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Local Authority Basic Carbon Tool

# User Guidance

V1.0

In House Analytical Consultancy

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Department for  
**Transport**

  
GOVERNMENT OPERATIONAL RESEARCH SERVICE

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## Using the tool

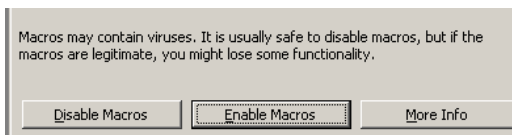
### 1.1 Purpose of the tool

This tool allows local authorities to assess the potential effects of transport interventions on carbon emissions in their area.

Chapter 2 gives more information on the background to the tool and how it may be used in the assessment process.

### 1.2 Opening the tool

Open the Excel document. A Security Warning message will appear. Please select “Enable Macros”.



### 1.3 Saving the tool

When you first use the tool you will need to save a copy of the tool on your system.

Remember to save the tool whenever you use it afterwards, otherwise any changes you make in the tool will not be kept.

### 1.4 Tool features

The tool has three main features:

#### **Carbon calculator**

Here you can create a scenario by entering details about a particular intervention. The tool will output results on the total change in carbon emissions following the effects of the intervention.

The tool allows you to save multiple scenario details and their results. The data will be stored in a table, where you can compare the results.

#### **Data**

The “Data summary” sheet lists potential data sources that might be useful for local authorities.

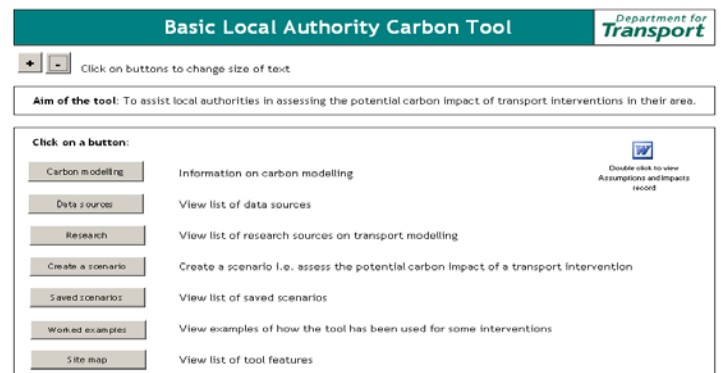
The tool also includes built-in data which is used to calculate carbon emissions (speed curve coefficients and average emission factors).

#### **Guidance**

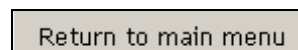
The tool includes a range of guidance, including how to appraise carbon, research and best practice on different types of interventions, guidance on their applicability at the local level and practical guidance about how to use the tool.

### 1.5 Main menu

Whenever you open the tool, the Main Menu sheet will appear. From this sheet, the main features of the tool can be accessed by clicking on the buttons.



To return to the main menu from any other sheet of the tool, click on the button on top of each sheet:



#### **Zoom buttons**

To adjust the size of the text on a sheet, click on the zoom buttons:



## Background to the tool

The tool has been developed following extensive research with local authorities about how the Department can better support local areas understand and assess how best to tackle climate change through their delivery of local transport services.

### The Climate Change Act

The UK Government is committed by The Climate Change Act 2008 to reduce UK's greenhouse gas emissions by at least 80% below 1990 levels by 2050. This is a legally binding target that would be achieved through action at home and abroad. The Act has also set five-yearly carbon budgets for the UK economy up to 2022, defining the emissions pathway to the 2050 target by limiting the total greenhouse gas emissions allowed in each five year period.

### Local Climate Change Research Report (May 2010)

The research report delivered findings and recommendations to the Department on how authorities in England were acting on climate change and monitoring emissions as part of the delivery of their transport services, as they prepared for their third round of Local Transport Plans.

#### *What was researched?*

- existing goals and public commitments signed up to, and how local partners perceive transport as contributing to these goals;
- transport policies and initiatives delivered to deliver climate change objectives;
- drivers, challenges and barriers that authorities are facing;
- tools, guidance and methodologies currently in use to assess the carbon impact of transport policies;

- coverage, advantages, disadvantages of monitoring and evaluation methodologies identified

#### *What was recommended?*

In summary, for the DfT to:

- Make best use of existing information;
- Improve certain data sources; and,
- Consider the creation of a transport carbon tool for authorities.

The full report is included here

<http://www.dft.gov.uk/pgr/regional/policy/climatechange/pdf/report100715.pdf>

### What can the tool be used for?

- Carbon and cost saving information for business cases - based on best estimates of take-up and effects of intervention
- Initial exploration of policies to see which policies might be worth researching and pursuing further
- Indicative exploration of sensitivity of carbon savings using a range of assumptions about take-up

The Department does not attach any weight to the tool in terms of bidding for central funding, or forming part of appraisal guidance.

