emission factors** should be chosen, and the **SAP 2001** dataset selected from the drop down list of **Emission Factors**. The GHG sector for these factors is Energy, and the associated year is 2001.

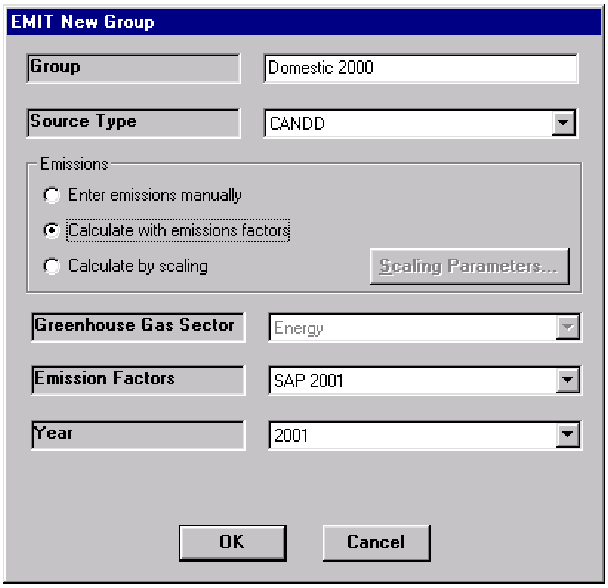


Figure 12.2 – **EMIT New Group** screen showing a CandD group being created using the **SAP 2001** emission factor dataset.

12.3.2 Creating a Region Type for your area

A **Region Type** is created to represent the average house in an area, in the same way that a **Route Type** is created to represent the average traffic composition on a major road (for further details of route types, please refer to Appendix A). Choosing **Region Type** from the **Data** menu activates the **Region Type** screen shown in **Figure 12.3**.

In order to create a new **Region Type**, click on the **New Region Type...** button in the top right hand corner of the screen. This activates the **New region type** screen shown in **Figure 12.4** where a name for the new region type should be entered.

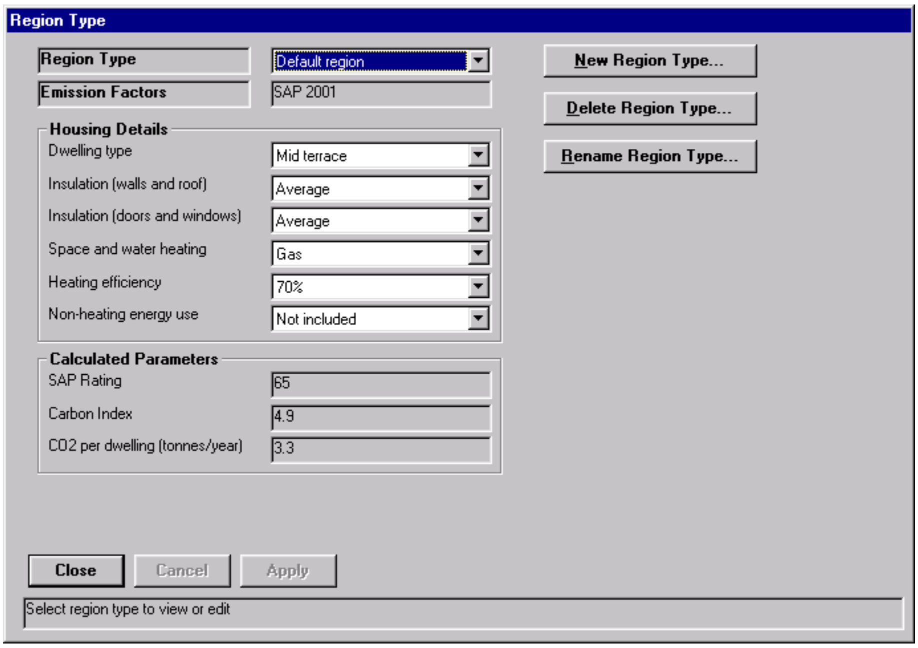


Figure 12.3 – Default **Region Type** screen in EMIT (from the **Region Type** option on the **Data** menu).

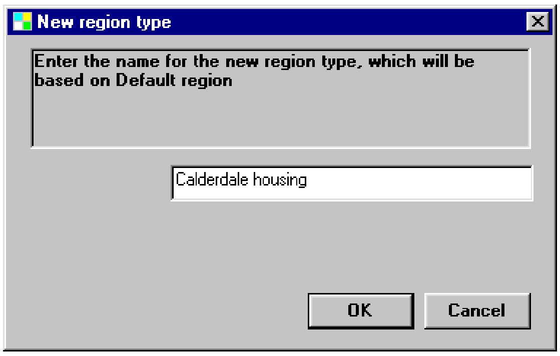


Figure 12.4 – After clicking on the **New Region Type...** button on the **EMIT Region Type** screen, a name for the new **Region Type** is entered in the **New region type** screen.

Clicking on **OK** generates a new **Region Type** (as shown in **Figure 12.4**). The parameters for this **Region Type** must then be chosen using the drop down lists given in the **Housing Details** section of the EMIT **Region Type** screen shown in **Figure 12.5**. These five options allow the user to define a **Region Type** using the variables given in **Table 12.1**. The associated SAP Rating, Carbon Index and CO_2 emission factor per dwelling (in tonnes per year) are displayed in the **Calculated Parameters** section of the screen. When one of the first five parameters is changed, the SAP Rating, Carbon Index and CO_2 emission factor change accordingly.

The last variable in the **Housing Details** section, **Non-heating energy use**, only has two options available: 'Included' or 'Not included'. If the 'Included' option is chosen then the estimated emissions due to non-heating energy use are included in the CO_2 emission rate (as described in Sections 12.1 and 12.2). Conversely, if the 'Not Included' option is chosen, these emissions are not included.

Note:

- Whether or not the non-heating energy use is included does not alter the SAP rating or the Carbon Index of the property; it is only the CO_2 emission value that is dependent on this parameter.
- If an **end-user** approach is being used, then it is likely that the 'Included' option should be used; conversely, if a **source of emissions** approach is being used i.e. the emissions from electricity generation have been included elsewhere in the inventory, the 'Not included' option should be chosen.

Clicking on the **Apply** button saves the **Region Type**. The **Delete Region Type...** button can be used to delete any unwanted region types and the **Rename Region Type...** button can be used to rename the **Region Type** as required.

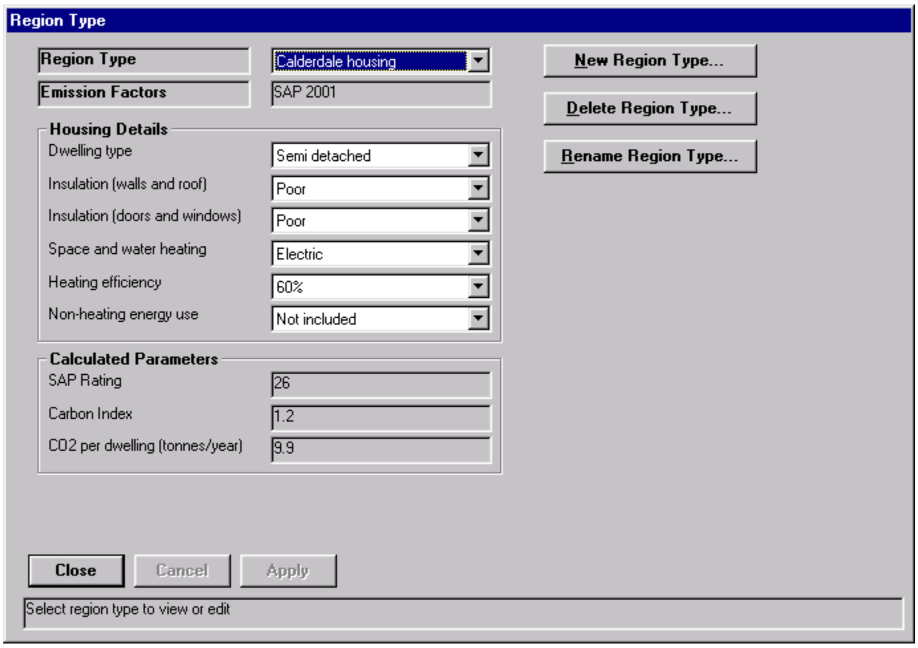


Figure 12.5 – Creating a new **Region Type** in EMIT.

12.3.3 Importing dwelling data into the SAP group

Usually, the available dwelling data are in the form of postcode districts, or wards. If these regions are all convex polygons, the data can be imported directly in CandD or area sources in EMIT. In most situations this will not be true, and it will be necessary to divide the area of interest into rectangular grid cells, with a number of dwellings assigned to each grid cell.

Consider as an example the Calderdale area, as discussed in Section 11 of this User Guide. **Figure 12.6** shows a map of the Calderdale region, with the 18 different wards marked, and the region divided into 1km^2 grid cells. The shading on this map represents the dwelling density: a darker colour, for example in the area to the East around Halifax Town, is densely populated, whereas the region to the northwest is relatively sparsely populated and has significantly less dwellings per km^2.

These dwelling data can be imported into EMIT using the EMIT Import Wizard (for further details, please refer to Section 6, and in particular, Table 6.6). In this example, the data are to be imported into a CandD source group, so the following column headings are required:

- CDNAME – source name column
- NUMDWELL – dwelling data column

and the following column headings are optional:

- NOTES – appropriate notes, for example, the data source
- KEYWORDS – appropriate keywords, for example, any additional data such as the area type

In addition, if the data are in CSV file format, the coordinates of the source are required.

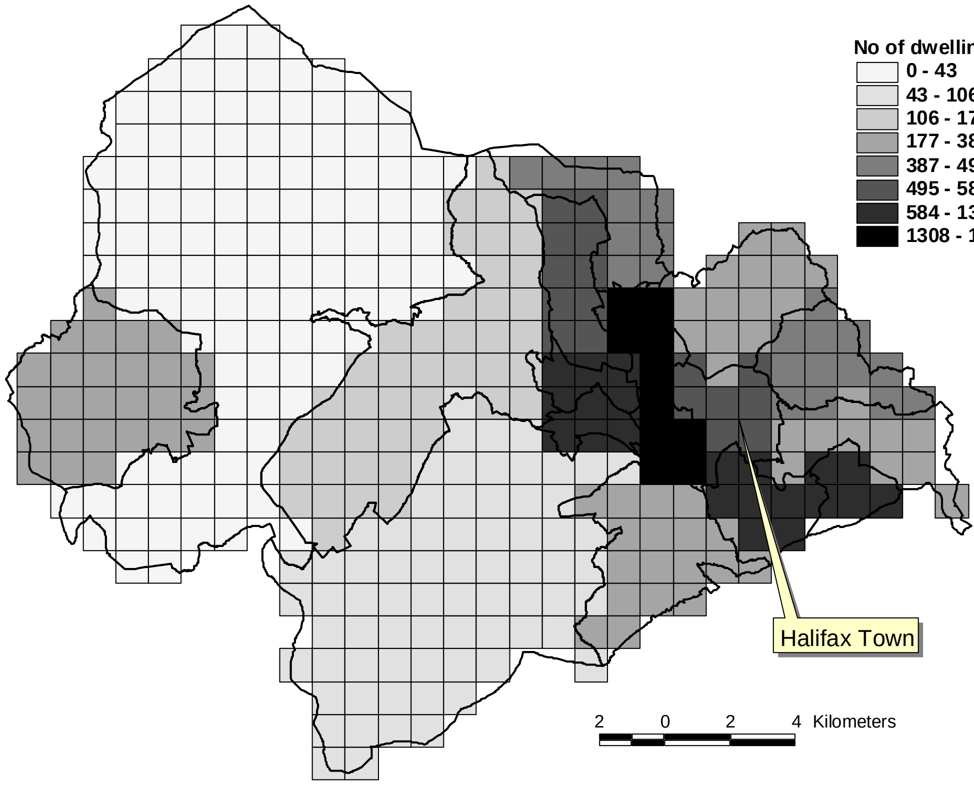


Figure 12.6 – Map of Calderdale showing the different wards and the average number of dwellings in each 1km^2 grid square.

During the import process, it is necessary to assign a **Region Type** to all the sources that are being imported. This may either be a user-defined **Region Type** (as explained in Section 12.3.2 above), or else, the default region type. If all sources are imported with the default region type, further manipulations of the data are required within EMIT to assign appropriate region types to the different sources. Examples of such manipulations are described in Section 12.3.5 below.

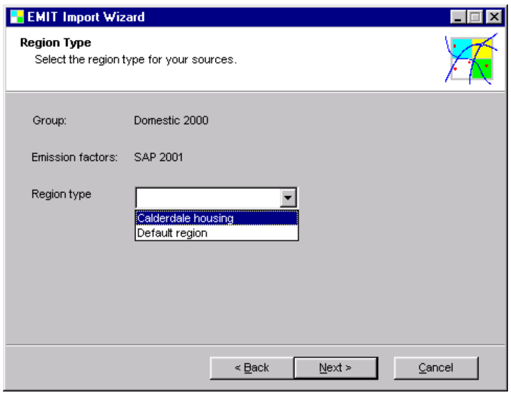


Figure 12.7 – Selecting the **Region Type** in the EMIT Import Wizard

12.3.4 Calculating the emissions

Once the source data have been imported, the sources can be viewed in the EMIT CandD source screen as shown in **Figure 12.8**. Here, the housing-related data are displayed on the Housing tab, with the **Region Type** and the **Number of dwellings** given as editable fields. In addition, the SAP Rating, Carbon Index and CO_2 emission factor per dwelling (in tonnes per year) appropriate for the chosen **Region Type** are displayed.

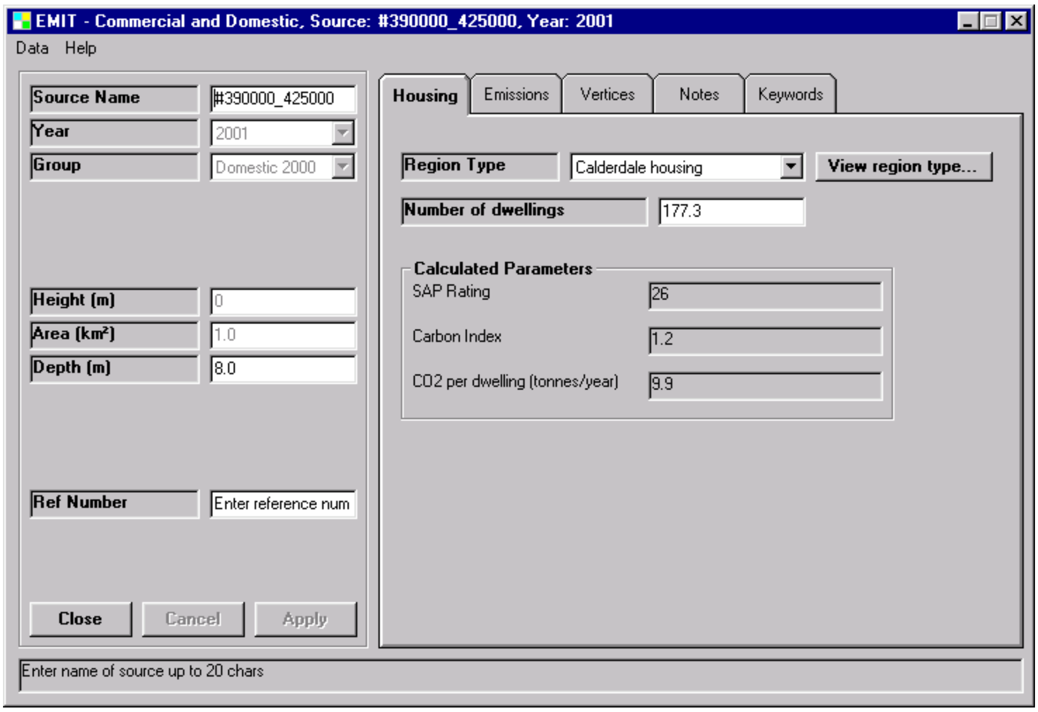


Figure 12.8 – EMIT CandD source screen showing a domestic dwelling source created using the **SAP 2001** emission factors.

As for other source types, the total emissions from the group can be calculated by clicking on the **Calculate** button on the EMIT Inventory screen. The emission totals can then be viewed by clicking on the **View Totals** button.

12.3.5 Further manipulations

Once the base case dwelling data have been imported, it is possible to manipulate the data further in EMIT, for example:

- More accurate region types can be applied to some areas in order to improve the accuracy of the emissions totals calculated; and
- Energy-reduction (and consequently emission-reduction) scenarios can be investigated.

The way in which these manipulations can be performed is described below.

Applying different region types to different areas

In one area, there may be a number of different housing types. Taking the Calderdale example, we have noted previously that the area to the East is more densely populated than that to the northwest. It would therefore seem likely that the housing types would be different. That is, in the built-up areas, the houses are more likely to be terraced, or perhaps blocks of flats, whereas in the rural areas, houses are more likely to be detached or bungalows. Also, the fuel type may be different; for example, in rural areas, solid fuel or oil may be used for heating, whereas in the town, people are more likely to use gas or electricity.

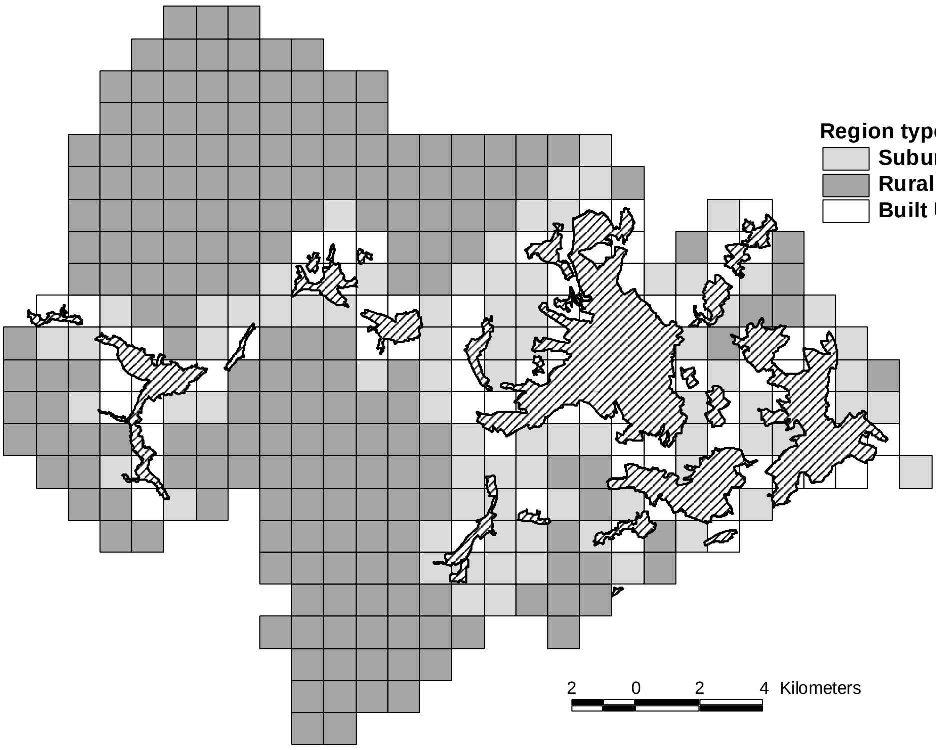


Figure 12.9 – Different region types in Calderdale, with the diagonally stripped polygon data indicating the built up areas.

In EMIT, different region types can be set up to represent these different housing areas (as described in Section 12.3.2 above). **Figure 12.9** shows the Calderdale area in terms of region types. The grid cells overlapping the built up area, shown in diagonal stripes, have been taken to be 'Built Up' (white grid cells), the areas surrounding the built up areas are 'Suburbia' (light grey grid cells) and the remaining parts are 'Rural' (dark grey grid cells).

In order to apply different region types to some areas it is necessary to make use of the Keywords column in the ESRI .shp, MapInfo .MIF or text file prior to import. In the above example, all ‘Built Up’ grid cells had the words ‘Built Up’ entered in as a keyword; similarly for the ‘Rural’ and ‘Suburbia’ grid cells.

After the dwellings data has been imported, the sources need to be filtered in the EMIT Group screen in order to select the different grid cells to which different region types need to be applied. The method is as follows:

- Set up appropriate region types for the different areas of interest;
- Go to the EMIT Group screen that lists all the SAP sources;
- Click on the **Filter...** button to display the **Filter for text fragment** screen shown in **Figure 12.10**;

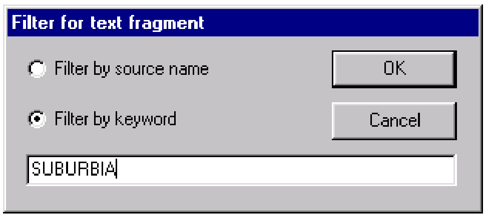


Figure 12.10 – **Filter for text fragment** screen being used to select all the ‘Suburbia’ grid cells.

- Click on the **Select All** button to select all the filtered sources;
- Click on the **Edit** button to display the **Multiple Source Edit** screen shown in **Figure 12.11**, and select the appropriate Region Type from the drop down list.

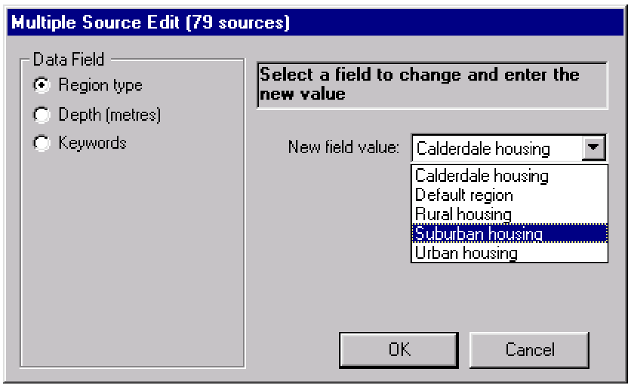


Figure 12.11 – Choosing the ‘Suburban housing’ **Region Type** in the **Multiple Source Edit** screen.

- Apply remaining region types to the other areas in the same way; and then
- Recalculate totals.

Energy / Emission reduction scenarios

Using EMIT, it is possible to consider ways of reducing domestic property energy use, and estimate any corresponding reduction in CO_2 emissions. This is simply done by creating new region types, and applying them to the sources of interest.

For example, a Council may consider giving out grants to people living within a particular postcode district where housing conditions are particularly poor. These grants would be used to improve, perhaps, all roofs of the properties within that area. For this scenario, a new region type would be created to represent this improved housing type – for example, increasing the 'Insulation (walls and roof)' from 'Very Poor' to 'Good'. This new **Region Type** can be applied to all the houses within the chosen area. Recalculating the emissions total for this scenario would show the reduction in CO_2 emissions.

Another scenario of interest may be to consider the decrease in emissions by changing the fuel used for heating from electricity to gas. A number of households are said to experience 'fuel poverty'; that is, households that "*need to spend more than 10% of [their] income on fuel in order to maintain a satisfactory heating regime*" (ENERGY 2001). This may be due to the fact that these houses use electricity for heating, which is expensive, and if the heating systems are old, they are likely to be inefficient, which means that a significant proportion of on-peak electricity may have to be used. If these households were fitted with new gas boilers, heating bills and CO_2 emissions would be significantly reduced. This scenario can also be investigated in EMIT by introducing new region types.

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APPENDIX A Data for road, rail and shipping sources

A.1 Introduction

One important family of sources is that due to road and rail traffic, i.e. EMIT major road, minor road and rail sources (refer to Section 3 for details of source type descriptions). In general, the emission rates for these source types cannot be measured directly, and instead must be estimated from the characteristics of the traffic on the road or trains on a railway line using standard emission factors datasets. Alternatively, emissions can be calculated from the quantity of fuel used by the vehicle; this method is used, for instance, to calculate the emissions from shipping sources.

This introductory section gives some background on road, rail and shipping emission factors, and the associated activity data that are required to calculate emission rates using these factors. Details of the pollutants for which emission factors are available are also given, in addition to the range of speeds and years.

Emission factors are regularly updated as new data are collated. Consequently, it is important to be aware that the emissions factors held in EMIT are intended to be accurate at the time at which they were collated but subsequent updates will not be included until the next release of the software. Some datasets are regularly updated and so the data given in EMIT may become out-of-date relatively quickly; this is unavoidable. If users are concerned that this is an issue, they should refer to the source of the emission factors (references given in Section 13).

Within the road traffic emission factor datasets, there is some uncertainty regarding the emissions from a small number of pollutants, for a small number of vehicle sub-categories. As a consequence, EMIT has been developed to allow the emission factors to be edited. Further details are given Sections 4.3.2 and 4.3.3.

Road vehicle exhaust emissions are described in Section A.2, with other emissions generated from road traffic discussed in Section A.3 (non-exhaust particulate emissions) and Section A.4 (cold start and evaporative emissions). Railway traffic emissions are discussed in Section A.5 and details of shipping emissions are given in Section A.6. Section A.7 gives details of the associated fleet composition data that are required to estimate road and rail traffic emission rates. The actual method of calculation of the road and rail traffic emission rates is detailed in Section A.8.

Traffic emission factors

Emission factors are concerned with characterising the rate at which a vehicle emits (or generates) pollution while its engine is running. Such data can be obtained by carrying out laboratory or field tests using a range of engines and under a variety of conditions. These emission rates depend on many parameters, including

- engine size,
- fuel type (petrol, diesel; sulphur content),

- speed,
- engine technology (legislative standard when engine was manufactured, use of catalytic converters or particle traps),
- acceleration,
- age of engine and standard of maintenance,
- load weight,
- gradient,
- recent history of activity (cold starts, hot soaks),
- level of brake and tyre activity, and
- road conditions, which affect particle re-suspension.

The above list is specifically aimed at road traffic, but the same categories would broadly apply to rail and shipping traffic as well. The moving vehicle emission factor datasets described in Section A.2 and Section A.5 have a dependence on many of these parameters, in particular the first four.

The majority of moving vehicle emission factor datasets included in EMIT are sets of numbers giving the emission rates for a set of pollutants for a set of vehicle sub-categories in units of g/km/vehicle. These vehicle sub-categories are *not* normally the same as those used to describe the traffic composition from traffic count data or output from traffic models: the latter are too coarse to allow the emission factors to give a good estimate of the emission rate, since a number of different engine/vehicle types with different emission characteristics may be lumped together in one fleet component, for example, light vehicles. Vehicle emissions from idling road traffic have been estimated from the moving vehicle exhaust emissions and are included in EMIT as a separate dataset; details are given in Section A.2.9.

The moving vehicle emission rates depend on the vehicle speed and, in some cases, the year and/or drive cycle (i.e. urban, rural or motorway). Note that the year dependence may account for a number of variables, for example, changes in vehicle design, and the fleet composition.

Some emission factor datasets depend solely on the amount of fuel used by the different types of vehicles. These datasets have a coarser categorisation than the aforementioned datasets, but they have their particular uses, for instance when calculating emissions from a managed fleet of vehicles. These factors may also be categorised by year and/or drive cycle, but are independent of speed.

Sets of emission factors are produced by organisations with specialised knowledge of emissions analysis, i.e. it is not necessary for the user to calculate them. Several sets of emission factors are built into EMIT – for road, rail and shipping sources. With the exception of the two detailed road traffic emissions datasets, these data are *not* editable.

Traffic source data

The source-specific data are as follows.

i. **Annual Average Daily Traffic count (AADT)** – the sum of the number of vehicles/day for each fleet component. This might be obtained by actual observation of the road in question or from a traffic model.

ii. **Fleet components** – the breakdown of the total traffic (AADT) into a number of categories or *fleet components*, e.g. heavy vehicles, light vehicles and motorcycles, that might be obtained from traffic count data or output from a traffic model. The number of fleet components is usually relatively small, reflecting the restrictions inherent in carrying out traffic counts – it is not currently practicable to divide observations of traffic into a large number of categories. EMIT supports 3 or 11 fleet components for road traffic and 2, 4 or 14 fleet components for rail. The total number of vehicles per day for each fleet component together adds up to the Annual Average Daily Traffic flow (AADT).

iii. **Length of road** – this is also needed because the emission factors are defined per unit length of road. It is derived from topographical data associated with the road.

iv. **Drive cycle** – the most recent emission factor datasets include 'urban', 'rural' and 'motorway' categorisations, as driving behaviour in the different environments leads to differing rates of engine deterioration, which affects emissions.

v. **Other factors** – there are other traffic source data such as road gradients, which are not taken into account in EMIT, but would affect emissions if full datasets were available.

Other traffic-related data are:

vi. **Quantity of fuel used** – this can be used to estimate emissions in the absence of traffic count data.

vii. **Number of trips** – used when calculating cold start and hot soak emissions.

viii. **Number of vehicles per day** – rather than the AADT, which is the number of vehicles that travel down a particular length of road, this vehicle count is the number of vehicles parked within an area. This value can be used to predict diurnal evaporative emissions.

ix. **Annual Vehicle Kilometres (AVK)** – this value can be used to estimate exhaust emissions from moving vehicles for minor road sources. It is the equivalent of the AADT value for major roads.

Traffic counts and traffic composition

The traffic composition is the term used to describe the breakdown of traffic into a relatively small number of categories for which counts exist, called fleet components. The breakdown is expressed as the number of vehicles per day in that category. The numbers of vehicles per day of all fleet components sum to the AADT.

The fleet component options available in EMIT are shown in **Table A.1** for road sources and **Table A.2** for rail sources. For road sources either 3 or 11 fleet components are allowed, while for rail sources 2, 4 or 14 fleet components are allowed. The tables give the names of the fleet components in each case. For road traffic, the 3-fleet-component option is one widely used, while the 11-fleet-component option has been used by the GLA (Greater London Authority) in the London Atmospheric Emissions Inventory (LAEI).

Road, 3 fleet components	Road, 11 fleet components
Heavy/Light/Mcycle	**LAEI inventory (11)**
Motorcycles	Motorcycles
Light vehicles	Cars
Heavy vehicles	Taxis
	Buses and coaches
	LGVs
	Rigid HGVs 2 axles
	Rigid HGVs 3 axles
	Rigid HGVs 4+ axles
	Artic[1] HGVs 3&4 axles
	Artic[1] HGVs 5 axles
	Artic[1] HGVs 6+ axles

Table A.1 – Sets of fleet components for road traffic in EMIT. The text in the second row is the name used in the EMIT interface for the set of fleet components, while the subsequent rows list the names of the fleet components themselves. [1]'Artic' is an abbreviation for articulated.

For rail traffic, the 2 fleet component option is the original, simple one, while the 4 and 14 fleet component options have been introduced to allow the user to specify traffic composition using exactly the same categories as those defining the more recent sets of rail emission factors (UKEFD 2001 and UK Diesel 2001). It is commonly the case that data on rail traffic are given directly in terms of these categories due to the diverse usage of a given line.

Rail, 14 fleet components	Rail, 4 fleet components	Rail, 2 fleet components
UKEFD 2001 (14)	**UK Diesel 2001 (4)**	**Freight/Passenger**
Cl 37 Freight 1 loco	IC125 per train	Freight
Cl 37 Freight 2 loco	Regional per train	Passenger
Cl 47 Freight	Freight per train	
Cl 47 Passenger	Electric per train	
Cl 56 Freight		
Cl 58 Freight		
Cl 60 Freight		
Cl 66 Freight		
Electric per train		
Heritage DMU (2 car)		
IC125 per power car		
Pacer DMU per car		
Sprinter DMU per car		
Turbo DMU per car		

Table A.2 – Fleet components for rail traffic used in EMIT. The name in the second row is that used in the EMIT interface for the set of fleet components, while the subsequent rows list the names of the fleet components themselves.

Fleet composition data

The **route type** is defined as the breakdown of traffic in each fleet component into the vehicle sub-categories used by the emission factors. The route type is specific to a given choice of emission factors and is a bridge between the emissions factors (which fix the vehicle sub-categories) and the source AADT data (which fixes the fleet components). For each fleet component, say, light vehicles, the user can give detailed information about the profile or spread of vehicle sub-categories that are observed for particular roads or groups of roads, and usually for a particular year.

This definition of route type allows the relative mix of different types of heavy vehicle, say, to be varied independently of the overall proportion of heavy vehicles on the road (relative to light vehicles and motorcycles). This might correspond to legislation that affects, for example, HGV emissions but not those from LGV or motorcycles.

A number of pre-defined route types are available in much the same way as sets of emission factors are available. Several such route types are included in EMIT (see for examples **Tables A.25** to **A.26**). However, it is also possible, and often desirable, to create new user-defined route types in EMIT, based on the pre-defined ones, to model changes in traffic patterns.

Pre-defined road route types are normally specific to a particular year because they reflect the traffic make-up of that year. EMIT will only allow these route types to be used with the appropriate year. The pre-defined route types for rail datasets are not specific to a year.

The route type is a property of the EMIT group. To use different route types for different sources, you must create a different group for each route type.

Rail and minor road sources

The above 'traffic' concepts apply to both minor road sources and rail sources, except that

- rail sources have their own sets of emission factors and route types, and
- minor road sources are defined for a given area (and not length) and use annual vehicle kilometres or AVK (rather than AADT) as the basic unit of traffic flow.

Pollutants

A wide range of pollutants are included within EMIT, from the more common pollutants such as PM_{10}, to the less common pollutants such as selenium. Not all datasets contain the same pollutant palette. To find the full list of pollutants found in each dataset, refer to the relevant tables in sections A.2 to A.6.

The range of pollutants found in road vehicle exhaust ("tailpipe") emission datasets in EMIT that use traffic count activity data can be split up into three sets. **EFT v5.2** and **EFT v6.0.1** contain the pollutants CO_2, NO_x, NO_2, PM_{10}, $PM_{2.5}$ and VOC. For details of the pollutants found in these datasets, please refer to **Table A.4**. The Dutch emission factors, contain a range of different emission factors, although they all contain NO_x, NO_2, and PM_{10}. For details of the pollutants found in the Dutch emission factor datasets, please refer to Section A.2.10.

For all versions of **EFT**, the proportion of NO_x that is NO_2 varies with year and route type (for route type classifications, please refer to **Table A.25**). For the **UKEFD07 Road Exhaust** dataset, the proportion of NO_x that is NO_2 is 17%, and for the Dutch emission factor datasets, it varies with vehicle category. For further details please refer to the sections for the specific datasets.

The non-exhaust emission factor datasets included within EMIT all have emissions for PM_{10} and $PM_{2.5}$, with the exception of the re-suspension emission factor datasets, which have factors for PM_{10} only.

Some of the emission factor datasets derived from the UK Emission Factor Database (**UKEFD 2007**) contain emissions for a wide range of pollutants. The list of pollutants is given in the tables in the relevant sections, specifically: **UKEFD07 Road Exhaust** (Section 0), **UKEFD07 Road HotCold** (Section A.4.3) **UKEFD07 Rail** (Section A.5.3) and **UKEFD07 Shipping** (Section A.6.1).

The older road traffic non-tailpipe emission factor datasets, **UKEFD03 Road HotCold** and **NAEI03 Cold Start**, cover a smaller range of pollutants. The two 2001 rail emission factor datasets held in the EMIT database cover the same 11 pollutants and include all three greenhouse gases (CO_2, N_2O or CH_4), while the original UKEFD factors did not include any greenhouse gases. All rail datasets include emissions of $PM_{2.5}$.

Range of speeds

All moving vehicle road exhaust emission factor datasets that are quantified in terms of traffic count data are defined for the same range of vehicle speeds, namely from 5 to 140 km/hr. The most recent versions of **EFT** has emission factors every 1 km/hr for speeds 5 to 50 km/hr, and every 5 km/hr for speeds 50 to 140 km/hr; all other datasets have emission factors every 5km/hr. **Table A.4** contains a summary of the speeds covered in each road exhaust emission factor dataset.

As noted earlier in this section, the speed dependence of the road exhaust emission factors has been interpolated from the available data, since emission rates were not measured at every one of the speeds covered. In some cases, particularly for HGVs, emissions for the higher speed ranges are set to a constant value.

There is no speed dependence for any of the sets of rail emission factors because these are based on total fuel consumption and therefore represent averaged conditions; similarly for the datasets whose activity parameter is fuel consumption: **UKEFD07 Road Exhaust**, **UKEFD07 Shipping** and **UKEFD07 Road HotCold**.

The Dutch emission factor datasets are drive-cycle dependent. Please refer to Section A.2.10 for further details.

Range of years

Some sets of emission factors are year specific and others are not.

- The **EFT** emission factors have associated years. For full details, please refer to Section A.2.2 below.
- The **EU09 ROAD IDLING [3]** and **EU09 ROAD IDLING [11]** datasets are defined between 2002 and 2025.
- The EMEP brake, tyre and road wear emission factor datasets have been derived using fleet composition data for the UK for 2010. However, the yearly variation of these

non-exhaust particulate emissions is minimal, and the factors can be used for all years.

- The Dutch emission factor datasets **NL HIGHWAY 2010** and **NL NON-HIGHWAY 2010** have emission factors for 2009 – 2020. The **NL TRUCK E-ZONE 2010** dataset has a restricted range of years: 2010, 2011, 2015 and 2020.

A.2 Road vehicle exhaust emissions

Section A.2.1 below gives some general information regarding the choice of exhaust emission factor dataset. The remaining subsections (A.2.1 to A.2.10) give details of the different datasets available.

A.2.1 Selecting a road vehicle exhaust emission dataset

When choosing between the available road datasets, it is useful to consider the following:

- Do you have traffic count data on a link-by-link basis, or fuel consumption data? If you have fuel consumption data, then the only available traffic exhaust emission factor dataset for use within EMIT is UKEFD07 Road Exhaust.
- Are your traffic count data for each road link provided as three counts or as eleven counts (refer to Table A.1)? If you have a different categorisation, attempt to bin the data into appropriate categories.
- Which years are you interested in modelling? Consider your base case year, and future years as required.
- Are you intending to carry out a standard review and assessment, or investigate an emission reduction scenario (e.g. a Low Emissions Zone)? See the explanation below for more details.
- Do you wish to use the most up-to-date traffic forecasts for your fleet composition? The newest traffic forecasts are associated with the newest emission factor datasets, i.e. EFT v10.1.

Select a dataset by consulting **Table A.3**, which details the applicability of a dataset, and **Table A.4**, which details the range of parameters in each dataset, bearing in mind your answers to the questions above.

It is recommended that the EFT v10.1 dataset be used for all studies, unless there is a particular reason for using one of the older datasets. Note that the emission factors contained within EFT v10.1 are identical to those in EFT v11, therefore EFT v11 emission factors are not included as a separate dataset in EMIT.

Investigating an emissions-reduction scenario (e.g. LEZ)

The most recent road transport **EFT v10.1** emission factor datasets (see above comment regarding EFT v11) can be used to investigate emissions-reduction scenarios, as they include a number of vehicle sub-categories that represent new vehicle technologies, for example:

- Diesel vehicles retrofitted with particulate traps;
- Hybrid vehicles; and
- Zero emissions vehicles.

As stated above, these datasets should be used in preference to the other detailed road traffic emission factor datasets held within the database.

For further details about which vehicle sub-categories are present within the detailed datasets, please refer to **Tables A.16** to **A.19**.

Dataset name	Description	Activity data	Date released	Officially released?	Suitable for standard review and assessment?	Suitable for emission reduction scenarios (e.g. LEZ)?
COPERT v5.5	Emission factors from Appendix 4 of the EMEP/EEA guidebook,	Traffic counts	2019	Yes	No†	(Yes) †
EFT v10.1	Factors developed by the Highways Agency for Defra and the Devolved Administrations. EFT v11 emission factors are identical to those in EFT v10.1, therefore EFT v11 emission factors are not included as a separate dataset in EMIT	Traffic counts	2020	Yes	Yes	Yes
EFT v9.0			2019	Yes	Yes	Yes
EFT v8.0			2017	Yes	Yes	Yes
EFT v6.0.1			2014	Yes	Yes	No
EFT v5.2			2013	Yes	Yes	No
UKEFD07 Road Exhaust	Emission factors from the UK Emission Factor Database (2007)	Fuel consumed	2010	Yes	Not recommended	No
EURO09 ROAD IDLING	Emission factors from idling traffic, derived from the EURO 2009 Urban dataset	Vehicle hours	n/a*	No	n/a**	n/a**
NL *** 2010	Three Dutch emission factor datasets, for use only within Holland.	Traffic counts	2010	Yes	Not recommended	Yes

Table A.3 – Road vehicle exhaust emissions factor datasets.

