Importing COPERT 4 Emissions into EMIT

1 Introduction 1

2 COPERT 4 summary 1

3 Importing emissions data from COPERT 4 to EMIT 2

4 Worked examples 9

1 Introduction

This document describes the way in which the emission factors included in COPERT 4 can be exported to the Emissions Inventory Tool, EMIT. Once in EMIT, the emission data can be exported in a format that can be imported and used in the ADMS-Urban air dispersion model.

Emissions for both major and minor roads can be calculated using this combination of tools. For major roads, the activity data required are traffic counts per road; for minor roads, the activity data are vehicle km.

Section 2 gives a brief overview of the way in which COPERT 4 calculates road traffic emissions. Section 3 describes how the emissions data from COPERT 4 can be imported into EMIT, by performing the following tasks:

- Manipulate the COPERT 4 database to be in a format compatible with the COPERTToEMIT tool.
- Export the emissions data from COPERT 4 for use in the COPERTToEMIT tool.
- Manipulate the traffic count and spatial road traffic data into a format that can be used in the COPERTToEMIT tool.
- Run the COPERTToEMIT tool in Excel.
- Import the road traffic emissions data from Excel into EMIT.
- Export the road traffic emissions data from EMIT into ADMS-Urban.

In Section 4, some worked examples are given, covering the tasks listed above.

2 COPERT 4 summary

The emissions calculated in COPERT 4 are categorised in a similar way to those in EMIT. However, the emissions calculations are not performed on a road-by-road basis. That is, no spatial data are associated with the emissions. Instead, for each vehicle category, activity data are entered in terms of:

- Population, and

- Mileage, in km/yr.

The total emissions for each vehicle category are calculated using the total annual mileage for each category, which is equal to the product of the population and mileage.

Emission factors for the urban, rural and highway part of the fleet mileage are calculated separately, with different speeds for each road type.

There are a number of parameters associated with the emissions factors that are required as input. These include:

- Minimum and maximum air temperatures,
- Fuel content (for example, proportion of Sulphur), and
- Mean fleet mileage

For each of the urban, rural and highway road types, COPERT 4 calculates:

- Hot emissions,
- Cold emissions,
- Evaporative emissions, and
- Total emissions.

Each of the vehicle subcategories are grouped together into the following six main categories:

- Passenger cars,
- Light Duty Vehicles (LDVs),
- Heavy Duty Trucks,
- Buses and coaches,
- Mopeds, and
- Motorcycles.

It is of interest to note that vehicles referred to in the UK as ‘light goods vehicles’ are referred to in COPERT 4 as ‘light duty vehicles’. In the UK, the category ‘light duty vehicles’ includes passenger cars. Similarly, in the UK, ‘heavy duty vehicles’ include buses and coaches.

3 Importing emissions data from COPERT 4 to EMIT

3.1 COPERT 4 set up

It will be assumed that a user is familiar with the way in which COPERT 4 calculates emissions, and is able to set up a road traffic emissions inventory within the database that represents the fleet on their roads.

In order for the COPERTtoEMIT utility to perform emissions calculations using the emission rates calculated in COPERT 4, the COPERT 4 database must be set up so that each road type (urban, rural and highway) has ‘100% driving share’. Details are given in the following

section. Note that to add the speed data in item ‘6) Input Circulation Data’, the user can either add this information in the interface before assigning 100% driving share to each road type, or add it to the Excel file produced from ‘Create Import Format Excel File’ when assigning 100% driving share, as detailed in Section 4.1.

Percentage driving share

It is necessary for the user to assign a 100% share to each of the urban, rural and highway road types. This is because the cold start and evaporative emissions calculated by COPERT 4 are non-linear in the percentage driving share. This should be done by performing the steps described in Section 4.1.

When running the COPERT 4 Run Wizard (item ‘6) Input Circulation Data’), this leads to the warning message in Figure 1.

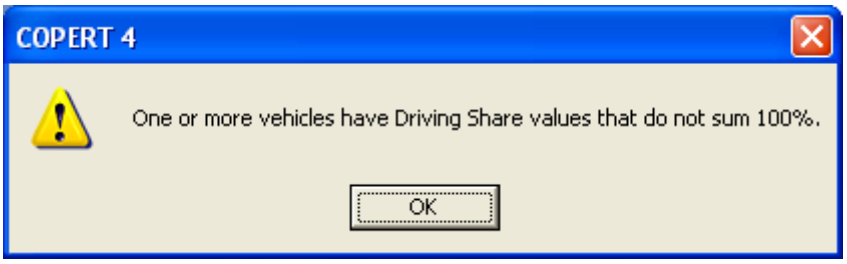


Figure 1: Warning message that is returned in item 6 of the COPERT 4 Run Wizard

The user should ignore this warning message and set up the remainder of the database as usual.

3.2 Exporting COPERT 4 data for use in the COPERTToEMIT macro

Table 1 summarises the COPERT 4 data that must be exported from the database. Data for any number of pollutants can be exported at the same time. Section 4.2 takes the user through the steps that are required to perform this task.

COPERT 4 import data or export data	Attribute name*	Units†	Description	Comments
Import	Population	-	Population per vehicle sub-category	
	Mileage_km_per_year	km/year	Mileage per sub-category	
	U_Share_perc	%	Percentage of vehicle km on urban roads	**Total percentage for each share should be set to 100.**
	R_Share_perc	%	Percentage of vehicle km on rural roads	
	H_Share_perc	%	Percentage of vehicle km on highways	
Export	U_*Pol*_Emiss_*units*	Tonnes/year	Emission rate on urban roads	This includes a cold start factor
	R_*Pol*_Emiss_*units*	Tonnes/year	Emission rate on rural roads	This includes a cold start factor
	H_*P*ol_Emiss_*units*	Tonnes/year	Emission rate on highways	No cold start emission rate is included

Table 1 - Summary of data exported from the COPERT 4 database, once emission calculations have been completed. *Pol* is the pollutant name

The Excel spreadsheet created by the COPERT 4 model will be required as input for the COPERTToEMIT tool. Further details are given in Section 3.4 below.