However this should not prevent authorities using the tool to inform their own decisions. The tool has deliberately been designed to allow a high degree of flexibility for local inputs. Assumptions about local behaviour should be well evidenced and proportionate.

## Carbon calculator

The carbon calculator allows you to calculate the change in carbon emissions over a year as a result of a transport intervention.

### 1.6 Creating a scenario

To create a scenario (a particular intervention) in the tool, you will need to enter details about your intervention onto the <Scenario> sheet. This can be accessed via a button on the Main menu.

**Estimate the effect of a transport intervention on carbon emissions**

Return to main menu Save details Clear sheet

Consider what will be affected by the transport intervention. The total change in emissions will be given at the bottom of the sheet. The assumptions and impacts document available on the main menu sheet will help you answer the following questions. Enter into the blue cells only.

When you have finished you can save the scenario, by clicking on the button above.

**Intervention details**

Intervention name: School travel planning

Brief description of intervention: Encourage primary school pupils to walk, cycle, participate in car share schemes and use public transport in Norfolk.

**1. What time period will be affected?**

Describe the time period that will be affected: Peak

The guidance document can assist you with your decision.

If the intervention will affect more than one time period, then you may need to create multiple scenarios. (one for each time period).

**2. What type of road and what type of area will be affected?**

If the intervention will affect more than one road type or area, then you will need to create multiple scenarios. (one for each road type / area).

You will need to enter details on your scenario before and after your intervention has taken place i.e. “pre-intervention” and “post-intervention”. You only need to enter data on the transport modes that are affected by your intervention, both directly and indirectly

Enter details into the light blue cells only. Some cells will have a drop-down menu to allow you to select an option from a list.

If no data has been entered into a required field, the model will assume the value is zero.

#### 1.6.1 Intervention details

- Name
- Description
- Time period affected
- Type of road affected

- Type of area affected
- Region affected
- Year affected

#### **Multiple scenarios for one intervention**

Your intervention may affect different conditions e.g. more than one time period (peak and inter-peak).

In this case you will need to create a separate scenario for each different set of conditions.

The reason for this is that different time periods will probably have different traffic speeds. It is more accurate to split the time periods than to take an average speed.

Refer to Worked Example A for more guidance on how this should be done.

#### **Sensitivity testing**

The tool will produce a carbon figure based only on the inputs you have chosen. You should also try inputting lower and higher speeds, take-up assumptions etc to see how sensitive your carbon saving is.

#### 1.6.2 Affected modes

Select the modes that will be affected by your intervention. For example, if your intervention is going to encourage car drivers to start cycling, both “Cars” and “Walking/cycling” checkboxes should be selected.

Remember to also include indirect effects of your intervention on other traffic.

Please ensure you tick the right modes, as you will only be allowed to enter data about the affected modes afterwards.

By default, all modes are affected.

### 1.6.3 Vehicle mix

#### Default vehicle mix

By default, the emissions are based on speed curves which use the national average vehicle mix within each mode.

For instance, the carbon emissions for a car will be based on the fact that x% of cars are petrol and y% are diesel. And within petrol and diesel cars, the proportion of each emission standard and engine capacity.

These proportions are dependent on the year you have selected.

The data you use for fleet proportions is recorded on the <Scenario> sheet (i.e. Own data or built-in).

#### Adjusting the vehicle mix

You can adjust the vehicle mix so that it is more relevant to your particular intervention or to your area.

To adjust the vehicle mix, click on the button “Vehicle mix”.

This will take you to the <Vehicle Mix> sheet, where you can adjust the broad vehicle mixes for some modes:

- Cars;
- LGVs;
- Trains; and
- Motorcycles.

The vehicle mixes by default are the same for pre-intervention and post-intervention. If you think the fleet will be affected by the intervention, you can make them different on the <Vehicle Mix> sheet.

For some modes, you can change the built-in data to be based on specific

areas or road types. For instance, for cars you may want to use the built-in data based on a rural road, urban road or a motorway. Alternatively, you may enter your own estimates.

Cars				
Pre-intervention				
Vehicle mix used:				
Own estimates				
	Rural	Urban	Motorway	Own estimates
Petrol	55.6%	68.7%	45.5%	50.0%
Diesel	44.4%	31.3%	54.5%	40.0%
LPG	0.0%	0.0%	0.0%	10.0%
CNG	0.0%	0.0%	0.0%	
Plug in hybrid electric	0.0%	0.0%	0.0%	
Electric	0.0%	0.0%	0.0%	
Total	100.0%	100.0%	100.0%	100.0%

If you are using your own estimates, please ensure that your proportions sum up to 100% for each mode.