* Derived by CERC

** Not a comprehensive dataset

*** HIGHWAY, NON-HIGHWAY and TRUCK E-ZONE

† Only includes non-regulatory pollutants such as CO_2: does not include NO_x, NO_2, PM_{10}, $PM_{2.5}$

Dataset name	Years	Range of speeds covered (km/hr)	Speed interval between emission factors (km/hr)	Pollutants available
COPERT v5.5	2018-2030	5-140	1 km/hr for 5-50 k/hr then 5 km/hr for 50-140 k/hr	B[a]P, BENZENE, BUTADIENE, CO, CO2, CO2INDIRECT, METHANE, N2O, NH3, SO2, VOC
EFT v10.1	2018-2030	5-140		NOx, NO2, PM10, PM2.5
EFT v9.0	2017-2030			NOx, NO2, PM10, PM2.5
EFT v8.0	2015-2030			NOx, NO2, PM10, PM2.5, VOC
EFT v6.0.1	2008-2030	5-140	1	CO2, NOx, NO2, PM10, PM2.5, VOC
EFT v5.2	2008-2030	5-140	1	CO2, NOx, NO2, PM10, PM2.5, VOC
UKEFD07 Road Exhaust	2007	Speed-independent	Speed-independent	ACENAPTHENE, Acenaphthylene, ANTHRACENE, ARSENIC, B[a]A, B[a]P, B[b]F, B[ghi]P, B[k]F, BENZENE, BERYLLIUM, BUTADIENE, CADMIUM, CHROMIUM, CHRYSENE, CO, CO2, COPPER, D[ah]A, FLUORANTHENE, FLUORENE, HCl, I[cd]P, LEAD, MERCURY, CH4, N2O, NAPHTHALENE, NH3, NICKEL, NOx, NO2, PCP, PHENANTHRENE, PM10, PM2.5, PYRENE, SELENIUM, SO2, TIN, VANADIUM, VOC, ZINC
EURO09 ROAD IDLING	2002-2025	Speed-independent	Speed-independent	CO, CO2, NOx, NO2, PM10, PM2.5, VOC
NL *** 2010	2009-2020	Drive-cycle dependent	Drive-cycle dependent	NOx, NO2, PM10, PM2.5*, CO**, B[a]P**†, BENZENE**††, SO2**

Table A.4 – The options available in road vehicle exhaust emissions factor datasets.

* NL HIGHWAY 2010 and NL NON-HIGHWAY 2010 only

** NL NON-HIGHWAY 2010 only

*** HIGHWAY, NON-HIGHWAY and TRUCK E-ZONE

† Exhaust only

†† Includes evaporative emissions

The different road vehicle exhaust emission factor datasets listed in **Table A.3** are discussed in detail below. Note that within each dataset type the datasets are discussed chronologically. However, the most recent dataset(s) should be used where possible, i.e. the '**EFT v10.1**' datasets should be used in preference to the '**EFT v9.0**' datasets.

A.2.2 EFT v10.1

These factors were released by Defra and the Devolved Administrations in August 2020 in the form of a spreadsheet (**EFT2020_v10.1**). Note that emission factors in **EFT v10.1** are identical to those in **EFT v11** (released 2021), therefore **EFT v11** are not included as a separate dataset within EMIT.

The **EFT v10.1** datasets in EMIT contain data for 2018-2030. They contain factors for NO_x, NO_2, PM_{10} and $PM_{2.5}$ (with separate PM values for brake, tyre and road abrasion). They contain data for 11 vehicle classes including motorcycles, although the motorcycle data has not been disaggregated into Euro classes or engine sizes.

The EMIT vehicle sub categories available for **EFT v10.1** are identical to those for **EFT v9.0**. **EFT v10.1** can calculate emissions based upon variable road gradients (-6 downhill to +6 uphill). Only HDV emission factors are affected by the gradient. Currently EMIT will only use the 0 gradient emission factors.

EFT 10.1 data has been incorporated into EMIT as separate datasets for NOx and PM, with a single set of vehicle sub-categories; these have code names Exxxx. The list of vehicle sub-categories and their descriptions can be viewed in the EMIT screen 'Data\Emission Factors\Edit Roads Factors'. The vehicle sub-categories are also listed in the file *VSC_List.xlsx*.

The multiple dataset approach was necessary because the EFT has two separate sets of factors and fleet for NOx and PM. The PM datasets in EMIT have been sub-divided into exhaust, brake wear, tyre wear and road wear. If all four PM datasets are used for one group, the EMIT output will exactly match the EFT output with 'Detailed Option 1,2 or 3'.

EFT v10.1 includes factors for pollutants NO_x, NO_2, PM_{10}, $PM_{2.5}$ and CO_2. The NO_2 emissions are not calculated directly by the **EFT v10.1**, but the fNO2 values are available and have been used to calculate NO_2 emission factors for EMIT. The particulate emissions from **EFT v10.1** can be output as exhaust, brake wear, tyre wear and road wear. The CO_2 emission factors in **EFT v10.1** have not been extracted for inclusion in EMIT.

In the EMIT screen ‘Emission Factors-Edit NO_2 percentage for Roads’ which displays the fraction of NO_x that is NO_2 (often called f-NO_2). Users should be aware that the EFT 10.1 f-NO_2 calculation incorporates assumptions about the failure rates of catalytic converters, so the f-NO_2 values produced by EFT are actually year-dependent. The f-NO_2 values shown in the EMIT screen are the basic values for each EURO class, without accounting for failure of catalytic converters. EMIT’s NO_2 calculations apply these values proportionately, combining them with the effect of the assumptions about failure rates of catalytic converters. The user can edit the f-NO_2 values in the usual way in the EMIT screen if they wish.

In **EFT v10.1**, factors are given for cars, taxis, LGVs, Buses, Rigid-HGVs, Artic-HGVs and motorcycles, and they are also divided into regions:

- England (not London), Northern Ireland, Scotland and Wales, all of which have the road type categorisation: urban, rural and motorway; and
- London, which has the road type categorisation: central, inner, outer and motorway.

Emission factors have been extracted for speeds 5 to 50 km/hr in 1 km/hr increments and for speeds 50 to 140 km/hr in 5 km/hr increments.

Viewing emission factors

The EMIT screen for viewing emission factors ‘Data-Emission Factors-Roads’ does not display the newer EFT emission factors. Users who wish to access the emission factors can look at the underlying .CSV files which contain the data. These can be found in the EMIT installation directory, in the folder ROADEM. There are subdirectories for each dataset. The values in these files are in g/(vehicle km). Users should take great care not to modify the data in these files and should not access the files while EMIT is running. Emission factors for EFT 8.0.1, EFT 9.0 and EFT 10.1 are also present within this folder.

A.2.3 COPERT v5.5

These factors were extracted from Appendix 4 to chapter '1.A.3.b.i-iv Road transport', of the EMEP/EEA air pollutant emission inventory guidebook 2019. The guidebook was last updated in October 2021, and the factors form part of COPERT version 5.5.

The **COPERT v5.5** datasets in EMIT contain data for 2018-2030. They contain factors for 11 vehicle classes for B[a]P, BENZENE, BUTADIENE, CO, CO2, CO2INDIRECT, METHANE, N2O, NH3, SO2, VOC.

The EMIT vehicle sub categories available for **COPERT v5.5** include all vehicles that have non-zero fleet proportion in the standard fleet in **EFT v10.1**, plus some older vehicles which may be of interest. **COPERT v5.5** can calculate emissions based upon variable road gradients (-6 downhill to +6 uphill). Only HDV emission factors are affected by the gradient. Currently EMIT will only use the 0 gradient emission factors.

In **COPERT v5.5**, factors are given for cars, taxis, LGVs, Buses, Rigid-HGVs, Artic-HGVs and motorcycles, and they are also divided into drive cycle (urban, rural, motorway. Route type data has been included, this data has been taken from **EFT v10.1** and includes route types for:

- England (not London), Northern Ireland, Scotland and Wales, all of which have the road type categorisation: urban, rural and motorway; and
- London, which has the road type categorisation: central, inner, outer and motorway.

Emission factors have been extracted for speeds 5 to 50 km/hr in 1 km/hr increments and for speeds 50 to 140 km/hr in 5 km/hr increments. The list of vehicle sub-categories and their descriptions can be viewed in the EMIT screen 'Data\Emission Factors\Edit Roads Factors'.

Viewing emission factors

The EMIT screen for viewing emission factors 'Data-Emission Factors-Roads' does not display the newer EFT emission factors. Users who wish to access the emission factors can look at the underlying .CSV files which contain the data. These can be found in the EMIT installation directory, in the folder ROADEM. There are subdirectories for each dataset. The values in these files are in g/(vehicle km). Users should take great care not to modify the data in these files and should not access the files while EMIT is running. Emission factors for EFT 8.0.1, EFT 9.0 and EFT 10.1 are also present within this folder.

A.2.4 EFT v9.0

These factors were released by Defra and the Devolved Administrations in May 2019 in the form of a spreadsheet (**EFT2019 v9.0**).

This dataset includes factors for pollutants NO_x, NO_2, PM_{10}, $PM_{2.5}$ and CO_2. The NO_2 emissions are not calculated directly by the **EFT v9.0**, but the fNO2 values are available and have been used to calculate NO_2 emission factors for EMIT. The particulate emissions from **EFT v9.0** can be output as exhaust, brake wear, tyre wear and road wear. The CO_2 emission factors in **EFT v9.0** have not been extracted for inclusion in EMIT.

In **EFT v9.0**, factors are given for cars, taxis, LGVs, Buses, Rigid-HGVs, Artic-HGVs and motorcycles, and they are also divided into regions:

- England (not London), Northern Ireland, Scotland and Wales, all of which have the road type categorisation: urban, rural and motorway; and
- London, which has the road type categorisation: central, inner, outer and motorway.

Emission factors have been extracted for speeds 5 to 50 km/hr in 1 km/hr increments and for speeds 50 to 140 km/hr in 5 km/hr increments.

A.2.5 EFT v8.0

These factors were released by Defra and the Devolved Administrations in December 2017 in the form of a spreadsheet (**EFT2017 v8.0**).

This dataset includes factors for pollutants NO_x, NO_2, PM_{10}, $PM_{2.5}$ and CO_2. The NO_2 emissions are not calculated directly by the **EFT v8.0**, but the fNO2 values are available and have been used to calculate NO_2 emission factors for EMIT. The particulate emissions from **EFT v8.0** can be output as exhaust, brake wear, tyre wear and road wear. The CO_2 emission factors in **EFT v8.0** have not been extracted for inclusion in EMIT. The **EFT v6.0.1** VOC emission factors have been included in the **EFT 8.0** datasets for use in EMIT.

In **EFT v8.0**, factors are given for cars, taxis, LGVs, Buses, Rigid-HGVs, Artic-HGVs and motorcycles, and they are also divided into regions:

- England (not London), Northern Ireland, Scotland and Wales, all of which have the road type categorisation: urban, rural and motorway; and
- London, which has the road type categorisation: central, inner, outer and motorway.

Emission factors have been extracted for speeds 5 to 50 km/hr in 1 km/hr increments and for speeds 50 to 140 km/hr in 5 km/hr increments.

A.2.6 EFT v6.0.1

These factors were released by Defra and the Devolved Administrations in July 2014 in the form of a spreadsheet (**EFT v6.0.1 2014**).

This dataset includes factors for pollutants NO_x, NO_2, PM_{10}, $PM_{2.5}$, VOC and CO_2. The NO_2 emissions are not calculated by the EFT v6.0.1, so these have been estimated as a proportion the NO_x emissions by using data from version 4.1 of the Defra 'NO_x to NO_2 conversion spreadsheet' (released in June 2013). The particulate emissions from EFT v6.0.1 include contributions from brake wear, tyre wear and road wear.

In **EFT v6.0.1**, factors are given for heavy vehicles, light vehicles and motorcycles, and they are also divided into regions:

- England (not London), Northern Ireland, Scotland and Wales, all of which have the road type categorisation: urban, rural and motorway; and
- London, which has the road type categorisation: central, inner, outer and motorway.

Emission factors are given for speeds 5 to 140 km/hr in 1 km/hr increments.

A.2.7 EFT v5.2

These factors were compiled by Bureau Veritas, the UK Highways Agency, Ricardo-AEA and TfL, on behalf of Defra and the Devolved Administrations, and released in January 2013 in the form of a spreadsheet (**EFT v5.2c 2013**). By selecting the 'Emissions rates' output, emissions for the following pollutants have been extracted from this spreadsheet:

CO_2, NO_x, PM_{10}, $PM_{2.5}$ and VOC.

where the CO_2 emission factors are converted from the carbon emission factor output.

These CO_2 emission factors are 'ultimate CO_2', i.e. factors that take into account all the carbon in the fuel emitted at the tailpipe as CO_2, CO, unburned hydrocarbons and particulate matter that ultimately have the potential to form CO_2.

The EFT v5.2 factors are given for heavy and light vehicles, and they are also divided into regions: England (not London), Northern Ireland, Scotland and Wales, all of which have the road type categorisation: urban, rural and motorway; and London, which has the road type categorisation: central, inner, outer and motorway.

EFT v5.2 route type	Classification in the fNO2 worksheet of the Defra 'NO$_x$ to NO$_2$ conversion spreadsheet'		
	All London traffic	All other urban UK traffic	All non-urban UK traffic
London Central	✓		
London Inner	✓		
London Outer	✓		
London Motorway	✓		
Non-London Urban		✓	
Non-London Rural			✓
Non-London Motorway			✓

Table A.5 – Route types classifications used for categorising the proportion of NO_x that is NO_2 in the **EFT v5.2** dataset, utilising the fNO2 worksheet of the Defra 'NO_x to NO_2 conversion spreadsheet'. "Non-London" represents all regions other than London, i.e. England (outside London), Northern Ireland, Scotland and Wales.

NO_2 emissions are not calculated by the EFT v5.2 so these have been estimated as a proportion of the NO_x emissions by using data from version 3.2 of the Defra 'NO_x to NO_2 conversion spreadsheet'[1] released in September 2012. In this spreadsheet, different proportions of NO_2 are given for various fleet mixes that may occur, for example, in different geographical regions within the UK. The proportions of NO_2 are also year dependent. **Table A.5** summarises the classification in the Defra spreadsheet for each EFT v5.2 route type (for more details on route types, please refer to Section A.7).

Note that:

- Brake, tyre and road wear
- Brake, tyre and road wear emissions *are* included in the **EFT v5.2** emission factor dataset.
- VOC emissions
- The VOC emissions are given as $CH_{1.85}$ equivalent.
- Motorcycles
- No motorcycle emission factors are given in the EFT v5.2 spreadsheet, so **EFT v5.2** motorcycle emissions are assumed to be the same as light vehicle emissions.

[1] http://laqm.defra.gov.uk/tools-monitoring-data/no-calculator.html (April 2013)

The vehicle sub-categories included within the **EFT v5.2** dataset are summarised in **Table A.21**.

A.2.8 UKEFD07 Road Exhaust

Data from the UKEFD were supplied to CERC in January 2010 (**UKEFD 2007**). Emissions for a wide range of pollutants are included in this dataset, as summarised in **Table A.6**.

Dataset name	Description	Reference	Source type	Pollutants available
UKEFD07 Road Exhaust	UKEFD exhaust emissions from road traffic	**UKEFD 2007**	point, line, area, volume and CandD sources	ACENAPTHENE, Acenaphthylene, ANTHRACENE, ARSENIC, B[a]A, B[a]P, B[b]F, B[ghi]P, B[k]F, BENZENE, BERYLLIUM, BUTADIENE, CADMIUM, CHROMIUM, CHRYSENE, CO, CO2, COPPER, D[ah]A, FLUORANTHENE, FLUORENE, HCl, I[cd]P, LEAD, MERCURY, CH4, N2O, NAPHTHALENE, NH3, NICKEL, NOx, NO2, PCP, PHENANTHRENE, PM10, PM2.5, PYRENE, SELENIUM, SO2. TIN, VANADIUM, VOC, ZINC

Table A.6 – Summary of the UKEFD07 Road Exhaust emission factor dataset contained in EMIT.

For general information about the UKEFD datasets, please refer to Section C.2.1.

$PM_{2.5}$ and NO_2 emission factors were not included explicitly in the UK Emission Factor Database in 2007. Therefore, $PM_{2.5}$ emission factors have been calculated as 95% of PM_{10} factors (**AEAT 2009**); NO_2 emission factors have been taken as 17% of NO_x emission factors (**AEAT 2009a**).

This dataset includes generalised emission factors for road traffic in terms of the quantity of fuel used by vehicles. Different emission factors are given for categorisations of:

- Vehicle type,
- Vehicle technology (i.e. catalyst/non-catalyst for light duty vehicles),
- Road type, and
- Fuel type.

The classifications are summarised in **Table A.7**.

A copy of this dataset in the form of a Microsoft Excel spreadsheet (UKEFD07 Road Exhaust.xls) has been supplied in the EMIT installation directory, in the subdirectory *Data\ActivityDatasets*. This spreadsheet contains the Nomenclature For Reporting (NFR) format (UNECE) and Selected Nomenclature for Air Pollution (SNAP, European Environment Agency) codes, in addition to the Intergovernmental Panel on Climate Change (IPCC) sectors for each activity.

Vehicle type	Vehicle technology			Road type			Fuel type		
	All vehicles	With catalyst	No catalyst	Urban	Rural	Motorway	Petrol	Diesel	LPG
Cars	✓	✓	✓	✓	✓	✓	✓		
LGVs	✓	✓	✓	✓	✓	✓	✓		
Rigid HGVs	✓			✓	✓	✓		✓	
Articulated HGVs	✓			✓	✓	✓		✓	
Buses and coaches	✓			✓	✓	✓		✓	
Moped (<50cc 2st)	✓			✓			✓		
M/C (>50cc 2st)	✓			✓	✓		✓		
M/C (>50cc 4st)	✓			✓	✓	✓	✓		
All vehicles	✓								✓

Table A.7 – Summary of the **UKEFD07 Road Exhaust** emission factor dataset.

A.2.9 Idling exhaust emission factors

It is useful to be able to calculate the exhaust emissions from stationary traffic, for instance buses idling at a bus stop. Exhaust emission factors are usually quantified in terms of mass unit per distance travelled, that is, g/km. For idling, as the vehicle does not move, it is not possible to use the same units and in fact functions representing the relationship between speed and emission factors in g/km are singular in limit of zero speed.

It is possible, however, to re-formulate speed emission curves so that the emission factor is quantified terms of mass unit per time period, i.e. g/hr rather than g/km. When this is done, estimates of emission rates can be made in the zero speed limit. Whilst this is not as good as deriving a dataset from real emissions data, this method of extrapolation of the emissions data is reasonable[2]. The idling emission factors included in the current version of the EMIT database have been derived from the DfT emissions data (**DfT 2009**) and urban fleet data from Ricardo-AEA (**AEAT 2009**) using this extrapolation method.

Dataset name	No. of fleet components
EURO09 ROAD IDLING [3]	3
EURO09 ROAD IDLING [11]	11

Table A.8 – Idling emission factor datasets.

For idling traffic, the activity data are the number of vehicle hours per year, and the emission factors can be applied to line, area, volume and CANDD source types.

[2] Private communication from Tim Barlow at TRL

Table A.8 summarises the idling emission factor datasets included within EMIT.

Note that idling emission factors are *not* appropriate for:

- representing stop/start or very slow moving traffic, nor for
- calculating emissions from modern vehicles with stop/start or hybrid engine technology, as for these vehicles, the emissions will be zero when the vehicle is idle.

A.2.10 Dutch exhaust emission factors

Dataset name	Description	Reference	No. of fleet components	Years available	Pollutants available
NL HIGHWAY 2010	Dutch emission factors for highways	NL Highway 2010	3	2009-2020	NOx, NO2, PM10, PM2.5
NL NON-HIGHWAY 2010	Dutch emission factors for non-highways	NL Non-Highway 2010	4	2009-2020	NOx, NO2, PM10, PM2.5, CO, B[a]P*, Benzene**, SO2
NL TRUCK E-ZONE 2010	Dutch emission factors for HDVs in Low Emission Zones	NL E-Zone Trucks 2010	3	2010, 2011, 2015, 2020	NOx, NO2, PM10

Table A.9 – Dutch emission factor datasets; * exhaust only; ** includes evaporative emissions. Note that non-exhaust emissions are included in the PM_{10} and $PM_{2.5}$ emission factors.

There are three Dutch emission factor datasets included within EMIT. These are summarised in **Table A.9**. There are three datasets, one for highway vehicles, one for non-highway vehicles and one for HDVs in Low Emission Zones.

These emission factors are classified according to drive cycle rather than speed. A summary of the drive cycles are used in the three datasets is given in **Table A.10**.

These emission factors should only be used for emission modelling studies in the Netherlands.

Drive cycle	Full description	Dataset		
		NL HIGHWAY 2010	NL NON-HIGHWAY 2010	NL TRUCK E-ZONE 2010
Free flowing (Speed limit 80 km/hr, SE)	Free flowing vehicles on a highway with a strictly-enforced speed limit of 80 km/hr	✓		
Free flowing (Speed limit 80 km/hr, no SE)	Free flowing vehicles on a highway with a speed limit of 80 km/hr (not strictly enforced).	✓		
Free flowing (Speed limit 100 km/hr, SE)	Free flowing vehicles on a highway with a strictly-enforced speed limit of 100 km/hr	✓		
Free flowing (Speed limit 100 km/hr, no SE)	Free flowing vehicles on a highway with a speed limit of 100 km/hr (not strictly enforced).	✓		
Free flowing (Speed limit 120 km/hr)	Free flowing vehicles on a highway with a speed limit of 120 km/hr	✓		
Traffic jam (Speed limit 80 km/hr, SE)	Vehicles in a traffic jam on a highway with a strictly-enforced speed limit of 80 km/hr	✓		
Traffic jam (Speed limit 80 km/hr, no SE)	Vehicles in a traffic jam on a highway with a speed limit of 80 km/hr (not strictly enforced).	✓		
Traffic jam (Speed limit 100 km/hr, SE)	Vehicles in a traffic jam on a highway with a strictly-enforced speed limit of 100 km/hr	✓		
Traffic jam (Speed limit 100 km/hr, no SE)	Vehicles in a traffic jam on a highway with a speed limit of 100 km/hr (not strictly enforced).	✓		
Traffic jam (Speed limit 120 km/hr)	Vehicles in a traffic jam on a highway with a speed limit of 120 km/hr	✓		
Stagnant urban traffic	A high degree of urban traffic congestion; an average speed less than 15 km/hr; an average of 10 stops per kilometre.		✓	✓
Normal urban traffic	Typical urban traffic with a reasonable degree of congestion; an average speed between 15 and 30 km/hr; an average of two stops per kilometre.		✓	✓
Urban traffic with less congestion	Urban traffic with a relatively higher proportion of free-flow behaviour; an average speed between 30 and 45 km/hr; an average of 1.5 stops per kilometre.		✓	✓
Rural	Typical road outside an urban area; an average speed of about 60 km/hr; an average of 0.2 stops per kilometre.		✓	

Table A.10 – Summary of drive cycles in the Dutch emission factor datasets

A.3 Non-exhaust emission factors

Section A.3.1 below gives some general information regarding the choice of non-exhaust emission factor dataset. The remaining subsections (A.3.2 to A.3.4) give details of the different datasets available.

A.3.1 Selecting a road vehicle non-exhaust emission dataset

Non-exhaust emission factors are road traffic particulate emissions due to mechanical abrasion and corrosion, and the re-suspension of material deposited on the road surface by tyre shear, vehicle-induced turbulence and wind. Exhaust emissions are decreasing with time due to improvements in vehicle technology, but non-exhaust emissions are uncontrolled and contribute an increasing proportion of total particulate emissions from road traffic, as traffic volumes increase.

Whilst non-exhaust particulates emissions are not as well quantified as exhaust emissions, their significant contribution to total particulate emissions means that they *should* be included in emissions calculations from road traffic.

Non-exhaust emission factors are usually categorised into:

- Tyre wear,
- Brake wear,
- Road wear, and
- Re-suspension.

When calculating emissions for use in source apportionment studies, it may be appropriate to present emissions from re-suspended particulates separately to those originating directly from vehicles.

There are a number of datasets available that can be used to calculate non-exhaust particulate emissions from road traffic in EMIT; these are summarised in **Table A.11**.

Prior to selecting a non-exhaust emission factor dataset, consider the following:

- Do you have traffic count data on a link-by-link basis, or total vehicle km? If you have total vehicle km data, then the only available non-exhaust traffic emission factor dataset for use within EMIT is UKEFD03 Road Wear.
- Does your ‘exhaust’ emission factor dataset account for any non-exhaust emissions? Currently, the only datasets in EMIT that account for any non-exhaust emissions are the EFT datasets, and the three Dutch emission factor datasets. When using the EFT datasets, only re-suspension emissions should be included in the calculations; when using the Dutch emission factor datasets, no non-exhaust emissions should be included in the calculations.
- Are you calculating emission factors for use in the UK? If not, consider local effects that may contribute to more, or less, non-exhaust particulate emissions. For instance, the use of studded tyres in Nordic countries significantly increases road wear, and using the non-exhaust road wear

emission factor datasets included in EMIT to calculate these emissions may lead to underestimation.

- Do you wish to use the most up-to-date non-exhaust emission factor datasets? If so, you should use the EMEP brake, tyre and road wear emission factors, and one of the Defra/TRL re-suspension factors.

Note on application of the 'traffic count' non-exhaust emission factor datasets

The EMEP and Defra/TRL emission factor datasets are associated with the exhaust road traffic datasets in such way that the inclusion of non-exhaust emission factors is straightforward when defining a **Group** in the EMIT interface. An example of how this can be done is given in Section 5.3.1.

Dataset	Description	Reference	Activity data	Source type	Pollutants available
EMEP Brake wear	Speed dependent factors for brake wear taken from EMEP/EEA documentation categorised by road type for 3 or 11 fleet components	**EMEP 2009**	Traffic counts	Major road or Minor road	PM_{10}, $PM_{2.5}$
EMEP Tyre wear	Speed dependent factors for tyre wear taken from EMEP/EEA documentation categorised by road type for 3 or 11 fleet components	**EMEP 2009**	Traffic counts	Major road or Minor road	PM_{10}, $PM_{2.5}$
EMEP Road wear	Speed independent factors for road wear taken from EMEP/EEA documentation categorised by road type for 3 or 11 fleet components	**EMEP 2009**	Traffic counts	Major road or Minor road	PM_{10}, $PM_{2.5}$
Defra/TRL re-suspension factors	Speed independent factors for re-suspension taken from work done by TRL/CERC for Defra categorised into light and heavy vehicles	**TRL 2007a, TRL 2007b**	Traffic counts	Major road or Minor road	PM_{10}
UKEFD03 Road Wear	UKEFD emissions from brake wear, tyre wear and re-suspension	**UKEFD 2003**	Annual vehicle km	Point, Area, Line, Volume or CandD	PM_{10}, $PM_{2.5}$

Table A.11 – Non-exhaust road traffic emission factor datasets.

A.3.2 UKEFD03 Road Wear

Emission factors for brake and tyre wear, and particle re-suspension have been downloaded from UK Emission Factor Database website (**UKEFD 2003**). The emission factors are quantified in terms of the annual vehicle kilometres travelled.

A copy of this dataset in the form of a Microsoft Excel spreadsheet (UKEFD03 Road

Wear.xls) has been supplied in the EMIT installation directory, in the subdirectory *Data\ActivityDatasets*.

A.3.3 EMEP brake, tyre and road wear emission factor datasets

These emission factor datasets have been derived using the Tier 2 methodology in the 2009 EMEP/ EEA emission inventory guidebook (Chapter 3 in **EMEP 2009**). In terms of the source data, the classification of the factors differs between the three datasets, and is summarised in **Table A.12**. This table shows that the categorisation for brake wear is considerably more detailed than for road wear.

Classification	Non-exhaust component classification		
	Brake wear	Tyre wear	Road wear
Number of vehicle classifications	8	4	4
Speed dependent	Yes	Yes	No

Table A.12 – Summary of EMEP source data for brake, tyre and road wear emission factor datasets

From these source data it is possible to derive a number of brake, tyre and road wear emission factor datasets that can be used on a road-by-road basis alongside the detailed traffic exhaust emission factor datasets included within EMIT. As fleet data for road sources are categorised into either three or eleven fleet components (refer to **Table A.1**), the non-exhaust emission factor datasets used within EMIT are required to have the same categorisation. As the correspondence between the vehicle categorisation used in EMEP and that used in EMIT is not one to one, representative fleet data for 2010 from Ricardo-AEA for urban, rural and motorway road types (**AEAT 2009**) were used to estimate the spread of vehicles between the different fleet components. The speed dependence of the emission factors has been included in the derived brake and tyre wear datasets.

Road type	No. of fleet components	Non-exhaust component classification		
		Brake wear	Tyre wear	Road wear
Urban	3	EMEP BW [3] Urb	EMEP TW [3] Urb	EMEP RW [3] Urb
	11	EMEP BW [11] Urb	EMEP TW [11] Urb	EMEP RW [11] Urb
Rural	3	EMEP BW [3] Rur	EMEP TW [3] Rur	EMEP RW [3] Rur
	11	EMEP BW [11] Rur	EMEP TW [11] Rur	EMEP RW [11] Rur
Motor-way	3	EMEP BW [3] Mway	EMEP TW [3] Mway	EMEP RW [3] Mway
	11	EMEP BW [11] Mway	EMEP TW [11] Mway	EMEP RW [11] Mway

Table A.13 – Summary of EMEP brake, tyre and road wear non-exhaust emission factor datasets.

Additional assumptions used in the derivation of the datasets include:

- A load factor of 56% was assumed for HGVs and 50% for buses and coaches (taken from Report 3 of **DfT 2009**).
- The HGV fleet split was taken from the HGV fleet data spreadsheet in **DfT 2009**.
- All buses and coaches are assumed to have two axles only.

Table A.13 summarises the brake, tyre and road wear exhaust emission factor datasets available for use in conjunction with the road traffic emission factors.

A.3.4 Re-suspension emission factor datasets

Estimates of emissions due to the re-suspension of particulates are not very reliable. Although the emissions are likely to depend on vehicle speed, street geometry and certain meteorological parameters, factors that take into account these variables are not currently available. It is known, however, that re-suspended particulate emissions from heavy duty vehicles are significantly greater than those from light duty vehicles. Therefore, it has been possible to categorise the available data (**TRL 2007a**, **TRL 2007b**) into re-suspended particulate emission factors from light and heavy duty vehicles.

Four datasets for re-suspended particulate emissions that can be applied on a road-by-road basis are included within EMIT. These are summarised in **Table A.14**.

Dataset name	No. of fleet components	Reference
Defra PPR110 RS [3]	3	**TRL 2007a**
Defra PPR110 RS [11]	11	**TRL 2007a**
Defra PPR224 RS [3]	3	**TRL 2007b**
Defra PPR224 RS [11]	11	**TRL 2007b**

Table A.14 – Summary of TRL re-suspension non-exhaust emission factor datasets.

A.4 Trip end emission factors

There are three cold start and hot soak/evaporative emission factor datasets included in the EMIT database. These are summarised in **Table A.15**, and described below.

<table>
<tr><th>Dataset name</th><th>Description</th><th>Reference</th><th>Activity data</th><th>Source type</th><th>Pollutants available</th><th>Years available</th></tr>
<tr><td>UKEFD07 Road HotCold</td><td>UKEFD emissions from cold starts and hot soaks</td><td>UKEFD 2007</td><td>Fuel consumed</td><td rowspan="3">Point, Area, Line, Volume or CandD</td><td>benzene, 1,3-butadiene, CO, NO2, NOx, PM10, PM2.5, VOC</td><td>2007</td></tr>
<tr><td>UKEFD03 Road HotCold</td><td>UKEFD emissions from cold starts and hot soaks</td><td>UKEFD 2003</td><td>Number of trips</td><td>benzene, 1,3-butadiene, CO, NO2, NOx, PM10, PM2.5, VOC</td><td>2003</td></tr>
<tr><td>NAEI03 Cold Start</td><td>NAEI cold start emissions</td><td>UKEFD 2003</td><td>Number of trips</td><td>NO2, NOx, PM10, PM2.5</td><td>1996-2015</td></tr>
</table>

Table A.15 – Cold start and hot soak datasets in EMIT

Copies of these three datasets (**UKEFD07 Road HotCold, UKEDF03 Road HotCold** and **NAEI03 Cold Start**) in the form of Microsoft Excel spreadsheets have been supplied in the EMIT installation directory, in the subdirectory *Data\ActivityDatasets*. The most recent dataset spreadsheet, **UKEFD07 Road HotCold**, contains the Nomenclature For Reporting (NFR) format (UNECE) and Selected Nomenclature for Air Pollution (SNAP, European Environment Agency) codes, in addition to the Intergovernmental Panel on Climate Change (IPCC) sectors for each activity.

A.4.1 UKEFD03 Road HotCold

These transport emission factors have been downloaded from the UK Emission Factor Database website (**UKEFD 2003**). The cold start and hot soak emissions are given in terms of a ‘per trip’ value, and are sub-categorised into vehicles using petrol and those using diesel. As for the **UKEFD07 Road HotCold** dataset, no factors are provided for heavy vehicles.

A.4.2 NAEI03 Cold Start

The spreadsheet uk_fleet_composition_projections_v2.xls (downloadable from the UK Emission Factor Database on the NAEI website) gives cold start emission factors for NO_x and PM_{10} for light vehicles for years 1996 to 2015. These data have been given for 4 vehicle categories:

- petrol cars (NOx only),
- diesel cars (NOx and PM10),
- petrol LGVs (NOx only), and

- diesel LGVs (NOx and PM10).

In this spreadsheet, there are additional fleet composition data that give the fleet breakdown for 1996-2025 for urban, rural and motorway roads.

CERC have combined the fleet composition data with the emissions data to give year-dependent cold start emissions data (in units of emission per trip), suitable for urban, rural and motorway roads. These cold start factors are only applicable to light vehicles, as mentioned in Section A.4.1 for the **UKEFD03 Road HotCold** dataset.

A.4.3 UKEFD07 Road HotCold

These transport emission factors are those given on the UK Emission Factor Database website (**UKEFD 2007**), although the source data were received from Ricardo-AEA in a private communication. Cold start and evaporative emission factors are given in units of kg of emission per Mt of fuel used per year. Note that there are no cold start or evaporative emission factors for heavy vehicles. This is because "*these are normally considered negligible (particularly with respect to petrol engines), as diesel engines are less influenced*" (TRL, private communication).

For general information about the UKEFD datasets, please refer to Section C.2.1.