* Note that if *Pol* is B[a]P, then the Attribute name is simply *Pol_units* and the units are g/year

† Note that if *Pol* is Pb then the units of the Export Attribute name are kg/year

Column heading	Data	Units	Restrictions	Required	Default
ROAD SOURCES					
ROADNAME	Unique name of source	*text*	20 characters maximum	yes	-
DESCRIPT	Description of source	*text*	200 characters maximum	no	blank
NOTES	Notes on this source	*text*	200 characters maximum	no	blank
KEYWORDS	Searchable keywords	*text*	200 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	-
ROUTETYPE	Type of Road	text	Urban, Rural or Motorway	yes	-
SPEED	Average speed	km/hr	0 – 130km/hr in steps of 5 (depending on emission factor dataset)	no	-
GRADIENT	Gradient of road	-	0 – 50%	no	0
ROADSURF	Road surface type	*text*	Choose from one of the options given in Section 6.5 of the EMIT manual	no	No Correction
TEXDEPTH	Road surface texture depth	mm	0 – 100mm	no	0
CAR	Passenger car traffic count	vehicles/day	Greater than or equal to 0	yes	-
LGV	LGV traffic count	vehicles/day	Greater than or equal to 0	yes	-
HGV	HGV traffic count	vehicles/day	Greater than or equal to 0	yes	-
BUS	Bus and coach traffic count (combined)	vehicles/day	Greater than or equal to 0	yes	-
MOPED	Moped traffic count	vehicles/day	Greater than or equal to 0	yes	-
MC	Motorcycle traffic count	vehicles/day	Greater than or equal to 0	yes	-

Table 2 - Information needed for major road sources

Column heading	Data	Units	Restrictions	Required	Default
MINOR ROAD SOURCES					
MINRNAME	Unique name of source	*text*	20 characters maximum	yes	-
ROUTETYPE	Type of Road	text	Urban, Rural or Motorway	yes	-
DESCRIPT	Description of source	*text*	200 characters maximum	no	blank
NOTES	Notes for this source	*text*	200 characters maximum	no	blank
KEYWORDS	Searchable keywords	*text*	200 characters maximum	no	blank
SPEED	Average speed	km/hr	0 – 130km/hr in steps of 5 (depending on emission factor 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	-
CAR	Passenger car annual vehicle km	km/year	Greater than or equal to 0	yes	-
LGV	LGV annual vehicle km	km/year	Greater than or equal to 0	yes	-
HGV	HGV annual vehicle km	km/year	Greater than or equal to 0	yes	-
BUS	Bus and coach annual vehicle km (combined)	km/year	Greater than or equal to 0	yes	-
MOPED	Moped annual vehicle km	km/year	Greater than or equal to 0	yes	-
MC	Motorcycle annual vehicle km	km/year	Greater than or equal to 0	yes	-

Table 3 - Information needed for minor road sources

3.3 ArcGIS Shape file set up

In addition to setting up and exporting the COPERT 4 emissions data, users are required to create an ArcGIS shape file containing traffic count/vehicle km and spatial location data of the road network they are interested in.

For roads the shape file must contain the information in Table 2 and for minor roads the shape file must contain the information in Table 3.

The shape file(s) created will be required as input for the COPERTToEMIT tool. Further details are given in Section 3.4 below.

3.4 Running the CopertToEMIT tool in Excel

When you open COPERTtoEMIT tool in Excel you will see the interface shown in Figure 2 below.

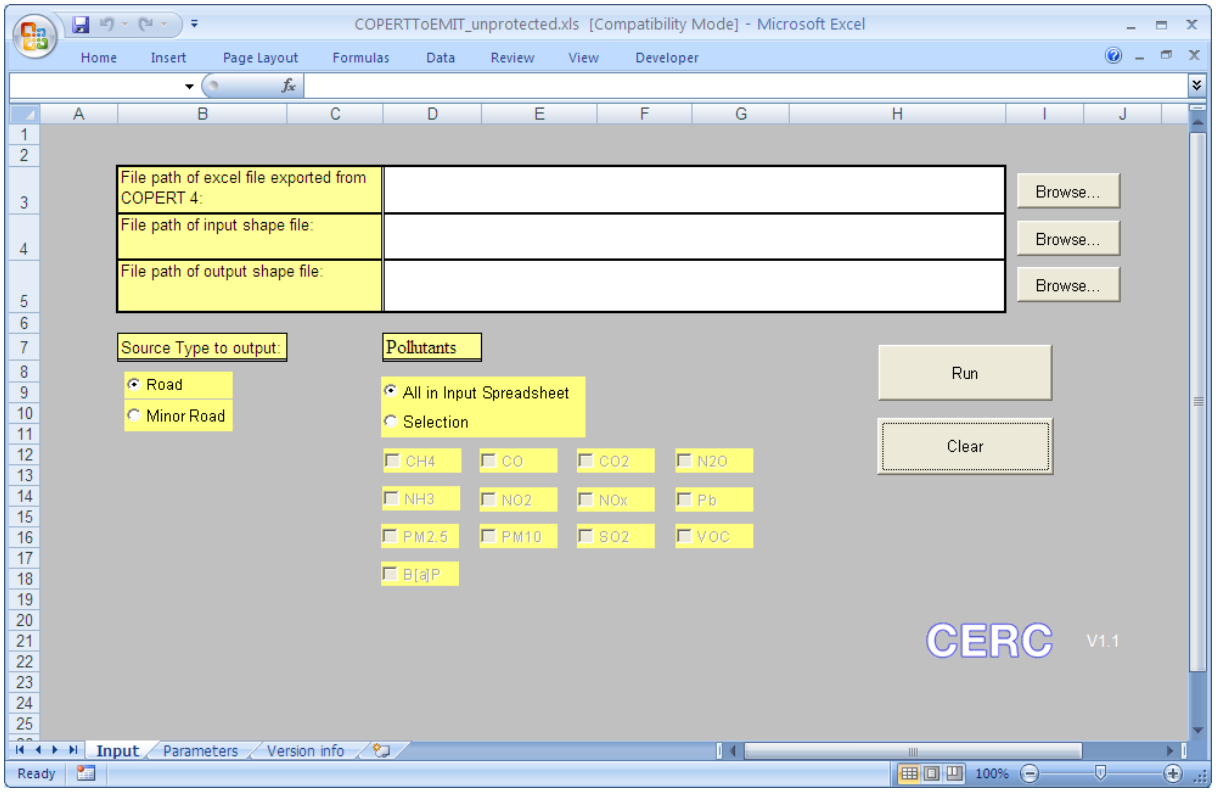


Figure 2 – COPERTToEMIT tool interface

The following steps should be followed:

Step 1

Decide on whether you are doing calculations for major roads, or minor roads. Select the 'Source Type to output' as appropriate:

- Major road – select 'Road'
- Minor road – select 'Minor Road'

Step 2

Browse to locate the Excel file created by exporting from COPERT 4 (as described in Section 3.2).