#### Adjusting the detailed vehicle mix

If you want to adjust the detailed vehicle mix, click on the button “Detailed vehicle mix”.

This will take you to the <Detailed vehicle mix> sheet, where you can adjust the vehicle mix for each mode by fuel type.

Cars						
<input type="checkbox"/> Pre-intervention: Use national proportions						
<input type="checkbox"/> Post-intervention: Use national proportions						
Petrol						
Vehicle type	Fuel type	Engine capacity (cc) or weight limit (tonnes)	Emission standard	National proportion	Own data Pre-int	Own data Post-int
Car <2.5 t	Petrol	<1400 cc	Pre-Euro 1	0.06%		
Car <2.5 t	Petrol	<1400 cc	Euro 1	0.68%		
Car <2.5 t	Petrol	<1400 cc	Euro 2	3.96%		
Car <2.5 t	Petrol	<1400 cc	Euro 3	5.40%		
Car <2.5 t	Petrol	<1400 cc	Euro 4	21.75%		
Car <2.5 t	Petrol	<1400 cc	Euro 5	6.42%		
Car <2.5 t	Petrol	<1400 cc	Euro 6	0.00%		
Car <2.5 t	Petrol	1400-2000 cc	Pre-Euro 1	0.08%		
Car <2.5 t	Petrol	1400-2000 cc	Euro 1	0.84%		

By default, all of these are based on national data, and are the same for pre-intervention and post-intervention.

To use your own estimates for a particular mode, untick the “Use national proportions” check-box.

If you are using your own estimates, please ensure that your proportions sum up to 100% for each mode.

### 1.6.4 Distances

For each affected mode, enter the following details for pre and post intervention in the particular time period you are considering:

- Daily distance per vehicle (km)
- Number of vehicles<sup>1</sup>
- Days affected per year

For instance: 150 cars travelling 100 km (at peak time) every day of the year:

Mode	Daily distance per vehicle (km)	# vehicles	Days affected per year
Cars	40	150	365

If your intervention will affect every day of the year, enter 365 in the last column.

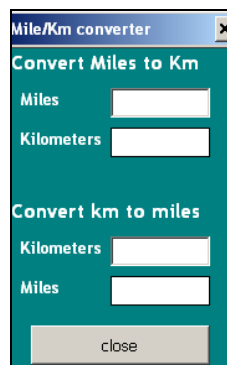
Please note that the distance will be assumed zero unless all three values have been given.

If you do not think the distance will be affected by your intervention, enter the same data into the “pre-intervention” and “post-intervention” tables.

All distances should be entered in kilometres.

#### Mile/km converter

Click on the button “Show mile / km converter” to use the converter. This will help you to convert distances and speeds from one unit to the other.



#### Notes on assumptions

Any details about the assumptions you have made should be entered into the box below the distance tables.

More detailed records of your assumptions, research and other information can be recorded on the “Assessing your Interventions” document mentioned in Chapter 5.

### 1.6.5 Speeds

For each affected mode enter the speed before and after your intervention.

All speeds should be entered in kilometres per hour.

If you do not think the distance will be affected by your intervention, enter the same data into the “pre-intervention” and “post-intervention” tables.

No speed is required for walking, cycling or trains, as the emissions for these are not dependent on speed curves.

Emissions for walking and cycling are considered negligible in this tool.

#### Built-in speeds

If you are unsure what speeds you should enter, the built-in speeds should be used.

These will be based on the conditions you have entered earlier:

- Time period

<sup>1</sup> For a train: 1 carriage = 1 vehicle



- Road type
- Area
- Region
- Year

To enter national-average speeds based on these conditions, click on the button “Enter speeds”.

Please note this feature will not be available if any of these fields are left blank, or if “Other” is selected.

There is no data available on the average speeds of motorcycles.

### 1.7 Emissions

After speed data has been entered, the average emission per km travelled for each affected mode will be shown in the next column.

Pre-intervention		
Data used:	Own	
Mode	Speed (Km/hour)	Emission (g CO <sub>2</sub> / km)
Cars	50.0	146.62
Taxis		
LGVs		

### 1.8 Results

If all the required inputs have been entered, the total carbon emissions for the pre-intervention scenario and post-intervention scenario will be given at the bottom of the sheet.

The unit of measurement is a thousand tonnes of CO<sub>2</sub>.

The change in total carbon emissions as a result of the intervention will also be calculated.

More detailed results are also given at the bottom, where the total emissions per mode are given.

### Cost of carbon

You may use the tool to get an estimate of the non-traded carbon value possible from your transport intervention.

A separate sheet lists carbon costs per thousand tonnes, which can be multiplied by the carbon saving you have calculated for your intervention.

### 1.9 Saving scenarios

To save details of a scenario, click on the “Save details” button on top of the <Scenario> sheet.