Light vehicle sub-categories for the 'EFTv10.1' and 'EFT v9.0' datasets						
Vehicle type	**Fuel type**	**Engine capacity (cc)**	**Weight class**	**EURO class**	**Additional vehicle technology information**	**Sub-category name**
Car	Petrol	<1400	All	Pre-EURO 1		E0002
				EURO 1		E0011
				EURO 2		E0014
				EURO 3		E0017
					Full Hybrid	E0018
				EURO 4		E0023
					Full Hybrid	E0024
				EURO 5		E0029
					Full Hybrid	E0030
					Plug-in Hybrid	E0031
				EURO 6		E0038
					Full Hybrid	E0039
					Plug-in Hybrid	E0040
				EURO 6c		E0047
					Full Hybrid	E0048
					Plug-in Hybrid	E0049
	Petrol	1400-2000	All	Pre-EURO 1		E0005
				EURO 1		E0012
				EURO 2		E0015
				EURO 3		E0019
					Full Hybrid	E0020
				EURO 4		E0025
					Hybrid	E0026
				EURO 5		E0032
					Full Hybrid	E0033
					Plug-in Hybrid	E0034
				EURO 6		E0041
					Full Hybrid	E0042
					Plug-in Hybrid	E0043
				EURO 6c		E0050
					Full Hybrid	E0051
					Plug-in Hybrid	E0052
	Petrol	>2000	All	Pre-EURO 1		E0008
				EURO 1		E0013
				EURO 2		E0016
				EURO 3		E0021
					Full Hybrid	E0022
				EURO 4		E0027

					Full Hybrid	E0028
				EURO 5		E0035
					Full Hybrid	E0036
					Plug-in Hybrid	E0037
				EURO 6		E0044
					Full Hybrid	E0045
					Plug-in Hybrid	E0046
				EURO 6c		E0053
					Full Hybrid	E0054
					Plug-in Hybrid	E0055
	Diesel	<1400	All	Pre-EURO 1		E0056
				EURO 1		E0059
				EURO 2		E0062
				EURO 3		E0065
					DPF	E0158
				EURO 4		E0068
					DPF	E0161
				EURO 5		E0071
					Full Hybrid	E0072
				EURO 6		E0077
					Full Hybrid	E0078
				EURO 6c		E0142
					Full Hybrid	E0143
				EURO 6c		E0148
					Full Hybrid	E0149
	Diesel	1400-2000	All	Pre-EURO 1		E0057
				EURO 1		E0060
				EURO 2		E0063
				EURO 3		E0066
					DPF	E0159
				EURO 4		E0069
					DPF	E0163
				EURO 5		E0073
					Full Hybrid	E0074
				EURO 6		E0079
					Full Hybrid	E0080
				EURO 6c		E0144
					Full Hybrid	E0145
				EURO 6d		E0150
					Full Hybrid	E0151
	Diesel	>2000	All	Pre-EURO 1		E0058
				EURO 1		E0061
				EURO 2		E0064

				EURO 3		E0067
					DPF	E0160
				EURO 4		E0070
					DPF	E0165
				EURO 5		E0075
					Full Hybrid	E0076
				EURO 6		E0081
					Full Hybrid	E0082
				EURO 6c		E0146
					Full Hybrid	E0147
				EURO 6d		E0152
					Full Hybrid	E0153
	LPG	<1400	All	EURO 1		E0098
				EURO 2		E0101
				EURO 3		E0104
				EURO 4		E0107
				EURO 5		E0110
				EURO 6		E0113
				EURO 6c		E0911
	LPG	1400-2000	All	EURO 1		E0099
				EURO 2		E0102
				EURO 3		E0105
				EURO 4		E0108
				EURO 5		E0111
				EURO 6		E0114
				EURO 6c		E0912
	LPG	>2000	All	EURO 1		E0100
				EURO 2		E0103
				EURO 3		E0106
				EURO 4		E0109
				EURO 5		E0112
				EURO 6		E0115
				EURO 6c		E0913
	E85 bioethanol	<1400	All	Pre EURO 1		E0116
				EURO 1		E0119
				EURO 2		E0122
				EURO 3		E0125
				EURO 4		E0128
				EURO 5		E0131
				EURO 6		E0134
				EURO 6c		E0137
	E85 bioethanol	1400-2000	All	Pre EURO 1		E0117
				EURO 1		E0120

				EURO 2		E0123
				EURO 3		E0126
				EURO 4		E0129
				EURO 5		E0132
				EURO 6		E0135
				EURO 6c		E0138
	E85 bioethanol	>2000	All	Pre EURO 1		E0118
				EURO 1		E0121
				EURO 2		E0124
				EURO 3		E0127
				EURO 4		E0130
				EURO 5		E0133
				EURO 6		E0136
				EURO 6c		E0139
	Battery EV	All	All	All		E0140
	FCEV	All	All	All		E0141
Car (London taxi)	Diesel	All	All	Pre-EURO 1		E0083
				EURO 1		E0084
				EURO 2		E0085
				EURO 3		E0086
				EURO 4		E0087
				EURO 5		E0088
				EURO 6		E0089
				EURO 6c		E0154
				EURO 6d		E0155
				All	ZEC	E0090
Car (UK taxi)	Diesel	All	All	Pre-EURO 1		E0091
				EURO 1		E0092
				EURO 2		E0093
				EURO 3		E0094
				EURO 4		E0095
				EURO 5		E0096
				EURO 6		E0097
				EURO 6c		E0156
				EURO 6d		E0157
				All	ZEC	E0917
LGV N1(I)	Petrol	All	<1.305 t	Pre-EURO 1		E0167
					Plug-in Hybrid	E0277
				EURO 1		E0170
				EURO 2		E0173
				EURO 3		E0176
				EURO 4		E0179
					Full Hybrid	E0180

				EURO 5		E0185
					Full Hybrid	E0186
					Plug-in Hybrid	E0187
				EURO 6		E0194
					Full Hybrid	E0195
					Plug-in Hybrid	E0196
				EURO 6c		E0203
					Full Hybrid	E0204
					Plug-in Hybrid	E0205
	Diesel	All	<1.305 t	Pre-EURO 1		E0212
				EURO 1		E0215
					DPFRF	E0286
				EURO 2		E0218
					DPFRF	E0289
				EURO 3		E0221
					DPFRF	E0292
				EURO 4		E0224
				EURO 5		E0227
				EURO 6		E0230
				EURO 6c		E0280
				EURO 6d		E0283
	LPG	All	<1.305 t	EURO 1		E0233
				EURO 2		E0236
				EURO 3		E0239
				EURO 4		E0242
				EURO 5		E0245
				EURO 6		E0248
				EURO 6c		E0914
	E85 bioethanol	All	<1.305 t	Pre EURO1		E0253
				EURO 1		E0256
				EURO 2		E0259
				EURO 3		E0262
				EURO 4		E0265
				EURO 5		E0268
				EURO 6		E0271
				EURO 6c		E0274
LGV N1(II)	Petrol	All	1.305-1.76 t	Pre-EURO 1		E0168
					Plug-in Hybrid	E0278
				EURO 1		E0171
				EURO 2		E0174
				EURO 3		E0177
				EURO 4		E0181
					Full Hybrid	E0182

				EURO 5		E0188
					Full Hybrid	E0189
					Plug-in Hybrid	E0190
				EURO 6		E0197
					Full Hybrid	E0198
					Plug-in Hybrid	E0199
				EURO 6c		E0206
					Full Hybrid	E0207
					Plug-in Hybrid	E0208
	Diesel	All	1.305-1.76 t	Pre-EURO 1		E0213
				EURO 1		E0216
					DPFRF	E0287
				EURO 2		E0219
					DPFRF	E0290
				EURO 3		E0222
					DPFRF	E0293
				EURO 4		E0225
				EURO 5		E0228
				EURO 6		E0231
				EURO 6c		E0281
				EURO 6d		E0284
	LPG	All	1.305-1.76 t	EURO 1		E0234
				EURO 2		E0237
				EURO 3		E0240
				EURO 4		E0243
				EURO 5		E0246
				EURO 6		E0249
				EURO 6c		E0915
	E85 bioethanol	All	1.305-1.76 t	Pre-EURO 1		E0254
				EURO 1		E0257
				EURO 2		E0260
				EURO 3		E0263
				EURO 4		E0266
				EURO 5		E0269
				EURO 6		E0272
				EURO 6c		E0275
LGV N1(III)	Petrol	All	>1.76 t	Pre-EURO 1		E0169
						E0279
				EURO 1		E0172
				EURO 2		E0175
				EURO 3		E0178
				EURO 4		E0183
					Full Hybrid	E0184

				EURO 5		E0191
					Full Hybrid	E0192
					Plug-in Hybrid	E0193
				EURO 6		E0200
					Full Hybrid	E0201
					Plug-in Hybrid	E0202
				EURO 6c		E0209
					Full Hybrid	E0210
					Plug-in Hybrid	E0211
	Diesel	All	>1.76 t	Pre-EURO 1		E0214
				EURO 1		E0217
					DPFRF	E0288
				EURO 2		E0220
					DPFRF	E0291
				EURO 3		E0223
					DPFRF	E0294
				EURO 4		E0226
				EURO 5		E0229
				EURO 6		E0232
				EURO 6c		E0282
				EURO 6d		E0285
	LPG	All	>1.76 t	EURO 1		E0235
				EURO 2		E0238
				EURO 3		E0241
				EURO 4		E0244
				EURO 5		E0247
				EURO 6		E0250
				EURO 6c		E0916
	E85 bioethanol	All	>1.76 t	Pre- EURO 1		E0255
				EURO 1		E0258
				EURO 2		E0261
				EURO 3		E0264
				EURO 4		E0267
				EURO 5		E0270
				EURO 6		E0273
				EURO 6c		E0276
LGV	Battery EV	All	All	All		E0251
	FCEV	All	All	All		E0252

Table A.16 – ‘**EFTv10.1**’ and ‘**EFTv9.0’** light vehicle sub-categories.

Heavy vehicle sub-categories for the 'EFT v10.1' and 'EFT v9.0' datasets					
Vehicle type	**Fuel class**	**Weight class**	**EURO class**	**Additional vehicle technology information**	**Sub-category name for Diesel fuel category**
HGV - Rigid	Diesel	3.5-7.5 t	Pre-EURO I		E0521
			EURO I		E0529
				DPFRF	E0689
			EURO II		E0537
				SCRRF	E0625
				DPFRF	E0697
			EURO III		E0545
				SCRRF	E0633
				DPFRF	E0705
			EURO IV		E0553
				SCRRF	E0641
				DPFRF	E0713
			EURO V	SCR	E0561
				EGR	E0562
				EGR + SCRRF	E0649
			EURO VI		E0577
		7.5-12 t	Pre-EURO I		E0522
			EURO I		E0530
				DPFRF	E0690
			EURO II		E0538
				SCRRF	E0626
				DPFRF	E0698
			EURO III		E0546
				SCRRF	E0634
				DPFRF	E0706
			EURO IV		E0554
				SCRRF	E0642
				DPFRF	E0714
			EURO V	SCR	E0563
				EGR	E0564
				EGR + SCRRF	E0650
			EURO VI		E0578
		12-14 t	Pre-EURO I		E0523
			EURO I		E0531
				DPFRF	E0691
			EURO II		E0539
				SCRRF	E0627
				DPFRF	E0699
			EURO III		E0547

				SCRRF	E0635
				DPFRF	E0707
			EURO IV		E0555
				SCRRF	E0643
				DPFRF	E0715
			EURO V	SCR	E0565
				EGR	E0566
				EGR + SCRRF	E0651
			EURO VI		E0579
		14-20 t	Pre-EURO I		E0524
			EURO I		E0532
				DPFRF	E0692
			EURO II		E0540
				SCRRF	E0628
				DPFRF	E0700
			EURO III		E0548
				SCRRF	E0636
				DPFRF	E0708
			EURO IV		E0556
				SCRRF	E0644
				DPFRF	E0716
			EURO V	SCR	E0567
				EGR	E0568
				EGR + SCRRF	E0652
			EURO VI		E0580
		20-26 t	Pre-EURO I		E0525
			EURO I		E0533
				DPFRF	E0693
			EURO II		E0541
				SCRRF	E0629
				DPFRF	E0701
			EURO III		E0549
				SCRRF	E0637
				DPFRF	E0709
			EURO IV		E0557
				SCRRF	E0645
				DPFRF	E0717
			EURO V	SCR	E0569
				EGR	E0570
				EGR + SCRRF	E0653
			EURO VI		E0581
		26-28 t	Pre-EURO I		E0526
			EURO I		E0534

				DPFRF	E0694
			EURO II		E0542
				SCRRF	E0630
				DPFRF	E0702
			EURO III		E0550
				SCRRF	E0638
				DPFRF	E0710
			EURO IV		E0558
				SCRRF	E0646
				DPFRF	E0718
			EURO V	SCR	E0571
				EGR	E0572
				EGR + SCRRF	E0654
			EURO VI		E0582
		28-32 t	Pre-EURO I		E0527
			EURO I		E0535
				DPFRF	E0695
			EURO II		E0543
				SCRRF	E0631
				DPFRF	E0703
			EURO III		E0551
				SCRRF	E0639
				DPFRF	E0711
			EURO IV		E0559
				SCRRF	E0647
				DPFRF	E0719
			EURO V	SCR	E0573
				EGR	E0574
				EGR + SCRRF	E0655
			EURO VI		E0583
		>32 t	Pre-EURO I		E0528
			EURO I		E0536
				DPFRF	E0696
			EURO II		E0544
				SCRRF	E0632
				DPFRF	E0704
			EURO III		E0552
				SCRRF	E0640
				DPFRF	E0712
			EURO IV		E0560
				SCRRF	E0648
				DPFRF	E0720
			EURO V	SCR	E0575

				EGR	E0576
				EGR + SCRRF	E0656
			EURO VI		E0584
HGV - Articulated		14-20 t	Pre-EURO I		E0761
			EURO I		E0766
				DPFRF	E0866
			EURO II		E0771
				SCRRF	E0826
				DPFRF	E0871
			EURO III		E0776
				SCRRF	E0831
				DPFRF	E0876
			EURO IV		E0781
				SCRRF	E0836
				DPFRF	E0881
			EURO V	SCR	E0786
				EGR	E0787
				EGR+SCRRF	E0841
			EURO VI		E0796
		20-28 t	Pre-EURO I		E0762
			EURO I		E0767
				DPFRF	E0867
			EURO II		E0772
				SCRRF	E0827
				DPFRF	E0872
			EURO III		E0777
				SCRRF	E0832
				DPFRF	E0877
			EURO IV		E0782
				SCRRF	E0837
				DPFRF	E0882
			EURO V	SCR	E0788
				EGR	E0789
				EGR+SCRRF	E0842
			EURO VI		E0797
		28-34 t	Pre-EURO I		E0763
			EURO I		E0768
				DPFRF	E0868
			EURO II		E0773
				SCRRF	E0828
				DPFRF	E0873
			EURO III		E0778
				SCRRF	E0833

				DPFRF	E0878
			EURO IV		E0783
				SCRRF	E0838
				DPFRF	E0883
			EURO V	SCR	E0790
				EGR	E0791
				EGR+SCRRF	E0843
			EURO VI		E0798
		34-40 t	Pre-EURO I		E0764
			EURO I		E0769
				DPFRF	E0869
			EURO II		E0774
				SCRRF	E0829
				DPFRF	E0874
			EURO III		E0779
				SCRRF	E0834
				DPFRF	E0879
			EURO IV		E0784
				SCRRF	E0839
				DPFRF	E0884
			EURO V	SCR	E0792
				EGR	E0793
				EGR+SCRRF	E0844
			EURO VI		E0799
		40-50 t	Pre-EURO I		E0765
			EURO I		E0770
				DPFRF	E0870
			EURO II		E0775
				SCRRF	E0830
				DPFRF	E0875
			EURO III		E0780
				SCRRF	E0835
				DPFRF	E0880
			EURO IV		E0785
				SCRRF	E0840
				DPFRF	E0885
			EURO V	SCR	E0794
				EGR	E0795
				EGR+SCRRF	E0845
			EURO VI		E0800

Table A.17 – '**EFTv10.1** and '**EFT v9**' HGV vehicle sub-categories for diesel fuelled vehicles only

Bus and Coach vehicle sub-categories for the 'EFT v10.1' and 'EFT v9.0' datasets						
Vehicle type	**Fuel Class**	**Weight class**	**EURO class**	**Additional vehicle technology information**	**Sub-category name Not London**	**Sub-category name London**
Bus	Diesel	<15 t	Pre-EURO I		E0295	E0296
			EURO I		E0301	E0302
				DPFRF	E0470	E0469
			EURO II		E0307	E0308
				SCRRF	E0413	E0412
				DPFRF	E0475	
			EURO III		E0313	E0314
				SCRRF	E0419	E0418
				DPFRF	E0481	E0482
			EURO IV		E0319	E0320
				Hybrid	E0321	E0322
				SCRRF	E0425	E0424
				DPFRF	E0487	E0488
			EURO V	SCR	E0330	E0331
				Hybrid		E0333
				Hybrid SCR	E0332	
				Hybrid EGR	E0334	
				EGR	E0335	E0336
				EGR + SCRRF	E0431	E0430
			EURO VI		E0350	E0351
				Hybrid	E0352	E0353
		15-18 t	Pre-EURO I		E0297	E0298
			EURO I		E0303	E0304
				DPFRF	E0471	E0472
			EURO II		E0309	E0310
				SCRRF	E0415	E0414
				DPFRF	E0477	
			EURO III		E0315	E0316
				SCRRF	E0421	E0420
				DPFRF	E0483	E0484
			EURO IV		E0323	E0324
				Hybrid	E0325	E0326
				SCRRF	E0427	E0426
				DPFRF	E0489	E0490
			EURO V	SCR	E0337	E0341
				Hybrid		E0339
				Hybrid SCR	E0338	
				Hybrid EGR	E0340	
				EGR	E0343	E0342

				EGR + SCRRF	E0433	E0432
			EURO VI		E0354	E0357
				Hybrid	E0355	E0356
		>18 t	Pre-EURO I		E0299	E0300
			EURO I		E0305	E0306
				DPFRF	E0473	E0474
			EURO II		E0311	E0312
				SCRRF	E0417	E0416
				DPFRF	E0479	
			EURO III		E0317	E0318
				SCRRF	E0423	E0422
				DPFRF	E0485	E0486
			EURO IV		E0327	E0329
				Hybrid	E0328	
				SCRRF	E0429	E0428
				DPFRF	E0491	E0492
			EURO V	SCR	E0344	E0345
				Hybrid SCR	E0347	
				Hybrid EGR	E0346	
				EGR	E0348	E0349
				EGR + SCRRF	E0435	E0434
			EURO VI		E0358	E0359
				Hybrid	E0360	
Coach	Diesel	15-18 t	Pre-EURO I		E0361	
			EURO I		E0363	
				DPFRF	E0493	
			EURO II		E0365	
				DPFRF	E0495	
				SCRRF	E0436	
			EURO III		E0367	
				DPFRF	E0497	
				SCRRF	E0438	
			EURO IV		E0369	
				DPFRF	E0499	
				SCRRF	E0440	
			EURO V	SCR	E0371	
				EGR	E0372	
				EGR + SCRRF	E0442	
			EURO VI		E0375	
		>18 t	Pre-EURO I		E0362	
			EURO I		E0364	
				DPFRF	E0494	
			EURO II		E0366	

				DPFRF	E0496
				SCRRF	E0437
			EURO III		E0368
				DPFRF	E0498
				SCRRF	E0439
			EURO IV		E0370
				DPFRF	E0500
				SCRRF	E0441
			EURO V	SCR	E0373
				EGR	E0374
				EGR + SCRRF	E0443
			EURO VI		E0376

Table A.18 – ‘**EFTv10.1** and ‘**EFT v9**’ Bus vehicle sub-categories for diesel fuelled vehicles only

Motorcycle vehicle sub-categories for the ‘EFTv10.1’, ‘EFT v9.0’ and ‘EFT v8.0’ datasets					
Vehicle type	**Fuel type**	**Additional information**	**Engine capacity (cc)**	**EURO class**	**Sub-category name**
Motorcycle (All)	Petrol	n/a	All	All	E0001

Table A.19 –motorcycle vehicle sub-category

Motorcycle vehicle sub-categories for the ‘COPERT v5.5’ datasets					
Vehicle type	**Fuel type**	**Additional information**	**Engine capacity (cc)**	**EURO class**	**Sub-category name**
Motorcycle	Petrol	2-stroke	< 50	Pre-Euro 1	E0918
	Petrol	2-stroke	< 50	Euro 1	E0919
	Petrol	2-stroke	< 50	Euro 2	E0920
	Petrol	2-stroke	< 50	Euro 3	E0921
	Petrol	2-stroke	< 50	Euro 4	E0922
	Petrol	2-stroke	< 50	Euro 5	E0923
	Petrol	2-stroke	< 50	Pre-Euro 1	E0924
	Petrol	2-stroke	< 50	Euro 1	E0925
	Petrol	2-stroke	< 50	Euro 2	E0926
	Petrol	2-stroke	< 50	Euro 3	E0927
	Petrol	2-stroke	< 50	Euro 4	E0928
	Petrol	2-stroke	< 50	Euro 5	E0929
	Petrol	4-stroke	< 250	Pre-Euro 1	E0930
	Petrol	4-stroke	< 250	Euro 1	E0931
	Petrol	4-stroke	< 250	Euro 2	E0932
	Petrol	4-stroke	< 250	Euro 3	E0933
	Petrol	4-stroke	< 250	Euro 4	E0934

	Petrol	4-stroke	< 250	Euro 5	E0935
	Petrol	4-stroke	250 - 750	Pre-Euro 1	E0936
	Petrol	4-stroke	250 - 750	Euro 1	E0937
	Petrol	4-stroke	250 - 750	Euro 2	E0938
	Petrol	4-stroke	250 - 750	Euro 3	E0939
	Petrol	4-stroke	250 - 750	Euro 4	E0940
	Petrol	4-stroke	250 - 750	Euro 5	E0941
	Petrol	4-stroke	> 750	Pre-Euro 1	E0942
	Petrol	4-stroke	> 750	Euro 1	E0943
	Petrol	4-stroke	> 750	Euro 2	E0944
	Petrol	4-stroke	> 750	Euro 3	E0945
	Petrol	4-stroke	> 750	Euro 4	E0946
	Petrol	4-stroke	> 750	Euro 5	E0947

Table A.20 –motorcycle vehicle sub-category

EFT v5.2 and EFT v6.0.1	
Vehicle sub-category name	
HEAVY vehicle sub-categories	**LIGHT vehicle sub-categories**
HEAVY mway London	LIGHT mway London
HEAVY outer London	LIGHT outer London
HEAVY inner London	LIGHT inner London
HEAVY central London	LIGHT central London
HEAVY mway England	LIGHT mway England
HEAVY rural England	LIGHT rural England
HEAVY urban England	LIGHT urban England
HEAVY mway NI	LIGHT mway NI
HEAVY rural NI	LIGHT rural NI
HEAVY urban NI	LIGHT urban NI
HEAVY mway Scotland	LIGHT mway Scotland
HEAVY rural Scotland	LIGHT rural Scotland
HEAVY urban Scotland	LIGHT urban Scotland
HEAVY mway Wales	LIGHT mway Wales
HEAVY rural Wales	LIGHT rural Wales
HEAVY urban Wales	LIGHT urban Wales

Table A.21 – **EFT v5.2** and **EFT 6.0.1** vehicle sub-categories

UKEFD 2001		UK Diesel 2001		UKEFD	
Vehicle sub-category name	**Emission factors vehicle unit**	**Vehicle sub-category name**	**Emission factors vehicle unit**	**Vehicle sub-category name**	**Emission factors vehicle unit**
Heritage	per 2 cars	Intercity	per car	Heritage	per 2 cars
IC125	per power car	Regional	per car	IC125	per power car
Pacer	per car	Freight	per train	Pacer	per car
Sprinter	per car	Electric	per car	Sprinter	per car
Turbo	per car			Turbo	per car
Class47P	loco + 7 coaches			Class47P	loco + 7 coaches
Electric	per train			Class37F	per loco
Class37F	per loco			Class47F	per loco
Class37F_2loco	per pair of locos			Class56F	per loco
Class47F	per loco			Class58F	per loco
Class56F	per loco			Class60F	per loco
Class58F	per loco				
Class60F	per loco				
Class66F	per loco				

Table A.22 – Vehicle sub-categories for sets of rail emission factors available in EMIT. The “Emission factors vehicle unit” column gives the definition of “vehicle” for use in calculating emission factors (see text).

A.5 Railway emissions

In terms of activity data, the rail emission factor datasets included within EMIT are classified in two different ways. The older datasets (**UKEFD 2001**, **UK Diesel 2001** and **UKEFD**) use the number of trains per day as the activity parameter, whereas for the newest dataset (**UKEFD07 Rail**), the emissions are calculated in terms of fuel use. **Table A.23** summarises the rail transport emission factor datasets in EMIT.

For **UKEFD 2001** and **UK Diesel 2001**:

- A vehicle sub-category has been added for electric trains. Although electric trains have zero emissions as far as the emission calculations in EMIT are concerned, a category has been included to allow count data to be stored on electric trains.
- The $PM_{2.5}$ emissions are set equal to the PM_{10} emissions as a conservative estimate.

Dataset name	Description	Reference	Number of vehicle sub-categories	Pollutants available
UKEFD07 Rail	Emission factors from the UK Emission Factors Database (2007)	**UKEFD 2007**	n/a	ARSENIC, B[a]P, B[b]F, B[ghi]P, B[k]F, BENZENE, BERYLLIUM, BUTADIENE, CADMIUM, CHROMIUM, CO, CO2, COPPER, FLUORANTHENE, HCl, I[cd]P, LEAD, MERCURY, CH4, N2O, NICKEL, NOx, NO2, PCP, PM10, PM2.5, SELENIUM, SO2, TIN, VANADIUM, VOC, ZINC
UKEFD 2001	Emission factors from the UK Emission Factors Database (2001)	**UKEFD 2001**	14	BENZENE, BUTADIENE, CO, CO2, CH4, NOx, N2O, PM10, PM2.5, SO2, VOC
UK Diesel 2001	Emission factors from the UK GHG Emissions Inventory	**EMEP 2001 and UKEFD 2003**	4	BENZENE, BUTADIENE, CO, CO2, CH4, NOx, N2O, PM10, PM2.5, SO2, VOC
UKEFD	Emission factors from the UK Emission Factors Database (1998)	**UKEFD 2001**	11	BENZENE, BUTADIENE, CO, NOx, PM10, SO2, VOC

Table A.23 – Summary of rail transport emission factor datasets in EMIT.

A.5.1 UKEFD and UKEFD 2001

The older emission factors for rail traffic are from the UK Emission Factors Database, updated in 2001 from the earlier version in 1998 (**UKEFD 2001**). These data form the basis for the EMIT rail emission factors **UKEFD 2001** and **UKEFD** respectively. The latter are retained for compatibility with earlier versions of EMIT.

There are 14 vehicle sub-categories in **UKEFD 2001** and 11 in **UKEFD** (see **Table A.22**). The definition of 'vehicle' for these emission factors varies according to the vehicle sub-category, and this is reflected in the column 'Emission factors vehicle unit'. The number of complete trains in a traffic count needs to be multiplied by the number of vehicle units in each train for the purposes of calculating emissions. For example, each Sprinter passenger train contributes N_C vehicles to the traffic count, where N_C is the number of cars in the train, while each Class66F freight train would contribute N_L vehicles to the traffic count, where N_L is the number of locomotives in the train.

A.5.2 UK Diesel 2001

Rail emission factors may also be derived from the UK Greenhouse Gas Inventory (which gives factors per unit fuel consumed so that fuel consumption data are needed to give factors per vehicle km, **Salway *et al.* 2001**), yielding the **UK Diesel 2001** set of emission factors in EMIT.

A.5.3 UKEFD07 Rail

These data from the UKEFD were supplied to CERC in January 2010 (**UKEFD 2007**). $PM_{2.5}$ and NO_2 emission factors were not included explicitly in the UK Emission Factor Database for 2007. Therefore, $PM_{2.5}$ emission factors have been calculated as 66.7% and 75% of PM_{10} factors for stationary and mobile sources respectively (**AEAT 2010**); NO_2 emission factors have been taken as 5% and 15% of NO_x emission factors for stationary and mobile sources respectively (**AEAT 2009a**).

This dataset includes generalised emission factors for freight, intercity and regional trains, as well as for stationary combustion. These factors are suitable for use when the quantity of fuel consumed by the vehicles is known.

A copy of this dataset in the form of a Microsoft Excel spreadsheet (UKEFD07 Rail.xls) has been supplied in the EMIT installation directory, in the subdirectory *Data\ActivityDatasets*. This spreadsheet contains the Nomenclature For Reporting (NFR) format (UNECE) and Selected Nomenclature for Air Pollution (SNAP, European Environment Agency) codes, in addition to the Intergovernmental Panel on Climate Change (IPCC) sectors for each activity.

For general information about the UKEFD datasets, please refer to Section C.2.1.

A.6 Shipping emissions

One dataset for shipping emissions is included within EMIT: **UKEFD07 Shipping**. This is summarised in **Table A.24** and described below.

Dataset name	Description	Reference	Source type	Pollutants available
UKEFD07 Shipping	UKEFD emissions from shipping	**UKEFD 2007**	point, line, area, volume and CandD sources	ARSENIC, B[a]P, B[b]F, B[ghi]P, B[k]F, BENZENE, BERYLLIUM, CADMIUM, CHROMIUM, CO, CO2, COPPER, FLUORANTHEN, HCl, I[cd]P, LEAD, MERCURY, CH4, N2O, NICKEL, NOx, NO2, PCP, PM10, PM2.5 , SELENIUM, SO2, TIN, VANADIUM, VOC, ZINC

Table A.24 – Summary of the shipping emission factor dataset contained in EMIT.

A.6.1 UKEFD07 Shipping

Table A.24 summarises the shipping emission factor dataset included within EMIT. These data from the UKEFD were supplied to CERC in January 2010 (**UKEFD 2007**). $PM_{2.5}$ and NO_2 emission factors were not included explicitly in the UK Emission Factor Database for 2007. Therefore, $PM_{2.5}$ emission factors have been calculated as 75% of PM_{10} factors (**AEAT 2010)**; NO_2 emission factors have been taken as 8% of NO_x emission factors (**ENTEC 2010**).

This dataset includes generalised emission factors for UK, coastal, international and naval shipping for different fuel types. These factors are suitable for use when the quantity of fuel consumed by the ships is known.

A copy of this dataset in the form of a Microsoft Excel spreadsheet (UKEFD07 Shipping.xls) has been supplied in the EMIT installation directory, in the subdirectory *Data\ActivityDatasets*. This spreadsheet contains the Nomenclature For Reporting (NFR) format (UNECE) and Selected Nomenclature for Air Pollution (SNAP, European Environment Agency) codes, in addition to the Intergovernmental Panel on Climate Change (IPCC) sectors for each activity.

For general information about the UKEFD datasets, please refer to Section C.2.1.

A.7 Route types

A route type is a breakdown of traffic into the vehicle sub-categories belonging to a set of emission factors. The breakdown is specified for each of the fleet components. Thus the fleet components give the overall breakdown of traffic – such as 15% heavy vehicles, 80% light vehicles and 5% motorcycles – while the route type gives the split of the light vehicles, say, into petrol cars, diesel cars, petrol LGVs and diesel LGVs, and similarly for the heavy vehicles and motorcycles.

EMIT offers a number of pre-defined route types, at least one for each of the available sets of emission factors. **Tables A.25** to **A.31** summarise the pre-defined route types available in EMIT. Section A.7.6 gives a discussion of an example route type.

Differences between the route type fleet compositions

It is a good idea to update any old emissions inventories by applying a more up-to-date emissions dataset (although it is always a good idea to keep a copy of the old database for comparison purposes). For example, it may be appropriate to update road source emissions from an old database by using a new dataset, such as one the '**EFT v10.1**' datasets. This is straightforward to do using the **Modify Group...** button on the **EMIT Inventory** screen. However, during this process, it is necessary not only to choose a new emission factor dataset, but also to choose an appropriate route type for all the roads within the chosen group.

If one of the pre-defined route types are to be used, it is important to be aware of any differences in the definitions of the route types so that any change in emissions can be accounted for i.e. are the changes solely due to the new emission factor dataset, or are there some changes because a different route type has been used? Details are given below.

As outlined in Section A.2, and shown in **Tables A.16** to **A.22**, there are slightly different vehicle sub-categories for each of the emission factor datasets. In some cases, the different route types have also used different fleet composition data.

A.7.1 EFT v5.2 and EFT v6.0.1

Table A.25 summarises the **EFT v5.2** and **EFT v6.0.1** route types available in EMIT. The route types are independent of year.

The **EFT v5.2** and **EFT v6.0.1** datasets have separate route types for inside and outside London. The non-London datasets are split up into regions representing the four countries of the UK: England (not London), Northern Ireland, Scotland and Wales. These regions have pre-defined route types representing traffic flows on urban, motorway and rural roads. These route types are very simple due to the small number of vehicle sub-categories. In fact, they can only be defined in one way, so they never need to be modified.

The London route types cover central, inner, outer and motorway roads. **Figure A.1** shows the London regions classified as central, inner and outer London.

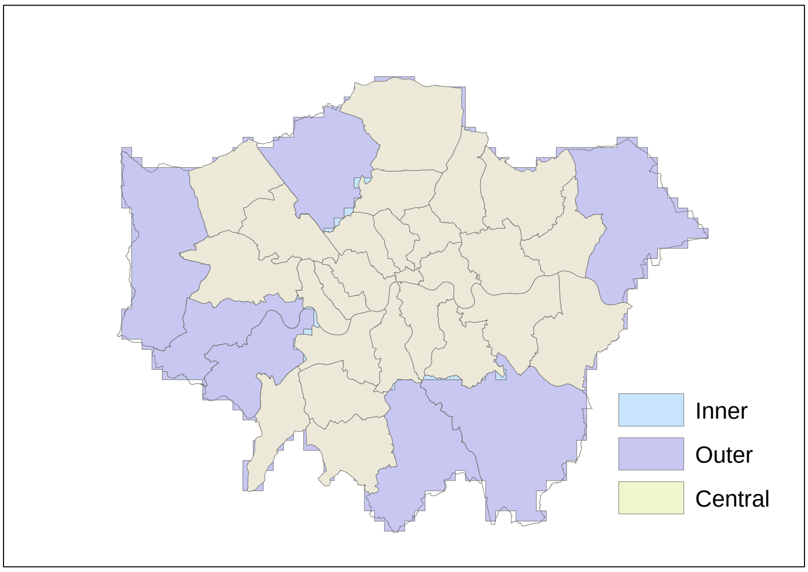


Figure A.1 – Definition of central, inner and outer areas of London

Note that in EMIT, the corresponding fleet composition available for the EFT factors is heavy/light/motorcycle (for further details, please refer to Section A.1 above). However, EFT emissions are only given for heavy duty vehicles and light duty vehicles. Therefore, emissions from motorcycles are assumed to be the same as those from light vehicles.

Dataset	Route type names					
	Motorway	Urban	Rural	Central	Inner	Outer
EFT v5.2	EFTv5.2 Mway Lon	-	-	EFTv5.2 Central Lon	EFTv5.2 Inner Lon	EFTv5.2 Outer Lon
	EFTv5.2 Mway Eng	EFTv5.2 Urban Eng	EFTv5.2 Rural Eng	-	-	-
	EFTv5.2 Mway NI	EFTv5.2 Urban NI	EFTv5.2 Rural NI	-	-	-
	EFTv5.2 Mway Scot	EFTv5.2 Urban Scot	EFTv5.2 Rural Scot	-	-	-
	EFTv5.2 Mway Wales	EFTv5.2 Urban Wales	EFTv5.2 Rural Wales	-	-	-
EFT v6.0.1	EFTv6.0 Mway Lon	-	-	EFTv6.0 Central Lon	EFTv6.0 Inner Lon	EFTv6.0 Outer Lon
	EFTv6.0 Mway Eng	EFTv6.0 Urban Eng	EFTv6.0 Rural Eng	-	-	-
	EFTv6.0 Mway NI	EFTv6.0 Urban NI	EFTv6.0 Rural NI	-	-	-
	EFTv6.0 Mway Scot	EFTv6.0 Urban Scot	EFTv6.0 Rural Scot	-	-	-
	EFTv6.0 Mway Wales	EFTv6.0 Urban Wales	EFTv6.0 Rural Wales	-	-	-

Table A.25 – Road route types available in EMIT for **EFT v5.2** and **EFT v6.0.1** emission factors. The names given here are those appearing in the EMIT interface.

A.7.2 Eleven fleet component route types for EFT v10.1 datasets

Table A.26 and **Table A.27** lists the pre-defined route types available for the 11 fleet-component split with the EFT v10.1 datasets.

- The London route types should be used for emissions modelling work in London in the absence of local data.

The route types have been split up into a "PM" route type, which should be used for PM emissions, and a "NOx" route type, which should be used for all other pollutants.

- Note that for the heavy vehicle components, data relating axle numbers to vehicle weights were required; these were obtained from the appropriate source data (**DfT 2020**).
- The EFT v10.1 route types should be used for emissions modelling work within the appropriate UK region (but outside London) in the absence of local data. As for the London route types, for the heavy vehicle components, data relating axle numbers to vehicle weights were required; these were obtained from the appropriate source data (**DfT 2020**).
- Separate route types are also defined for break wear, tyre wear and resuspension, but they have not been listed here.

Dataset group	Years	Region	Pollutant	Dataset road type		
				Motorway	Urban	Rural
'EFT v10.1	2018-2030	England (outside London)	PM	E10.1 PM[11]Eng M18 to E10.1 PM[11]Eng M30	E10.1 PM[11]Eng U18 to E10.1 PM[11]Eng U30	E10.1 PM[11]Eng R18 to E10.1 PM[11]Eng R30
			NO_x	E10.1 NOx[11]Eng M18 to E10.1 NOx[11]Eng M30	E10.1 NOx[11]Eng U18 to E10.1 NOx[11]Eng U30	E10.1 NOx[11]Eng R18 to E10.1 NOx[11]Eng R30
		Northern Ireland	PM	E10.1 PM[11]NI M18 to E10.1 PM[11]NI M30	E10.1 PM[11]NI U18 to E10.1 PM[11]NI U30	E10.1 PM[11]NI R18 to E10.1 PM[11]NI R30
			NO_x	E10.1 NOx[11]NI M18 to E10.1 NOx[11]NI M30	E10.1 NOx[11]NI U18 to E10.1 NOx[11]NI U30	E10.1 NOx[11]NI R18 to E10.1 NOx[11]NI R30
		Scotland	PM	E10.1 PM[11]Sco M18 to E10.1 PM[11]Sco M30	E10.1 PM[11]Sco U18 to E10.1 PM[11]Sco U30	E10.1 PM[11]Sco R18 to E10.1 PM[11]Sco R30
			NO_x	E10.1 NOx[11]Sco M18 to E10.1 NOx[11]Sco M30	E10.1 NOx[11]Sco U18 to E10.1 NOx[11]Sco U30	E10.1 NOx[11]Sco R18 to E10.1 NOx[11]Sco R30
		Wales	PM	E10.1 PM[11]Wal M18 to E10.1 PM[11]Wal M30	E10.1 PM[11]Wal U18 to E10.1 PM[11]Wal U30	E10.1 PM[11]Wal R18 to E10.1 PM[11]Wal R30
			NO_x	E10.1 NOx[11]Wal M18 to E10.1 NOx[11]Wal M30	E10.1 NOx[11]Wal U18 to E10.1 NOx[11]Wal U30	E10.1 NOx[11]Wal R18 to E10.1 NOx[11]Wal R30

Table A.26 – Pre-defined route types available for the UK EFT v10.1 emission factors with the 11 fleet-component split.

Dataset group	Years	Region and road type	Pollutant	Route Types
'EFT v10.1	2018-2030	London Inner	PM	E10.1 PM[11]Lon I18 to E10.1 PM[11]Lon I30
			NO_x	E10.1 NOx[11]Lon I18 to E10.1 NOx[11]Lon I30
		London Central	PM	E10.1 PM[11]Lon C18 to E10.1 PM[11]Lon C30
			NO_x	E10.1 NOx[11]Lon C18 to E10.1 NOx[11]Lon C30
		London Outer	PM	E10.1 PM[11]Lon O18 to E10.1 PM[11]Lon O30
			NO_x	E10.1 NOx[11]Lon O18 to E10.1 NOx[11]Lon O30
		London Motorway	PM	E10.1 PM[11]Lon M18 to E10.1 PM[11]Lon M30
			NO_x	E10.1 NOx[11]Lon M18 to E10.1 NOx[11]Lon M30

Table A.27 – Pre-defined route types available for the London EFT v10.1 emission factors with the 11 fleet-component split.

A.7.3 Eleven fleet component route types for COPERT v5.5 datasets

Table A.28 and **Table A.29** list the pre-defined route types available for the 11 fleet-component split with the COPERT v5.5 datasets. The route type data is identical to that given for EFT 10.1 NOx route types.

Dataset group	Years	Region	Dataset road type		
			Motorway	Urban	Rural
COPERT v5.5	2018-2030	England (outside London)	COPERT5_5[11]Eng M18 to COPERT5_5[11]Eng M30	COPERT5_5[11]Eng U18 to COPERT5_5 [11]Eng U30	COPERT5_5[11]Eng R18 to COPERT5_5[11]Eng R30
		Northern Ireland	COPERT5_5[11]NI M18 to COPERT5_5[11]NI M30	COPERT5_5[11]NI U18 to COPERT5_5[11]NI U30	COPERT5_5[11]NI R18 to COPERT5_5[11]NI R30
		Scotland	COPERT5_5[11]Sco M18 to COPERT5_5[11]Sco M30	COPERT5_5[11]Sco U18 to COPERT5_5[11]Sco U30	COPERT5_5[11]Sco R18 to COPERT5_5[11]Sco R30
		Wales	COPERT5_5[11]Wal M18 to COPERT5_5[11]Wal M30	COPERT5_5[11]Wal U18 to COPERT5_5[11]Wal U30	COPERT5_5[11]Wal R18 to COPERT5_5[11]Wal R30

Table A.28 – Pre-defined non-London route types available for COPERT v5.5 emission factors

Dataset group	Years	Region and road type	Route Types
COPERT v5.5	2018-2030	London Inner	COPERT5_5[11]Lon I18 to COPERT5_5[11]Lon I30
		London Central	COPERT5_5[11]Lon C18 to COPERT5_5[11]Lon C30
		London Outer	COPERT5_5[11]Lon O18 to COPERT5_5[11]Lon O30
		London Motorway	COPERT5_5[11]Lon M18 to COPERT5_5[11]Lon M30

Table A.29 – Pre-defined London route types available for COPERT v5.5 emission factors

A.7.4 Dutch emission factors

There are three routes types for the Dutch emission factor datasets, one corresponding to each dataset. These are summarised in **Table A.30** below.

Dataset	Route type
NL HIGHWAY 2010	NL HIGHWAY RT
NL NON-HIGHWAY 2010	NL NON-HIGHWAY RT
NL TRUCK E-ZONE 2010	NL TRUCK E-ZONE RT

Table A.30 – Road route types available in EMIT for the Dutch emission factor datasets. The names given here are those appearing in the EMIT interface.

A.7.5 UKEFD, UKEFD 2001 and UK Diesel 2001

Table A.31 summarises the rail route types available in EMIT.

It is likely that route types for rail sources will often be user-defined due to the wide variation in use of railway lines. Therefore route types ‘test rail route (13)’ (for **UKEFD 2001**), ‘test rail route (3)’ (for **UK Diesel 2001**) and ‘rail route (2)’ (for **UKEFD**) are intended only as a starting point for this process.

In the route type ‘UKEFD 2001 Full’, the number of rail fleet components is equal to the number of vehicle sub-categories, so that individual traffic counts can be entered directly for each vehicle sub-category for every source (the route type matrix is then simply the unit matrix); similarly for ‘UK Diesel 2001 Full’.

UKEFD 2001	UK Diesel 2001	UKEFD
UKEFD 2001 Full	UK Diesel 2001 Full	rail route
test rail route (3)		
test rail route (13)		

Table A.31 – Rail route types available in EMIT. The names given here are those that appear in the EMIT interface.