Step 3

Browse to locate the major or minor roads shape file created (as described in Section 3.3).

Step 4

Browse to locate a working directory where you would like the ArcGIS shape file to be created, and enter a suitable file name with extension *.shp*.

Step 5

This step relates to the pollutants for which you have calculated emissions in COPERT 4. Decide on whether you want all the pollutants you have calculated emissions for to be imported into EMIT, or whether you would like a subset of pollutants. For:

- All pollutants – choose the 'All in Input Spreadsheet' option
- Selected pollutants – choose the 'Selection' option and then select the pollutants of interest from the list.

Remember, if you want to model with *NO_x chemistry* in ADMS-Urban, you should export emissions of NO_x, NO_2, and VOCs, and if you want to model with *sulphate chemistry*, then you should export emissions of SO_2, PM_{10} and $PM_{2.5}$.

Step 6

Click on the Run button.

3.5 Importing road transport emissions data into EMIT

The EMITToCOPERT Tool creates an ArcGIS shape file that can be imported directly into EMIT, using the EMIT Import Wizard. Instructions for doing this are given in the EMIT User Guide. Please refer to Sections 5 ('Setting up a new inventory') and 6 ('Importing data into EMIT using the Import Wizard') for details. Note that the group in the inventory that the shape file is being exported to in EMIT must have 'Enter emissions manually' selected.

3.6 Exporting road transport emissions data from EMIT into ADMS-Urban

Once a full emissions inventory has been compiled in EMIT, the next step is to export the emissions data into the ADMS-Urban air dispersion model. Instructions for doing this are given in Section 8.3 of the EMIT User Guide.

4 Worked examples

4.1 Setting COPERT 4 to have 100% driving share

The following steps should be followed in order to set up a '100% driving share' within the COPERT 4 database.

Step 1 – Opening the COPERT 4 database

- Open the COPERT 4 database that holds your emissions data.

Step 2 – Specifying the fleet

- Select 'File' , 'Run New Wizard'
- Click 'Next >' in the wizard and the 'Select Country' and 'Year' screen will appear (Figure 3). Select the desired country and click 'OK'.

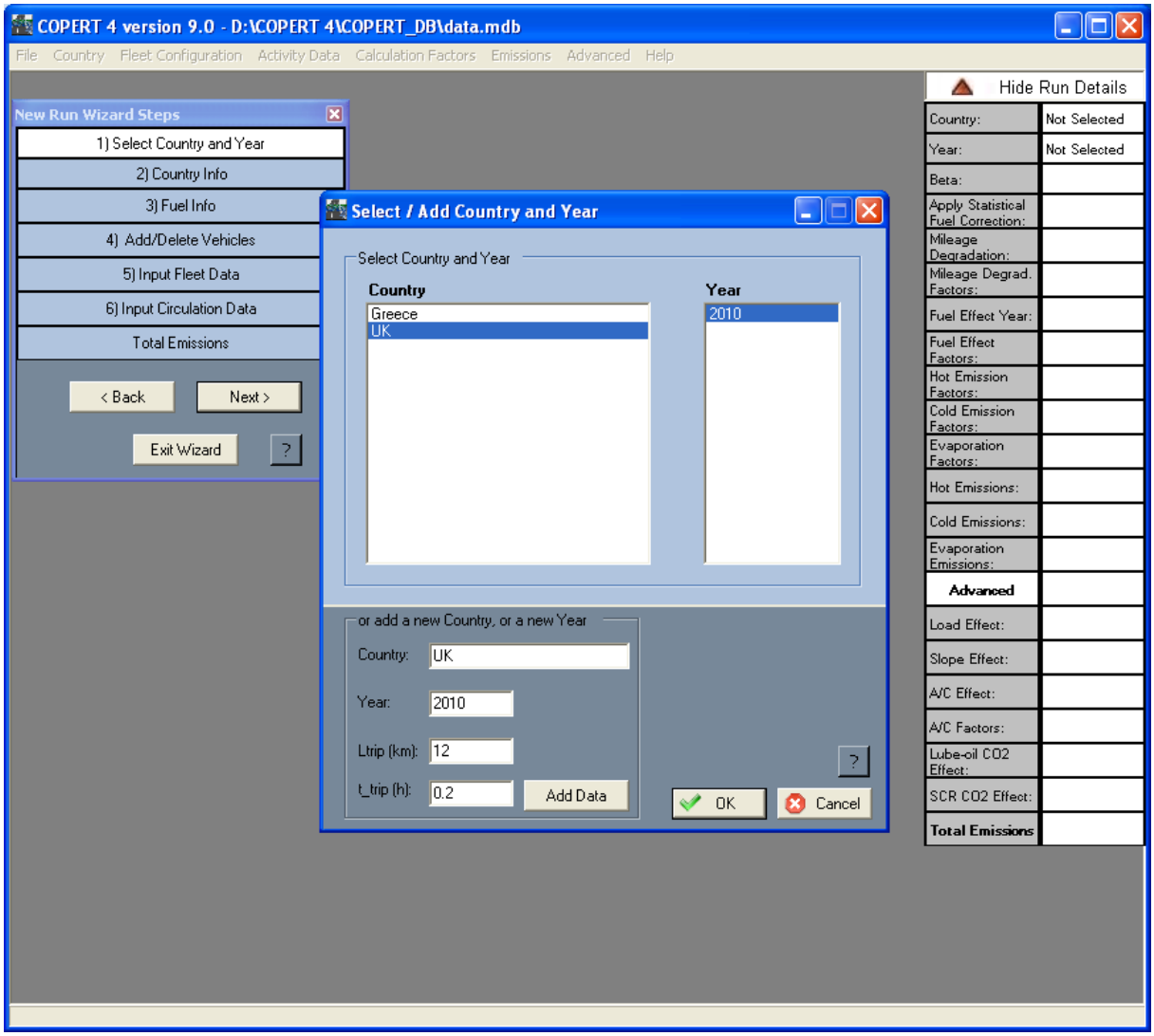


Figure 3 - Wizard: Select Country and Year Screen

- Click 'Next >' and then 'OK' for the 'Country Info' screen.
- Click 'Next >' and then 'OK' for the 'Fuel Info' screen.
- Click 'Next >' and the 'Add/Delete Vehicles' screen will appear (Figure 4).