The data and results will be saved onto the next free row of the <Record of scenarios> sheet:

Return to main menu		Return to scenario		Record of scenarios +							
#	Intervention name	Brief description of intervention	Pre-intervention	Post-intervention	Change	Cars	Taxis	LGVs	HGVs		
1	School Travel Planning - Norfolk	Encourages primary school children	146.62	0.00	-146.62	TRUE	FALSE	FALSE	FALSE		

To filter the data, click on a filter arrow on the header row.

### Data not saved

Please note that if you have entered any vehicle mix data of your own (rather than using the built-in data), this will not be saved. Please ensure that you have kept a record of your actual entries elsewhere.

However, the <Record of scenarios> sheet will keep a record of the fact that you used your own data or built-in data.

### 1.10 Clear scenario sheet

To clear the <Scenario> sheet, click on the “Clear sheet” button at the top of the sheet. Please ensure that you have saved this scenario if you want to keep a record of the scenario.



# Data

## 1.11 Data summary sheet

The <Data summary> sheet lists data sources that you may find useful.

These include data on modes, speed, emissions, distances and baseline figures.

This sheet can be accessed via a button on the Main menu.

Hyperlinks are provided to the relevant data source in the second column of the table.

Mode	Description	Responsible sector	How it can be used?	Can data be obtained at local authority level?	Latest year	Updated when?
High Traffic	The latest compilation of road traffic in Great Britain. This web page provides additional quarterly road traffic statistics and more detailed annual statistics.	DfT	Use to determine the total population who may wish to leave traffic jams, and the total number of vehicles to allow to different vehicle types within their region or, at a higher level of detail, to their local authority.	Annual in 2010, 2011 and projected at local authority level, although a detailed breakdown of traffic, on a road-by-road basis, is not available beyond regional level.	2010	Quarterly
National Travel Survey	Information on personal travel in Great Britain from the National Travel Survey. This web page provides personal travel data from the National Travel Survey. This is a continuous survey designed to monitor long-term trends in travel in Great Britain.	DfT (National Travel Survey)	This survey collects information on where, how, why and when people travel as well as factors which affect personal travel such as car availability, driving licence holding and access to bus services. Understanding travel patterns may help when considering what transport is best for transport infrastructure.	The national and regional data is available from 2005 onwards, but is not available at local authority level.	2010	Yearly
Vehicle registration	These registers contain details of vehicle type and estimated year of earliest model data available.	DfT (Vehicle Registration)	All different vehicle types have different emission factors. It might be useful to know the number of each vehicle type registered in the local authority, in order to estimate, however, that licensing figures do not directly measure the distance driven.	Yes, but for major roads only.	2010	Annually, although data can be requested to near time.
Local Data Tools	This site enables the user to view and download estimated traffic flow on a sample line of the M road and motorway network in the large urban conurbation areas.	DfT	If a proposed intervention affects a specific road, information can be obtained on the estimated traffic flow on that road.	Yes, but for major roads only.	2010	Annually.
National Travel Survey	The DfT has established a database of available interview, public transport and home interview survey data. The database comprises a list of all locations for which transport datasets held by DfT	DfT		Yes.	2010	

## 1.12 Built-in data

### Speed curves

These are used to calculate the amount of carbon emitted from a vehicle, based on the speed the vehicle is travelling at.

The following formula is used:

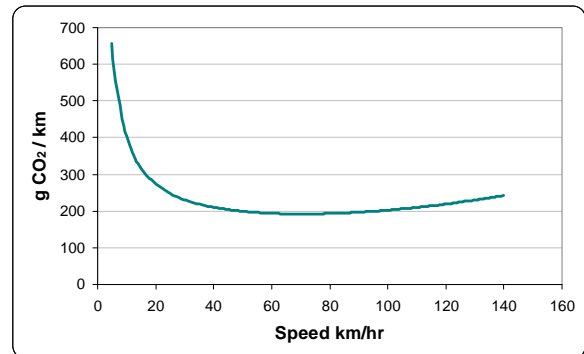
$$CO_2 \text{ (g/km)} = k \cdot (a + bx + cx^2 + dx^3 + ex^4 + fx^5 + gx^6) / x$$

Where x= speed (km/h);  
k= adjustment factor; and  
a-g are different for each vehicle type

The formula produces a “u-shaped” curve –i.e. more carbon is emitted at slower and faster speeds than moderate speeds. Each vehicle has a different curve.

Whilst the emissions equation is in a different form to that given in WebTag the curves in the latest ((draft version 3.3.5 D), January 2011) guidance have been estimated from the same source data and are therefore compatible.