A.7.6 An example route type

Examples of two route types from the '**NAEI 2012**' datasets are shown in **Figure A.2**, namely *NAEI 12 Eng[3] U15* and *NAEI 12 Eng[3] M15*. The NAEI emission dataset has been removed from EMIT as it is dated, however, as users may find this illustration useful this example has been left in the User Guide. This figure illustrates how the route types are defined: we have a certain number of vehicle sub-categories because of our choice of emission factors – in this case 372 for each '**NAEI 2012**' dataset – and a certain number of fleet components – in this case 3. Each fleet component is then comprised of a distribution of the relevant vehicle sub-categories.

The breakdown by vehicle types within the fleet components are shown in **Figure A.2**. In the *NAEI 12 Eng[3] U15* route type, 44% of the light vehicles component are petrol cars, compared to 32% of the light vehicles component in the *NAEI 12 Eng[3] M15* route type. **Tables A.16** to **A.19** give the meanings of the vehicle sub-category names used in the '**NAEI 2012**' datasets.

Points to note from this example are as follows:

(a) The route types have an associated year, namely 2015. The vehicle sub-category proportions will change in the route types for different years (for instance compare *NAEI 12 Eng[3] U15* and *NAEI 12 Eng[3] U20* using the menu option **Data**, **Route Types**, **Road**). The changes in later years for equivalent route types represent the penetration of newer vehicles into the fleet.

(b) The year dependence of the '**NAEI 2012**' datasets is incorporated both into the route type and the emission factors. The emission factor year dependence accounts for the uptake and effect of new fuels and higher emissions from deteriorated engines of older vehicles under different driving conditions.

(c) The *NAEI 12 Eng[3] U15* and *NAEI 12 Eng[3] M15* route types represent traffic in urban areas and motorways respectively; there are also route types for rural areas. The urban/rural/motorway route type split accounts for factors such the larger proportion of articulated HGVs on motorways as compared to buses and rigid HGVs.

(d) The route types also have an associated region, which in the example is England (outside London). The region accounts for differences in diesel and petrol car proportions across the UK and the accelerated up-take of newer vehicle technologies in London required for compliance with the city's Low Emission Zone (LEZ).

(e) **Figure A.3** shows the relationship between fleet components, vehicle sub-categories and AADT (total number of vehicles per day) based on the *NAEI 12 Eng[3] U15* and *NAEI 12 Eng[3] M15* route types. The figure shows three bars:

- The top bar represents the fleet components. There are 8000 light vehicles / day, 1500 heavy vehicles / day, and 500 motorcycles / day, making a total AADT of 10000.

- The other two bars show how the AADT of 10000 is split into different vehicle types for the two route types. The relative contributions of different vehicle types within the light, heavy and motorcycles components changes between the urban and motorway route type. For example a greater proportion of the 1500 heavy vehicles / day is made up of articulated HGVs (vehicle sub-categories R168 to R202) in the motorway route type *NAEI 12 Eng[3] M15* (808 vehicles / day) compared with the urban route type *NAEI 12 Eng[3] U15* (176 vehicles / day).

(f) A detailed vehicle breakdown of petrol cars in the *NAEI 12 Eng[3] U15* route type is shown in **Figure A.4**. The breakdown of petrol cars is split into three engine size categories: <1400cc (vehicle sub-categories R001 to R007f); 1400 – 2000cc (vehicle sub-categories R008 to R014f); and >2000cc (vehicle sub-categories R015 to R021f). The vehicle breakdown is further split within the engine size categories by the Euro standard of the vehicles. For example, a traffic flow of 8000 light vehicles / day for the *NAEI 12 Eng[3] U15* route type will include 542 Euro 5 petrol cars <1400cc (vehicle sub-categories R006 and R006f).

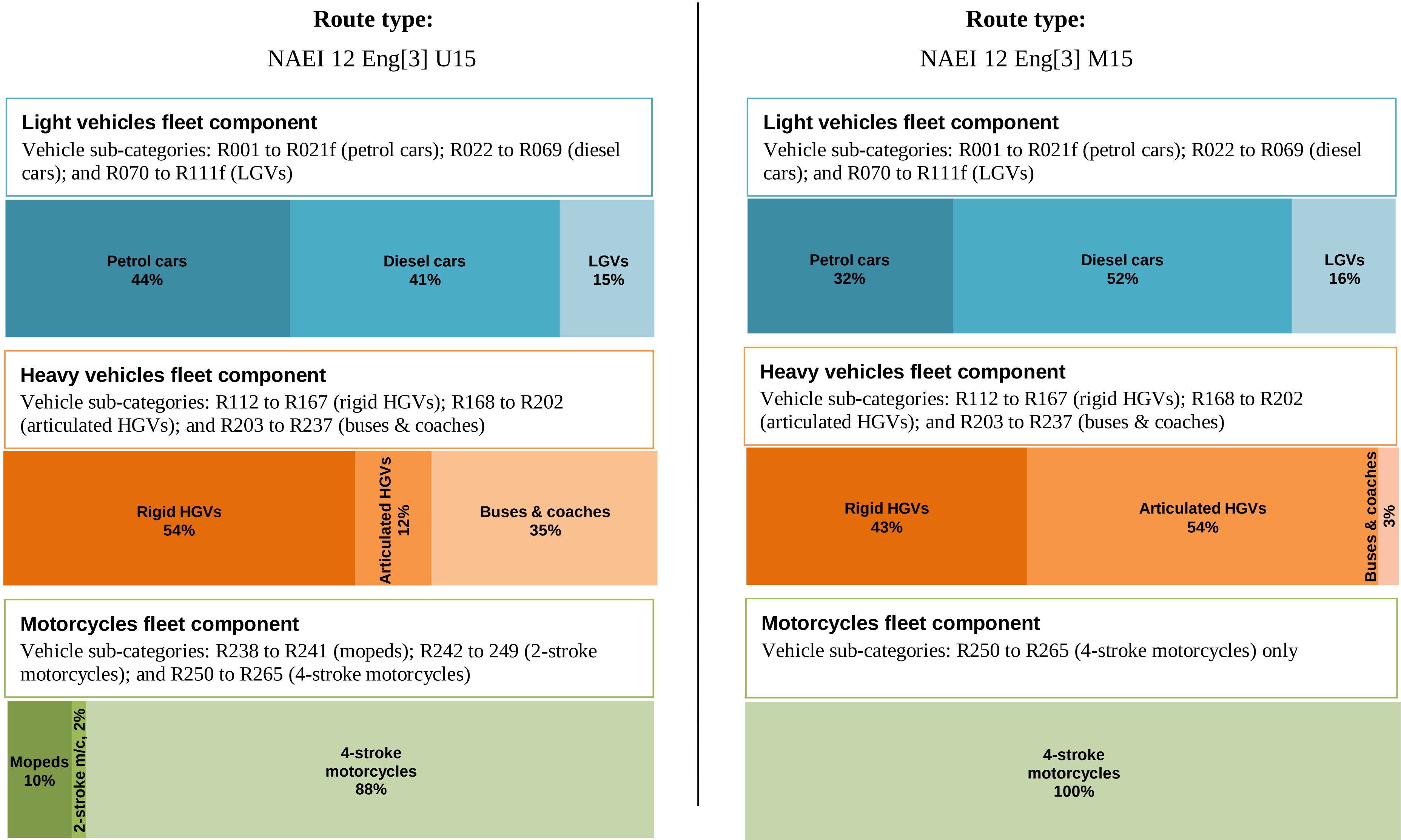


Figure A.2 – Comparison of the breakdown by vehicle type for the fleet components of two route types from the '**NAEI 2012**' datasets. The route types shown represent vehicle breakdowns for England outside London for 2015 for urban roads (*NAEI 12 Eng[3] U15*) and motorways (*NAEI 12 Eng[3] M15*).

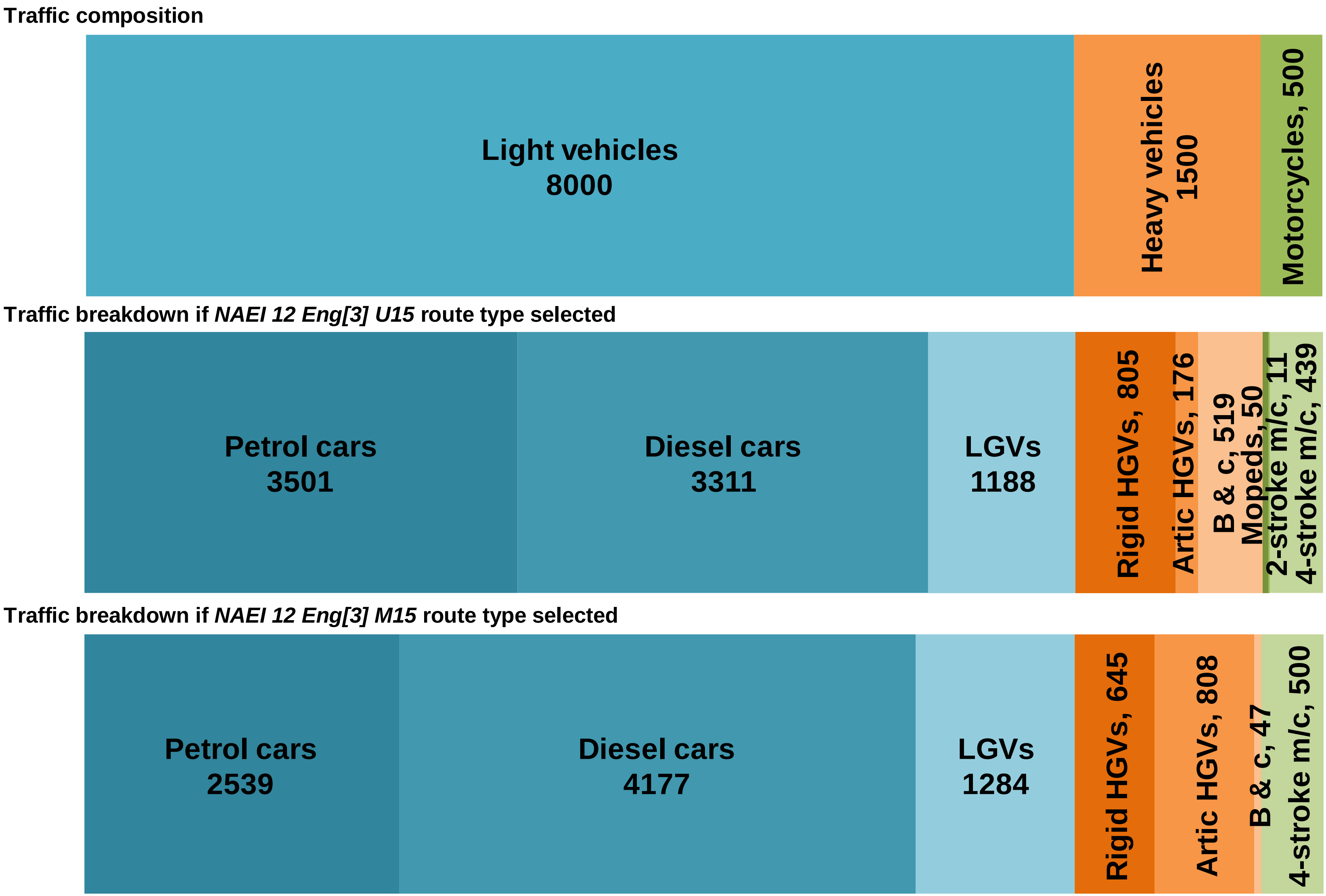


Figure A.3 – Schematic illustration of the relationship between traffic composition and route type, comparing the breakdown by vehicle type for *NAEI 12 Eng[3] U1*5 and *NAEI 12 Eng[3] M15* route types for an example AADT of 10000 vehicles per day.

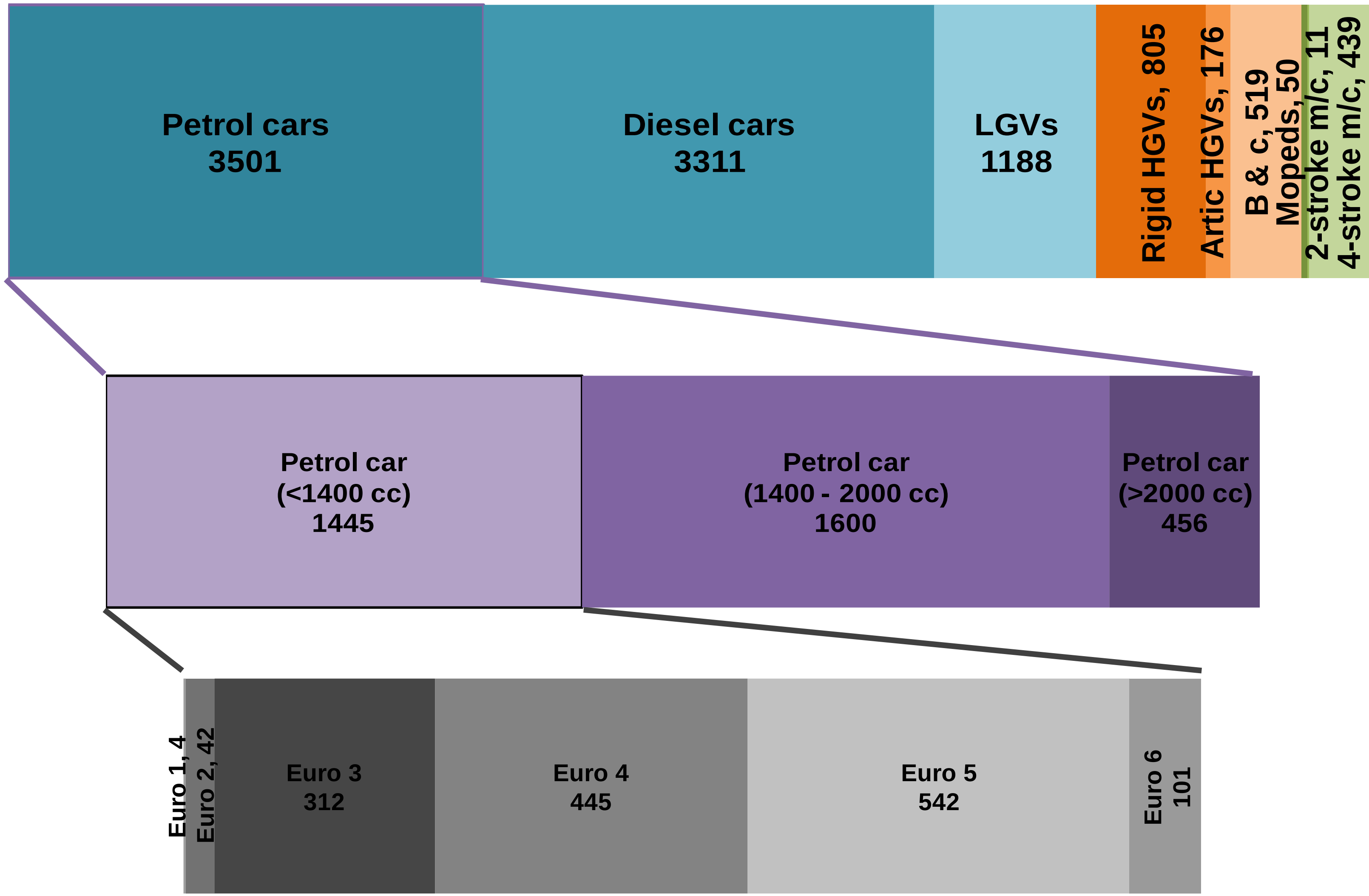


Figure A.4 – Breakdown of petrol cars in *NAEI 12 Eng[3] U15* for an example AADT of 10000. For simplicity, vehicle sub-categories names are not shown.

A.8 Calculation of emission rates from traffic data

We saw in Section 3.1.3 the various quantities used to describe traffic and the calculation of emission rates for this traffic. In this section we show how these quantities are related mathematically, using an older set of emission factors that are no longer in EMIT, the **LRC** emission factors. The LRC factors use only 8 vehicle sub-categories, so the calculation is easier to follow. The same principles apply to all the traffic emission factor sets.

(a) The starting point is a set of emission factors. For a given year and vehicle speed, we can represent the emission factors as a matrix **E**, e.g. the **LRC** emission factors for a speed of 30 km/hr and year 1999 has the following elements:

$$\begin{array}{cc} & \begin{array}{cccccccc} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \end{array} \\ \mathbf{E} = & \begin{pmatrix} 2.53 & 5.62 & 0.525 & 0.992 & 19.0 & 7.56 & 14.3 & 2.58 \\ 1410 & 1040 & 187 & 300 & 106 & 231 & 315 & 676 \\ 12.9 & 10.3 & 0.482 & 0.851 & 0.118 & 0.772 & 1.22 & 6.81 \\ 0.535 & 0.612 & 0.0854 & 0.231 & 0.0874 & 0.0227 & 0.0369 & 0.525 \\ 1.68 & 1.79 & 0.0977 & 0.300 & 5.01 & 0.984 & 1.68 & 2.15 \end{pmatrix} \begin{array}{l} \mathbf{CO} \\ \mathbf{CO_2} \\ \mathbf{NO_x} \\ \mathbf{PM} \\ \mathbf{VOC} \end{array} \end{array}$$

In this matrix, the units are g/vehicle/km and the emission factors have been rounded to 3 significant figures. The numbers above the columns represent the 8 emission factor vehicle sub-categories, i.e.

1 = articulated HGV

2 = bus

3 = diesel car

4 = diesel LGV

5 = motorcycle

6 = petrol car

7 = petrol LGV

8 = petrol HGV

while each row corresponds to a particular pollutant, shown down the right-hand side of the matrix.

(b) Next, we specify a traffic composition, which we represent by the column vector **c**, of traffic counts, e.g.

$$\mathbf{c} = \begin{pmatrix} 300 \\ 1600 \\ 100 \end{pmatrix} \begin{array}{l} \text{heavy} \\ \text{light} \\ \text{m/c} \end{array}$$

where we have taken the traffic composition to be specified using 3 fleet components and the numbers in the vector are the traffic counts for each component in vehicles/day. The total AADT is thus 2000 vehicles/day.

(c) Next, we choose a route type, which we represent by a matrix $\mathbf{\Phi}$, e.g. the (pre-defined) LRC non-Motorway 1998 route type for which

$$\begin{array}{cc} & \begin{array}{ccc} \text{heavy} & \text{light} & \text{m/c} \end{array} \\ \mathbf{\Phi} = & \begin{pmatrix} 23.88 & 0 & 0 \\ 17.91 & 0 & 0 \\ 0 & 11.59 & 0 \\ 0 & 6.72 & 0 \\ 0 & 0 & 100 \\ 0 & 78.11 & 0 \\ 0 & 3.58 & 0 \\ 58.21 & 0 & 0 \end{pmatrix} \begin{array}{c} 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \\ 7 \\ 8 \end{array} \end{array}$$

where the units are percent (as given in the **Route Type** screen).

(d) The number of vehicles per day in each emission factors vehicle sub-category, $\mathbf{n}$, is then given by the following, since $\mathbf{\Phi}$ is in percent

$$\mathbf{n} = 0.01 \cdot \mathbf{\Phi} \cdot \mathbf{c} = \begin{pmatrix} 72 \\ 54 \\ 185 \\ 108 \\ 100 \\ 1250 \\ 57 \\ 175 \end{pmatrix} \begin{array}{c} 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \\ 7 \\ 8 \end{array}$$

(e) Finally, we obtain the emission rate $\dot{\mathbf{m}}$ for each pollutant by multiplying the number of vehicles $\mathbf{n}$ by the road length L (metres) and the emission factors matrix $\mathbf{E}$ thus:

$$\dot{\mathbf{m}} = 0.001 \cdot L \cdot \mathbf{E} \cdot \mathbf{n},$$

where the units are g/day.

Alternatively, writing this out in full, and changing units to tonnes/yr, we have

$$\dot{\mathbf{m}} = (3.65 \times 10^{-9} L)\, \mathbf{E}\, \mathbf{\Phi}\, \mathbf{c}$$

From this it is clear that the route type $\mathbf{\Phi}$ is a "bridge" between the emission factors $\mathbf{E}$ and the traffic composition $\mathbf{c}$.

In this example, if we take L = 4000m we would obtain

$$\dot{\mathbf{m}} = \begin{pmatrix} 19.43 \\ 961.6 \\ 5.687 \\ 0.3543 \\ 3.607 \end{pmatrix} \begin{array}{c} \mathbf{CO} \\ \mathbf{CO_2} \\ \mathbf{NO_x} \\ \mathbf{PM} \\ \mathbf{VOC} \end{array}$$

in units of tonnes/yr.

The above procedure would also apply to calculation of emission rates from emission factors and route types for rail traffic. For minor roads the procedure is again basically the same, except that the traffic composition **c** must be given in annual vehicle kilometres rather than annual average daily number of vehicles (for each fleet component); it is then straightforward to show that for a minor roads source

$$\dot{\mathbf{m}} = 10^{-8}\,\mathbf{E}\,\mathbf{\Phi}\,\mathbf{c}$$

in units of tonnes/yr.

APPENDIX B Data for airport sources

B.1 Introduction

Airport activity emission datasets are included within the EMIT database. These datasets are discussed in this appendix. Copies of all datasets in the form of Microsoft Excel spreadsheets have been supplied in the EMIT installation directory, in the subdirectory *Data\ActivitySpreadsheets*.

Emission factors are regularly updated as new data are collated. Consequently, it is important to be aware that the emissions factors held in EMIT are intended to be accurate at the time at which they were collated but subsequent updates will not be included until the next release of the software. If users are concerned that this is an issue, they should refer to the source of the emission factors (references given in Section 13).

The different airport activity datasets are listed in **Table B.1**. This table gives a brief description of the datasets, their corresponding GHG sector, a reference for the factors, the pollutants included within the dataset and the name of the reference spreadsheet supplied with EMIT (as mentioned above). The datasets have been derived from the following sources:

- The ICAO Engine Emissions Databank – Issue 20B (**EASA 2014**);
- The ICAO Carbon Emissions Calculator Methodology - Version 7 (**ICAO 2014**);
- The ICAO Engine Emissions Databank – Issue 17A (**CAA 2010**);
- Aerospace Information Report: Procedure for the Calculation of Aircraft Emissions (**AIR5715 2009**);
- Piston engine aircraft emission factors from the Swiss Federal Office of Civil Aviation (**FOCA 2007**);
- Turboprop aircraft emissions factors from the Swedish Defence Research Agency (**FOI 2007**);
- USA Office of Environment and Energy (AEE), Federal Aviation Administration (**FAA 2004**); and
- The revised 1996 Intergovernmental Panel on Climate Change Guidelines for National Greenhouse Gas Inventories (**IPCC 1996**).

The ICAO factors should be used in preference to the IPCC values where appropriate activity data are available. Note that, if the data are being used to compile a GHG emissions inventory, the ICAO values within Issue 17A do not include CO_2 emissions, the most recent version, ICAO Issue 20B, does include CO_2 emissions.

The most recent ICAO factors should be used in preference to the older ones, which are included in this version of EMIT for users who wish to continue working with an existing inventory without converting to the more recent factors.

Dataset Name	Description	GHG category	Reference	Pollutants	Data spreadsheet
AIRPORT GSE 2007	Airport Ground Support Equipment (GSE)	Energy	UNIQUE 2006	CO, NO_2, NO_x, PM_{10}, $PM_{2.5}$, VOC	AIRPORT GSE 2007.xls
APU 2004	Aircraft Auxiliary Power Units	Energy	FAA 2004	CO, NO_2, NO_x, VOC	APU 2004.xls
ICAO 20 + Other	Aircraft Engine Emissions	Energy	EASA 2014, ICAO 2014, FOCA 2007, FOI 2007, AIR5715 2009	CO, CO_2, NO_2, NO_x, (PM_{10}), ($PM_{2.5}$), SO_2, VOC	ICAO 20 + Other.xls
ICAO 17 + Other	Aircraft Engine Emissions	Energy	CAA 2010, FOCA 2007, FOI 2007, AIR5715 2009	CO, NO_2, NO_x, (PM_{10}), ($PM_{2.5}$), SO_2, VOC	ICAO 17 + Other.xls
IPCC96 Air (average)	Aircraft emission factors from the IPCC manual - average fleet	Energy	IPCC 1996	CO, CO_2, CH_4, N_2O, NO_2, NO_x, SO_2, VOC	IPCC96 Air average.xls
IPCC96 Air (old)	Aircraft emission factors from the IPCC manual - old fleet	Energy	IPCC 1996	CO, CO_2, CH_4, N_2O, NO_2, NO_x, SO_2, VOC	IPCC96 Air old.xls

Table B.1 – Summary of airport emission factor datasets. A pollutant name in brackets implies that emissions for this pollutant are not comprehensive.

Pollutants

The following pollutants are included in each dataset: CO, NO_2, NO_x, VOC.

- The data sets IPCC96 Air (average) and IPCC96 Air (old) also include: CO_2, CH_4, N_2O, SO_2.
- The 'ICAO 20 + Other' data set also includes: CO_2, PM_{10}, $PM_{2.5}$ and SO_2. PM_{10} factors have only been calculated for engines from the ICAO database (please refer to Section B.2.3 for more details). $PM_{2.5}$ emission factors have been set equal to the PM_{10} emission factors.
- The 'ICAO 17 + Other' data set also includes: PM_{10}, $PM_{2.5}$ and SO_2. PM_{10} factors have only been calculated for engines from the ICAO database (please refer to Section B.2.4 for more details). $PM_{2.5}$ emission factors have been set equal to the PM_{10} emission factors.
- The AIRPORT GSE 2007 factors also include PM_{10} and $PM_{2.5}$. Again, the $PM_{2.5}$

factors have been set equal to the PM_{10} factors.

Greenhouse Gas sectors

Each of the datasets described in this appendix have been associated with the Energy GHG sector.

Source types

The airport datasets can be used to estimate emissions from point, line, area and volume sources.

A note on Nitrogen Oxides

The NO_x emission rates discussed in this Appendix are 'NO_x as NO_2' values, making them consistent with all other datasets included in EMIT.

B.2 Emission factors

Detailed descriptions of all the airport source datasets held in EMIT are given below. The ICAO factors should be used in preference to the IPCC values where appropriate activity data are available (unless a GHG emission inventory is being compiled).

B.2.1 AIRPORT GSE 2007

The AIRPORT GSE 2007 dataset includes emission factors for airport ground support equipment (GSE). The GSE included incorporate some generic heavy GSE and some specific GSE based on equipment at Zurich airport. The emission factors have been compiled from EC Non Road Mobile Machinery legislative limits (EC directive 97/68/EC) and EURO BASE 03 emission factors for stationary EURO standard vehicles.

B.2.2 APU 2004

The APU 2004 dataset includes emission factors for 29 different types of Auxiliary Power Units (APU). Each aircraft included in an inventory should have an associated APU. **Table B.3** provides a list of some of the common aircrafts with compatible APUs. These factors were compiled by the FAA.

B.2.3 ICAO 20 + Other

The ICAO 20 + Other dataset calculates aircraft engine emissions from the activity data shown in **Table B.2**. The user enters one or more sets of this activity data for each source: therefore one EMIT source can include emissions from multiple aircraft movements. The activity data can be typed manually into the EMIT source screen or can be imported from an external file – see SECTION 6 for details of the import procedure.

Activity data	Units	Valid range	Notes
Aircraft, engine, (UID), num of engines	The user selects from a predefined list	-	UID stands for Unique IDentifier, and is the engine code from the ICAO database.
Thrust	%	0-100	The user can select one of the standard thrust values (7%, 30%, 85%, 100%), or can enter a custom value. For custom thrusts EMIT uses linear interpolation to calculate the emissions from the emissions indices and fuel flows at the standard thrusts.
LTO	Number of LTOs per year	0 – 1000000	LTO stands for Landing and Take-off Operation
TIM (mins)	minutes	0 – 720	TIM stands for Time in Mode

Table B.2 – Activity data for the ICAO 20 + Other dataset.

The EMIT ICAO 20 + Other dataset has been compiled from four sources.

- Jet engine emissions have been taken from Issue 20 of the ICAO database (**EASA 2014**). A copy of this data source is included for reference in the EMIT installation directory, in the subdirectory *Data\ICAODatabanks*.
- The ICAO database contains information on exhaust emissions relating to those aircraft engines that have entered production. The information in the database has been provided by engine manufacturers, who are solely responsible for its accuracy.
- The ICAO database was downloaded from the EASA website where further supporting text can be found (http://easa.europa.eu). A copy of this database is in the Data folder in the EMIT install directory.
- PM_{10} emissions factors have been calculated from the ICAO data using version 3 of the First Order Approximation method (**AIR5715 2009**).
- CO_2 emissions factors for jet and turbo-prop engines have been calculated from the ICAO Carbon Emissions Calculator Method Version 7 (**ICAO 2014**).
- Generic emissions factors for turboprop engines have been developed by CERC for power bands (<1000HP, 1000-2000HP & >2000HP) from the Swedish Defence Research Agency database (**FOI 2007**). PM_{10} factors were not included in these data.
- Piston engine emission factors (including CO_2) have been taken from the Swiss Federal Office of Civil Aviation database (**FOCA 2007**). PM_{10} factors were not included in these data.

B.2.4 ICAO 17 + Other

The EMIT ICAO 17 + Other dataset has been compiled from three sources.

- Jet engine emissions have been taken from Issue 17 of the ICAO database (**CAA 2010**). A copy of this data source is included for reference in the EMIT installation directory, in the subdirectory *Data\ICAODatabanks*.
- The ICAO database contains information on exhaust emissions relating to those aircraft engines that have entered production. The information in the database has been provided by engine manufacturers, who are solely responsible for its accuracy.
- The ICAO database was downloaded from the Civil Aviation Authority website. A copy of this database is in the Data folder in the EMIT install directory.
- PM_{10} emissions factors have been calculated from the ICAO data using version 3 of the First Order Approximation method (**AIR5715 2009**).
- Generic emissions factors for turboprop engines have been developed by CERC for power bands (<1000HP, 1000-2000HP & >2000HP) from the Swedish Defence Research Agency database (**FOI 2007**). PM_{10} factors were not included in these data.

- Piston engine emission factors have been taken from the Swiss Federal Office of Civil Aviation database (**FOCA 2007**). PM_{10} factors were not included in these data.

B.2.5 IPCC96 Air (average) and IPCC96 Air (old)

The IPCC96 Air (average) and IPCC96 Air (old) datasets have been compiled using data from Table 1-52 in Section 1.5 of Volume 3 of the IPCC manual (IPCC, 1996). Emission factors for the Landing/Take-Off (LTO) cycle are given in addition to those for cruise. Emission factors for an ‘old’ fleet and an ‘average’ fleet have been given in different datasets.

Auxiliary Power Unit	Aircraft code (ACCODE)
APU 131-9	B737-6, B737-7, B737-7-BBJ, B737-8, B737-8-BBJ2, B737-9, MD90, B737-8W, B737-9ER
APU GTCP 331-350	A330-2, A330-3, A340-2, A340-3, A340-5, A340-6
APU GTCP 36 (80HP)	GULF5, GULF550, HS748-1, HS748-2, HS748-2A, HS748-2B, L188, SD360-1, YS11-1, GULF5-SP
APU GTCP 36-100	BAE146-100, BAE146-100Q, BAE146-200, BAE146-RJ100, BAE146-RJ115, BAE146-RJ70, BAE146-RJ85, CL-216, CL600, CL601, CL602, CL604, FAL50, FAL50-EX, GULF2, GULF2-B, GULF2-SP, GULF3, GULF350, GULF4, GULF450, GULF4-SP
APU GTCP 36-150[]	BAE146-200Q, BAE146-300, BAE146-300Q, DO328-1, DO328JET, EMB120, ERJ135, ERJ135-ER, ERJ135-LR, ERJ140, ERJ145, ERJ145-ER, ERJ145-LR, ERJ170, ERJ190, ERJ195, FAL2000, FAL2000EX, FAL20-C, FAL20-D, FAL20-E, FAL20-F, FAL20-G, FAL900, FAL900B, FAL900C, FAL900EX, GULF1, GULF100, GULF150, GULF200, H4000, HS125-8, ERJ140-LR, ERJ145-EP, ERJ145-EU, ERJ145-LU, ERJ145-MP, ERJ145-XR, ERJ170-LR, FAL900DX, HS125-9
APU GTCP 36-150[RR]	CRJ1, CRJ2, F28-100, CRJ1-LR, CRJ2-ER, CRJ2-LR, CRJ4, CRJ4-LR
APU GTCP 36-300 (80HP)	A318-1, A319-1, A319-1X/LR, A320-1, A320-2, A321-1, A321-2
APU GTCP 36-4A	F28-1000, F28-2000, F28-3000, F28-4000, F28-70
APU GTCP 660 (300 HP)	B747-1, B747-2, B747-3, B747-SP, B747-SR, IL18, IL62, IL76, IL86, IL96, L1011-3, IL114, L1011-1, L1011-100, L1011-200, L1011-250, L1011-500
APU GTCP 85 (200 HP)	B707-1, B707-3, B717-2, B720, CONCRD, CRJ7, CRJ9, CV640, GLOBALEXPRESS, TU134, TU154, TU204, YAK42, CRJ705-LR, CRJ7-ER, CRJ7-LR, CRJ9-ER
APU GTCP30-54	F27, F27-1, F27-2, F27-3, F27-4, F27-5, F27-50, F27-6, F27-60, F27-7
APU GTCP331-200ER (143 HP)	A300B4-6, A300C4-6, A300F4-6, A310-2, A310-3, B757-2, B757-3, B767-2, B767-2ER, B767-3, B767-3ER, B767-4, B767-4ER
APU GTCP331-500 (143 HP)	B777-2, B777-2ER, B777-3, B777-3ER, B777-2LR
APU GTCP85-129 (200 HP)	B737-1, B737-2, B737-3, B737-4, B737-5, BAC111-2, BAC111-4, BAC111-475, BAC111-5
APU GTCP85-98 (200 HP)	B727-1, B727-2, DC8-5, DC8-6, DC8-7, DC9-1, DC9-2, DC9-3, DC9-4, DC9-5, MD81, MD82, MD83, MD87, MD88
APU PW901A	B747-4, B747-4ER, B747-4F
APU TSCP700-4B (142 HP)	A300B2-1, A300B2-2, A300B2K-3, A300B4-1, A300B4-2, A300C4-2, A300F4-2, DC10-1, DC10-3, DC10-3ER, DC10-4, MD10-3, MD11, MD11-ER, MD10-1

Table B.3 – Auxiliary Power Unit (APU) with associated aircraft codes (ACCODE, as defined in EDMS version 5.1)

APPENDIX C Data for non-transport sources

C.1 Introduction

As outlined in Section 5, a number of non-transport activity emissions datasets are included within the EMIT database. These datasets are discussed in this appendix. Copies of all datasets in the form of Microsoft Excel spreadsheets have been supplied in the EMIT installation directory, in the subdirectory *Data\ActivitySpreadsheets*. The most recent dataset spreadsheets containing the UK Emission Factor Database (UKEFD) emission factors for 2007 include the Nomenclature For Reporting (NFR) format (UNECE) and Selected Nomenclature for Air Pollution (SNAP, European Environment Agency) codes, in addition to the Intergovernmental Panel on Climate Change (IPCC) sectors for each activity.

Emission factors are regularly updated as new data are collated. Consequently, it is important to be aware that the emissions factors held in EMIT are intended to be accurate at the time at which they were collated but subsequent updates will not be included until the next release of the software. Some datasets, for example, those given on the UKEFD website (see below for further details) are regularly updated and so the data given in EMIT may become out-of-date; this is unavoidable. If users are concerned that this is an issue, they should refer to the source of the emission factors (references given in Section 13).

The different activity datasets are listed in **Table C.1**. This table gives a brief description of all datasets, their corresponding GHG sector, a reference for the factors and the name of the reference spreadsheet supplied with EMIT (as mentioned above). The datasets have been derived from the following seven sources:

- The UK Emission Factor Database (2007), private communication from AEA (**UKEFD 2007**);
- The UK Environment Agency Intensive farming guidance note (**UK EA 2009**);
- Guidelines for Company Reporting on Greenhouse Gas Emissions (**DEFRA 2002**);
- Industrial Sector Carbon Dioxide Emissions: Projections and Indicators for the UK, 1990-2020 (**GAD 2002**);
- The revised 1996 Intergovernmental Panel on Climate Change Guidelines for National Greenhouse Gas Inventories (**IPCC 1996**);
- The UK Greenhouse Gas Inventory, 1990 to 1999 (**Salway *et al.* 2001**); and
- The UK Emission Factor Database website (**UKEFD 2003**).

Pollutants

The pollutants included in each dataset are summarised in **Table C.2**. With the exception of the data obtained from the UK Emission Factor Database and the UK Environment Agency intensive farming datasets, the datasets include only greenhouse gas emissions data (including the indirect greenhouse gas pollutants, NO_x, CO, NMVOC and SO_2). The consequence of this is that only the UK Emission Factor Database datasets include emissions of non-GHG pollutants, such as particulate emissions. It is important to be aware of this fact when compiling emissions inventories that are to be used for the modelling of local toxic pollutants rather than GHG emissions inventories.

Greenhouse Gas sectors

Each of the datasets described in this appendix have a pre-defined associated GHG sector. For most of the datasets, the GHG sector is obvious, for example, UKGHG99 Agriculture is in the Agriculture sector, and Electricity-End Use is in the Energy sector. However, for some industrial sources, in particular Part A and Part B sources, it is difficult to decide whether the emissions should be included under the Energy sector or the Industrial Processes sector. This discrepancy occurs because industrial processes often have emissions from both power generation (such as the coal used in a furnace) in addition to the process emissions themselves; it has been resolved in the following way:

- All the emission factors given in terms of fuel use (such as coal, fuel oil, gas oil, natural gas) from the UK Emission Factor Database (**UKEFD 2007**, **UKEFD 2003**) for *any* process have been included in the **UKEFD07/UKEFD03 Energy** datasets, which are in the Energy GHG sector;
- All the other process emission factors given on the UK Emission Factor Database have been included in the **UKEFD07/UKEFD03 Ind Proc** datasets, which are in the Industrial Processes GHG sector; and
- All the industrial process emissions data obtained from the IPCC manual have been included in the **IPCC96 Indust Proc** dataset, which is in the Industrial Processes GHG sector.

Source types

All the datasets listed in **Table C.1** can be used to estimate emissions from point, line, area, volume and CandD sources.

A note on Nitrogen Oxides

The NO_x emission rates discussed in this Appendix are ‘NO_x as NO_2’ values, making them consistent with all other datasets included in EMIT.