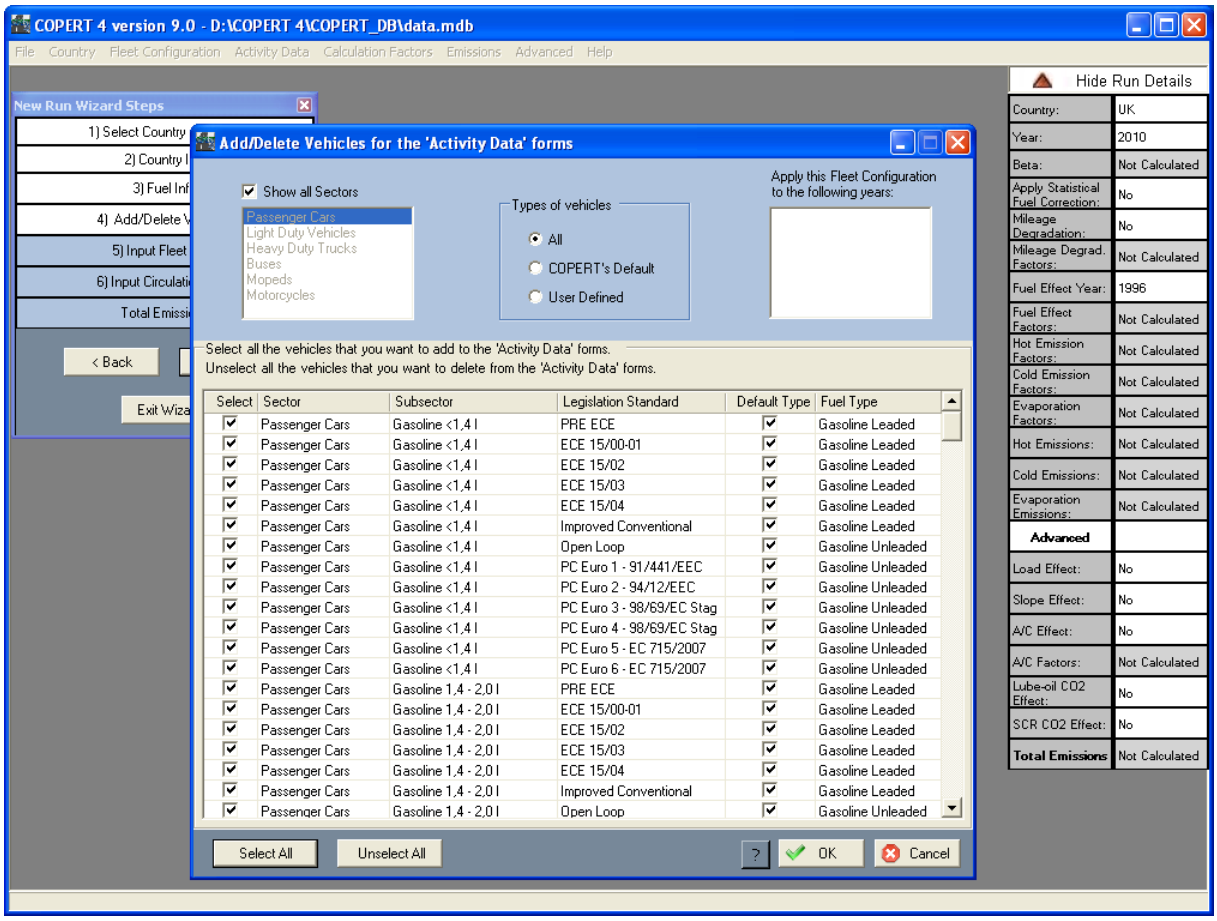


Figure 4 - Wizard: Add/Delete Vehicles Screen

- In the ‘Types of vehicles’ section, select ‘All’, or select the vehicles you would like to include in your inventory, and click ‘OK’.
- Then exit the wizard, by clicking on ‘Exit Wizard’.

Step 3 – Creating an import format Excel spreadsheet

- Select ‘File’, ‘Import/Export’ , ‘Create Import Format Excel File’ (Figure 5)

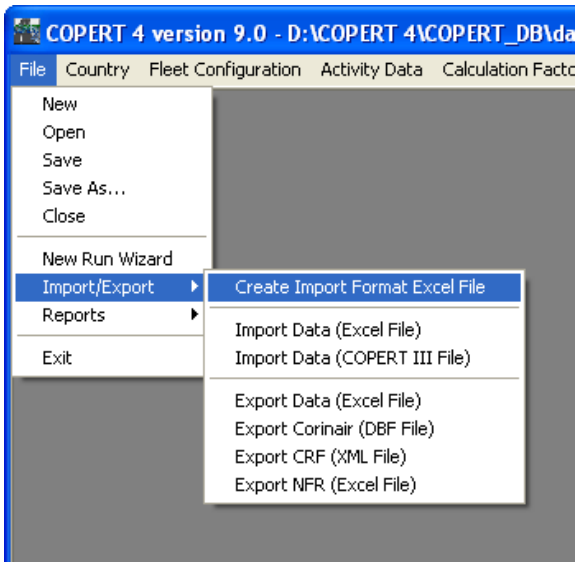


Figure 5 – Creating an Import format Excel file

- The screen shown in Figure 6 will appear. Click on 'Unselect all' in the Input Data section, and then select 'U Share-perc', 'R Share-perc' and 'H Share-perc'. To add speed to the circulation data in the database, 'U Speed-km per h', 'R Speed-km per h' and 'H Speed-km per h' should also be selected. In the vehicles section, click on 'Select all' and then click 'Create File'.
- Save the file in a working directory.