The following is an example of a speed curve for a particular diesel car:



The data and calculations for each mode are given on sheets <Emissions - ...>

### Average emission factors

Speed curve data is not available for all specific vehicle types, so average emission factors are used instead for the following:

- Cars
- Plug-in hybrid vehicles
- Electric vehicles
- Trains (Electric and diesel).

These emissions are based on average speeds.

### Average speed data

Average speed data taken from the National Transport Model are stored on the <Data – Speeds> sheet.

### Fleet mix data

Fleet mix data, and calculations based upon the data are included on the following sheets:

- <Data - National fleet mix data>;
- <Data - National fleet mix data2>;
- <Data - Euro Composition>; and
- <Data - NTM Vehicle splits>.

## Guidance

The tool contains a range of guidance.

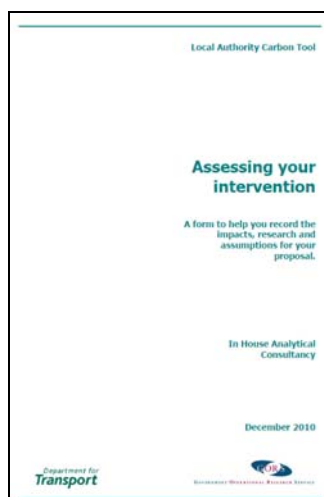
### 1.13 User Guide

A copy of this User Guide is included in the tool: Double click on the link on the Main Menu sheet.

### 1.14 “Assessing your intervention” document

Accompanying the tool is a document to help you to think through and record the impacts, research and assumptions for your intervention.

This is included in the tool: Double click on the link on the Main Menu sheet.



### 1.15 Worked examples

Worked examples of how the tool might be used are included in the Annex of this document, together with policy guidance about how transport interventions can be delivered at the local level.

### 1.16 Research summary

The tool includes a “Research Summary” sheet which includes a list of research to give more information about the effects of different interventions.

This can be accessed via a button on the Main menu.

Research summary		
This sheet gives a summary of research conducted or commissioned by DfT that has relevance to carbon emissions and transport.		
Smarter choices		
1 Study: <a href="#">Smarter choices: Carbon's 20, 40, 60, 80, 100</a>	<b>Study description</b> Over a series of 10 scenarios published by the UK and compared on 10th November. Case study interviews with local authority staff relating to 20 specific initiatives. Includes 2 different policy scenarios for the next 10 years. A high intensity scenario that identifies the potential for a significant expansion of activity and a low intensity scenario from a perspective of the current (2010) levels of total and carbon activity as well as emissions.	<b>Potential overall findings</b> Case study interviews with local authority staff relating to 20 specific initiatives.
2 Study: <a href="#">A study of the implications of a 20% reduction in car journeys</a>	<b>Study description</b> A study of the implications of a 20% reduction in car journeys. It identifies the impact of a 20% reduction in car journeys on total and carbon activity as well as emissions. It also identifies the impact of a 20% reduction in car journeys on total and carbon activity as well as emissions.	<b>Potential overall findings</b> The research will provide evidence of total GHG, which may be translated to carbon impact, although this may have variations.
Carbon reduction		
1 Study: <a href="#">Local Authority Carbon Footprint</a>	<b>Study description</b> This research reports on the results of a journey pattern and length and parking preferences of carbon emissions from transport.	<b>Potential overall findings</b> Identifying the impact of the highest rates of carbon emissions between 10-20 miles. Highest proportion of high intensity trips.
Public transport integration		
1 Study: <a href="#">How to Stop Public Transport</a>	<b>Study description</b> Identifying existing good practice in the provision of integration facilities and services. Identifying a list of facilities and services that may be provided by public transport, ensuring a comprehensive list of facilities and services that may be provided by public transport.	<b>Potential overall findings</b> Highlights that more sustainable travel choices such as walking, cycling and taking public transport to the station have a lower carbon impact, but also cost less.

### 1.17 Information on carbon modelling

A quick guide to carbon modelling is included in the tool, accessed via a button on the Main menu. A summary of web-tag unit 3.3.5 is below.

**Carbon modelling**

The amount of CO<sub>2</sub> produced by different modes of transport is dependent on three important factors:

- Speed
- Distance
- Engine type / efficiency

This tool uses the speed and vehicle types chosen by the user to calculate the CO<sub>2</sub> emitted per km, and multiplies this by the total distance travelled and number of vehicles of each type.

The relationship between speed and CO<sub>2</sub> emissions is different for each mode - i.e. buses are different from cars. There are also differences within each mode - e.g. some cars are more carbon efficient than others.