Dataset Name	Description	GHG category	Reference	Data spreadsheet
UKEFD07 Agriculture	UKEFD emissions from agriculture	Agriculture	UKEFD 2007	UKEFD07 Agriculture.xls
UKEFD07 Energy	UKEFD emissions from energy generation	Energy	UKEFD 2007	UKEFD07 Energy.xls
UKEFD07 Ind Proc	UKEFD emissions from industrial processes	Industrial Processes	UKEFD 2007	UKEFD07 Ind Proc.xls
UKEFD07 Other	Other UKEFD emissions	Other	UKEFD 2007	UKEFD07 Other.xls
UKEFD07 Solvents	UKEFD solvent emissions	Solvents & other product use	UKEFD 2007	UKEFD07 Solvents.xls
UKEFD07 Waste	UKEFD emissions from waste processing	Waste	UKEFD 2007	UKEFD07 Waste.xls
UK EA 09 Pigs	UK Environment Agency emissions from intensive farming of pigs	Agriculture	UK EA 09	UK EA 09 Pigs.xls
UK EA 09 Poultry	UK Environment Agency emissions from intensive farming of poultry	Agriculture	UK EA 09	UK EA 09 Poultry.xls
Electricity-End Use	Emissions from end use electricity consumption (CO_2 only)	Energy	DEFRA 2002 and GAD 2002	Electricity End Use.xls
IPCC96 Indust Proc	Industrial Process emissions from the IPCC manual	Industrial Processes	IPCC 1996	IPCC96 Indust Proc.xls
UKGHG99 Agriculture	UK GHG emission inventory agriculture emissions	Agriculture	Salway *et al.* 2001	UKGHG99 Agriculture.xls
UKGHG99 Electricity	UK GHG emissions from electricity generation	Energy	Salway *et al.* 2001	UKGHG99 Electricity.xls
UKGHG99 Fuels	UK GHG emission inventory fuel emissions	Energy	Salway *et al.* 2001	UKGHG99 Fuels.xls
UKEFD03 Agriculture	UKEFD emissions from agriculture	Agriculture	UKEFD 2003	UKEFD03 Agriculture.xls
UKEFD03 Energy	UKEFD emissions from energy generation	Energy	UKEFD 2003	UKEFD03 Energy.xls
UKEFD03 Forestry	UKEFD emissions from forests	Land-use change + forestry	UKEFD 2003	UKEFD03 Forestry.xls
UKEFD03 Ind Proc	UKEFD emissions from industrial processes	Industrial Processes	UKEFD 2003	UKEFD03 Ind Proc.xls
UKEFD03 Other	Other UKEFD emissions	Other	UKEFD 2003	UKEFD03 Other.xls
UKEFD03 Waste	UKEFD emissions from waste	Waste	UKEFD 2003	UKEFD03 Waste.xls

Table C.1 – Summary of non-transport emission factor datasets

Pollutant	Dataset																		
	UKEFD07 Agriculture	**UKEFD07 Energy**	**UKEFD07 Ind Proc**	**UKEFD07 Other**	**UKEFD07 Solvents**	**UKEFD07 Waste**	**UK EA 09 Pigs**	**UK EA 09 Poultry**	**Electricity-End Use**	**IPCC96 Indust Proc**	**UKGHG99 Agriculture**	**UKGHG99 Electricity**	**UKGHG99 Fuels**	**UKEFD03 Agriculture**	**UKEFD03 Energy**	**UKEFD03 Forestry**	**UKEFD03 Ind Proc**	**UKEFD03 Other**	**UKEFD03 Waste**
ACENAPTHENE		✓	✓	✓		✓													
ACENAPTHYLE		✓	✓	✓		✓													
ANTHRACENE		✓	✓	✓		✓													
ARSENIC		✓	✓			✓													
B[a]A		✓	✓	✓		✓													
B[a]P		✓	✓	✓		✓									✓		✓		
B[b]F		✓	✓	✓		✓													
B[ghi]P		✓	✓	✓		✓													
B[k]F		✓	✓	✓		✓													
BENZENE		✓	✓	✓		✓									✓		✓		
BERYLLIUM		✓	✓			✓													
BUTADIENE		✓	✓	✓											✓		✓		
CADMIUM		✓	✓			✓													
C6Cl6		✓	✓	✓	✓	✓													
CHROMIUM		✓	✓			✓													
CHRYSENE		✓	✓	✓		✓													
CO		✓	✓	✓		✓				✓		✓	✓	✓	✓		✓		✓
CO_2		✓	✓			✓			✓	✓		✓	✓	✓	✓		✓		
COPPER		✓	✓	✓		✓													
D[ah]A		✓	✓	✓		✓													
FLUORANTHEN		✓	✓	✓		✓													
FLUORENE		✓	✓	✓		✓													
HCl		✓	✓			✓													
HF		✓	✓			✓													
I[cd]P		✓	✓	✓		✓													
LEAD		✓	✓			✓								✓	✓		✓	✓	
MERCURY		✓	✓	✓		✓								✓	✓		✓	✓	✓
METHANE		✓	✓			✓	✓	✓		✓	✓	✓	✓		✓				✓
N_2O		✓	✓			✓				✓	✓	✓	✓		✓		✓		
NAPHTHALENE		✓	✓	✓		✓													
NH_3		✓	✓	✓		✓	✓	✓											
NICKEL		✓	✓			✓													
NO_2		✓	✓	✓		✓				✓		✓	✓	✓	✓		✓		
NO_x		✓	✓	✓		✓				✓		✓	✓	✓	✓		✓		
PCB						✓													
PCP	✓	✓	✓	✓		✓				✓				✓					
PFC			✓																
PHENANTHREN		✓	✓	✓		✓													
PM_{10}	✓	✓	✓	✓		✓		✓							✓		✓	✓	
$PM_{2.5}$	✓	✓	✓	✓		✓		✓							✓		✓	✓	
PYRENE		✓	✓			✓													
SELENIUM		✓	✓																
SO_2		✓	✓	✓		✓						✓	✓	✓	✓		✓		
TIN		✓	✓			✓													
VANADIUM		✓	✓																
VOC	✓	✓	✓	✓	✓	✓						✓	✓	✓	✓	✓	✓	✓	✓
ZINC		✓	✓			✓													

Table C.2 – Summary of pollutants in the non-transport emission factor datasets Emission factors

C.2 Emission factors

Detailed descriptions of all the non-transport datasets held in EMIT are given below.

C.2.1 UKEFD07 Agriculture, UKEFD07 Energy, UKEFD03 Ind Proc, UKEFD07 Solvents, UKEFD07 Waste and UKEFD07 Other

The emissions data from the 2007 UK Emission Factor Database were supplied to CERC in January 2010 (**UKEFD 2007**). The emission factors are those that used to calculate the UK National Atmospheric Emissions Inventory for 2007. As mentioned at the beginning of this Appendix, any later updates of the data given on the website have not been included in these datasets. There is no reference list available for these data. In previous communications regarding references for the UKEFD, AEA Technology has stated:

"There are also numerous sources for this huge dataset. Many of the data have been generated from highly specific data e.g. individual point source data aggregated across the UK, combination of several UK specific datasets. It is possible to reference some ... (e.g. CORINAIR handbook), but the vast majority of the data are UK specific with extensive processing to generate the emission factors."

With the exception of the transport emission factors, which are described in Appendix A, the data have been divided into six categories:

- Agriculture,
- Energy,
- Industrial Processes,
- Solvents,
- Waste, and
- Other.

Each of these categories applies to a different GHG sector. It is straightforward to assign most of the emission factors to an appropriate group. The way in which the Energy/Industrial Processes split has been made has been discussed in Section C.1 above.

$PM_{2.5}$ and NO_2 emission factors were not included explicitly in the UK Emission Factor Database in 2007. $PM_{2.5}$ emission factors have been calculated as a proportion of PM_{10} factors; the proportion used has been derived from **AEAT 2010**. The proportion of NO_x that is NO_2 was taken from **AEAT 2009a**.

C.2.2 UK EA 09 Pigs and UK EA 09 Poultry

In appendices 1 and 2 of the UK Environment Agency's intensive farming guidance note (**UK EA 09**), emission factors for pigs and poultry are given. These factors are categorised according to animal and housing type. Factors for manure storage are also listed.

Dust emission factors for poultry are tabulated. Within the document, it is advised that PM_{10} emission factors can be taken to be a third of the dust emission factors. It has been further assumed that the $PM_{2.5}$ emission factors are 15% of the PM_{10}, as given in **AEAT 2010**.

C.2.3 UKEFD03 Agriculture, UKEFD03 Energy, UKEFD03 Forestry, UKEFD03 Ind Proc, UKEFD03 Waste and UKEFD03 Other

The emissions data supplied on the UK Emission Factor Database website (**UKEFD 2003**) were downloaded in July 2003.

With the exception of the transport emission factors, the data have been divided into six categories:

- Agriculture,
- Energy,
- Forestry,
- Industrial Processes,
- Waste, and
- Other.

For further details of corresponding transport emission factors, please refer to Appendix A.

C.2.4 IPCC96 Indust Proc

The **IPCC96 Indust Proc** dataset gives emission factors from industrial processes. The data included in this dataset have been obtained from Module 2 in Volume 2 and Chapter 2 in Volume 3 of the IPCC manual (**IPCC, 1996**). The exception to this was the emission factors of N_2O from the production of nitric acid, as these values are very plant-dependent; these data were obtained from Section 7, Appendix 4 of the UK GHG Emissions Inventory (**Salway *et al.* 2002**).

A few other minor points to note:

- For ammonia production, emissions of Total Organic Compounds are given; these have been assumed to be VOCs.
- Table 2.10 on page 2.23 of the IPCC manual gives two emission factors for 1,2-dichloroethane; both values have been entered, with their respective SNAP codes.
- In FerroAlloy production (Ferrosilicon – 50%, 75% and 90% Si), it is unclear whether the 35g/tonne of product is for Sulphur or SO_2 (Section 2.13.4.3); due to this uncertainty, this emission factor has not been included.

C.2.5 UKGHG99 Agriculture

The **UKGHG99 Agriculture** dataset gives livestock emission factors of enteric methane and methane from wastes, in addition to N_2O emissions from wastes. It has been compiled using data from Tables 1, 5, 7 and 9 in Section 1, Appendix 5, UK Greenhouse Gas Emissions Inventory, 1990 to 1999 (**Salway *et al.* 2001**). References for these emission factors are given in the same document beneath the respective tables, and consequently have been omitted here.

There was some incompatibility in the naming of animal categories in the various tables mentioned above. For example, Table 1, which gives the methane emission factors, gives one category for poultry, whereas Table 5, which gives the nitrogen excretion factors, gives 7 categories (broilers, broiler breeders, layers, ducks, turkeys, growing pullets and other poultry). In such cases, the methane emission factor categorisation has been used, and assumptions have been made in order to 'fit' the nitrogen categories to them (with the exception of the 'Others>1 , Dairy Heifers' category which has been divided into 2 categories).

The amount of N_2O produced from nitrogen depends on the type of waste handling system used (please refer to Table 8 in **Salway *et al.* 2001**). The distribution of how different animal wastes are dealt with in the UK is summarised in Table 7 of Salway *et al*. The data given in Tables 5, 7 and 8 of Salway *et al.* were used to obtain a weighted average emission factor of N_2O for the different animal types. Note that again, the categorisation of the nitrogen emission factors differs from the categorisation of the waste management systems; assumptions have been made to 'fit' the two datasets together.

C.2.6 UKGHG99 Electricity

The **UKGHG99 Electricity** dataset gives the emission factors from power stations used to generate electricity using a number of different fuels; for example coal, fuel oil, tyres, natural gas and poultry litter. It is a **source of emissions** dataset and should only be used if **end-user** emissions (for example, those generated using the dataset 'Electricity-End Use' described below) are not being included in the inventory. For further discussion of **source of emissions** and **end-user** approaches to compiling GHG emissions inventories, please refer to Section 11.

This dataset has been compiled using data from Table 6 in Section 4, Appendix 2, UK Greenhouse Gas Emissions Inventory, 1990 to 1999 (**Salway *et al.* 2001**). References for these emission factors are given in the same document on pages A2.13-14, and consequently have been omitted here.

C.2.7 UKGHG99 Fuels

The **UKGHG99 Fuels** dataset includes emission factors for liquid, solid (including coal) and gaseous fuels. It has been compiled using data from Tables 1 - 4 in Section 2, Appendix 2, UK Greenhouse Gas Emissions Inventory, 1990 to 1999 (**Salway *et al.* 2001**). References for these emission factors are given in the same document on page A2.11, and consequently have been omitted here.

As it is of interest to know which emission factors should be used for commercial and public service energy use (i.e. council and government buildings), this information was obtained from AEA Technology (Salway, private communication):

"*For commercial premises (e.g. Marks and Spencer) I would advise using the miscellaneous factors. For government and council buildings, I suggest that Public Service factors should be used.*"

C.2.8 Electricity-End Use

These data have been collated from two data sources. The first of these, Guidelines for Company Reporting on Greenhouse Gas Emissions (**DEFRA 2002**), gives CO_2 emission factors from electricity for 1990 to 1999; these values are shown in **Figure C.1** as circles. The second reference, **GAD 2002**, gives end user emission factors for 1990 to 1998 inclusive and 'predicted' emission factors for 2000, 2005, 2010 and 2020; these values are shown in **Figure C.1** by crosses. **Figure C.1** indicates that the data from these two sources are in approximate agreement for years 1990 to 1998.

EMIT includes end-use electricity emission factors for years 1996 to 2020. These have been compiled in the following way:

- For 1996 to 1999, the **DEFRA 2002** emission factors are included;
- For 2000, 2005, 2010, 2020, the **GAD 2002** emission factors are included; and
- For all remaining years (2001-2004, 2006-2009, 2011-2019) values interpolated from **GAD 2002** are included.

The end use electricity emission factors included in EMIT are shown by the dashed line in **Figure C.1**.

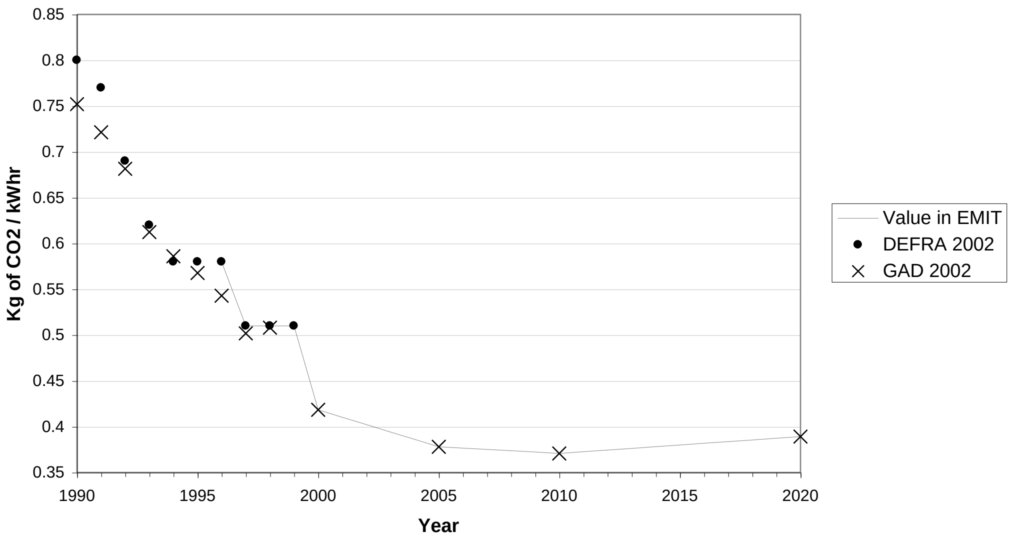


Figure C.1 – CO_2 emission factors for end-use electricity: 1990 to 2020

APPENDIX D Reference

This Appendix is included for reference, and describes all the EMIT menus and screens with their controls.

D.1 EMIT menu options

The availability of the EMIT menu options is as follows.

- The EMIT **File** menu is only available from the EMIT Database screen.
- The EMIT **Data** menu is available from the **EMIT Inventory** screen and **EMIT Group** screen as well as all "data" screens.
- The EMIT **Help** menu is available from all screens.

In the following table, an asterisk, e.g. "**EMIT Operator*** screen", denotes that the name given for the screen, etc. is not exactly as shown in its banner, but has been simplified for use in this table.

MENU	OPTIONS		DESCRIPTION
File	**New**		Create a new EMIT database. The **New Database** dialogue box prompts the user for the name of the new database. An empty database (based on an EMIT template) is created: it does not contain any inventories, groups or sources, but does have access to the sets of emission factors and route types available.
	Open		Open an existing EMIT database. The **Open Database** dialogue box prompts the user for the name of the new database.
	Close		Close the currently open EMIT database.
	Import Data…		Start the EMIT Import Wizard (Section 5), used to import data from files such as ESRI shape (*.shp*) files, MapInfo (*.mif*) files or comma-separated variable (*.csv*) files.
	About Database		Launch the **About database** dialogue box, giving information on data packs applied for the current database.
	Compact Database		Compact the current database. This procedure removes deleted records and recovers wasted disk space that has accumulated during editing and emissions recalculation. **Note:** the database should be compacted at regular intervals.
	1.mdb **2.mdb** **…** **16.mdb**		Open recently-accessed EMIT databases. The list shows the path names of up to 16 EMIT databases, and selecting one member of the list will open the corresponding database (if it still exists).

MENU	OPTIONS		DESCRIPTION
	Exit		Exit from the EMIT program.
Data	**Operators**		Open the **EMIT Operator*** screen (see Section D.5.7). Allows the details of a new or existing industrial source operator to be entered or edited.
	Route Types ►	**Road**	Open the **EMIT road route type*** screen (see Section D.5.4). Displays the data for pre-defined road traffic route types, and allows the user to add new route types and replace references to existing ones.
		Rail	Open the **EMIT rail route type*** screen (see Section D.5.4). Displays the data for pre-defined rail traffic route types, and allows the user to add new route types and replace references to existing ones.
	Traffic Apportionment ►	**Define Apportioned Pollutants**	Open the **Define Apportioned Pollutants** screen to select which pollutants to include in traffic apportionment.
		Vehicle Categories	Open the **Vehicle Categories** screen to create the vehicle group names to include in traffic apportionment.
		Vehicle Category Membership	Open the **Vehicle Category Membership** screen to allocate each vehicle sub category to a vehicle group for traffic apportionment.
	Emission Factors ►	**Roads**	Open the **EMIT road emission factors*** screen (see Section D.5.1). Displays the data for available sets of emission factors for road traffic. These data may NOT be edited.
		Rail	Open the **EMIT rail emission factors*** screen (see Section D.5.1). Displays the data for available sets of emission factors for rail traffic. These data may NOT be edited.
		Edit NO2 Percentage for Roads	Open the **Edit NO2 Percentage for Roads** screen (see Section D.5.2). Allows user to edit the percentage of NO_x that is NO_2 for vehicle sub-categories within available datasets.
		Edit Roads Factors	Open the **Edit Road Emission Factors** screen (see Section D.5.3). For available datasets, allows user to edit the percentage of base emission factor that is used for calculations.
	Region Types		Open the **EMIT region type** screen (see Section D.5.5). Displays the available default and user-created region types for modelling emissions from domestic dwellings.
	Groups		Open the **EMIT Group data** screen (see Section D.5.6). Displays all groups of each source type in the current database (not just current inventory) and allows the user to create new (empty) groups and replace references to existing ones.
Help	**User Guide**		Open the User Guide in Adobe Acrobat Reader, if this is installed.

MENU	OPTIONS		DESCRIPTION
	About…		Display the version information for EMIT. The **About EMIT** dialogue box is launched.
	Licence Details…		Display information about the licence in use by EMIT. The dialogue box giving licence details is launched.

D.2 Database hierarchy screens

In Sections D.2.1 to D.2.3 we describe the database hierarchy screens used to navigate the EMIT data hierarchy (database, inventory, group, source).

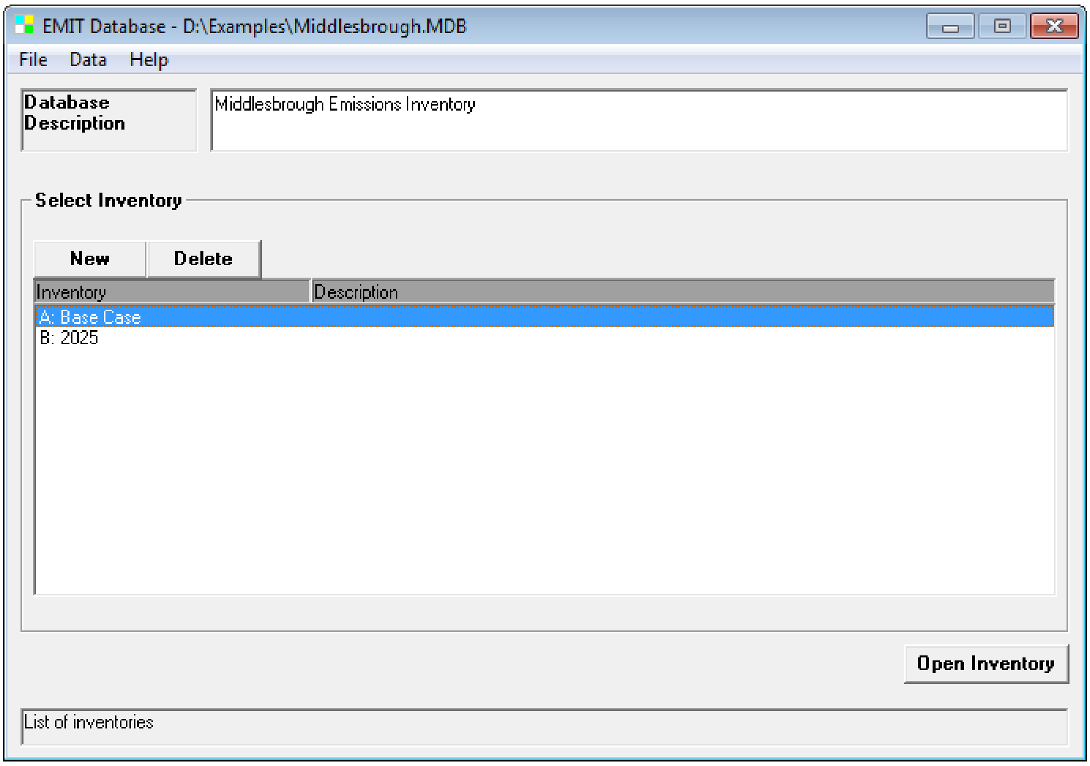
D.2.1 EMIT Database screen

Banner formulation is

EMIT Database - <path name of database>

e.g.

EMIT Database – D:\Examples\Middlesbrough.mdb



SCREEN AREA	CONTROL	DESCRIPTION OF FUNCTION	RESTRICTIONS
Database Description	**-**	Description of the database entered/edited here. This can be used to highlight particular features of the database.	Up to 255 characters
Select Inventory	**New**	Adds a new inventory to the list in the table. The default name of the new inventory is the current date and time, which should be changed to a meaningful name. The new inventory is automatically opened for editing.	
	Delete	Deletes the highlighted inventory from the list in the table, following confirmation by the user.	
	<Table>	List of all inventories contained in the EMIT	Not editable.

		database currently loaded. There are two columns. **Inventory**: the name of the inventory **Description**: the inventory description (as set in the EMIT Inventory screen – see Section D.2.2). Double-clicking on a member of the list opens that inventory in the EMIT Inventory screen.	
Open Inventory	**-**	Opens the inventory highlighted in the list in the EMIT Inventory screen	

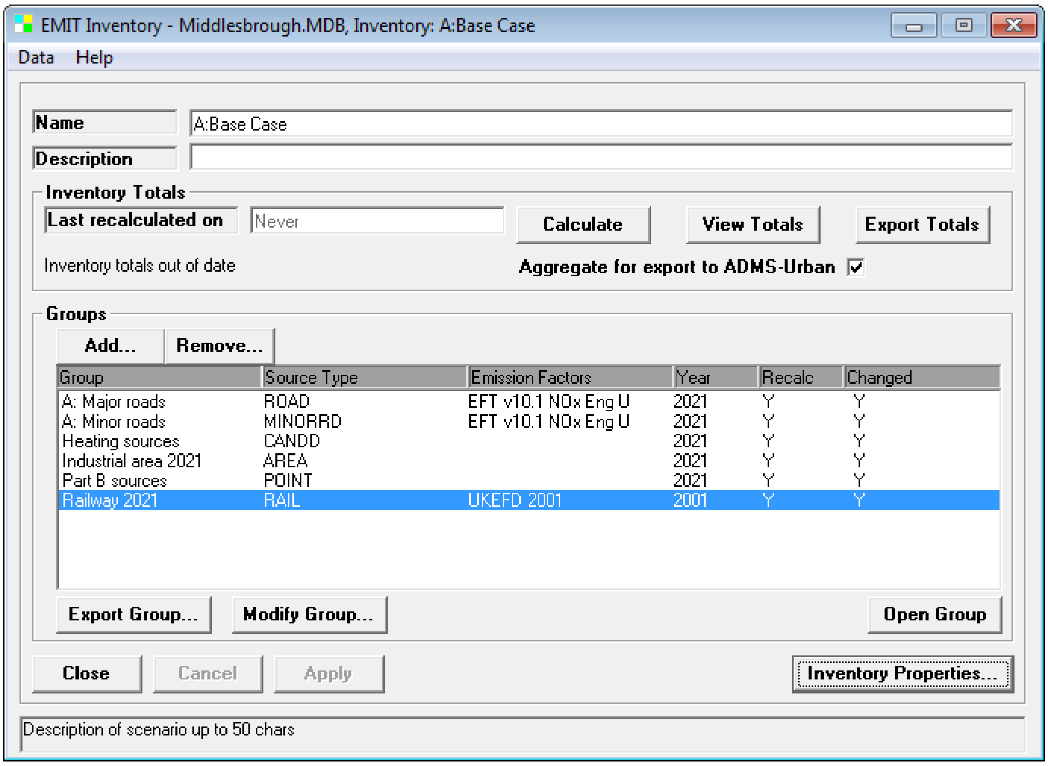
D.2.2 EMIT Inventory screen

Banner formulation is

EMIT Inventory - <file name of database>, Inventory: <name of inventory as listed on Database screen>

e.g.

EMIT Inventory – Middlesbrough.mdb, Inventory: A: Base Case



SCREEN AREA	**CONTROL**	**DESCRIPTION OF FUNCTION**	**RESTRICTIONS**
Name	**-**	Name of inventory may be entered/edited here.	Up to 50 characters
Description	**-**	Description of inventory entered/edited here. This can be used to highlight particular features of the inventory.	Up to 255 characters.
Inventory Totals	**Last recalculated on**	This text box gives the date and time when the emissions for the inventory were last recalculated. If changes have been made to *any* data for this inventory since this date then the **Calculate** button may be used to bring the emissions data up to date.	Not editable.
	Calculate	Recalculate the emissions for the current inventory. Includes all groups in the inventory that have “Y” in the **Changed** column in the	

		Groups table. As the calculation is in progress the **Progress** box is displayed giving the user information on what the calculation is doing; the top panel shows the current activity.	
	View Totals	Display the **Inventory Totals** screen (for further details, please see Section 9). The screen has tabs for the total emissions for the whole inventory, the total Greenhouse Gas emissions and the emissions for each $1km^2$ grid square.	
	Export Totals	Export the 2D or 3D grid totals for this inventory to an ADMS-Urban or CMAQ format file so that these data may be used in a modelling run. The **Export** dialogue box is launched after choosing one of the output options. For a 2D grid, the user must supply the name of the output files to which the grid totals are to be exported. The user must also enter a grid depth in metres, in the **Grid Depth** text box and the pollutants for which totals are to be exported: this may either be all pollutants (select **All pollutants** radio button) or selected pollutants (select **Select pollutants** radio button and check the boxes next to the pollutants to be exported). Click on **Export** when the above data have been supplied. For a 3D grid, the user must choose between exporting to ADMS-Urban or CMAQ format files. Then enter the output folder name and NetCDF output file structure.	
	Aggregate for export to ADMS-Urban	If this check box is checked, special consideration is given to NO_x and NO_2 emissions when aggregating for the inventory totals. Only relevant if data to be used in conjunction with the ADMS-Urban dispersion model.	Editable; it is recommended you leave it checked if you are exporting to ADMS-Urban, and unchecked otherwise.
Groups	**Add…**	Add an existing group to the inventory. This launches the **Add Group** screen. The user selects one of the groups from the **Group** drop-down list box – if the group is not already contained in the inventory, the **Add** button is available and the user may add the selected group by clicking on this button.	
	Remove…	Remove the highlighted group from the inventory, following confirmation. Note that the group still exists within the database but is now outside the current inventory.	
	<Table>	List of all groups in the current inventory. There are 6 columns. **Group**: Name of the group **Source Type**: Type of source the group contains **Emission Factors**: The set of emission factors	

		used for calculation of emissions, if appropriate. **Year**: The year associated with the group (in particular the year used in emissions calculations from emission factors). **Recalc**: This is not used. **Changed**: “Y” or “N” appears in this column depending on whether source data for the group have changed. Double-clicking on a member of the list opens that inventory in the **EMIT Group** screen.	
	Export Group…	This button activates a list with three options: **To ADMS SPT …** **To Inventory…** **To Shape File…** These options are described in Section 9. If the source group is a minor road, rail or CandD source, only the latter export option is available.	
	Modify Group…	This button launches the **Modify group** dialogue box. For further details, please refer to Section D.4.1.	
	Open Group	The highlighted group is opened in the **EMIT Group** screen for editing.	
Inventory Properties…		This button launches the **Inventory Properties** screen. This screen defines the inventory time period, the grid used in calculation of grid totals, including the grid extent and the cell size, and the 3D grid properties. For more details, please refer to Section D.4.1	
Close		Save any changes, close this screen and return to the **EMIT Database** screen for the parent database.	
Cancel		Reject changes to data (that have not been saved using the **Apply** button).	
Apply		Update the screen as a result of changes to data but do not close the screen.	

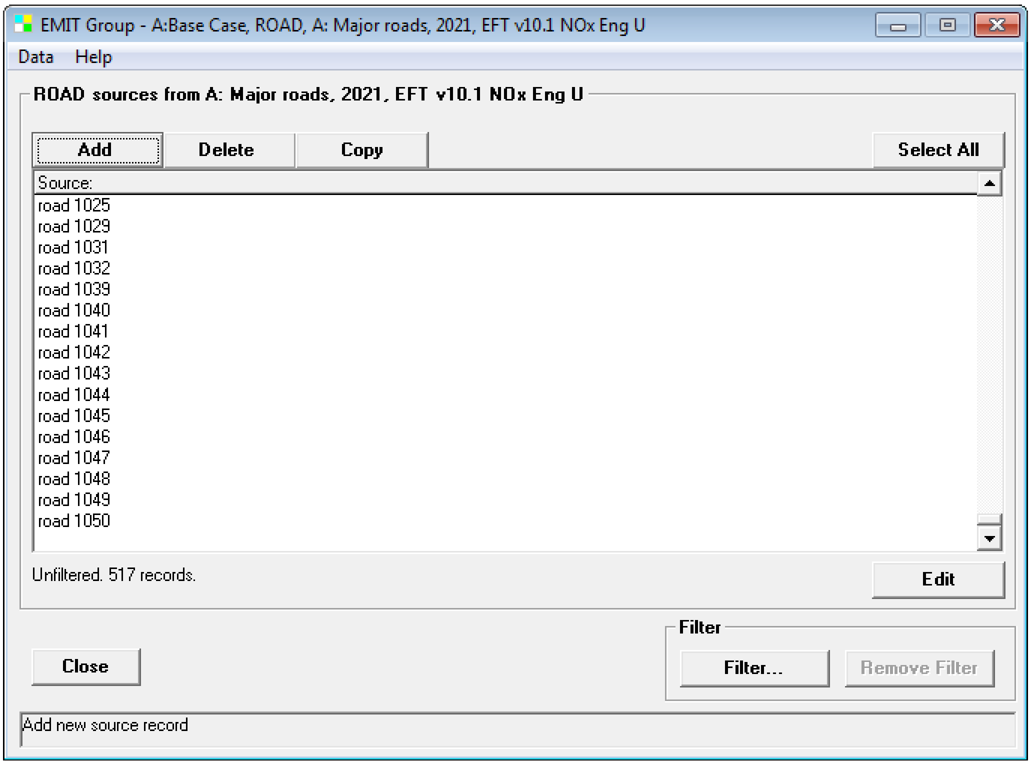
D.2.3 EMIT Group screen

Banner formulation is

EMIT Group - <name of inventory>, <one of group types>, <name of group as listed on Inventories screen>, <year>, <dataset>

e.g.

EMIT Group – A: Base Case, Road, A- Major Roads, 2021, EFT v10.1 NOxEngU



SCREEN AREA	CONTROL	DESCRIPTION OF FUNCTION	RESTRICTIONS
<Source type> from <name of group as listed on Inventories screen>, <year>, <dataset>	**<Table>**	List of all sources in the current group. There is only one column. **Source**: Name of source. In addition, a text string appears below the table indicating whether the list is Filtered or Unfiltered together with the number of sources (records) listed.	
	Add	Creates a new source of the same type and year as the current group: it is added to the list of sources and the appropriate source data screen is opened to allow editing of data for the source. The default name is based on the current date and time.	
	Delete	Deletes the source from the current group (and therefore from the entire database) following confirmation from the user.	

	Copy	Allows the user to copy one or more selected sources to another group. First highlight the required sources, and then click this button to launch the **Copy Records** dialogue box. The sources are copied to the designated group and are renamed (a prefix is added to the original name in each case), but are otherwise identical to the originals. Since groups do not share sources, the copied sources are completely independent of the original ones.	
	Select All	A convenient way to select all the sources in the list.	
	Edit	Allows editing of source data. (a) If only one source is highlighted, this button causes the relevant source data form to be opened. (b) If more than one source is highlighted, the **Multiple Source Edit** dialogue box is launched, as described in Section D.4.3.	
Filter	**Filter…**	By default, all the sources in the group are listed in the table. The **Filter…** button launches the **Filter for text fragment** dialogue box. This allows the user to restrict the sources listed to those that contain a specified text fragment in either the source name or in the keywords data.	
	Remove Filter	This allows the complete list of sources in the group to be displayed once more.	
Close		Save any changes, close this screen and return to the **EMIT Inventory** screen for the parent inventory.	

D.3 Source screens

In Sections D.3.1 to D.3.8 we describe the source data screens used to display and edit the properties of individual sources.

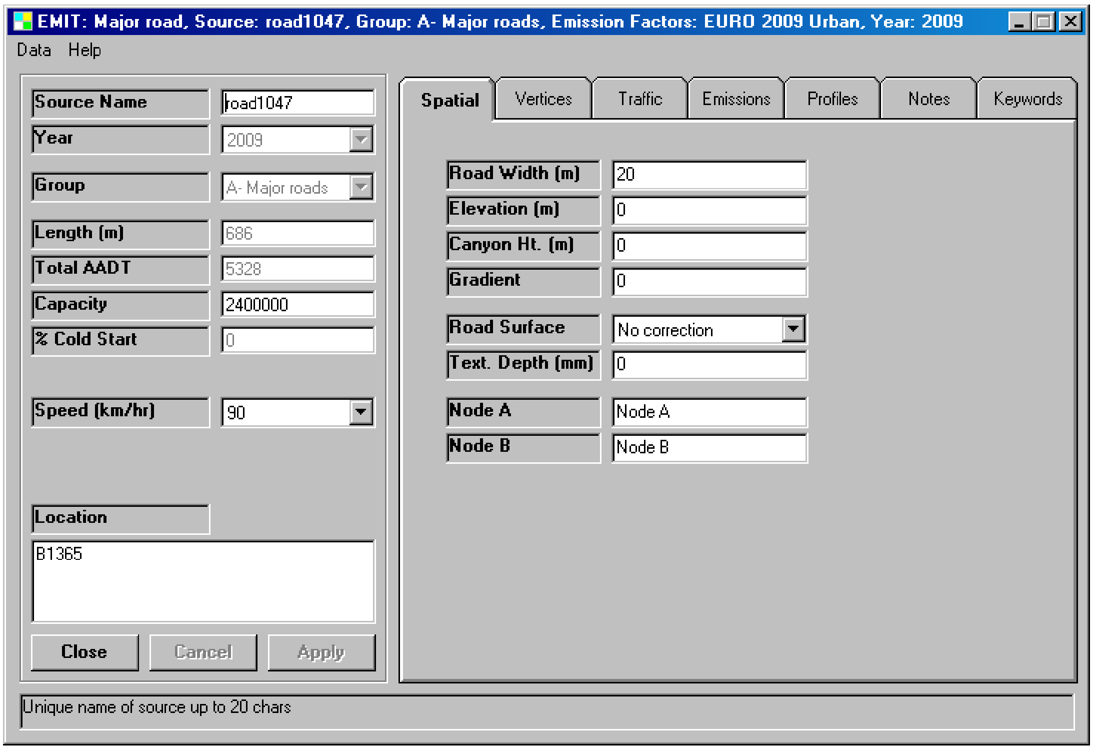
Banner formulation is

Step 1 **EMIT: <source type>, Source: <name>, Group: <name of group>, Emission Factors: <emission factors data set name>, Year: <year>**

e.g.

EMIT: Major road, Source: road1047, Group: A- Major roads, Emission Factors: EURO 2009 Urban, Year: 2009

D.3.1 Major roads

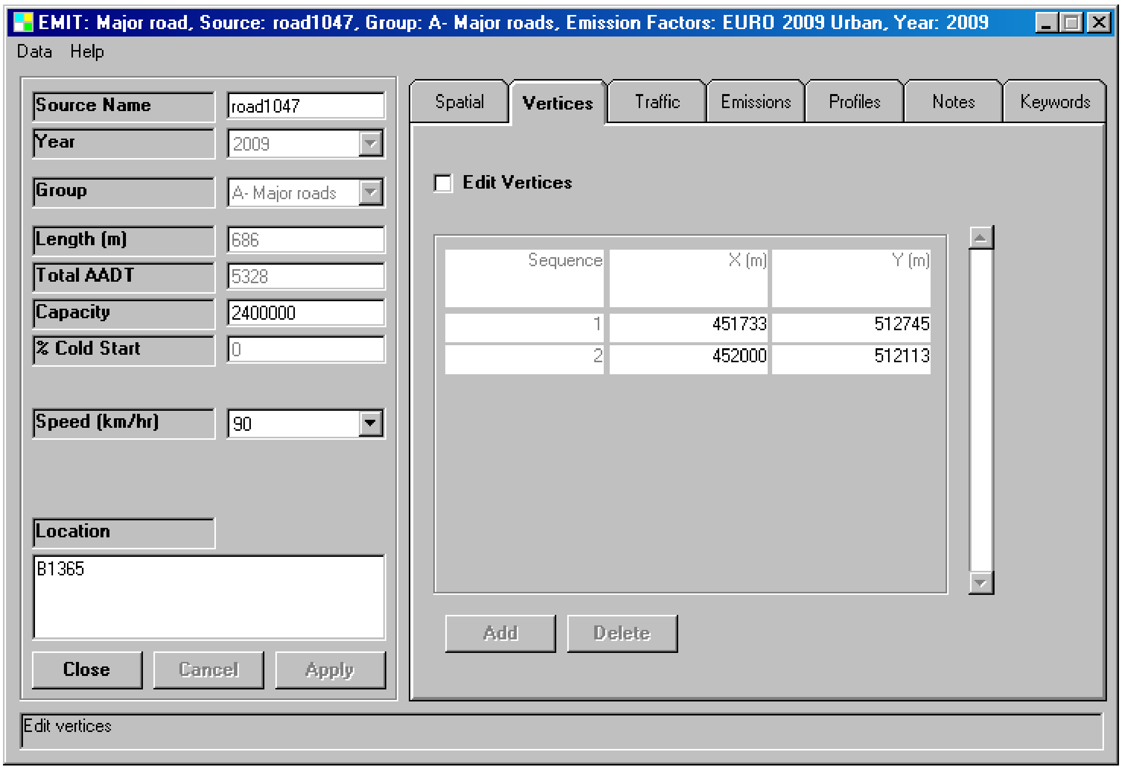


SCREEN AREA	CONTROL	DESCRIPTION OF FUNCTION	RESTRICTIONS
Source Name	-	Allows the source name to be defined/edited. The name must be unique within the database. If this screen has been launched when adding a new source to a group, the name will need to be changed from the default, which is simply based on the current date and time.	Up to 20 characters.
Year	-	Year associated with the parent group, which therefore applies to all the sources it contains.	Not editable.
Group	-	Name of parent group.	Not editable.
Length (m)	-	The length of the road in metres. This value is	Not editable.

		calculated by EMIT using the vertices data (see the **Vertices** tab). Its value is recalculated when the **Apply** button is clicked following changes to the vertices data.	
Total AADT	-	The total annual average daily traffic for the road in vehicles per day. This is the sum of the traffic count totals on the **Traffic** tab.	Not editable.
Capacity[1]	-	The **Capacity** of the road in vehicles per day.	Must be ≥ AADT.
% Cold Start[1]	-	Percentage of vehicles whose engines were cold at the start of their journey.	Not currently used.
Speed (km/hr)[1]	-	Vehicle speed on the road in km/hr. Select a value from the drop-down list box of options.	Options depend on the choice of emission factors.
Location	-	A text description of the location of the road.	Up to 200 characters.
Close	-	Save any changes, close this screen and return to the calling screen, e.g. the **EMIT Group** screen of the parent group.	
Cancel	-	Reject changes to data (that have not been saved using the **Apply** button).	
Apply	-	Update the screen as a result of changes to data but do not close the screen.	