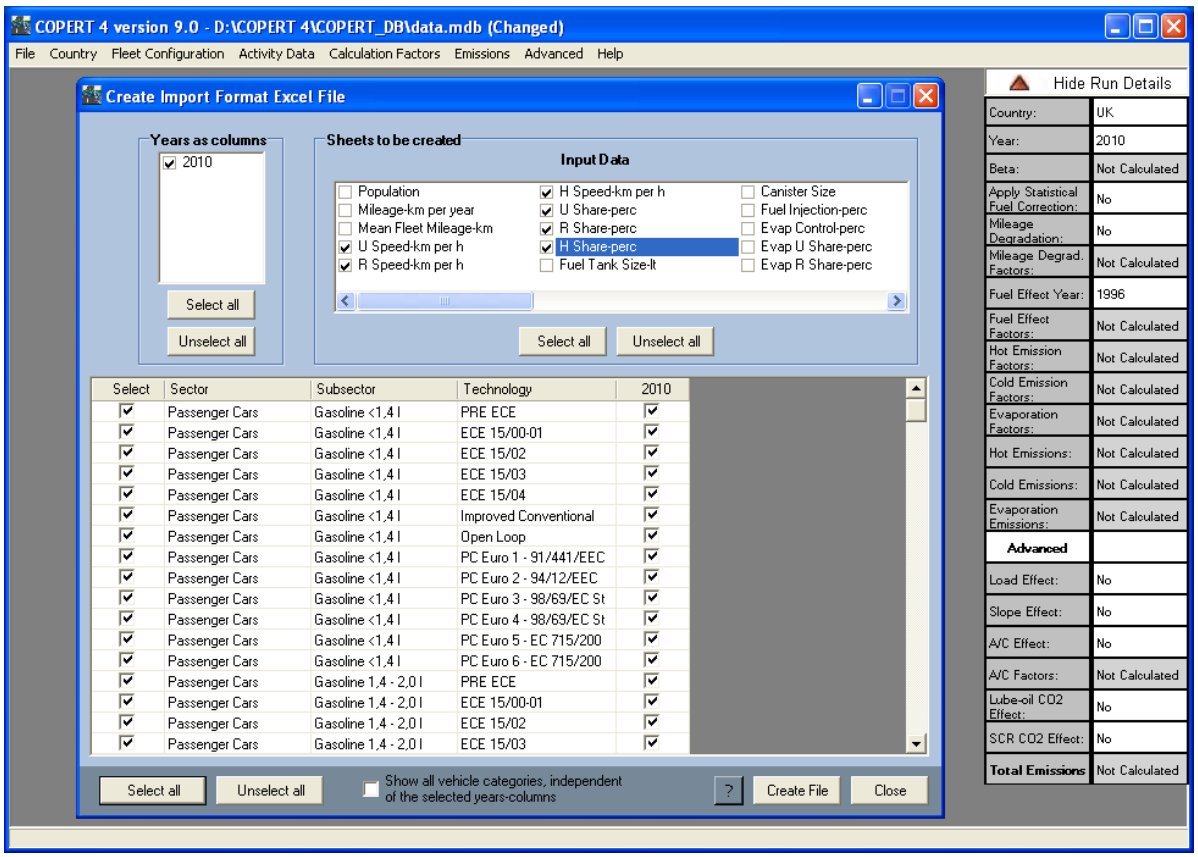


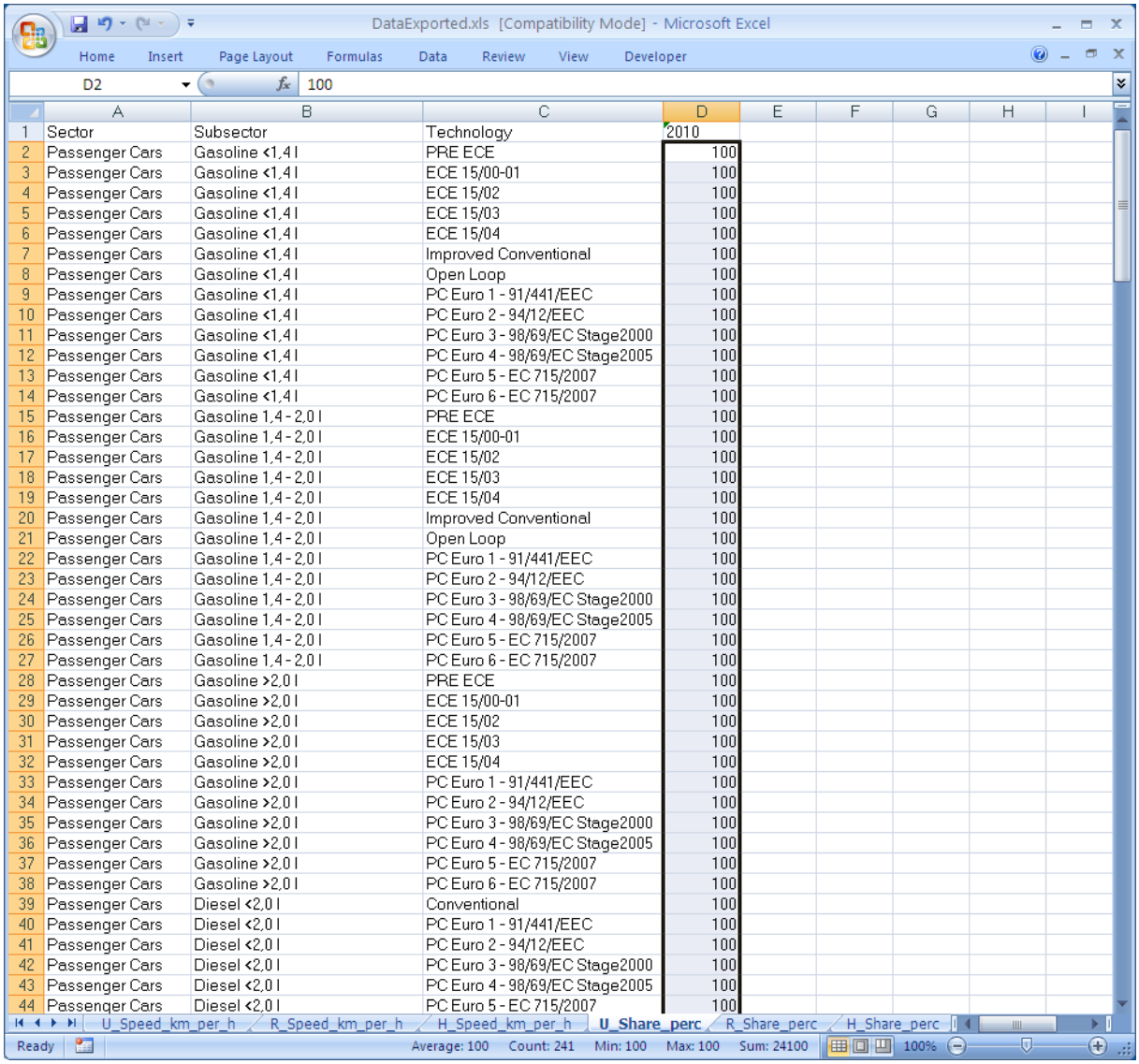
Figure 6 - Create Import Format Excel File Screen