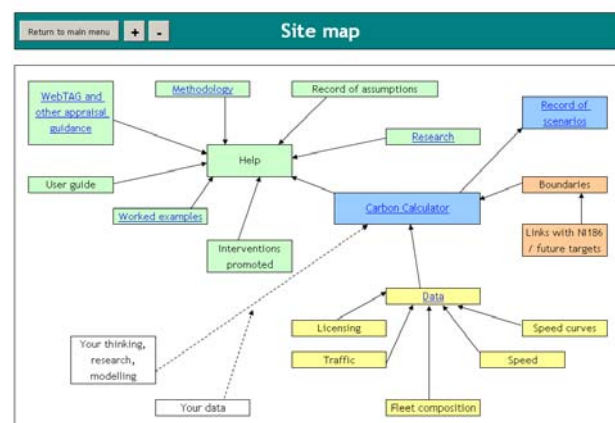
For each type of vehicle, more CO<sub>2</sub> is emitted per km at low speed and high speed than at moderate speed.

The relationship between speed and CO<sub>2</sub> emissions for each type of vehicle is described by a mathematical formula known as a **speed curve**.

The tool asks the user to split the travel by time period and road type so that appropriate speeds can be used. Using an average speed for a whole day tends to underestimate the CO<sub>2</sub> emissions.

### 1.18 Site map

A map of the tool’s contents can be seen by clicking on the “Site map” button from the Main Menu sheet. Particular features of the tool can be accessed by clicking on the hyperlinks on the map.



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## Q & A

This chapter includes typical question and answers about the tool.

### 1.19 Tool

#### ***Nothing happens when I click on the buttons.***

When opening the tool, make sure that you select “Enable macros” in the Security Warning message that appears.

If you did not get a security message then you need to ensure that your security setting is at Medium – where you choose whether to accept macros or not.

To do this, in Excel go to Tool – Macro – Security and select Medium.

You will need to close Excel and open the tool again.

### 1.20 Carbon calculator

#### ***How do I increase the decimal points shown in a cell?***

Right click on the cell and select “Format Cells...”

Select the “Number” tab, and increase the decimal points shown.

#### ***No results are shown at the bottom of the page.***

Make sure that you have entered all required data:

- Selected all affected modes;
- Speeds for all affected modes (pre and post-intervention);
- Distances for all affected modes (pre and post-intervention);
- Make sure that all proportions sum up to 100% on the <Vehicle mix> sheet;
- Make sure that all proportions sum up to 100% on the <Detailed vehicle mix> sheet.

#### ***When the tool says CO<sub>2</sub> emissions, does this mean CO<sub>2</sub> equivalents?***

No, the output of the tool is in ‘ultimate CO<sub>2</sub>’ emissions. This is all the gases emitted that ultimately become CO<sub>2</sub>

### 1.21 Intervention

#### ***What if an intervention affects two different time periods?***

You will need to create multiple scenarios, according to the number of different time periods that are affected. Refer to Worked Example A, for more information on how this can be done.

**What if an intervention affects a different time-period, road type, area type or region, which is not listed in the drop-down menu?**

Select “Other” and specify in the text box that appears on the right.

Please note that if you select “Other”, you will not be able to use the built-in average speeds data.

**Please note that certain combinations of Road and Area Type give a null value because there is no data available on those combinations. The final version of the tool will include a specific error message to alert users to the fact that these are not valid combinations.**

**The speed of vehicles will not be affected by the intervention. How should I model this?**

This means that the speed for a mode is the same before and after the intervention. Enter the same speeds in the pre-intervention table and post-intervention table.

**The distance travelled will not be affected by the intervention. How should I model this?**

This means that the distance for a mode is the same before and after the intervention. Enter the same distances in the pre-intervention table and post-intervention table.

**How do I vary the mix of petrol and diesel cars for my intervention?**

You will need to change the vehicle mix for pre-intervention and post-intervention.

On the <Scenario> sheet, click on the “Vehicle mix” button. Select “Own estimates” in the drop down menu, and enter your estimated proportions in the blue cells.

Cars				
Pre-intervention				
Vehicle mix used:				
Own estimates				
Rural				
Urban				
Motorway				
Own estimates				Own
	Rural	Urban	Motorway	estimates
Petrol	55.6%	68.7%	45.5%	50.0%
Diesel	44.4%	31.3%	54.5%	50.0%
LPG	0.0%	0.0%	0.0%	
CNG	0.0%	0.0%	0.0%	
Plug in hybrid electric	0.0%	0.0%	0.0%	
Electric	0.0%	0.0%	0.0%	
Total	100.0%	100.0%	100.0%	100.0%

Post-intervention				
Vehicle mix used:				
Own estimates				
	Rural	Urban	Motorway	Own estimates
Petrol	55.6%	68.7%	45.5%	40.0%
Diesel	44.4%	31.3%	54.5%	60.0%
LPG	0.0%	0.0%	0.0%	
CNG	0.0%	0.0%	0.0%	
Plug in hybrid electric	0.0%	0.0%	0.0%	
Electric	0.0%	0.0%	0.0%	
Total	100.0%	100.0%	100.0%	100.0%

**My intervention will only affect diesel cars. How should I model this?**

On the <Scenario> sheet, ensure that only the “Cars” checkbox is selected on the affected modes section.