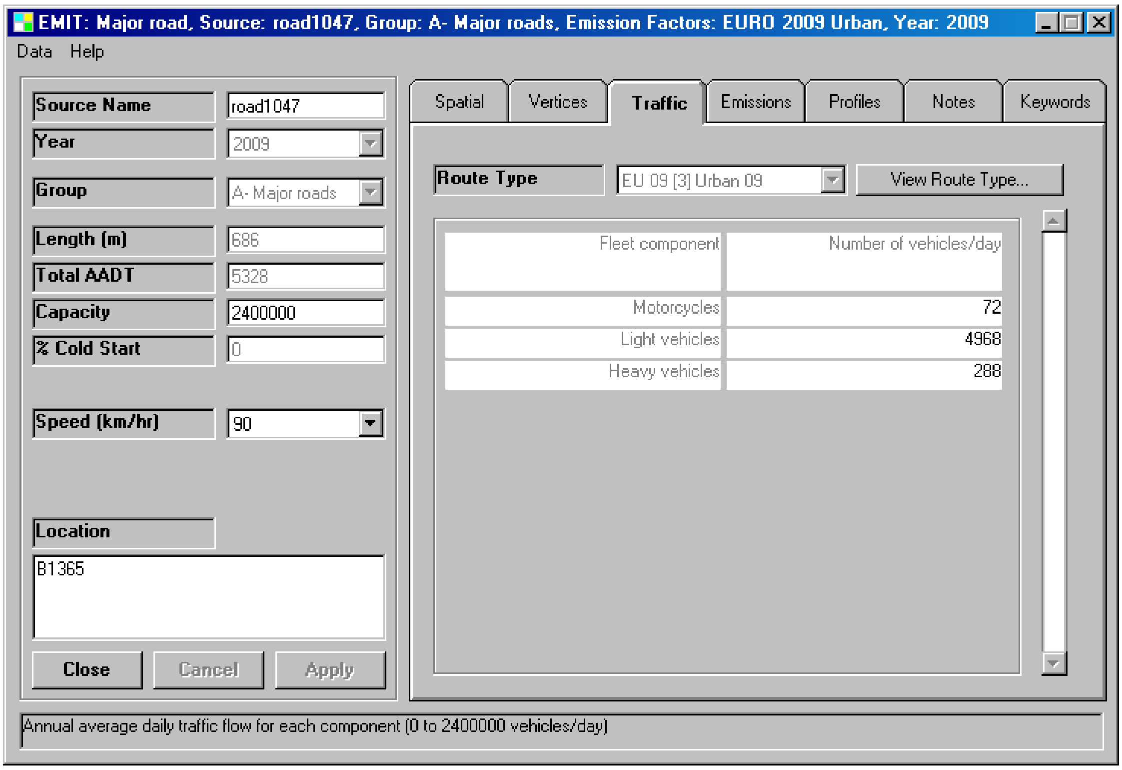
Spatial tab			
Road Width (m)	-	The width of the road in metres.	5m ≤ x ≤ 100m
Elevation (m)	-	The height of the road above the ground in metres. This is usually zero, but is non-zero for overhead by-passes, etc.	0 ≤ x ≤ 2000m
Canyon Ht. (m)	-	The average height of buildings at the side the road in metres. This is needed in urban areas when the emissions data are to be used in a dispersion calculation using ADMS-Urban.	0 ≤ x ≤ 100m
Gradient	-	Gradient of road in percent.	0 ≤ x ≤ 50%
Road Surface	-	Select a road surface type from the drop down menu (options apply to those used in CRTN 1998).	
Text. Depth (mm)	-	Enter a road surface texture depth in mm (as measured by the sand-patch test).	0 ≤ x ≤ 100mm
Node A	-	Text string for use in linking with the SATURN traffic model.	Up to 20 characters.
Node B	-	Text string for use in linking with the SATURN traffic model.	Up to 20 characters.

[1] This field is only present if the emissions have been calculated with a dataset held within EMIT.



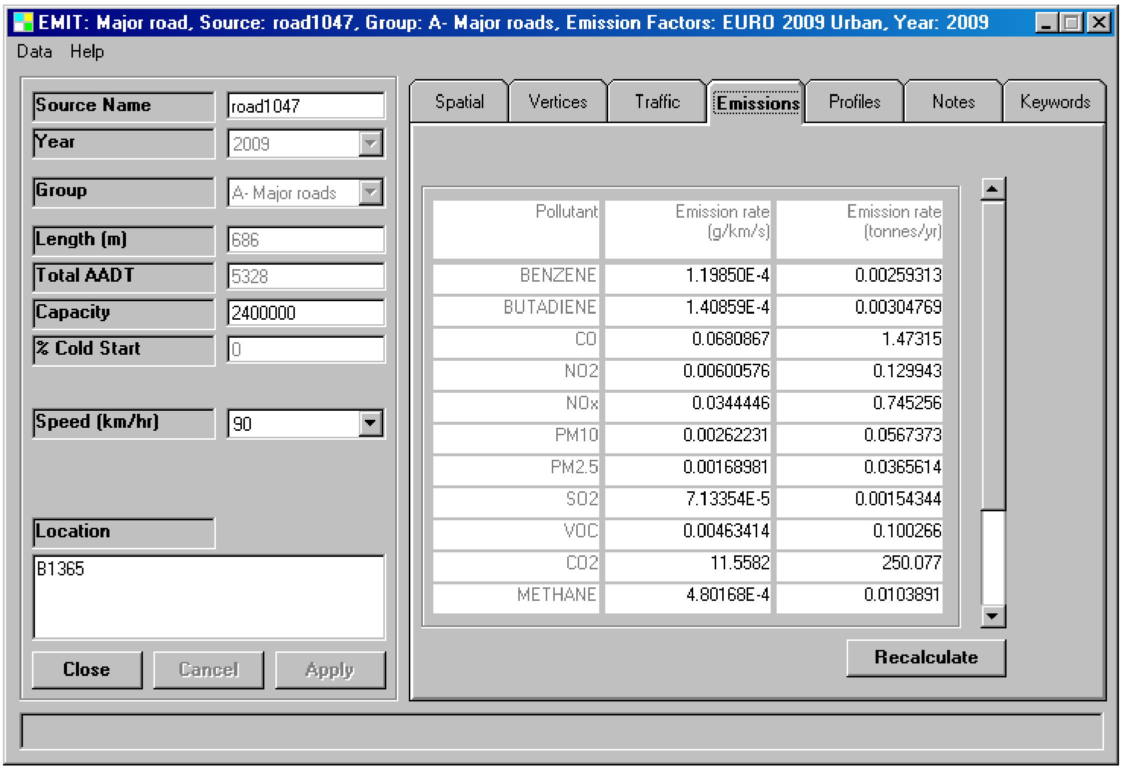
Vertices tab			
Edit Vertices	-	This check box must be checked in order to edit the vertices data contained in the table (see below).	
<Table>	-	The table lists the vertices for the road, listed in sequence along the road, which is assumed to be made up of a series of straight-line segments joining successive vertex points in the list. **Sequence**: Number of vertex along the road. **X(m)**: *x*-coordinate of the vertex **Y(m)**: *y*-coordinate of the vertex The coordinates are usually the 6-figure OS National Grid coordinates of the point (i.e. Eastings and Northings, respectively), or 7-figure UTM[2] coordinates. If the vertices data are modified, the road length may be recalculated by means of the **Apply** button.	Maximum number of vertices is 50. -9,999,999 $\leq x \leq$ 9,999,999 for both coordinates.
Add	-	When **Edit Vertices** is checked, this button adds a vertex (row) to the list of vertices above the vertex where the cursor is currently positioned.	
Delete	-	When **Edit Vertices** is checked, this button deletes the vertex (row) from the list of vertices where the cursor is currently positioned.	

[2] Universal Transverse Mercator coordinates.

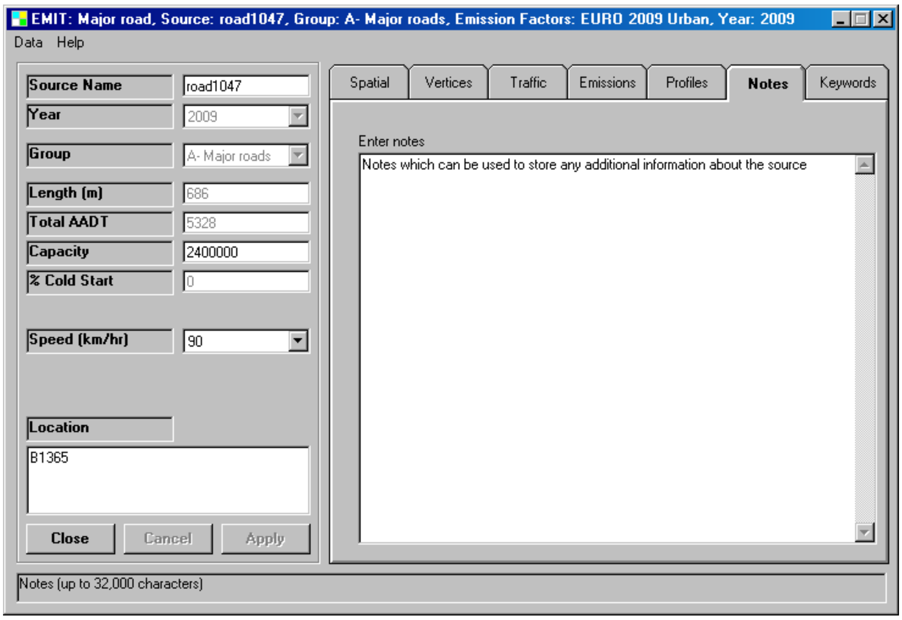


Traffic tab[3]			
Route Type	-	The drop-down list box shows the route type for the group. This cannot be changed here.	
View route type...	-	Displays the **Route Type** screen. The route type data may be viewed but not edited here (see Section D.5.2 for a more detailed discussion of this screen).	
<Table>	-	The table lists the annual average daily traffic count (AADT), in each fleet component for this road in vehicles/day, e.g. for 3 fleet components the number of light vehicles, heavy vehicles and motorcycles per day. The **Total AADT** (shown on the left-hand side of screen) is the sum of these numbers. The number of rows in the table, i.e. the number of fleet components, is inherited from the parent group.	$0 \leq x \leq 2.4\times10^6$ veh/day for each fleet component.

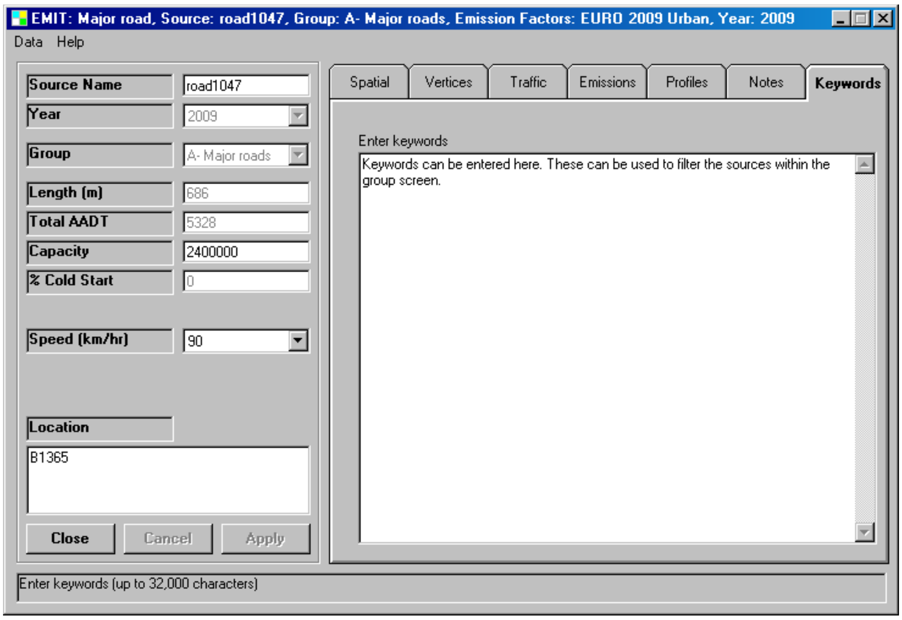
[3] This tab is only present if the emissions have been calculated with a dataset held within EMIT.



Emissions tab			
<Table>	-	Emission rate displayed in g/km/s and in tonnes/year for each pollutant for this source. **Pollutant**: pollutant name drawn from the fixed list of pollutants available in EMIT. **Emission rate (g/km/s)**: Emission rate for this pollutant from this source in g/km/s. **Emissions rate (tonnes/yr)**: Emission rate for this pollutant from this source in tonnes/year.	Editable if the group has been created using manual emissions, non-editable otherwise.
Add	-	Another pollutant for this source can be added using the **Add** button if the group has been created using manually entered emissions i.e. not using a pre-defined dataset within EMIT. Clicking on the **Add** button launches the **Add pollutant** dialogue box, which requires the user to select a pollutant from the drop-down list box containing the EMIT pollutants that have not already been chosen for this source.	
Delete	-	If the group has been created using manual emissions, the user may delete a pollutant for this source using the **Delete** button.	
Recalculate	-	The **Recalculate** button may be used to update the calculated emissions data in the table as a result of any changes to other data (e.g. traffic data).	

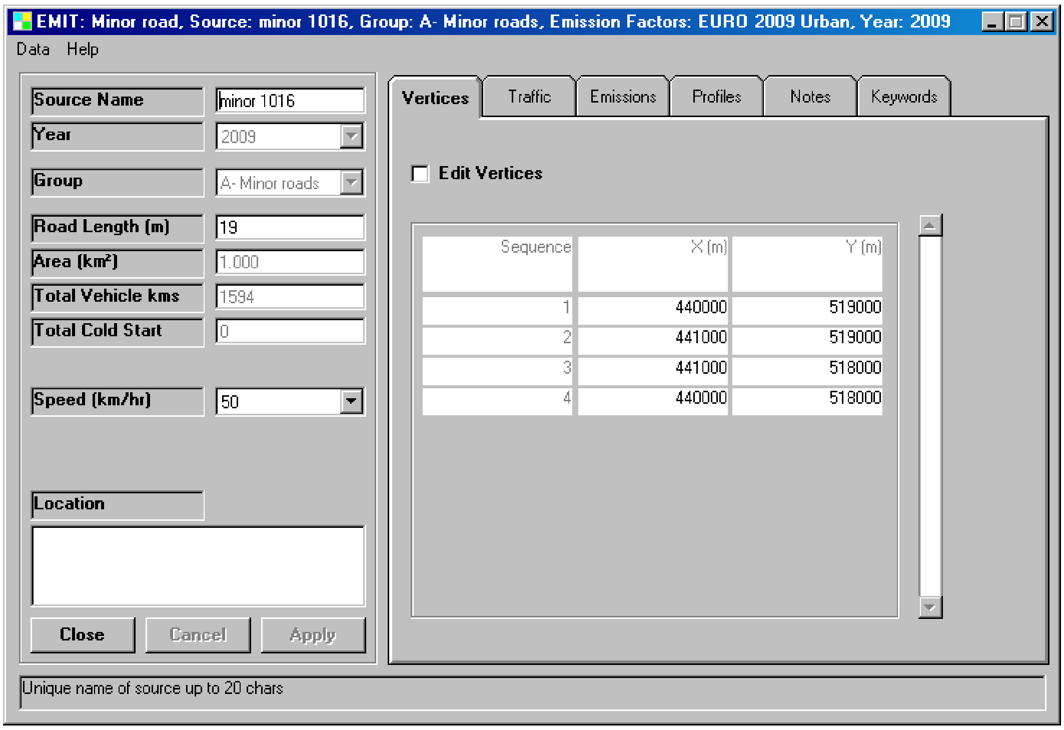


Notes tab			
Enter notes	-	Provide text notes on the source. This could be used to record, for example, changes made to the source.	Up to 32000 characters.



Keywords tab			
Enter keywords	-	Provide a list of keywords for the source. These keywords can be used to filter sources in the parent group.	Up to 32000 characters.

D.3.2 Minor roads



SCREEN AREA	CONTROL	DESCRIPTION OF FUNCTION	RESTRICTIONS
Source Name	-	Allows the source name to be defined/edited. The name must be unique within the database. If this screen has been launched when adding a new source to a group, the name will need to be changed from the default, which is simply based on the current date and time.	Up to 20 characters.
Year	-	Year associated with the parent group, which therefore applies to all the sources it contains.	Not editable.
Group	-	Name of parent group.	Not editable.
Road Length (m)	-	The total length of all minor roads within the source area.	
Area (km²)	-	The area of the minor road source region in km². This value is calculated by EMIT using the vertices data (see the **Vertices** tab) and is therefore not editable. Its value is recalculated when the **Apply** button is clicked following changes to the vertices data.	Not editable.
Total Vehicle kms[4]	-	The total distance travelled in kilometres by all vehicles in this minor road source area in one year. This is the sum of the annual vehicle kilometres for each fleet component specified on the **Traffic** tab.	Not editable.
Total Cold Start[4]	-	Percentage of vehicles whose engines were cold at the start of their journey.	Not currently used.

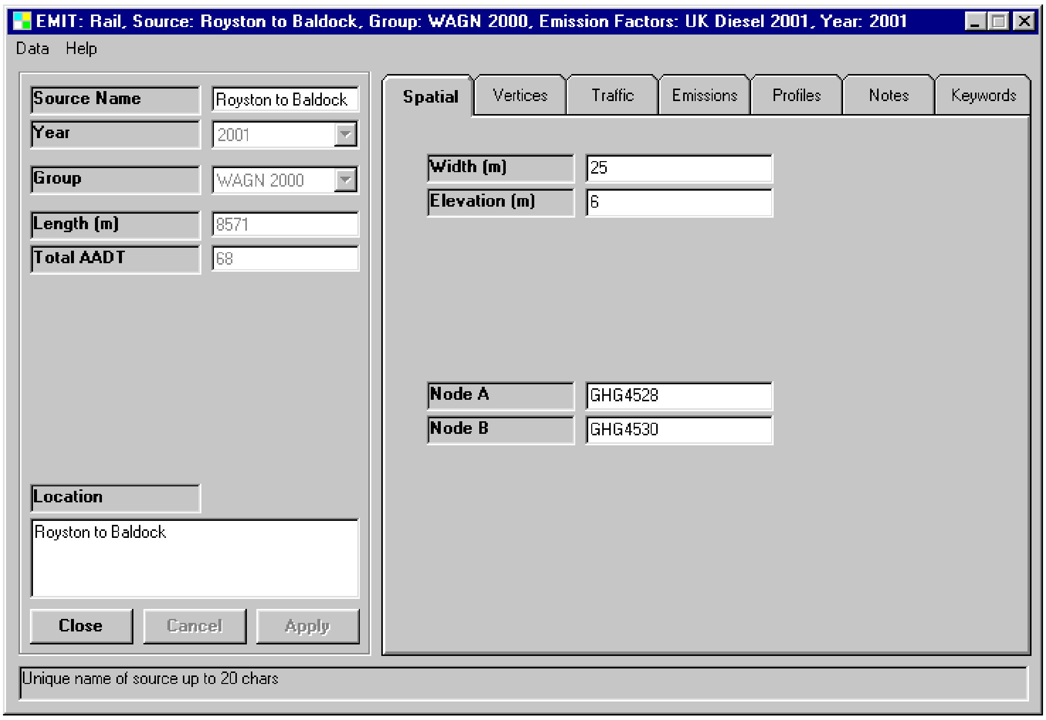
[4] This field is only present if the emissions have been calculated with a dataset held within EMIT

Speed (km/hr)[4]	-	Vehicle speed on the roads in this region in km/hr. Select a value from the drop-down list box of options.	Options depend on the choice of emission factors.
Location	-	A text description of the location of the minor road area.	Up to 200 characters.
Close	-	Save any changes, close this screen and return to the calling screen, e.g. the **EMIT Group** screen of the parent group.	
Cancel	-	Reject changes to data (that have not been saved using the **Apply** button).	
Apply	-	Update the screen as a result of changes to data but do not close the screen.	
Vertices tab			
Edit Vertices	-	This check box must be checked in order to edit the vertices data contained in the table (see below).	
<Table>	-	The table lists the 4 vertices of the minor road source region, listed in clockwise sequence starting with the top left-hand vertex. The region is assumed to be rectangular and aligned with the underlying 1km^2 grid. **Sequence**: Number of vertex **X(m):** x-coordinate of the vertex **Y(m):** y-coordinate of the vertex The coordinates are usually the 6-figure OS National Grid coordinates of the point (i.e. Eastings and Northings, respectively), or 7-figure UTM[5] coordinates. If the vertices data are modified, the source area may be recalculated by means of the **Apply** button.	$-9,999,999 \le x \le 9,999,999$ for both coordinates. Points must correspond to corners of a rectangle and must be multiples of 1000.
Traffic tab[6]			
Route Type	-	The drop-down list box shows the route type for the group. This cannot be changed here.	
View route type…	-	Displays the **Route Type** screen. The route type data may be viewed but not edited here.	
<Table>	-	The table lists the annual vehicles kilometres (AVK) for each fleet component for this minor road area, e.g. for 3 fleet components the total vehicle kilometres for light vehicles, heavy vehicles and motorcycles per year. The **Total Vehicle kms** (shown on the left-hand side of screen) is the sum of these numbers. The number of rows in the table, i.e. the number of fleet components, is inherited from the parent group.	$0 \le x \le 10^7$ vehicle km/year for each fleet component.
Emissions tab			

[5] Universal Transverse Mercator coordinates
[6] This tab is only present if the emissions have been calculated with a dataset held within EMIT

<Table>	-	Emission rate displayed in g/km^2/s and in tonnes/year for each pollutant for this source. **Pollutant**: pollutant name drawn from the fixed list of pollutants available in EMIT. **Emission rate (g/km2/s):** Emission rate for this pollutant from this source in g/km^2/s. **Emissions rate (tonnes/yr):** Emission rate for this pollutant from this source in tonnes/year.	Editable if the group has been created using manual emissions, non-editable otherwise.
Add	-	Another pollutant for this source can be added using the **Add** button if the group has been created using manually entered emissions i.e. not using a pre-defined dataset within EMIT. Clicking on the **Add** button launches the **Add pollutant** dialogue box, which requires the user to select a pollutant from the drop-down list box containing the EMIT pollutants that have not already been chosen for this source.	
Delete	-	If the group has been created using manual emissions, the user may delete a pollutant for this source using the **Delete** button.	
Recalculate	-	The **Recalculate** button may be used to update the calculated emissions data in the table as a result of any changes to other data (e.g. traffic data).	
Notes tab			
As for Major Road Sources			
Keywords tab			
As for Major Road Sources			

D.3.3 Rail source

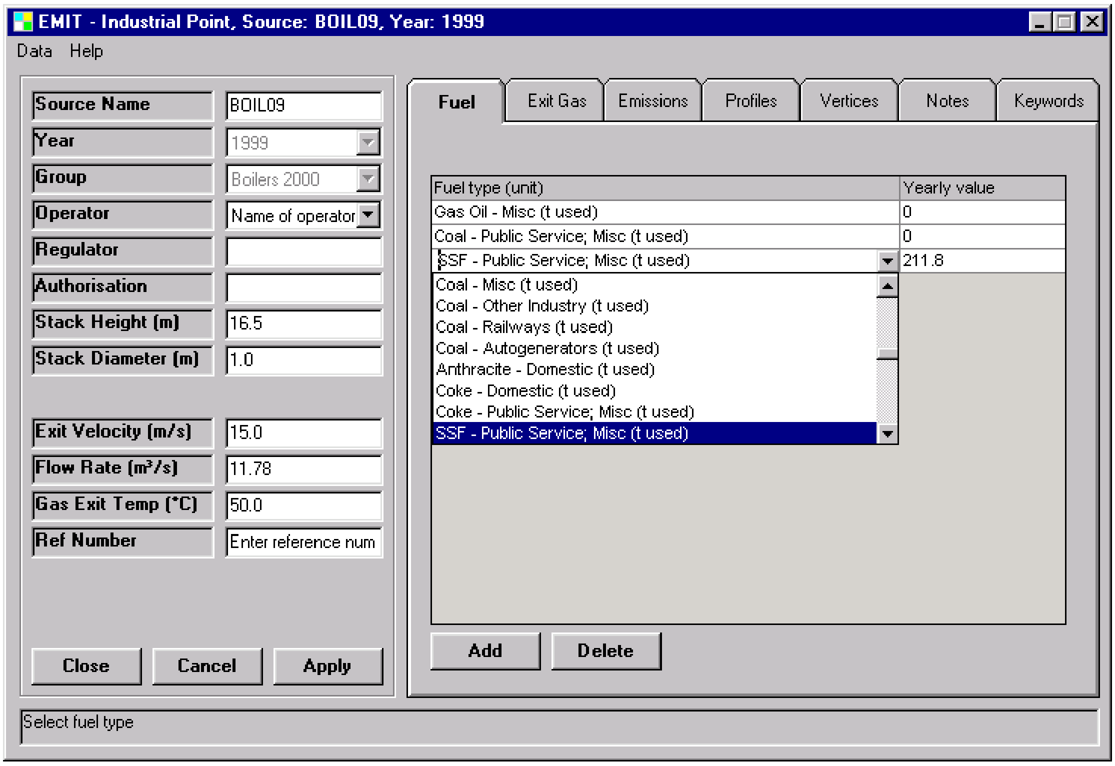


SCREEN AREA	CONTROL	DESCRIPTION OF FUNCTION	RESTRICTIONS
Source Name	-	Allows the source name to be defined/edited. The name must be unique within the database. If this screen has been launched when adding a new source to a group, the name should be changed from the default, which is simply based on the current date and time.	Up to 20 characters.
Year	-	Year associated with the parent group, which therefore applies to all the sources it contains.	Not editable.
Group	-	Name of parent group.	Not editable.
Length (m)	-	The length of the railway line in metres. This value is calculated by EMIT using the vertices data (see the **Vertices** tab). Its value is recalculated when the **Apply** button is clicked following changes to the vertices data.	Not editable.
Total AADT	-	The total annual average daily traffic for the railway line in vehicles per day. This is the sum of the traffic count totals on the **Traffic** tab.	
Location	-	A text description of the location of the railway line.	Up to 200 characters.
Close	-	Save any changes, close this screen and return to the calling screen, e.g. the **EMIT Group** screen of the parent group.	
Cancel	-	Reject changes to data (that have not been saved using the **Apply** button).	
Apply	-	Update the screen as a result of changes to data but do	

		not close the screen.	
Spatial tab			
Width (m)	-	The width of the railway line in metres.	$5m \le x \le 100m$
Elevation (m)	-	The height of the railway line above the ground in metres. This is usually zero, but is non-zero for viaducts, etc.	$0 \le x \le 2000m$
Node A	-	Text string for use in linking with the SATURN traffic model.	Up to 20 characters.
Node B	-	Text string for use in linking with the SATURN traffic model.	Up to 20 characters.
Vertices tab			
As for Major Roads			
Traffic tab[7]	-		
Route Type	-	Shows the **Route Type** for the group. This cannot be changed here.	
View route type…	-	Displays the **Route Type** screen. The route type data may be viewed but not edited here.	
<Table>	-	The table lists the annual average daily traffic count (AADT), in each fleet component for this railway line in train units/day, where a “train unit” is usually either a car or a power car (see **Table A.7** in Appendix A). Currently there are three possibilities, namely 2, 4 and 14 fleet components. The **Total AADT** (shown on the left-hand side of screen) is the sum of the individual traffic counts. The number of rows in the table, i.e. the number of fleet components, is inherited from the parent group.	$0 \le x \le 10^6$ train units/day for each fleet component.
Emissions tab			
As for Major Roads			
Notes tab			
As for Major Roads			
Keywords tab			
As for Major Roads			

[7] This tab is only present if the emissions have been calculated with a dataset held within EMIT

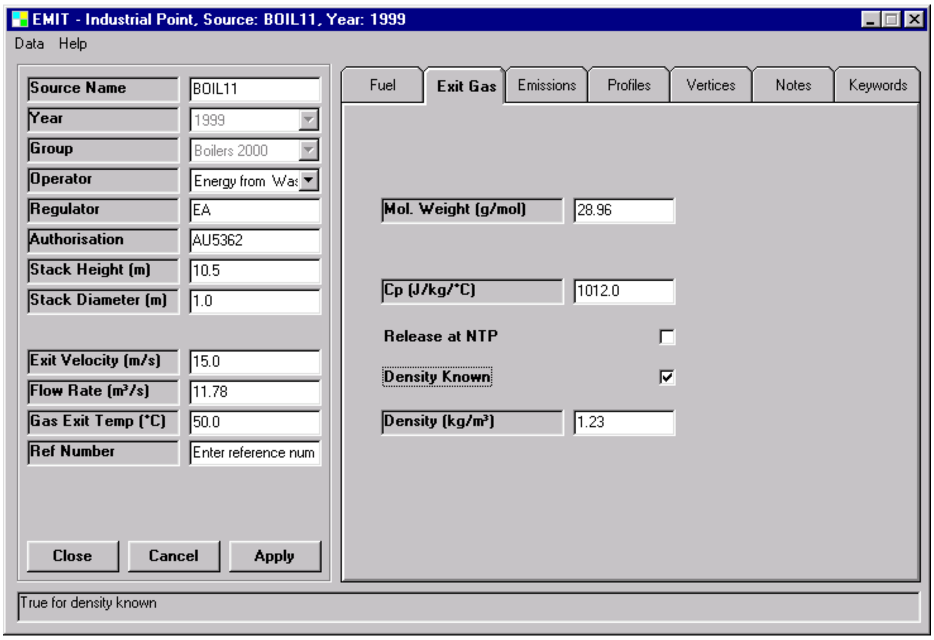
D.3.4 Point source



SCREEN AREA	CONTROL	DESCRIPTION OF FUNCTION	RESTRICTIONS
Source Name	-	Allows the source name to be defined/edited. The name must be unique within the database. If this screen has been launched when adding a new source to a group, the name will need to be changed from the default, which is simply based on the current date and time.	Up to 20 characters.
Year	-	Year associated with the parent group, which therefore applies to all the sources it contains.	Not editable.
Group	-	Name of parent group.	Not editable.
Operator	-	The operator for this industrial point source. The drop-down list box gives the available choices of operator within this database.	Optional.
Regulator	-	The name of the regulator associated with this industrial point source.	Optional.
Authorisation	-	Authorisation information for the industrial point source: text entered by the user could be reference number, e.g. AK2927.	Optional.
Stack Height (m)	-	The height of the emission source exit above ground level in metres.	$0 \le x \le 2000$m
Stack Diameter (m)	-	The internal diameter of the emission source exit in metres.	0.1m $\le x \le$ 100m
Exit Velocity (m/s)	-	The vertical exit velocity of the emission gases in	$0 \le x \le 1000$m/s

		m/s. Refers to actual release conditions unless the **Release at NTP** check box on the **Exit Gas** tab has been checked. Note that this parameter is linked to the **Stack Diameter** and **Flow rate** parameters: the user can specify either the **Flow rate** or **Exit Velocity** parameters and EMIT will calculate and display the other one as you type.	
Flow rate (m^3/s)	-	The volume flux of the emission gases in m^3/s. Refers to actual release conditions unless the **Release at NTP** check box on the **Exit Gas** tab has been checked. Note that this parameter is linked to the **Stack Diameter** and **Exit Velocity** parameters: the user can specify either the **Flow rate** or **Exit Velocity** parameters and EMIT will calculate and display the other one as you type.	
Gas Exit Temp (°C)	-	Temperature of the emission gases in °C.	-100°C ≤ x ≤ 5000°C
Ref Number	-	User-defined reference number for the source.	Optional.
Close	-	Save any changes, close this screen and return to the calling screen, e.g. the **EMIT Group** screen of the parent group.	
Cancel	-	Reject changes to data (that have not been saved using the **Apply** button).	
Apply	-	Update the screen as a result of changes to data but do not close the screen.	
<Dataset key word> tab[8]			
<Table>	-	Activity data for this source. **<Activity>**: this column gives the list of activities available within the chosen dataset. For some datasets, the available activities can be chosen from a list; for others, there are a fixed number of options available, all of which are displayed. For most datasets, the activity name includes the units in which the value must be entered (in brackets). **<Time period>**: the activity value is entered in this column, in units indicated by the **<Time period>** header and/or by the activity name.	
Add	-	Another **<Activity>** for this source can be added using the **Add** button. This option is only available for datasets with a large number of activities.	
Delete	-	An **<Activity>** can be deleted using this button. This option is only available for datasets with a large number of activities.	

[8] This tab is only present if the emissions have been calculated with a dataset held within EMIT



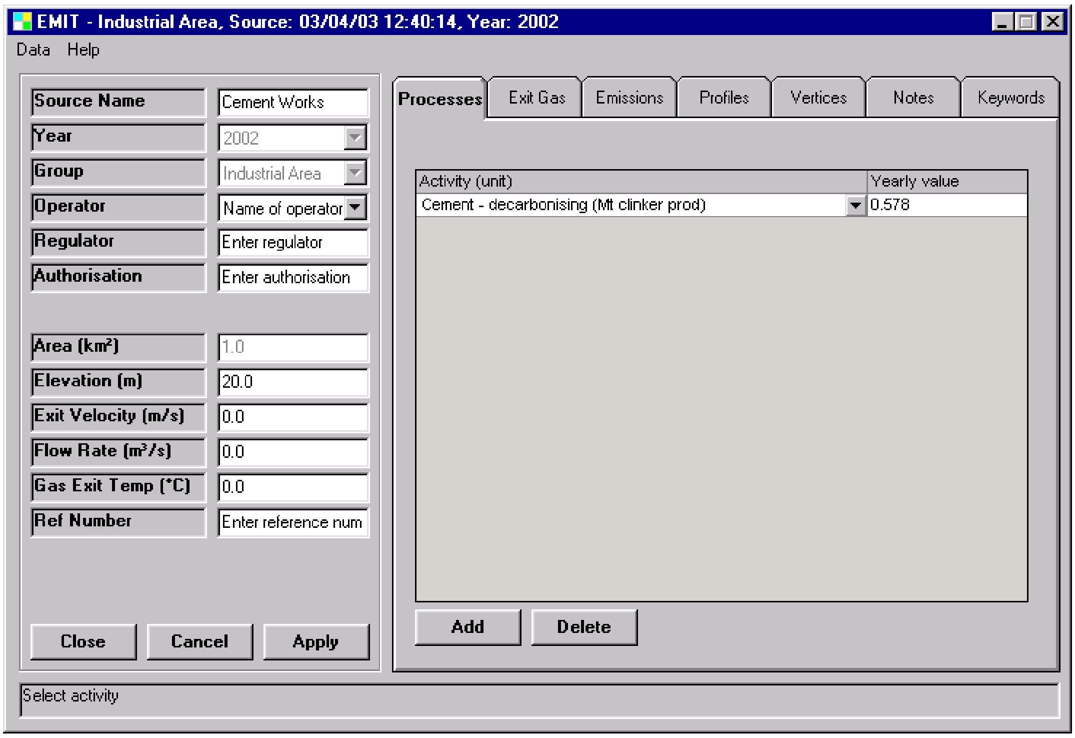
Exit Gas tab			
Mol. Weight (g/mol)	-	The molecular weight of the emission gases in g/mol.	1g/mol ≤ *x* ≤ 300g/mol
Cp (J/kg/°C)	-	The specific heat capacity of the emission gases in J/kg/°C.	1J/kg/°C≤ *x* ≤10^5 J/kg/°C
Release at NTP	-	Check this box to indicate that the emission characteristics are specified at normal temperature and pressure, NTP, i.e. a pressure of 1013mB and a temperature of 0°C, otherwise they are assumed to be at the release temperature (**Gas Exit Temp**).	
Density Known	-	Check this box if the density of the emission gases is known. If the box is unchecked, the temperature of the emission gases is used instead.	
Density (kg/m³)	-	The density of the emission gases in kg/m^3.	0.01kg/m^3 ≤ *x* ≤ 2kg/m^3
Emissions tab			
<Table>	-	Emission rate displayed in g/s and in tonnes/year for each pollutant for this source. **Pollutant**: pollutant name drawn from the fixed list of pollutants available in EMIT. **Emission rate (g/s):** Emission rate for this pollutant from this source in g/s. **Emissions rate (tonnes/yr):** Emission rate for this pollutant from this source in tonnes/year.	Editable if the group has been created using manual emissions, non-editable otherwise.
Add	-	The user may add another pollutant for this source using the **Add** button. This launches the **Add pollutant** dialogue box, which requires the user to select a pollutant from the drop-down list box, which contains the EMIT pollutants that have not already been chosen for this source.	Only available if the group has manually specified emissions.

Delete	-	The user may delete a pollutant for this source using the **Delete** button.	As above.
Recalculate	-	The **Recalculate** button may be used to update the calculated emissions data in the table as a result of any changes to other data (e.g. activity data).	

Vertices tab			
Edit Vertices	-	This check box must be checked in order to edit the vertices data contained in the table (see below).	
<Table>	-	The table gives the location of the single point that defines an industrial point source. **Sequence**: there is one point only. **X(m):** *x*-coordinate of the point source **Y(m):** *y*-coordinate of the point source The coordinates are usually the 6-figure OS National Grid coordinates of the point (i.e. Eastings and Northings, respectively), or 7-figure UTM[9] coordinates.	-9,999,999 $\leq x \leq$ 9,999,999 for both coordinates.
Notes tab			
As for Major Roads			
Keywords tab			
As for Major Roads			

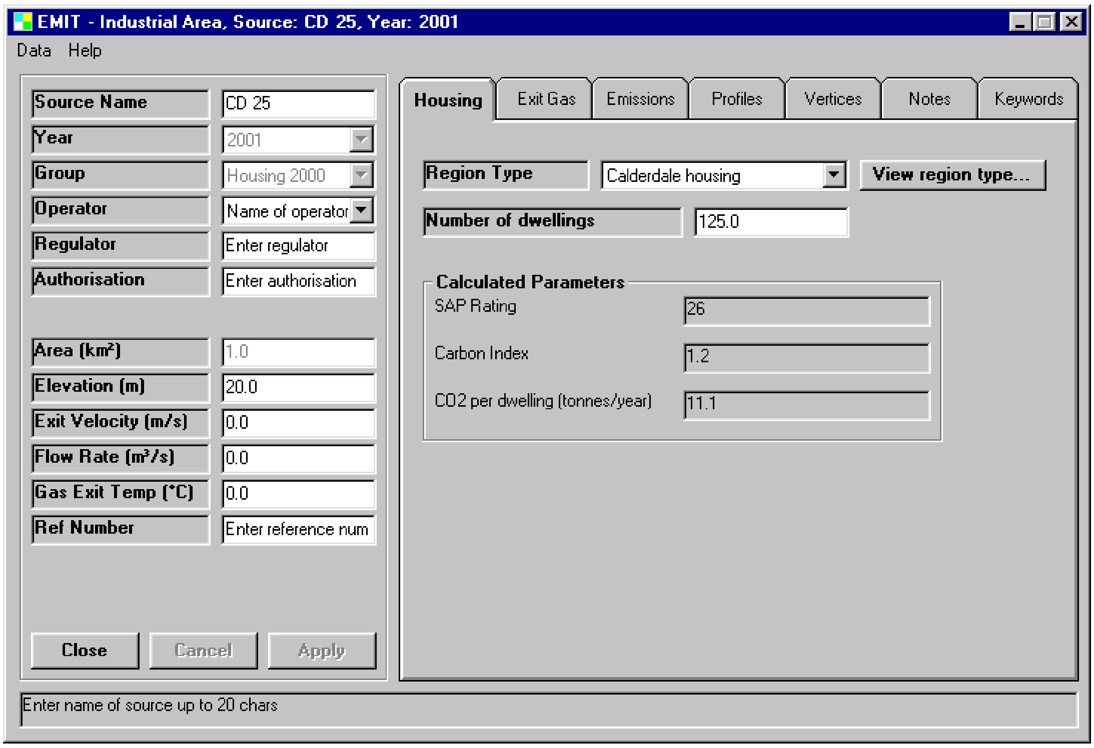
[9] Universal Transverse Mercator coordinates.