Step 4 – Editing the Percentage share spreadsheet in Excel

- Open the newly created spreadsheet in Excel, as shown in Figure 7 below.
- Enter the number 100 into each row of the column with the year as the header (for example, 2010), for each of the three worksheets 'U Share-perc', 'R Share-perc' and 'H-Share-perc'. If the 'Speed-km per h' sheets were selected, the speed in km per hour should be added to each of the three worksheets 'U Speed-km per h', 'R Speed-km per h' and 'H Speed-km per h' in each row of the column with the year as the header. Once this has been done, save the file.

Step 5 – Import the 100% driving share into COPERT 4

- Return to COPERT 4. Click on 'File', 'Import/Export', 'Import Data (Excel File)', as shown in Figure 8 below.



	A	B	C	D	E	F	G	H	I
1	Sector	Subsector	Technology	2010					
2	Passenger Cars	Gasoline <1,4 l	PRE ECE	100					
3	Passenger Cars	Gasoline <1,4 l	ECE 15/00-01	100					
4	Passenger Cars	Gasoline <1,4 l	ECE 15/02	100					
5	Passenger Cars	Gasoline <1,4 l	ECE 15/03	100					
6	Passenger Cars	Gasoline <1,4 l	ECE 15/04	100					
7	Passenger Cars	Gasoline <1,4 l	Improved Conventional	100					
8	Passenger Cars	Gasoline <1,4 l	Open Loop	100					
9	Passenger Cars	Gasoline <1,4 l	PC Euro 1 - 91/441/EEC	100					
10	Passenger Cars	Gasoline <1,4 l	PC Euro 2 - 94/12/EEC	100					
11	Passenger Cars	Gasoline <1,4 l	PC Euro 3 - 98/69/EC Stage2000	100					
12	Passenger Cars	Gasoline <1,4 l	PC Euro 4 - 98/69/EC Stage2005	100					
13	Passenger Cars	Gasoline <1,4 l	PC Euro 5 - EC 715/2007	100					
14	Passenger Cars	Gasoline <1,4 l	PC Euro 6 - EC 715/2007	100					
15	Passenger Cars	Gasoline 1,4 - 2,0 l	PRE ECE	100					
16	Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/00-01	100					
17	Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/02	100					
18	Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/03	100					
19	Passenger Cars	Gasoline 1,4 - 2,0 l	ECE 15/04	100					
20	Passenger Cars	Gasoline 1,4 - 2,0 l	Improved Conventional	100					
21	Passenger Cars	Gasoline 1,4 - 2,0 l	Open Loop	100					
22	Passenger Cars	Gasoline 1,4 - 2,0 l	PC Euro 1 - 91/441/EEC	100					
23	Passenger Cars	Gasoline 1,4 - 2,0 l	PC Euro 2 - 94/12/EEC	100					
24	Passenger Cars	Gasoline 1,4 - 2,0 l	PC Euro 3 - 98/69/EC Stage2000	100					
25	Passenger Cars	Gasoline 1,4 - 2,0 l	PC Euro 4 - 98/69/EC Stage2005	100					
26	Passenger Cars	Gasoline 1,4 - 2,0 l	PC Euro 5 - EC 715/2007	100					
27	Passenger Cars	Gasoline 1,4 - 2,0 l	PC Euro 6 - EC 715/2007	100					
28	Passenger Cars	Gasoline >2,0 l	PRE ECE	100					
29	Passenger Cars	Gasoline >2,0 l	ECE 15/00-01	100					
30	Passenger Cars	Gasoline >2,0 l	ECE 15/02	100					
31	Passenger Cars	Gasoline >2,0 l	ECE 15/03	100					
32	Passenger Cars	Gasoline >2,0 l	ECE 15/04	100					
33	Passenger Cars	Gasoline >2,0 l	PC Euro 1 - 91/441/EEC	100					
34	Passenger Cars	Gasoline >2,0 l	PC Euro 2 - 94/12/EEC	100					
35	Passenger Cars	Gasoline >2,0 l	PC Euro 3 - 98/69/EC Stage2000	100					
36	Passenger Cars	Gasoline >2,0 l	PC Euro 4 - 98/69/EC Stage2005	100					
37	Passenger Cars	Gasoline >2,0 l	PC Euro 5 - EC 715/2007	100					
38	Passenger Cars	Gasoline >2,0 l	PC Euro 6 - EC 715/2007	100					
39	Passenger Cars	Diesel <2,0 l	Conventional	100					
40	Passenger Cars	Diesel <2,0 l	PC Euro 1 - 91/441/EEC	100					
41	Passenger Cars	Diesel <2,0 l	PC Euro 2 - 94/12/EEC	100					
42	Passenger Cars	Diesel <2,0 l	PC Euro 3 - 98/69/EC Stage2000	100					
43	Passenger Cars	Diesel <2,0 l	PC Euro 4 - 98/69/EC Stage2005	100					
44	Passenger Cars	Diesel <2,0 l	PC Euro 5 - EC 715/2007	100					

Figure 7 - Excel Import File

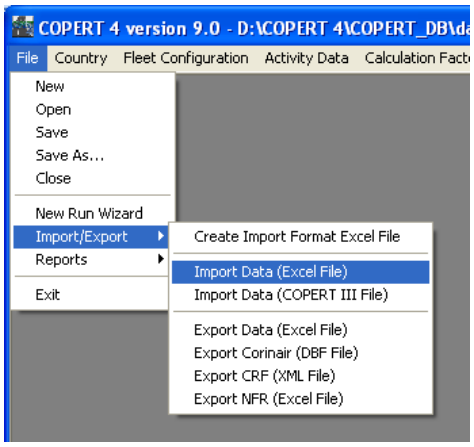


Figure 8 - Import Data from Excel

- The 'Import Data (Excel File)' screen will appear (Figure 9).
- Click 'Import Excel File'.
- Browse to select the Excel file you have just created, and click 'Open' and then 'Close' once the file has imported.