Your affected car mix is 100% diesel cars, so you will need to change from the default-vehicle mix.

On the <Scenario> sheet, click on the “Vehicle mix” button.

Select “Own estimates” in the drop down menu, and enter 100% for diesel cars. (Do this for pre-intervention and post-intervention).

**My intervention will only affect (e.g.) taxis of emission class Euro 6. How should I model this?**

On the <Scenario> sheet, ensure that only the “Taxis” checkbox is selected on the affected modes section.

On the <Scenario> sheet, click on the “Vehicle mix” button. On the <Vehicle Mix> sheet, click on the “Detailed vehicle mix” button.

Click on the “Taxis” hyperlink and unselect the checkbox so that national proportions are not used. As only Euro 6 taxis will be affected by your intervention, enter 100% for this vehicle type.

If your intervention affected this vehicle mix, you would need to have a different value for pre-intervention and post-intervention.

## Taxis

- Pre-intervention: Use national proportions  
 Post-intervention: Use national proportions

Vehicle type	Fuel type	Engine capacity (cc) or weight limit (tonnes)	Emission standard	National proportion	Own data Pre-int	Own data Post-int
Car (taxi)	Diesel	All	Pre-Euro 1	0.04%		
Car (taxi)	Diesel	All	Euro 1	0.84%		
Car (taxi)	Diesel	All	Euro 2	3.49%		
Car (taxi)	Diesel	All	Euro 3	25.99%		
Car (taxi)	Diesel	All	Euro 4	47.83%		
Car (taxi)	Diesel	All	Euro 5	21.81%		
Car (taxi)	Diesel	All	Euro 6	0.00%	100.00%	100.00%
				100.00%		

### **Why can't I enter speeds for trains?**

Unlike the other modes, the emissions for trains are not calculated using speed curves. Instead, they are average emission factors, which are calculated based on average train speeds.

### **How do I model a switch to biofuels?**

The CO<sub>2</sub> emitted by vehicles burning biofuels is considered to be absorbed by the crops that are grown to produce the fuel. Therefore, we assume there are no net emissions from biofuels. So, if 10% of the fuel used in your fleet is biofuel, you can model the carbon saving by taking 10% off the total carbon emissions.

### **My intervention will introduce electric cars in my area. How should I model this?**

This means that only mode being affected is Cars. On the <Scenario> sheet, ensure that only the "Cars" checkbox is selected on the affected modes section.

On the <Scenario> sheet, click on the "Vehicle mix" button. Select "Own estimates" in the drop down menu, and enter your estimated proportions in the blue cells.

The proportion of electric cars will be 0% in the pre-intervention table, and other fuels summing up to 100%. In the post-intervention table, include a proportion of electric cars, and adjust the other fuels.

## 1.22 Year-on-year

The tool is not designed primarily to model year-on-year effects of an intervention. However, the built-in national vehicle mixes and speeds depend on the year selected on the <Scenario> sheet.

The modelling period for the model is 1 year. So if you want to model the effects of an intervention over more than one year, you will need to model every year separately e.g.:



- Year 0 before and after the intervention,
- Year 1 before and after the intervention;
- Year 3 before and after the intervention;
- Etc.

## 1.23 Data

### ***How do I insert regional speed data?***

Click on the button on the <Scenario> sheet:



Enter speeds

### ***Why can't I insert regional speed data?***

Make sure that you have entered details of the conditions for your interventions:

- Time period;
- Area
- Region;
- Road type; and
- Year.

No speeds are available if “Other” is selected to any of the above.

## Worked Examples

### 1.24 School travel planning

This intervention affects two different time periods: Peak and Inter-peak

#### Intervention details

Intervention name

Brief description of intervention (max 255 characters)

#### 1. What time period will be affected?

Describe the time period that will be affected:

If the intervention will affect more than one time period, then you may need to create multiple scenarios (one for each time period).

**Time period**  
The intervention affects two different time periods: morning (peak) and afternoon (inter-peak).  
The speeds will be different for these time periods, so two scenarios need to be modelled.

#### 2. What type of area will be affected?

If the intervention will affect more than one road type or area, then you will need to create multiple scenarios. (one for each road type / area).