D.3.5 Area source



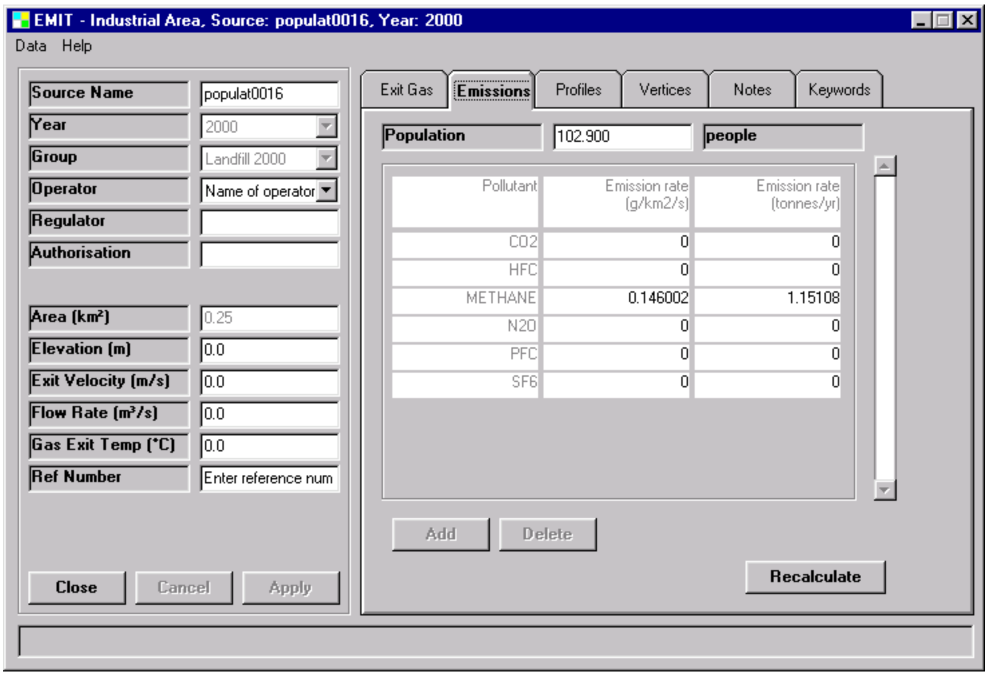
SCREEN AREA	CONTROL	DESCRIPTION OF FUNCTION	RESTRICTIONS
Source Name	-	Allows the source name to be defined/edited. The name must be unique within the database. If this screen has been launched when adding a new source to a group, the name should be changed from the default, which is simply based on the current date and time.	Up to 20 characters.
Year	-	Year associated with the parent group, which therefore applies to all the sources it contains.	Not editable.
Group	-	Name of parent group.	Not editable.
Operator	-	The operator for this industrial area source. The drop-down list box gives the available choices of operator within this database.	Optional.
Regulator	-	The name of the regulator associated with this industrial area source.	Optional.
Authorisation	-	Authorisation information for the industrial area source: text entered by the user could be reference number, e.g. AK2927.	Optional.
Area (km²)	-	The area of the industrial area source in km^2. This value is calculated by EMIT using the vertices data (see the **Vertices** tab) and is therefore not editable. Its value is recalculated when the **Apply** button is clicked following changes to the vertices data.	Not editable.
Elevation (m)	-	The height of the emission source exit plane above ground level in metres.	$0 \le x \le 2000$m
Exit Velocity	-	The vertical exit velocity of the emission gases in m/s. Refers to actual release conditions unless the **Release at**	$0 \le x \le 1000$m/s

(m/s)		**NTP** check box on the **Exit Gas** tab has been checked. Note that this parameter is linked to the **Area** and **Flow rate** parameters: the user can specify either the **Flow rate** or **Exit Velocity** parameters and EMIT will calculate and display the other one as you type.	
Flow rate (m^3/s)	-	The volume flux of the emission gases in m^3/s. Refers to actual release conditions unless the **Release at NTP** check box on the **Exit Gas** tab has been checked. Note that this parameter is linked to the **Area** and **Exit Velocity** parameters: the user can specify either the **Flow rate** or **Exit Velocity** parameters and EMIT will calculate and display the other one as you type.	
Gas Exit Temp (°C)	-	Temperature of the emission gases in °C.	-100°C ≤ *x* ≤ 5000°C
Ref Number	-	User-defined reference number for the source.	Optional.
Close	-	Save any changes, close this screen and return to the calling screen, e.g. the **EMIT Group** screen of the parent group.	
Cancel	-	Reject changes to data (that have not been saved using the **Apply** button).	
Apply	-	Update the screen as a result of changes to data but do not close the screen.	
<Dataset key word> tab[10]			
As for Point Sources			



[10] This tab is only present if the emissions have been calculated with a dataset held within EMIT.

Housing tab[11]			
Region Type	**-**	The **Region Type** for the source can be selected from the list. For further details, please refer to Section 12.	
View Region Type…	**-**	This button displays details of the selected **Region Type**. The **Region Type** is non-editable in this screen.	
Number of dwellings	**-**	The number of dwellings is entered in this box.	Value must be greater than or equal to 0.
Calculated Parameters	**SAP Rating**	The **SAP Rating** of the dwelling as defined in the **Region Type.**	Not editable
	Carbon Index	The **Carbon Index** of the dwelling as defined in the **Region Type.**	Not editable
	CO2 per dwelling (in tonnes/year)	The CO_2 emission factor of the dwelling as defined in the **Region Type**.	Not editable
Exit Gas tab			
As for Point Sources			

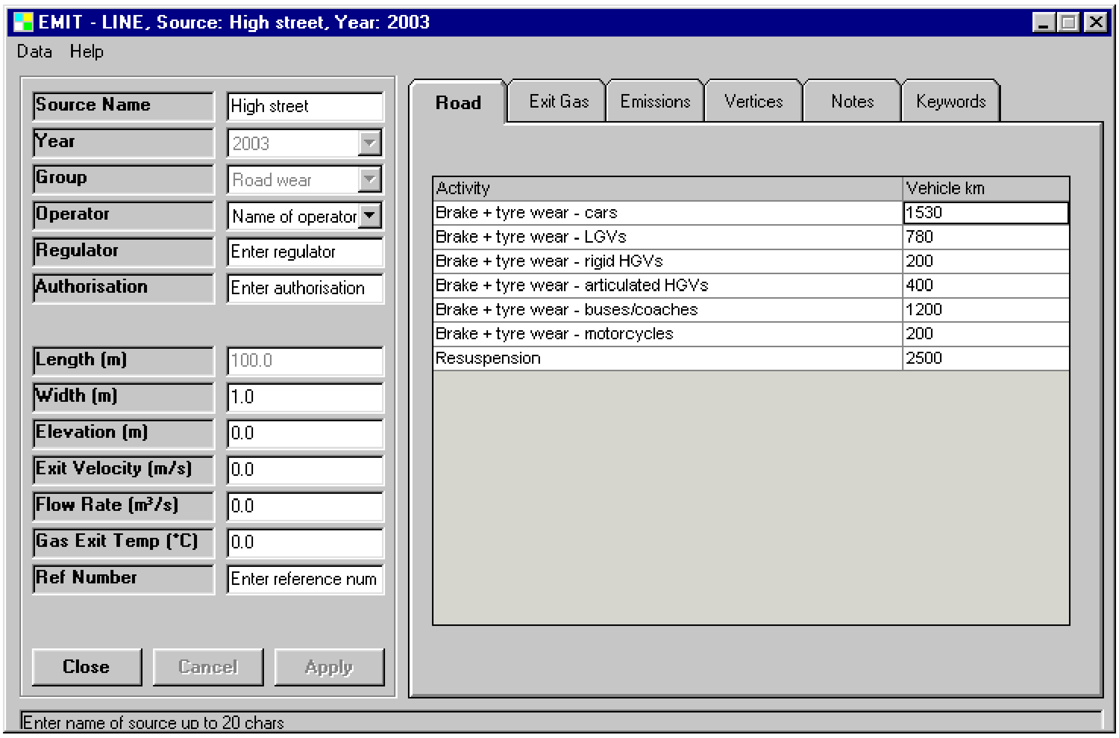


Emissions tab			
<Statistic>[12]		The **<Statistic>** that has been used to scale a national emissions figure is given; the unit is also given. All data is as entered on the **Scaling Parameters…** screen – for further details, please refer to Section 5.	

[11] This tab is only present if the emissions have been calculated with the SAP dataset held within EMIT.
[12] This field is only present if the emissions have been calculated using a scaling of a national emissions value

<Table>	**-**	Emission rate displayed in g/km^2/s and in tonnes/year for each pollutant for this source. **Pollutant**: pollutant name drawn from the fixed list of pollutants available in EMIT. **Emission rate (g/km2/s):** Emission rate for this pollutant from this source in g/km^2/s. **Emissions rate (tonnes/yr)**: Emission rate for this pollutant from this source in tonnes/year.	Editable if the group has been created using manual emissions, non-editable otherwise.
Add	**-**	The user may add another pollutant for this source using the **Add** button. This launches the **Add pollutant** dialogue box, which requires the user to select a pollutant from the drop-down list box, which contains the EMIT pollutants that have not already been chosen for this source.	Only available if the source has manual emissions.
Delete	**-**	The user may delete a pollutant for this source using the **Delete** button.	As above.
Recalculate	**-**	The **Recalculate** button may be used to update the calculated emissions data in the table as a result of any changes to other data (e.g. activity data).	
Notes tab			
As for Major Roads			
Keywords tab			
As for Major Roads			

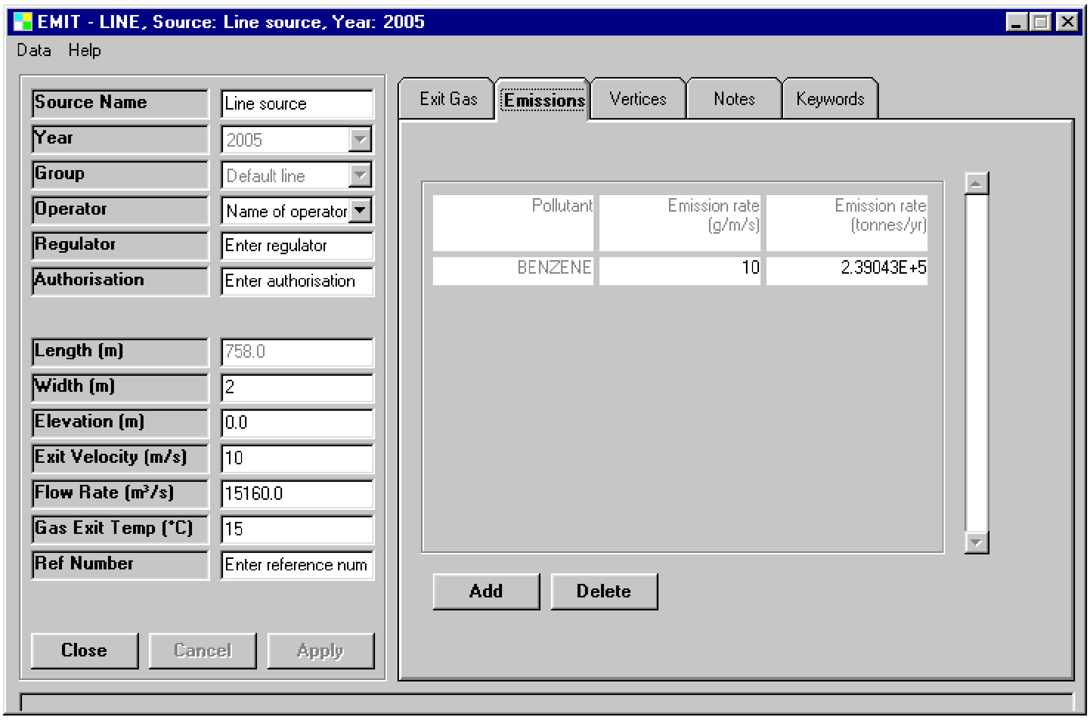
D.3.6 Line source



SCREEN AREA	CONTROL	DESCRIPTION OF FUNCTION	RESTRICTIONS
Source Name	-	Allows the source name to be defined/edited. The name must be unique within the database. If this screen has been launched when adding a new source to a group, the name should be changed from the default, which is simply based on the current date and time.	Up to 20 characters.
Year	-	Year associated with the parent group, which therefore applies to all the sources it contains.	Not editable.
Group	-	Name of parent group.	Not editable.
Operator	-	The operator for this industrial line source. The drop-down list box gives the available choices of operator within this database.	Optional.
Regulator	-	The name of the regulator associated with this industrial line source.	Optional.
Authorisation	-	Authorisation information for the industrial line source: text entered by the user could be reference number, e.g. AK2927.	Optional.
Length (m)	-	The length of the industrial line source in m. This value is calculated by EMIT using the vertices data (see the **Vertices** tab) and is therefore not editable. Its value is recalculated when the **Apply** button is clicked following changes to the vertices data.	Not editable.
Width (m)	-	The width of the line source in metres.	$0 \leq x \leq 100$m
Elevation (m)	-	The height of the emission source above ground level in metres.	$0 \leq x \leq 2000$m

Exit Velocity (m/s)	**-**	The vertical exit velocity of the emission gases in m/s. Refers to actual release conditions unless the **Release at NTP** check box on the **Exit Gas** tab has been checked. Note that this parameter is linked to the **Length, Width** and **Flow rate** parameters: the user can specify either the **Flow rate** or **Exit Velocity** parameters and EMIT will calculate and display the other one as you type. The parameters are connected as follows: **Length x Width x Exit Velocity = Flow Rate**	$0 \le x \le 1000$m/s
Flow rate (m^3/s)	**-**	The volume flux of the emission gases in m^3/s. Refers to actual release conditions unless the **Release at NTP** check box on the **Exit Gas** tab has been checked. Note that this parameter is linked to the **Length, Width** and **Exit Velocity** parameters: the user can specify either the **Flow rate** or **Exit Velocity** parameters and EMIT will calculate and display the other one as you type. The parameters are connected as follows: **Length x Width** x **Exit Velocity = Flow Rate**	
Gas Exit Temp (°C)	**-**	Temperature of the emission gases in °C.	-100°C $\le x \le$ 5000°C
Ref Number	**-**	User-defined reference number for the source.	Optional.
Close	**-**	Save any changes, close this screen and return to the calling screen, e.g. the **EMIT Group** screen of the parent group.	
Cancel	**-**	Reject changes to data (that have not been saved using the **Apply** button).	
Apply	**-**	Update the screen as a result of changes to data but do not close the screen.	
<Dataset key word> tab[13]			
As for Point Sources			

[13] This tab is only present if the emissions have been calculated with a dataset held within EMIT

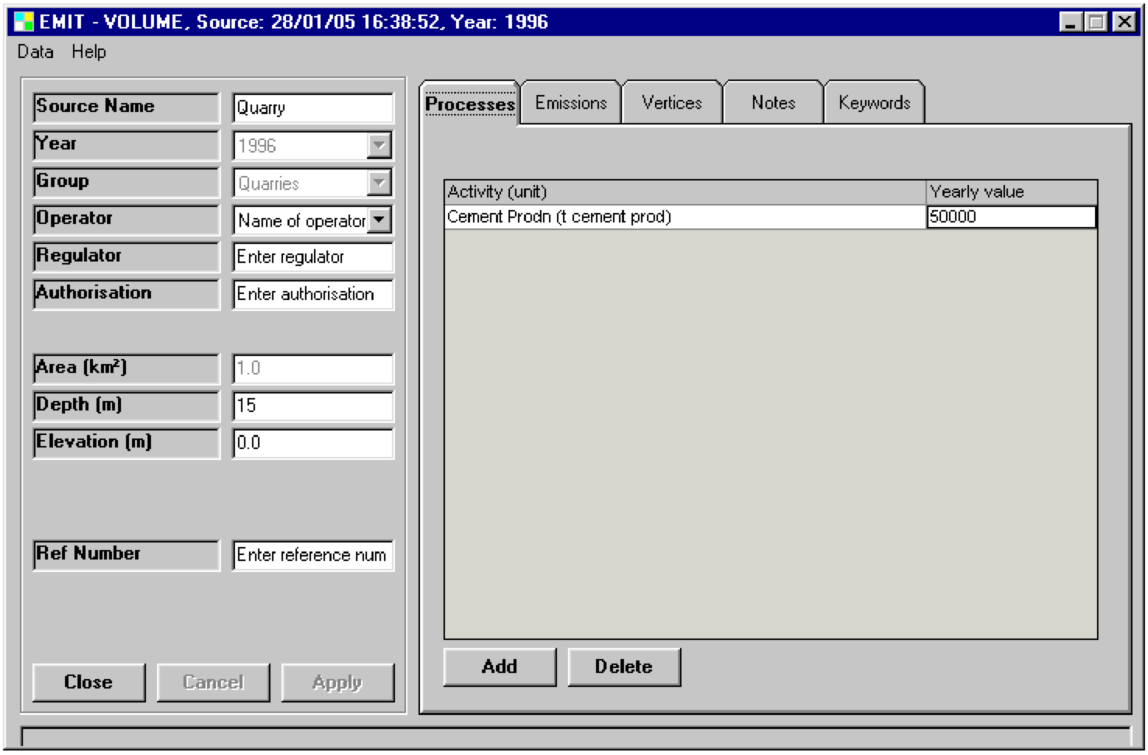


Emissions tab			
<Table>	-	Emission rate displayed in g/m/s and in tonnes/year for each pollutant for this source. **Pollutant**: pollutant name drawn from the fixed list of pollutants available in EMIT. **Emission rate (g/m/s):** Emission rate for this pollutant from this source in g/m/s. **Emissions rate (tonnes/yr):** Emission rate for this pollutant from this source in tonnes/year.	Editable if the group has been created using manual emissions, non-editable otherwise.
Add	-	The user may add another pollutant for this source using the **Add** button. This launches the **Add pollutant** dialogue box, which requires the user to select a pollutant from the drop-down list box, which contains the EMIT pollutants that have not already been chosen for this source.	Only available if the group has been created using manual emissions.
Delete	-	The user may delete a pollutant for this source using the **Delete** button.	As above.
Recalculate	-	The **Recalculate** button may be used to update the calculated emissions data in the table as a result of any changes to other data (e.g. activity data).	
Vertices tab			
Edit Vertices	-	This check box must be checked in order to edit the vertices data contained in the table (see below).	

<Table>	-	The table lists the vertices of the line source in order. **Sequence**: Number of vertex **X(m):** *x*-coordinate of the vertex **Y(m):** *y*-coordinate of the vertex The coordinates are usually the 6-figure OS National Grid coordinates of the point (i.e. Eastings and Northings, respectively), or 7-figure UTM[14] coordinates. If the vertices data are modified, the source length may be recalculated by means of the **Apply** button.	$-9{,}999{,}999 \leq x \leq 9{,}999{,}999$ for both coordinates. There must be between two and fifty vertices.
Notes tab			
As for Major Roads			
Keywords tab			
As for Major Roads			

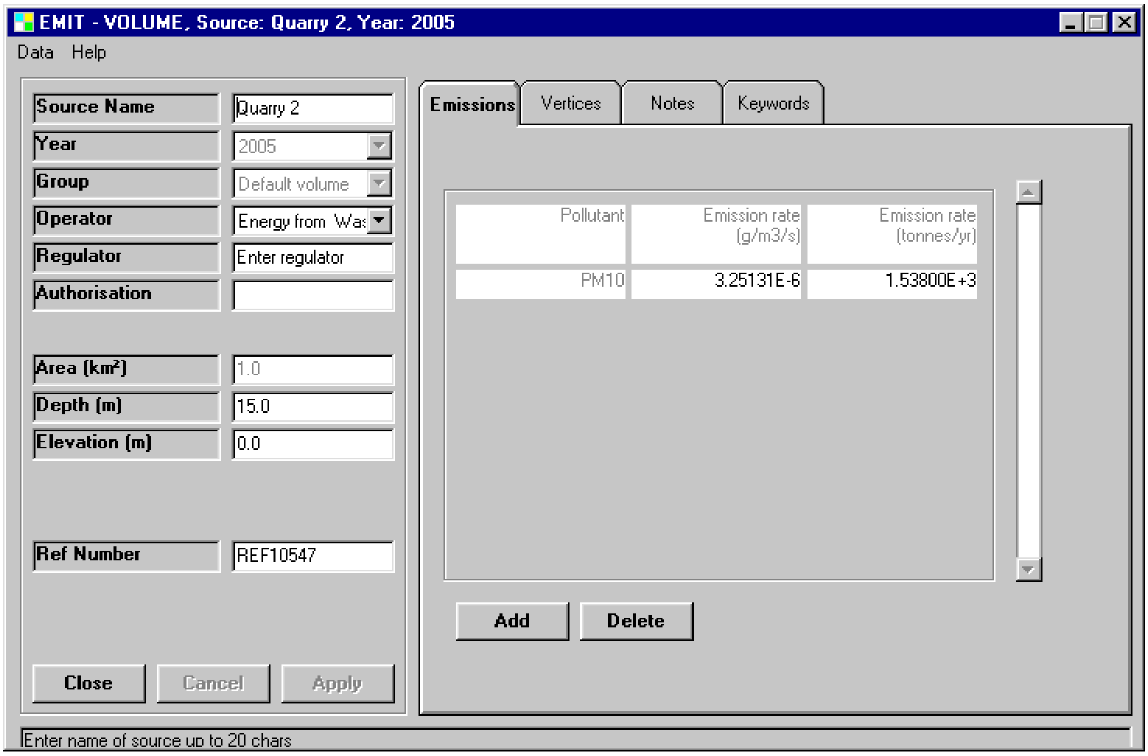
[14] Universal Transverse Mercator coordinates.

D.3.7 Volume source



SCREEN AREA	CONTROL	DESCRIPTION OF FUNCTION	RESTRICTIONS
Source Name	-	Allows the source name to be defined/edited. The name must be unique within the database. If this screen has been launched when adding a new source to a group, the name should be changed from the default, which is simply based on the current date and time.	Up to 20 characters.
Year	-	Year associated with the parent group, which therefore applies to all the sources it contains.	Not editable.
Group	-	Name of parent group.	Not editable.
Operator	-	The operator for this volume source. The drop-down list box gives the available choices of operator within this database.	Optional.
Regulator	-	The name of the regulator associated with this volume source.	Optional.
Authorisation	-	Authorisation information for the volume source: text entered by the user could be reference number, e.g. AK2927.	Optional.
Area (km²)	-	The area of the source in km^2. This value is calculated by EMIT using the vertices data (see the **Vertices** tab) and is therefore not editable. Its value is recalculated when the **Apply** button is clicked following changes to the vertices data.	Not editable.
Elevation (m)	-	The height of the centre of the source above ground level in metres.	$0 \le x \le 2000$m

Depth (m)	-	The vertical depth of the source in metres. The emission is assumed to be uniformly spread over this depth.	$0 \le x \le 1000$m
Ref Number	-	User-defined reference number for the source.	Optional.
Close	-	Save any changes, close this screen and return to the calling screen, e.g. the **EMIT Group** screen of the parent group.	
Cancel	-	Reject changes to data (that have not been saved using the **Apply** button).	
Apply	-	Update the screen as a result of changes to data but do not close the screen.	
<Dataset key word> tab[15]			
As for Point Sources			



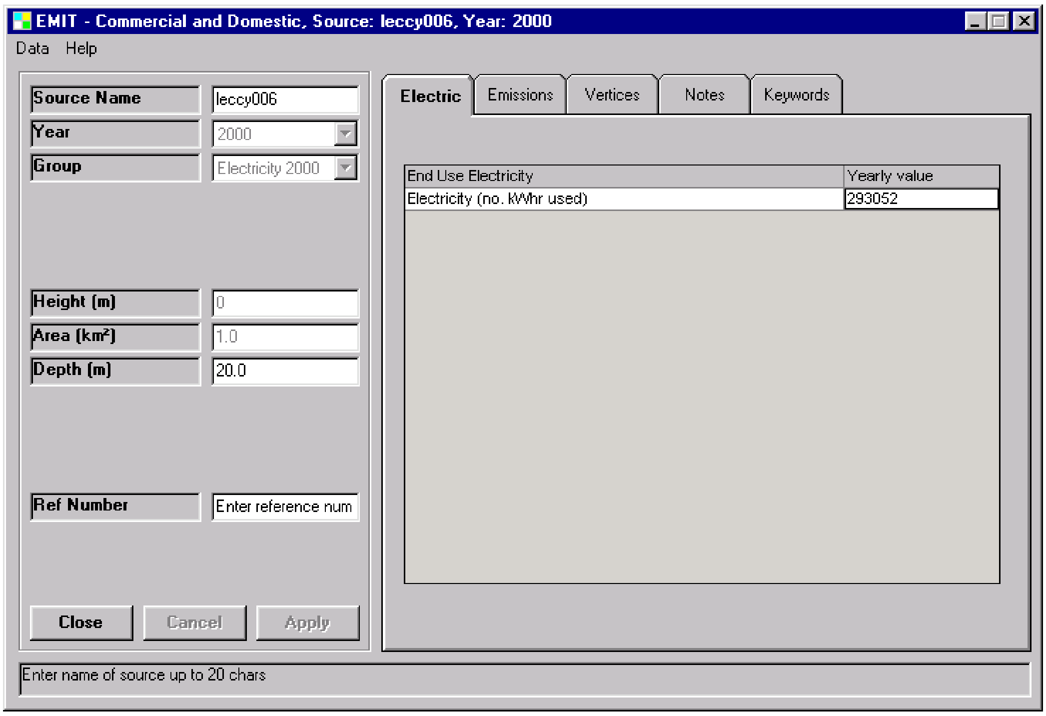
Emissions tab			
<Table>	-	Emission rate displayed in g/m^3/s and in tonnes/year for each pollutant for this source. **Pollutant**: pollutant name drawn from the fixed list of pollutants available in EMIT. **Emission rate (g/m3/s):** Emission rate for this pollutant from this source in g/m^3/s. **Emissions rate (tonnes/yr):** Emission rate for this pollutant from this source in tonnes/year.	Editable if the group has been created using manual emissions, non-editable otherwise.

[15] This tab is only present if the emissions have been calculated with a dataset held within EMIT.

Add	-	The user may add another pollutant for this source using the **Add** button. This launches the **Add pollutant** dialogue box, which requires the user to select a pollutant from the drop-down list box, which contains the EMIT pollutants that have not already been chosen for this source.	Only available if the group has been created using manual emissions.
Delete	-	The user may delete a pollutant for this source using the **Delete** button.	As above.
Recalculate	-	The **Recalculate** button may be used to update the calculated emissions data in the table as a result of any changes to other data (e.g. activity data).	
Vertices tab			
Edit Vertices	-	This check box must be checked in order to edit the vertices data contained in the table (see below).	
<Table>	-	The table lists the vertices of the industrial volume source region, listed in either clockwise or anti-clockwise sequence, starting from any vertex. The region must be a convex polygon. **Sequence**: Number of vertex **X(m):** *x*-coordinate of the vertex **Y(m):** *y*-coordinate of the vertex The coordinates are usually the 6-figure OS National Grid coordinates of the point (i.e. Eastings and Northings, respectively), or 7-figure UTM[16] coordinates. If the vertices data are modified, the source area may be recalculated by means of the **Apply** button.	$-9{,}999{,}999 \le x \le 9{,}999{,}999$ for both coordinates. Points must correspond to corners of a convex polygon. There can be 3 to 50 vertices.
Notes tab			
As for Major Roads			
Keywords tab			
As for Major Roads			

[16] Universal Transverse Mercator coordinates.

D.3.8 C&D source



SCREEN AREA	CONTROL	DESCRIPTION OF FUNCTION	RESTRICTIONS
Source Name	-	Allows the source name to be defined/edited. The name must be unique within the database. If this screen has been launched when adding a new source to a group, the name will need to be changed from the default, which is simply based on the current date and time.	Up to 20 characters.
Year	-	Year associated with the parent group, which therefore applies to all the sources it contains.	Not editable.
Group	-	Name of parent group.	Not editable.
Height (m)	-	The height of the emission source above ground level in metres.	Currently must be zero (ground-level).
Area (km²)	-	The area of the industrial C&D source in km^2. This value is calculated by EMIT using the vertices data (see the **Vertices** tab) and is therefore not editable. Its value is recalculated when the **Apply** button is clicked following changes to the vertices data.	
Depth (m)	-	The height over which the emission is assumed to be uniformly spread.	Not required by EMIT itself, only for dispersion applications.
Ref Number	-	User-defined reference number for the source.	Optional.

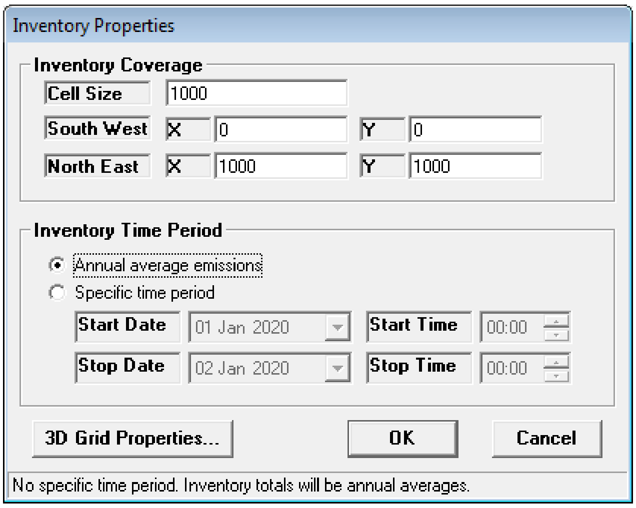
Close	-	Save any changes, close this screen and return to the calling screen, e.g. the **EMIT Group** screen of the parent group.	
Cancel	-	Reject changes to data (that have not been saved using the **Apply** button).	
Apply	-	Update the screen as a result of changes to data but do not close the screen.	
Housing[17]			
As for Area Sources			
<Dataset key word> tab[18]			
As for Point Sources			
Emissions tab			
As for Area Sources			
Vertices tab			
Edit Vertices	-	This check box must be checked in order to edit the vertices data contained in the table (see below).	
<Table>	-	The table lists the vertices of the C&D source region, listed in either clockwise or anti-clockwise sequence, starting from any vertex. The region must be a convex polygon. **Sequence**: Number of vertex **X(m):** *x*-coordinate of the vertex **Y(m):** *y*-coordinate of the vertex The coordinates are usually the 6-figure OS National Grid coordinates of the point (i.e. Eastings and Northings, respectively), or 7-figure UTM[19] coordinates. If the vertices data are modified, the source area may be recalculated by means of the **Apply** button.	$-9{,}999{,}999 \le x \le 9{,}999{,}999$ for both coordinates. Points must correspond to corners of a convex polygon. There can be 3 to 50 vertices.
Notes tab			
As for Major Roads			
Keywords tab			
As for Major Roads			

[17] This tab is only present if the emissions have been calculated with the SAP dataset held within EMIT
[18] This tab is only present if the emissions have been calculated with a dataset held within EMIT
[19] Universal Transverse Mercator coordinates.

D.4 Data Manipulation Screens

D.4.1 Inventory Properties screen

This screen allows the user to edit an inventory's properties.



The limits for the emissions calculation are set in the **Inventory Coverage** part of the screen. The rectangular area of the inventory to be used for the emissions calculation is defined in terms of the coordinates of its south-west and north-east corners and must be multiples of 1000m. The inventory coverage may cover some or all of the sources contained in the database. The **Cell Size** sets the size of the grid squares used for the inventory totals. Note that if the difference between the maximum coordinate and the minimum coordinate is an exact whole multiple of the cell size, the calculated inventory totals grid cells will overlap the maximum coordinate by an entire row or column.

The Inventory Time Period part of the screen allows the user to specify a time period for which the emissions data applies for the inventory. If specified, the totals screen will display the totals for that period in tonnes. If no time period has been specified, the totals screen will show annual average emissions for the inventory in tonnes/year. See Section 8 for more details of the totals screen.

The **3D Grid Properties** define the grid name, output time settings, coordinate system, vertical levels and chemical mechanism for the 3D grid. If the user is modelling on a 2D plane this screen can be ignored. See Section 8 for more details of the **3D Grid Properties** screen.

SCREEN AREA	DESCRIPTION OF FUNCTION		RESTRICTIONS
Inventory Coverage	-		

SCREEN AREA	DESCRIPTION OF FUNCTION		RESTRICTIONS
	South West X	The *x*-coordinate of the south-west (bottom left) corner of the inventory coverage area (m). These are typically OS grid coordinates.	4-digit integer followed by “000”
	Y	The *y*-coordinate of the south-west (bottom left) corner of the inventory coverage area (m). These are typically OS grid coordinates.	4-digit integer followed by “000”
	North East X	The *x*-coordinate of the north-east (top right) corner of the inventory coverage area (m). These are typically OS grid coordinates.	4-digit integer followed by “000”
	Y	The *y*-coordinate of the north-east (top right) corner of the inventory coverage area (m). These are typically OS grid coordinates.	4-digit integer followed by “000”
	Cell Size	The size of the grid cells to be used for the inventory grid totals (m)	10 to 10000m
Inventory Time Period	**-**	Select either **Annual average emissions** or **Specific time period.** If **Specific time period** is chosen, a time period must be given on the screen. The totals screen will display the totals for that period in tonnes. If **Annual average emissions** is chosen, the totals screen will show annual average emissions for the inventory in tonnes/year. See Section 9 for more details of the totals screen.	
	Start Date	The start date of the specific time period	
	Start Time	The start time of the specific time period	
	Stop Date	The end date of the specific time period	The Stop Date / Stop Time must be after the Start Date / Start Time.
	Stop Time	The end time of the specific time period	
3D Grid Properties…	**Grid name**	The name of the 3D grid.	
	Output time settings	Defines the number of hours per output file, time zone and overlap between output files.	
	Coordinate system Data	Datum definition and coordinate system.	
	Vertical levels	Vertical level height or sigma settings.	
	Chemical mechanism	Output species and units required in the 3D grid.	

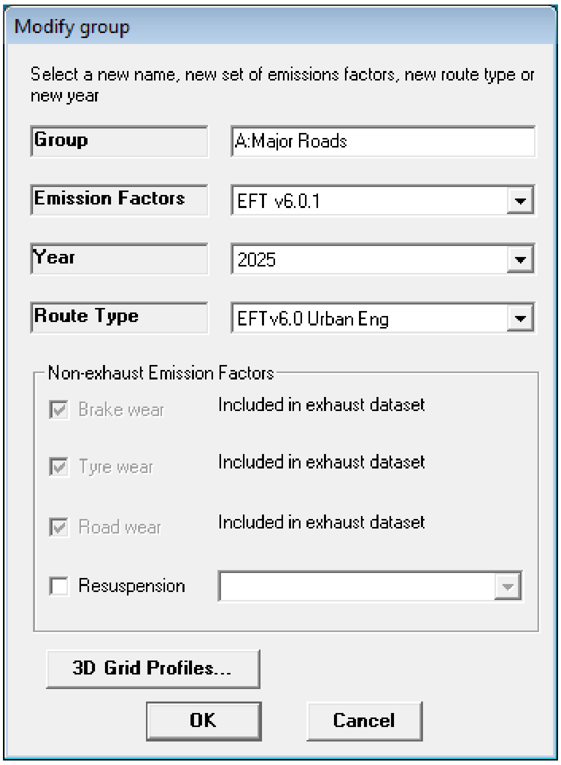
D.4.2 Modify Group screen

The available options on this screen depend on the type of group – not only the source type, but also how the emissions have been calculated; that is, the options vary depending on whether the emissions have been entered manually, calculated using an emission factor dataset or if they are scalings of national emission values.

In the tables given below, a command in italics, such as ***Emission Factors***, implies that this option is only available in certain circumstances. Details are given in each section.

- Major roads, minor roads and rail source groups

  The **Emission Factors**, **Route Type** and **Non-exhaust Emission Factors** options are only available for groups that have used an emission factor dataset to calculate the emissions i.e. not for groups whose emissions have been entered manually.

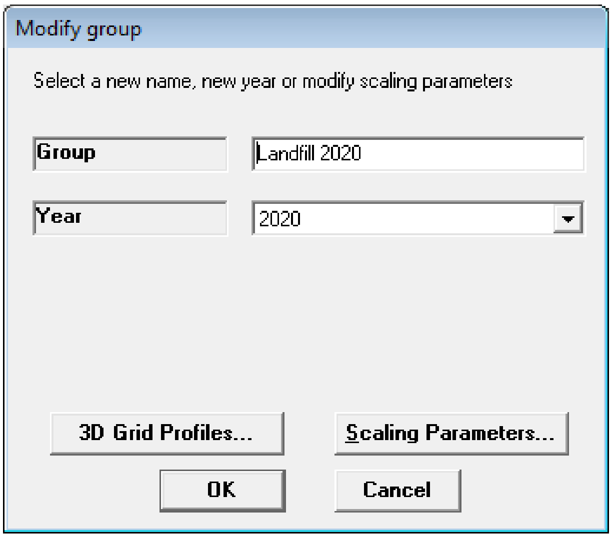


SCREEN AREA		DESCRIPTION OF FUNCTION	RESTRICTIONS
Group		Allows the group name to be changed.	Up to 50 characters.
Emission Factors		A new emission factor dataset can be chosen from the list.	
Year		A new **Year** can be chosen from the list.	
Route Type		A new route type can be chosen from the list.	
Non-exhaust Emission Factors	**Brake wear**	Select a brake wear emission factor dataset from the list.	
	Tyre wear	Select a tyre wear emission factor dataset from the list.	

	Road wear	Select a road wear emission factor dataset from the list.	
	Resuspension	Select a resuspension emission factor dataset from the list.	
3D Grid Profiles…	**Species map**	Edit the speciation and conversion factors for pollutants of interest.	
	Vertical profile	Define the proportion of emissions in each vertical level.	
	Diurnal profile	Define the hourly and daily variation in emission rates.	
	Monthly profile	Define the monthly variation in emission rates.	
OK		Clicking on **OK** executes the change. If a new emission factor dataset has been chosen, the **Route Type** drop-down is cleared, and a new route type must be chosen before the change can be executed.	
Cancel		Cancels all changes.	

- Point, line, volume, area and CandD sources

The **Emission Factors** are only displayed if an emission factor dataset has been used to calculate the emissions. The **Scaling Parameters…** option is only displayed for groups that have been set up using a scaling of a national emissions figure (only available for area, volume and CandD groups).



SCREEN AREA	DESCRIPTION OF FUNCTION	RESTRICTIONS
Group	Allows the group name to be changed.	Up to 50 characters.
Year	A new Year can be chosen from the list.	
Emission Factors	The emission factor dataset name is displayed.	Not editable.
3D Grid Profiles…	Activates the **3D Grid Profiles** screen and allows the 3D profiles to be edited.	
Scaling Parameters…	Activates the **Scaling Parameters** screen (as described in Section 5) and allows the scaling parameters to be edited.	
OK	Clicking on OK executes the change.	

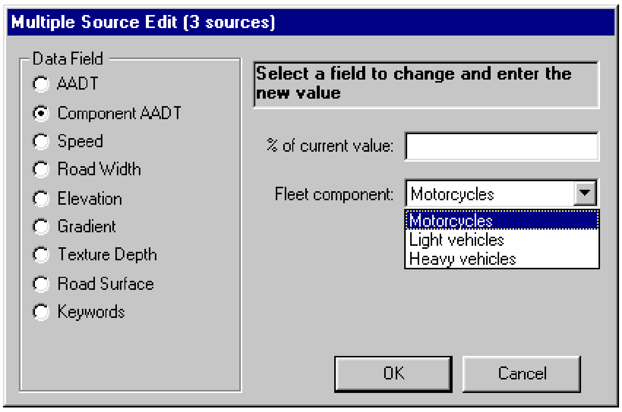
Cancel	Cancels all changes.	