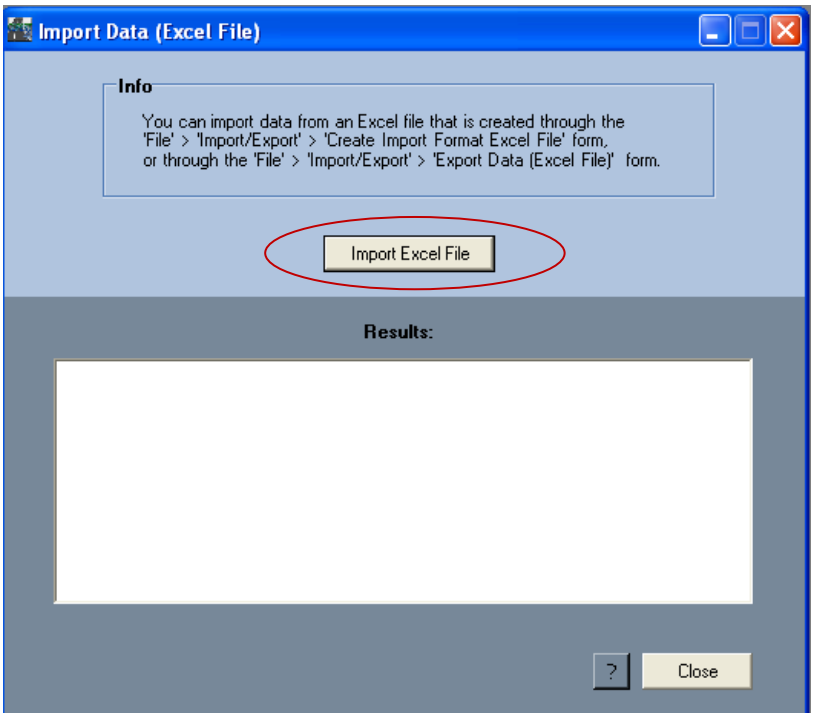


Figure 9 - Import Data from Excel Screen

- Repeat the instructions in 'Step 2' that guide you through the Run Wizard, but this time continue through to the 'Input Circulation Data' screen (Figure 10).

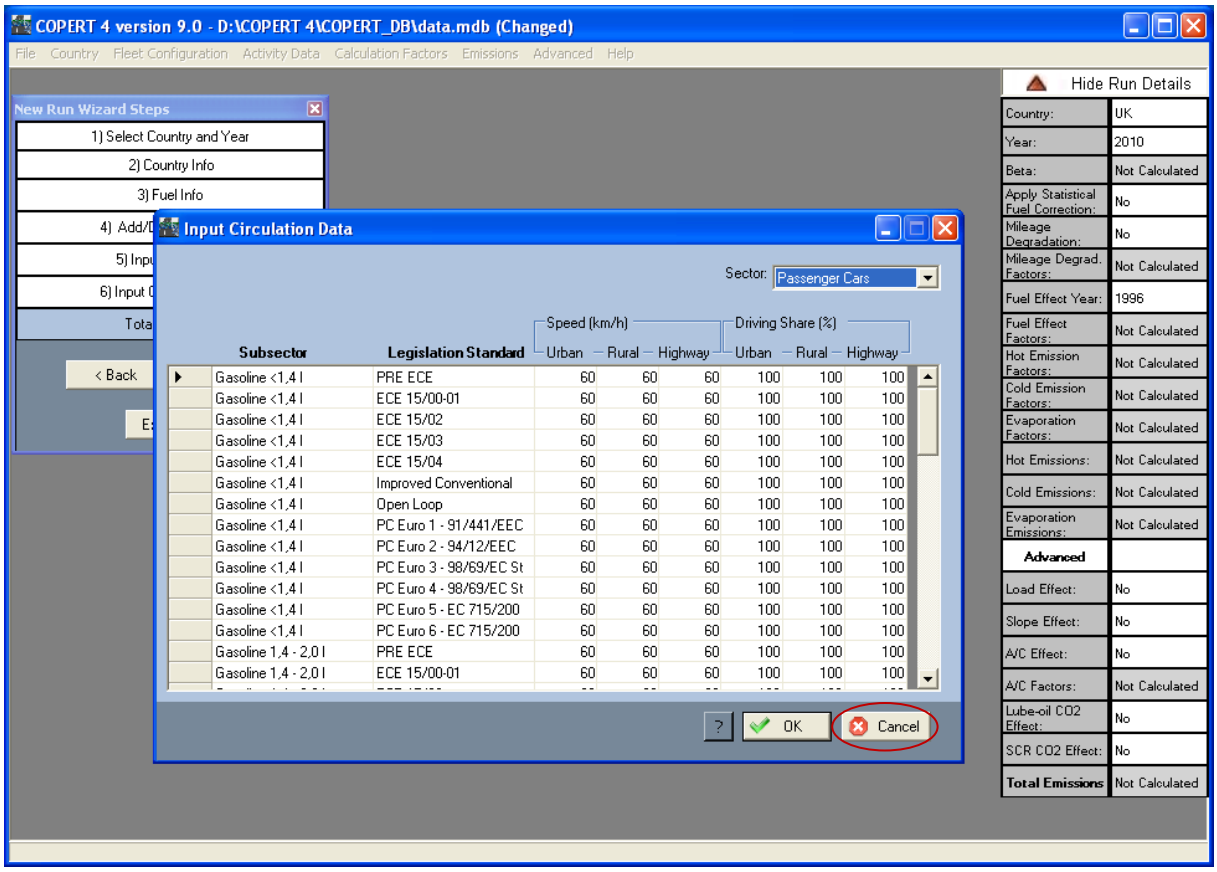


Figure 10 - Input Circulation Data Screen

- Click ‘Cancel’ on this screen in order to avoid getting the error message shown in Figure 11.
- Continue to the ‘Total Emissions Screen’ (Figure 12)
- Select ‘Recalculate All Emissions (including all factors)’.
- Now your file is ready to export.

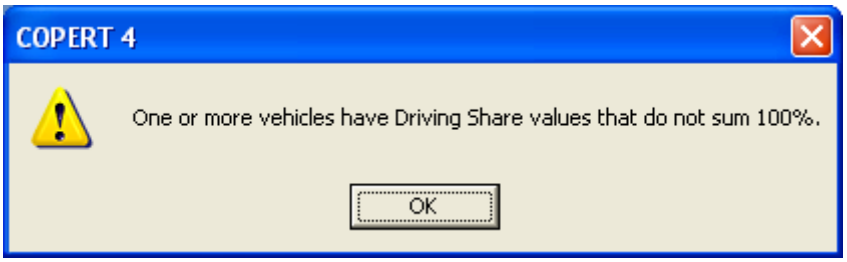


Figure 11 – Error message displayed when 100% driving share is assigned to each or urban, rural or highway

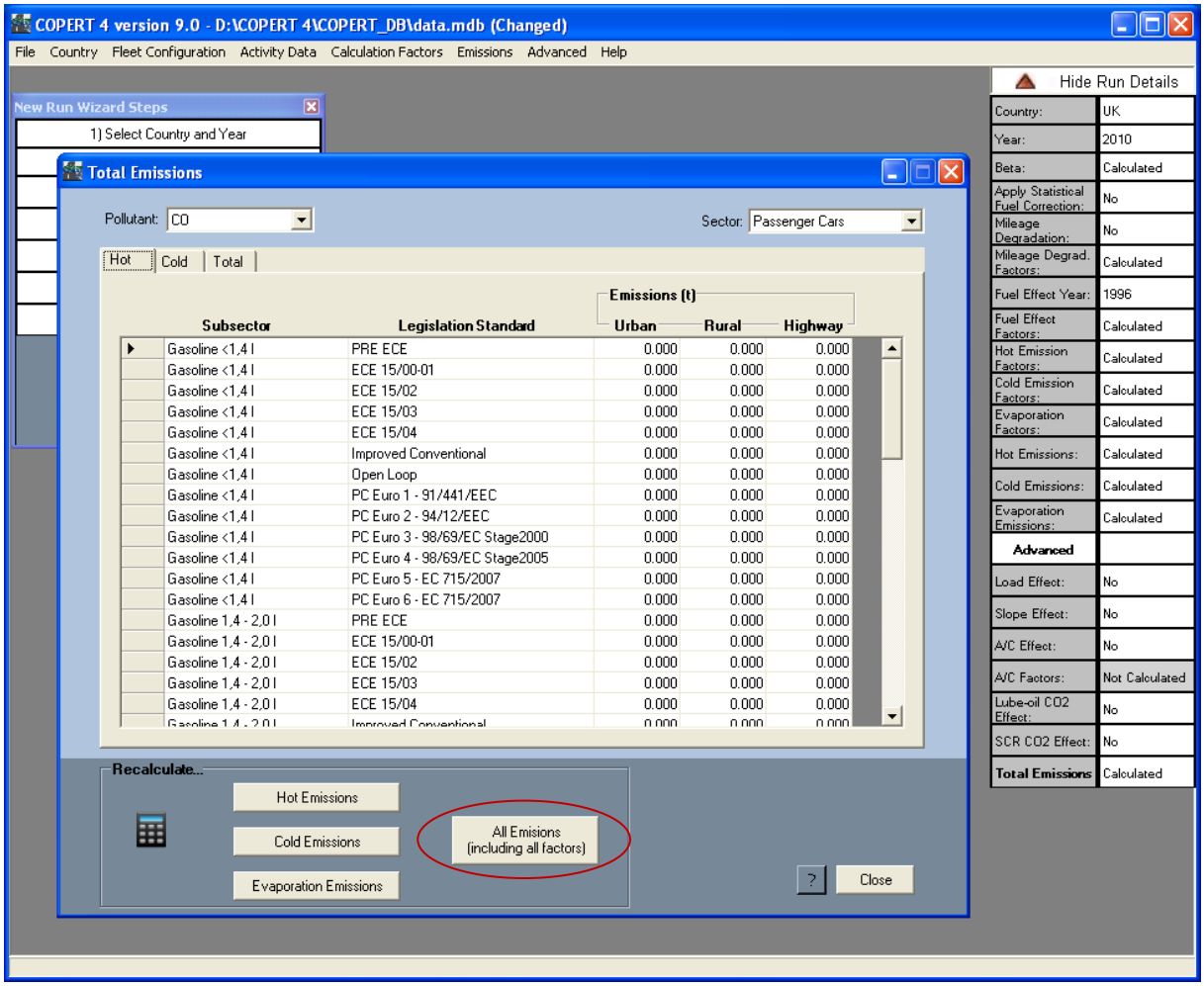


Figure 12 - Total Emissions Screen

4.2 Exporting emissions data from COPERT 4

It is straightforward to export the emissions data from COPERT 4 to an Excel spreadsheet, once the emissions calculations have been performed.

Step 1

- Select ‘File’, ‘Import/Export’, ‘Export Data (Excel File)’.

Step 2

- Click on ‘Unselect all’ in the ‘Input Data’ section, and then reselect the ‘Import’ columns specified in Table 1.
- Click on ‘Unselect all’ in the ‘Results’ section, and then reselect the ‘Export’ columns specified in Table 1.
- Click on ‘Select all’, or make an appropriate selection of vehicles in the table (bottom left). Note that for the COPERTToEMIT tool to run successfully, you must select at least one vehicle type from each of the vehicle categories (listed in Section 2).

Step 3

- Click on ‘Export File’, and browse to a working directory in order to save the file.