D.4.3 Multiple Source Edit screen

As for the **Modify Group** screen described above, the options on the **Multiple Source Edit** screen vary depending on the type of group.

- Major roads

  If the emissions are calculated by EMIT using an emission factor dataset then the **AADT**, **Component AADT**, and **Speed** are available options; if the emissions are entered manually, the **Emission** field is available.

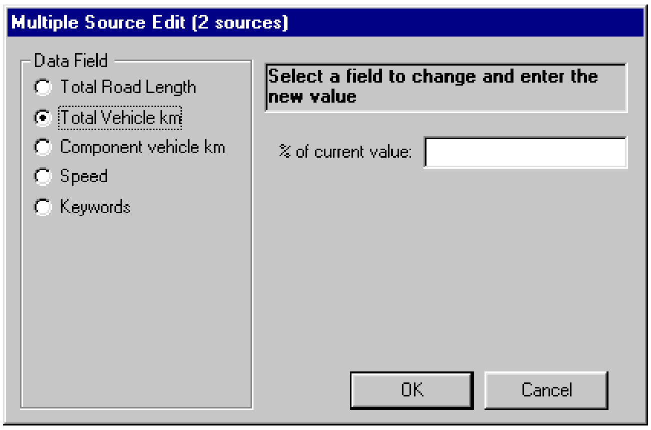


SCREEN AREA	CONTROL	DESCRIPTION OF FUNCTION	RESTRICTIONS
Data Field	**Emission**	For the pollutant selected from **Pollutant:** list, this option allows the emission value of all selected sources to be changed by the factor entered in the **% of current value:** box.	Value entered must be greater than or equal to 0.
	AADT	All the AADTs of the selected sources are changed by the factor entered in the **% of current value:** box.	Value entered must be greater than or equal to 0.
	Component AADT	As above, except the percentage change is applied only to the **Fleet component** selected from the list.	Value entered must be greater than or equal to 0.
	Speed	A new speed, chosen from the **New field value:** list, is applied to all selected sources.	
	Road Width	A new **Road Width** value for all roads can be entered in the **New field value (m):** box.	Minimum value is 5m.
	Elevation	A new **Elevation** value for all roads can be entered in the **New field value (m):** box.	Value between 0 and 2000m
	Gradient	A new **Gradient** entered in the **New field value (%):** box is applied to all selected sources.	Value between 0 and 50%.
	Texture Depth	A new **Texture Depth** value entered in the **New field value (mm):** box is applied to all selected sources.	Value between 0 and 100mm.
	Road Surface	The **Road Surface** selected from the **New field value:** list, is applied to all selected sources.	
	Keywords	Any **Keywords** entered in the **Add keyword:** box will be added to the **Keywords** field for all selected	The total **Keywords** field length must be less than 32000

		sources.	characters.
OK		Confirms the edits made.	
Cancel		Rejects changes made.	

- Minor roads

  If the emissions are calculated using an emission factor dataset held in EMIT then the **Total Vehicle km**, **Component vehicle km** and **Speed** are available options; if the emissions are entered manually, the **Emission** field is available.



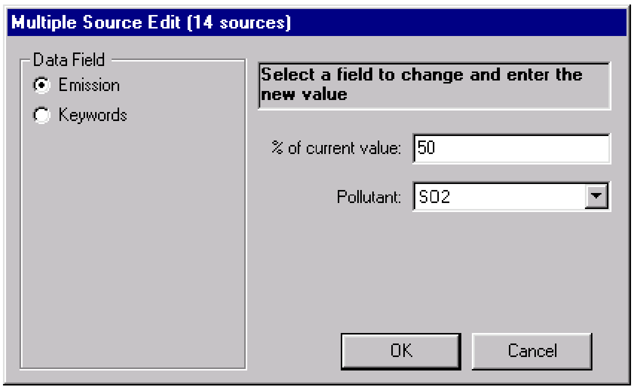
SCREEN AREA	CONTROL	DESCRIPTION OF FUNCTION	RESTRICTIONS
Data Field	**Emission**	As for Major Roads.	
	Total Road Length	The total road lengths of the selected sources are changed by the factor entered in the **% of current value:** box.	Value entered must be greater than or equal to 0.
	Total Vehicle km	The total vehicle kms of the selected sources are changed by the factor entered in the **% of current value:** box.	Value entered must be greater than or equal to 0.
	Component vehicle km	As above, except the percentage change is applied only to the **Fleet component** selected from the list.	Value entered must be greater than or equal to 0.
	Speed	As for Major Roads.	
	Keywords	As for Major Roads.	
OK		As for Major Roads.	
Cancel		As for Major Roads.	

- Rail sources

  Bulk changes cannot be applied to rail sources in the present version of EMIT.

- Point sources

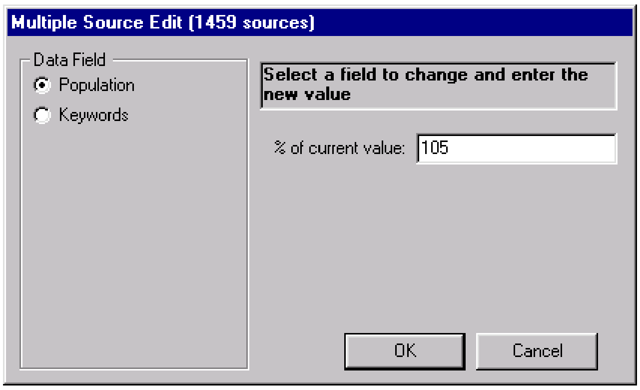
  If the emissions are entered manually, the **Emission** field is available.



SCREEN AREA	CONTROL	DESCRIPTION OF FUNCTION	RESTRICTIONS
Data Field	**Emission**	As for Major Roads.	
	Keywords	As for Major Roads.	
OK		As for Major Roads.	
Cancel		As for Major Roads.	

- Area sources

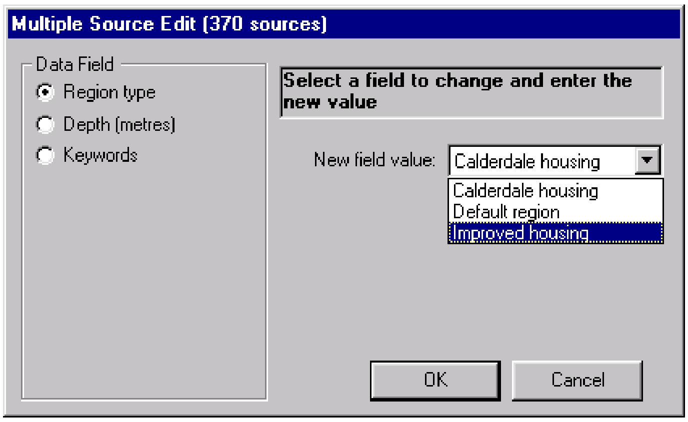
If a group has been created using manual emissions, then the **Emission** option is available; if a group has been created using a scaling of a national emissions figure, then the **<statistic>** option is available; and if a group has been created using the SAP-based emission factor dataset (as described in Section 12), then the **Region Type** option is available.



SCREEN AREA	CONTROL	DESCRIPTION OF FUNCTION	RESTRICTIONS
Data Field	**Emission**	As for Major Roads.	
	<statistic>	For all selected sources, the statistic that has been used to scale a national emissions figure can be changed by the factor entered in the **% of current value:** box.	Value entered must be greater than or equal to 0.
	Region Type	A new **Region Type** can be selected from the list, and applied to all selected sources.	
	Keywords	As for Major Roads.	

OK		As for Major Roads.	
Cancel		As for Major Roads.	

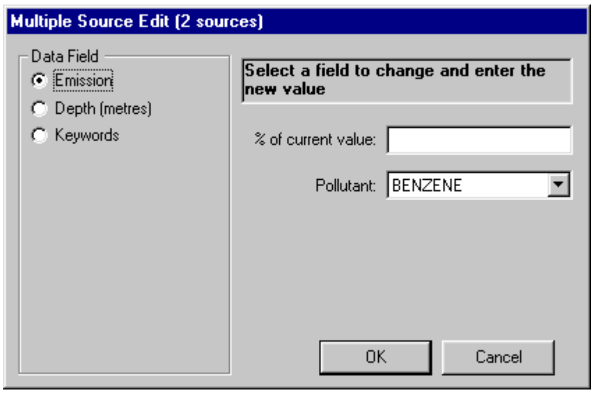
- CandD sources



SCREEN AREA	CONTROL	DESCRIPTION OF FUNCTION	RESTRICTIONS
Data Field	**Emission**	As for Major Roads.	
	<statistic>	As for Area sources.	
	Region Type	As for Area sources.	
	Depth (metres)	A value entered in the **New field value (m):** can be applied to all the selected CandD sources.	Value entered must be greater than or equal to 0.
	Keywords	As for Major Roads.	
OK		As for Major Roads.	
Cancel		As for Major Roads.	

- Volume sources

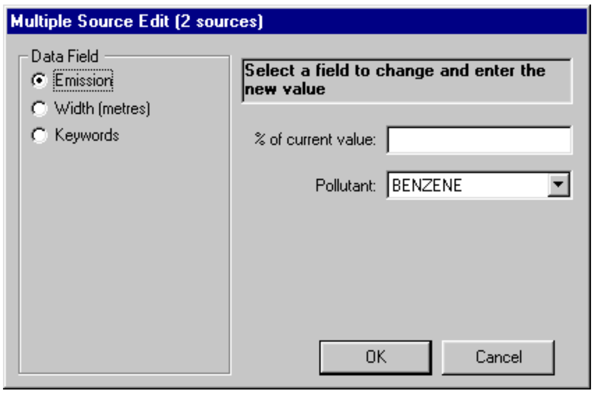
  If a group has been created using manual emissions, then the **Emission** option is available; if a group has been created using a scaling of a national emissions figure, then the **<statistic>** option is available.



SCREEN AREA	CONTROL	DESCRIPTION OF FUNCTION	RESTRICTIONS
Data Field	**Emission**	As for Major Roads.	
	<statistic>	As for Area	Value entered must be greater than or equal to 0.
	Depth (metres)	A value entered in the **New field value (m):** can be applied to all the selected sources.	Value entered must be between 0 and 1000.
	Keywords	As for Major Roads.	
OK		As for Major Roads.	
Cancel		As for Major Roads.	

- Line sources

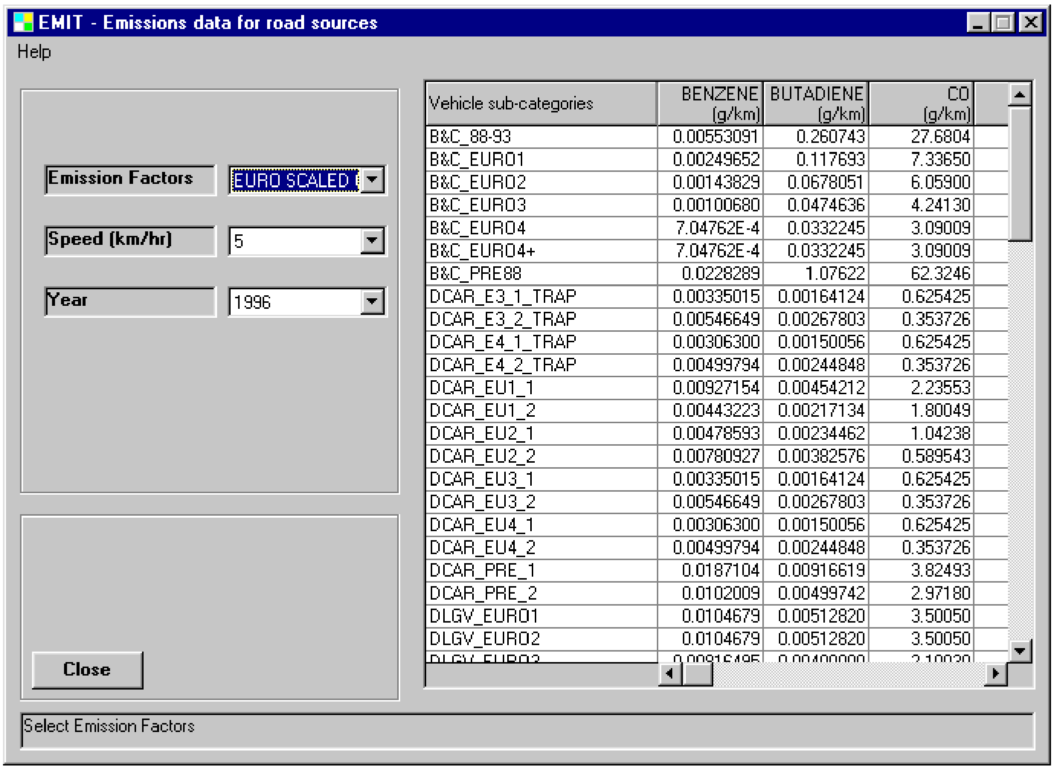
  If a group has been created using manual emissions, then the **Emission** option is available.



SCREEN AREA	CONTROL	DESCRIPTION OF FUNCTION	RESTRICTIONS
Data Field	**Emission**	As for Major Roads.	
	Width (metres)	A value entered in the **New field value (m):** can be applied to all the selected sources.	Value entered must be between 0 and 100.
	Keywords	As for Major Roads.	
OK		As for Major Roads.	
Cancel		As for Major Roads.	

D.5 Auxiliary data screens

D.5.1 Emission Factors screen

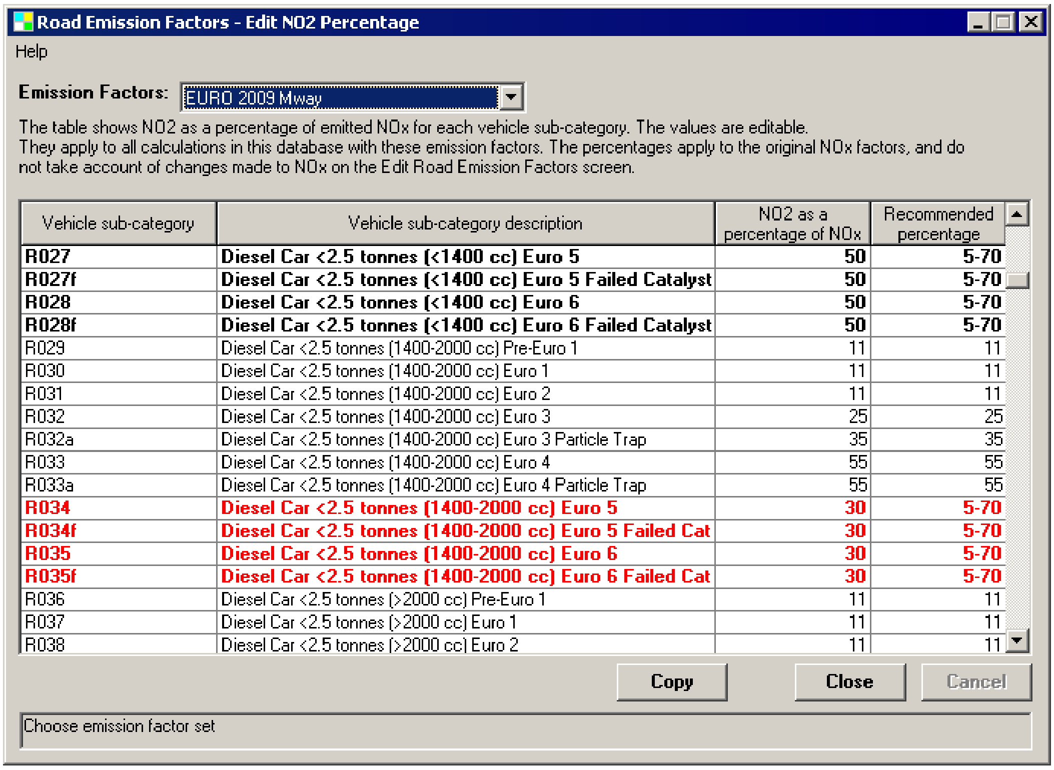


The EMIT emission factor screen is accessed through the menu options **Data, Emission Factors, ...Roads** or **...Rail**. The screens for road and rail emission factors have the same layout, although the choices from the drop-down list boxes are different. The data in the table on the right-hand side of the screen are **not editable**. See Appendix A for discussion of the use of emission factors.

SCREEN AREA	CONTROL	DESCRIPTION OF FUNCTION	RESTRICTIONS
Emission Factors	-	Choose the set of road/rail emission factors from the drop-down list, which lists all the available sets of emission factors built into EMIT.	
Speed (km/hr)	-	Choose the traffic speed from the drop-down list of options. The available choice will depend on the set of emission factors selected, but typically consists of multiples of 5km/hr over a range 5-140km/hr.	Currently, the Dutch road emission factors and the rail emission factors do not use speed.
Drive Cycle	-	Choose the drive cycle from the drop-down list of options. The available choice will depend on the set of emission factors selected.	Currently, only the Dutch road emission factor datasets use drive cycles.
Year	-	Choose the year from the drop-down list of options. The available choice will depend on the set of emission factors selected.	

<Table>		The table gives the values of the emission factors in the set specified by the other parameters on the screen. The columns of the table are as follows.	
	Vehicle sub-categories	The first column lists the vehicle sub-categories used by the particular emission factors selected.	
	<pollutant> (g/km)	The following columns list the emission factors in g/km for each pollutant included in the selected emission factors.	
Close		Close this screen and return to the calling screen.	

D.5.2 Edit NO2 Percentage for Roads screen



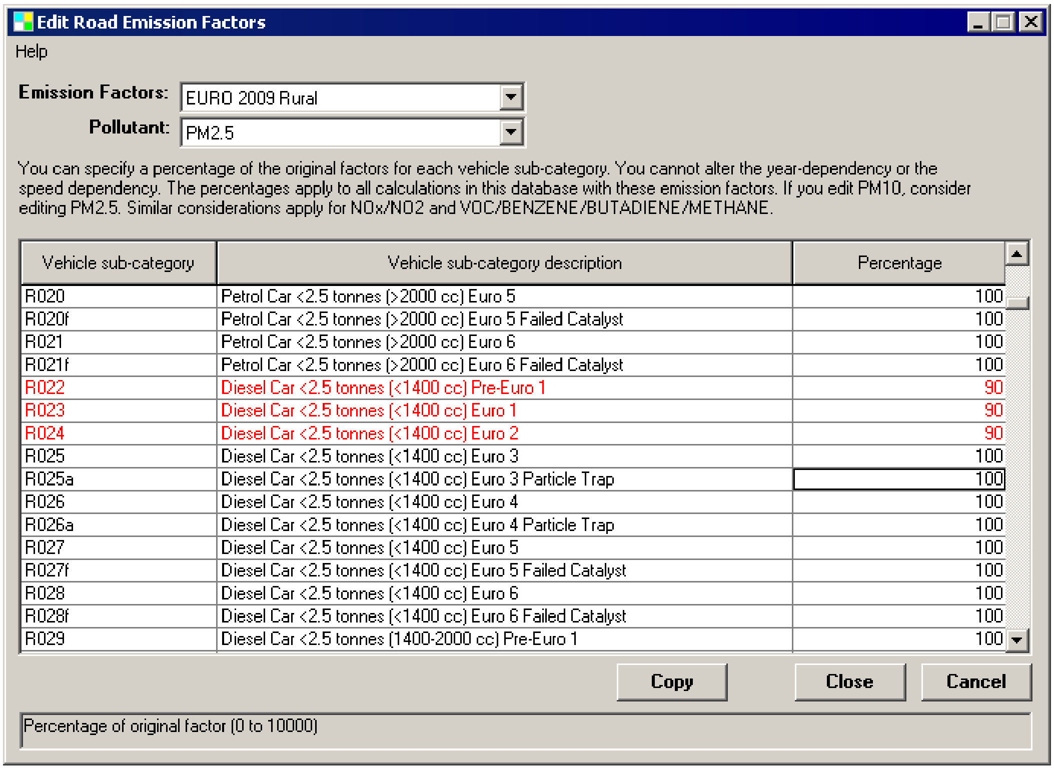
The EMIT **Edit NO2 Percentage for Roads** is accessed through the menu options **Data, Emission Factors, Edit NO2 Percentage for Roads.** This screen is used to edit the proportion of NO_x that is NO_2 for the '**NAEI 2014**' and '**NAEI 2012**' road traffic emission factor datasets.

SCREEN AREA	CONTROL	DESCRIPTION OF FUNCTION	RESTRICTIONS
Emission Factors:		Choose one of the '**NAEI 2014**' or ''**NAEI 2012**' emission factor datasets from the drop-down list.	
<Table>		The table gives the proportion of NO_x that is NO_2 for the road traffic emission factor dataset selected.	
	Vehicle sub-category	The first column lists the vehicle sub-categories.	
	Vehicle sub-category description	The next column gives the description of the vehicle sub-categories, as the names of the vehicle sub-categories are non-intuitive.	
	NO2 as a percentage of NOx.	The values entered in this column apply to the underlying NO_x emission factors held in the EMIT database.	$0 \le x \le 10000\%$[20]
	recommended percentages	The fourth column lists the recommended or maximum percentage of NO_x that is NO_2, as	

[20] This range allows users to increase NO_2 emission factors in line with any changes made to the NO_x emission factors via the **Edit Road Emission Factors** screen.

		given in the source data.	
Copy		Copies the data on this screen to the clipboard.	
Close		Close this screen and return to the calling screen.	
Cancel		Reject changes to data and return to the calling screen.	

D.5.3 Edit Road Emission Factors screen

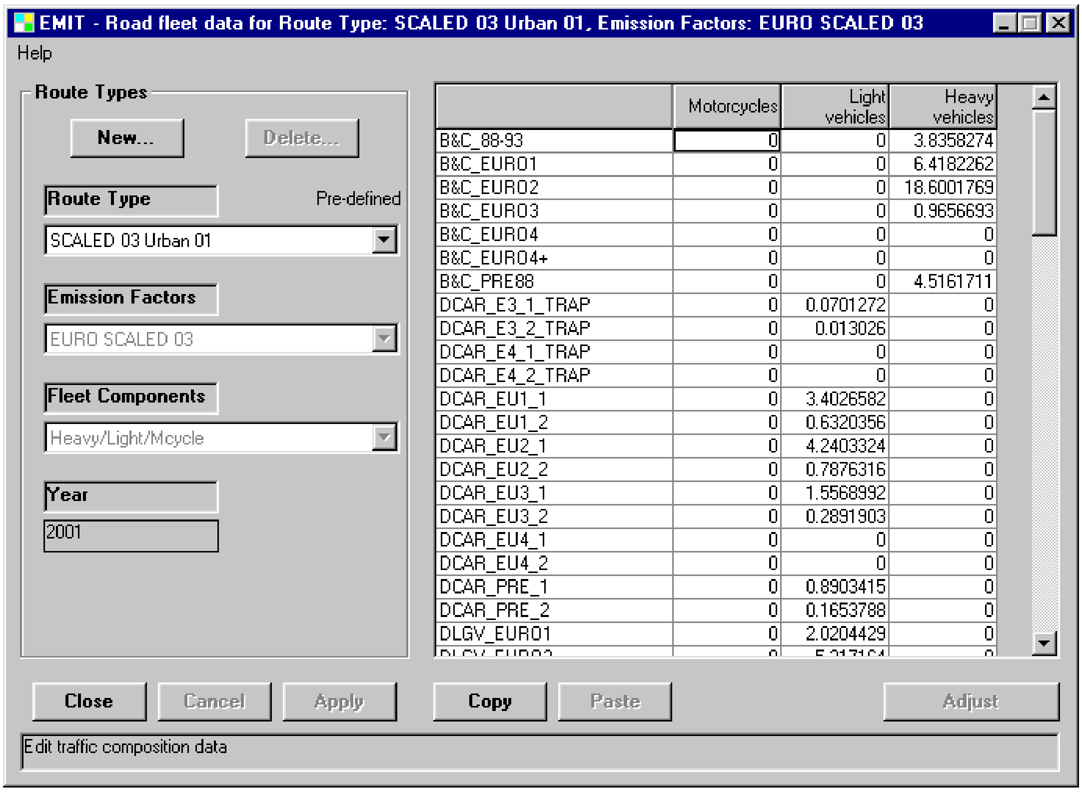


The EMIT **Edit Road Emission Factors** is accessed through the menu options **Data, Emission Factors, Edit Road Emission Factors**. This screen is used to edit the base emission factors that are used in calculations using available road traffic emission factor datasets, for all pollutants apart from NO_2. A percentage of the base emission factor can be specified.

SCREEN AREA	CONTROL	DESCRIPTION OF FUNCTION	RESTRICTIONS
Emission Factors:		Choose one of the available datasets from the drop-down list.	
Pollutant:		Select one of the available pollutants from the drop-down list of options.	
<Table>		The table gives the percentage of underlying emission that is used in calculations using the selected road traffic emission factor dataset.	
	Vehicle sub-category	The first column lists the vehicle sub-categories.	
	Vehicle sub-category description	The next column gives the description of the vehicle sub-categories, as the names of the vehicle sub-categories are non-intuitive.	
	Percentage	The values entered in this column apply to the underlying emission factors held in the EMIT database.	$0 \le x \le 10000\%$
Copy		Copies the data on this screen to the clipboard.	

Close		Close this screen and return to the calling screen.	
Cancel		Reject changes to data and return to the calling screen.	

D.5.4 Route Types screen



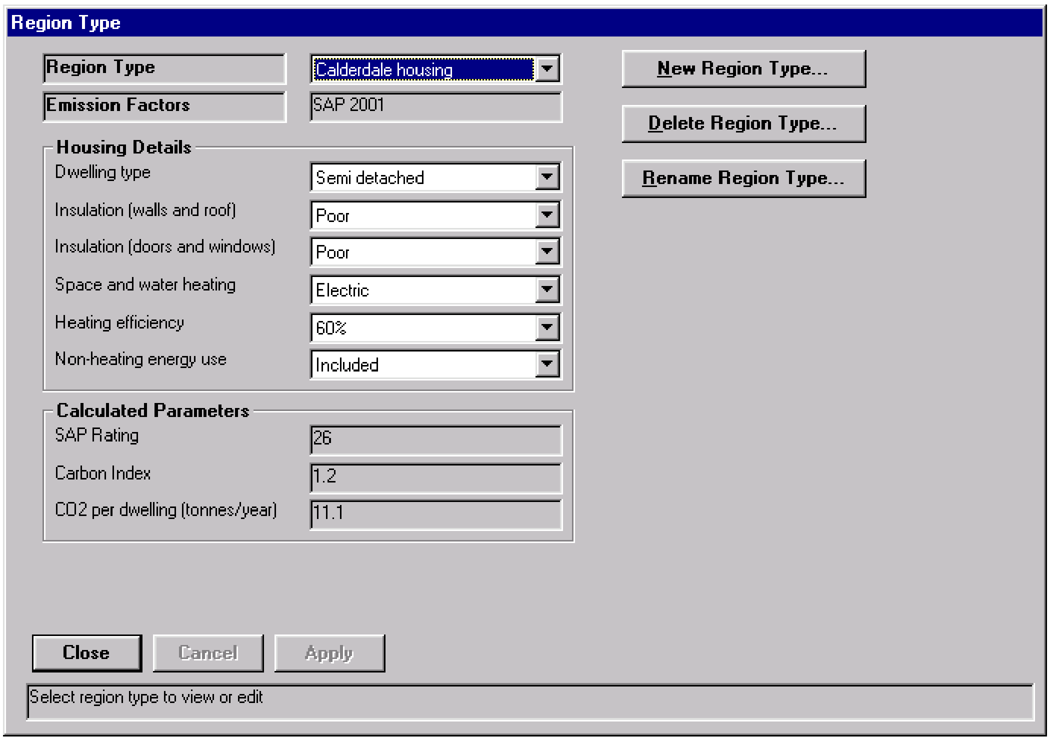
The EMIT Route Types screen is accessed through the menu options **Data, Route Types, ...Road** or **...Rail**. The screens for road and rail route types have the same layout, although the choices from the drop-down list boxes are different and the number and headings of the columns are also different. This screen is used both to display route type data and to define new user-defined route types (and delete existing ones). The data in the table on the right-hand side of the screen may be edited for user-defined route types, but not for pre-defined route types. See Appendix A for more on the definition and use of route types.

SCREEN AREA	CONTROL	DESCRIPTION OF FUNCTION	RESTRICTIONS
Route Types	**New...**	This button launches the **New route type** dialogue box. The user enters a name for the new route type and uses the list to select the name of the existing route type on which it is based. The table of data on the route type screen may then be edited to define the new route type.	
	Delete...	This button launches the **Delete route type** dialogue box, which may be used to replace all instances of the current route type (i.e. as displayed in the table) with another route type.	

	Route Type	Select the route type from the drop-down list box. The choices available will include the pre-defined route types built-in to EMIT as well as any user-defined route types in the current database.	
	Emission Factors	Shows the emission factors for the currently selected route type. The choice available will depend on whether road or rail route types are being considered.	
	Fleet Components	Shows the fleet components for the currently selected route type. The choice available will depend on whether road or rail sources are being considered and on the emission factors selected.	
	Year	Most road route types contain fleet composition data for a particular year. For these route types, the year is shown here. Other route types can be used with any year, in which case “All years” is shown here.	
<Table>		The route types table shows the matrix of values for the route type, expressing the fleet composition breakdown in terms of the emission factor vehicle sub-categories. The number of columns depends on the number of fleet components, which may be either 3 or 11 for road traffic or 2, 4 or 14 for rail traffic. The columns are then as follows.	
	<Vehicle sub-categories>	The first column lists the vehicle sub-categories used by the particular emission factors selected.	
	<fleet component #1> (%)	The next column gives the breakdown of the first fleet component in terms of the emission factor vehicle sub-categories.	
	…	etc.	
	<fleet component #n> (%)	The final column gives the breakdown of the final (n^{th}) fleet component in terms of the emission factor vehicle sub-categories.	
Copy		Copies the **Route Type** data onto the clipboard, so it can be pasted into other packages. For example, the data can be pasted into Microsoft Excel, and edited to create a new route type, such as one to represent a Low Emission Zone.	
Paste		If a new **Route Type** has been calculated in an external package (such as Microsoft Excel), it can be pasted back into EMIT using this button. The total contribution from each **Fleet Component** must add up to 100% (to within < 0.01%).	The vehicle subcategory names must all be present, and in the correct order.
Adjust		This button may be used to adjust the current table entry so that the column total is 100%. An error message is shown if this action	

		requires a negative value.	
Close		Save any changes, close this screen and return to the calling screen.	
Cancel		Reject changes to data (that have not been saved using the **Apply** button).	
Apply		Update the screen as a result of changes to the **Route Type** data (table) but do not close the screen.	

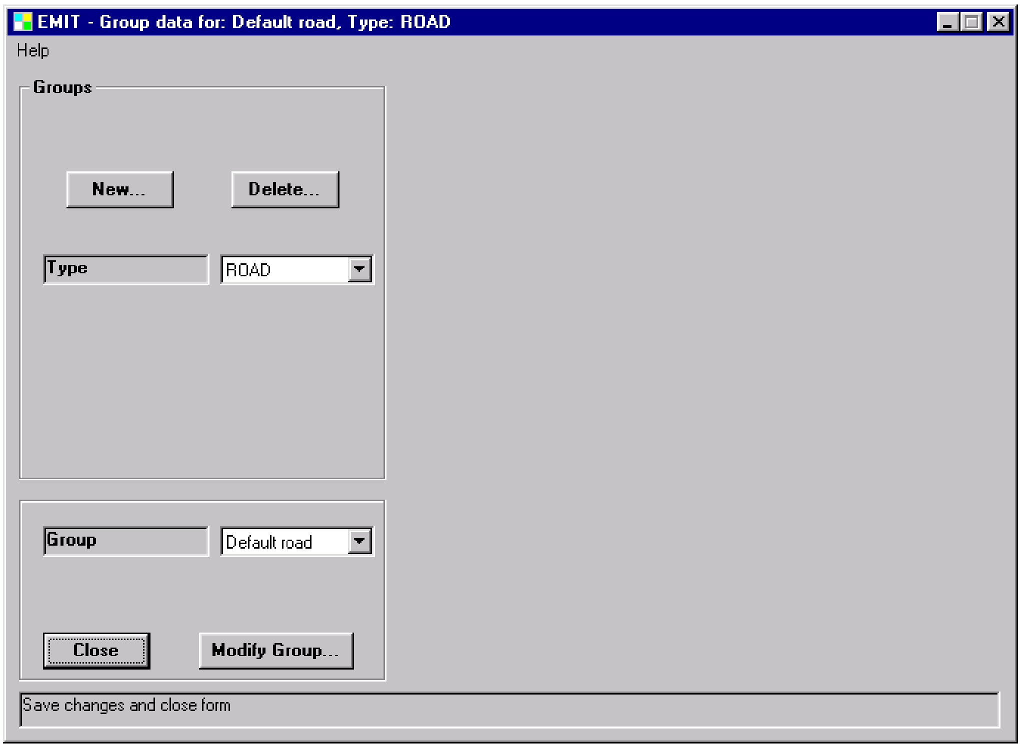
D.5.5 Region Types screen



SCREEN AREA	CONTROL	DESCRIPTION OF FUNCTION	RESTRICTIONS
Region Type		A **Region Type** can be selected from the list.	
Emission Factors		In EMIT 2.2, the emission factor dataset for all region types is **SAP 2001**.	Not editable
Housing Details	**Dwelling type**	Choose the **Dwelling Type** from the 5 options given in the list. (Please refer to **Table 12.1**for further details of options.)	
	Insulation (walls and roof)	Choose the **Insulation (walls and roof)** from the 5 options given in the list. (Please refer to **Table 12.1**for further details of options.)	
	Insulation (doors and windows)	Choose the **Insulation (doors and windows)** from the 5 options given in the list. (Please refer to **Table 12.1** for further details of options.)	
	Space and water heating	Choose the **Space and water heating** from the 5 options given in the list. (Please refer to **Table 12.1** for further details of options.)	
	Heating efficiency	Choose the **Heating efficiency** from the 5 options given in the list. (Please refer to **Table 12.1** for further details of options.)	
	Non-heating energy use	Choose (from the list) whether or not the **Non-heating energy use** should be **Included** or **Not included.**	

Calculated parameters	**SAP Rating**	The **SAP Rating** of the dwelling as defined in the **Region Type**.	Not editable
	Carbon Index	The **Carbon Index** of the dwelling as defined in the **Region Type.**	Not editable
	CO2 per dwelling (in tonnes/year)	The CO_2 emission factor of the dwelling as defined in the **Region Type.**	Not editable
New Region Type…		Clicking on this button activates the **New region type** screen. A name for the new **Region Type** must be entered, and clicking on **OK** then returns to the main **Region Type** screen, where details of the new **Region Type** can be entered.	
Delete Region Type…		Clicking on this button deletes the current **Region Type**. Note that if a region type is in use then it cannot be deleted.	
Rename Region Type…		Clicking on this button allows the current **Region Type** to be renamed.	
Close		Save any changes, close this screen and return to the calling screen.	
Cancel		Reject changes to data (that have not been saved using the **Apply** button).	
Apply		Update the screen as a result of changes to the **Region Type** data, but do not close the screen.	

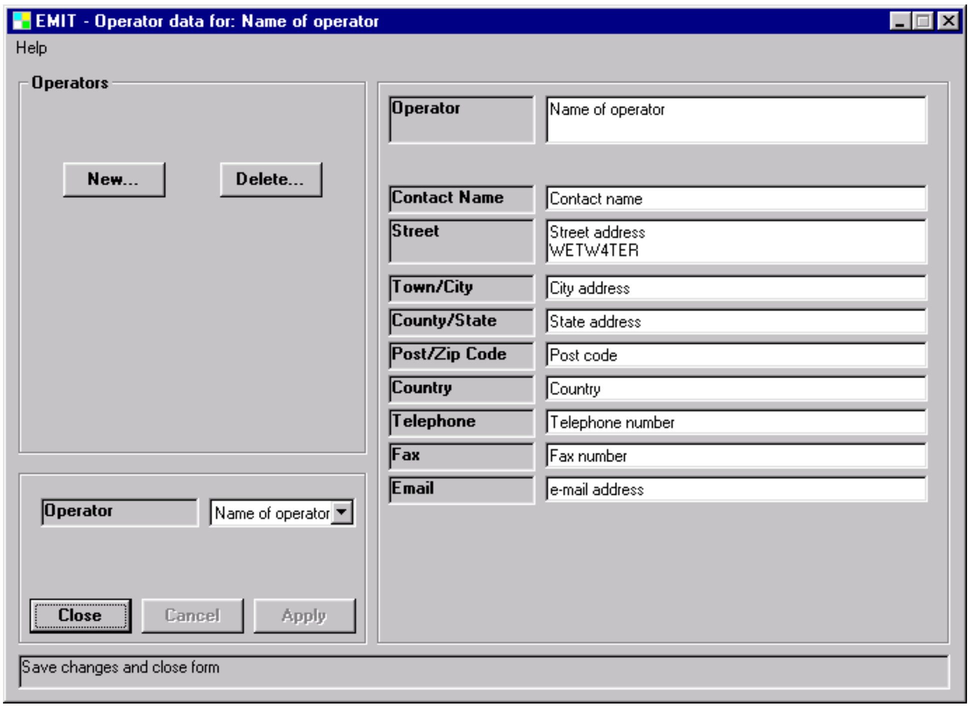
D.5.6 Groups screen



The EMIT Groups screen is accessed through the menu options **Data**, **Groups**. It is used to create new *empty* groups (which must then be populated with sources by adding new ones or copying sources from another group).

SCREEN AREA	CONTROL	DESCRIPTION OF FUNCTION	RESTRICTIONS
Groups	**New...**	This launches the **EMIT New Group** dialogue box. For further details, and examples, please refer to Section 5.	
	Delete...	This button deletes the selected **Group.** A **Group** can only be deleted if it contains no sources.	
Type		Select the source type from the drop-down list box. The selected source type is used to filter the groups in the **Group** drop-down list box.	
Group		Select the group from the drop-down list box. The choices available are restricted to all groups of the given type (as selected in the **Type** list box) in the current database.	
Modify Group...		This button activates the **Modify group** screen. See Section D.4.2 for further details.	
Close		Save any changes, close this screen and return to the calling screen.	

D.5.7 Operators screen



The EMIT operators screen is accessed through the menu options **Data**, **Operators**. It is used to record data on the operators of industrial sources. The data in the table on the right-hand side of the screen may be edited, i.e. this screen is used both to display operator data and to define new operators (and delete existing ones).

SCREEN AREA	CONTROL	DESCRIPTION OF FUNCTION	RESTRICTIONS
Operators	**New...**	This button launches the **New operator** dialogue box. The user enters a name for the new operator. The table of data on the operators screen may then be edited to define the new operator.	
	Delete...	This button launches the **Delete Operator** dialogue box, which may be used to replace all instances of the current operator (the one displayed in the table) with another operator.	
Operator		Select the operator from the drop-down list box. The list will contain the pre-defined operators available as options built in to EMIT together with any user-defined operators in the current database.	
Close		Save any changes, close this screen and return to the calling screen.	
Cancel		Reject changes to data (that have not been saved using the **Apply** button).	
Apply		Update the screen as a result of changes to the operator data (table) but do not close the	

		screen.	
	Operator	Name of operator (organisation)	
	Contact Name	Name of individual within operator organisation	
	Street	Street	
	Town/City	Town or city	
	County/State	County, state or other regional division	
	Post/Zip Code	Postal code	
	Country	Country	
	Telephone	Telephone number of contact	
	Fax	Fax number of contact	
	Email	E-mail address of contact	

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