Select the road type that will be affected:

Select the type of area that will be affected:

Select the region that will be affected:

Select the year that will be affected:

#### 3. Which transport modes will be affected by your transport intervention?

Please tick all transport modes which will be affected:

<input checked="" type="checkbox"/> Cars	<input type="checkbox"/> LGVs	<input checked="" type="checkbox"/> Buses/coaches	<input type="checkbox"/> Trains
<input type="checkbox"/> Taxis	<input type="checkbox"/> HGVs	<input type="checkbox"/> Motorcycles	<input checked="" type="checkbox"/> Walking/cycling

**Affected modes**  
Only cars, buses, walking and cycling are affected in this intervention. So all other checkboxes have been unticked.

**Vehicle mix** Default national data for a rural area used from 2011.  
**Detailed vehicle mix** All cars in the mix affected so national data used.

**5. How will the distance change?**

**Pre-intervention**

Mode	Daily distance per vehicle (km)	# vehicles	Days affected per year
Cars	5	20,000	190
Taxis			
LGVs			
Rigid HGVs			
Artic HGVs			
Buses	0	0	0
Coaches	0	0	0
Motorcycles			
Trains*			
Walking	0	0	0
Cycling	0	0	0

In the chosen period.



**Post-intervention**

Mode	Daily distance per vehicle (km)	# vehicles	Days affected per year
Cars	5	2,500	190
Taxis			
LGVs			
Rigid HGVs			
Artic HGVs			
Buses	40	50	190
Coaches	0	0	0
Motorcycles			
Trains			
Walking	5	5,000	190
Cycling	5	5,000	190

**Pre-intervention distance (morning period)**

- 50,000 primary school children in local authority
- Research shows that 30,000 are driven to school (average 1 child per car)
- 190 school days in year being affected
- Average distance to school = 2.5 km
- Distance travelled (during morning period) = 2 \* 2.5km = 5 km (Parent drives to school and back home).
- Intervention only affects 20,000 children (assume remaining 10,000 will still be driven to school)

Research suggests the effects of the intervention will be:

- 5,000 children now go on bus (50 per bus)
- 5,000 children will cycle
- 5,000 will walk
- 5,000 will car share (2 children per car)

(Remaining 10,000 will still be driven to school as before, so excluded from pre- and post-intervention.)

**So after intervention (morning period):**

- 5,000 / 2 = 2,500 cars at same distance
- 200 buses (average distance 40 km round trip per bus – based on research)
- 5,000 walking and 5,000 cycling

**6. How will the speed of vehicles change?** Help me

**Pre-intervention**

Data used: Own

Mode	Speed (Km / hr)	Emission (g CO <sub>2</sub> / km)
Cars	30.0	175.94
Taxis		
LGVs		
Rigid HGVs		
Artic HGVs		
Buses	30.0	783.93
Coaches	30.0	1098.65
Motorcycles		
Trains		
Walking	N/A	N/A
Cycling	N/A	N/A

*Emissions from walking and cycling are taken as zero.*



**Change in speed**  
 Assume speed is not affected by the intervention, so pre-intervention speed = post-intervention speed. (In a congested area, a large reduction in car travel might affect speeds of other road users – a secondary effect of the intervention).

**Post-intervention**

Data used: Own

Mode	Speed (Km / hr)	Emission (g CO <sub>2</sub> / km)
Cars	30.0	175.94
Taxis		
LGVs		
Rigid HGVs		
Artic HGVs		
Buses	30.0	783.93
Coaches	30.0	1098.65
Motorcycles		
Trains		
Walking	N/A	N/A
Cycling	N/A	N/A

**Change in total CO<sub>2</sub> emissions** -2.63 thousand tonnes CO<sub>2</sub> (a net saving)

Total emissions pre-intervention 3.34  
 thousand tonnes CO<sub>2</sub>

Total emissions post-intervention 0.72  
 thousand tonnes CO<sub>2</sub>

**Second scenario (afternoon period) –**

- The distances will be the same for the afternoon period.
- The speed will be different for the inter-peak period (slightly higher because less congestion on roads at inter-peak time).
- Save both scenarios and sum up the results to get the overall result for that intervention e.g.  $-2.63 + -2.47 =$  a saving of 5.10 kT CO<sub>2</sub>

Return to main menu		Return to scenario		Record of scenario										Hide info				
#	Intervention name	Brief description of intervention	kT CO <sub>2</sub>			affected												
			Pre-intervention	Post-intervention	Change	Cars	HGVs	Buses/Coaches	Motorcycles	Trains	Walking/Cycling	Time period	Road type	Area type				
1	School travel planning - Morning period	Encourage primary school pupils to walk, cycle, participate in car share schemes and use public transport. This will affect two-time periods - morning (peak) and afternoon (inter-peak), so two scenarios have to be modelled.	3.34	0.72	-2.63	TRUE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE	TRUE	Peak	Minor	Rural		
2	School travel planning - Afternoon period	Encourage primary school pupils to walk, cycle, participate in car share schemes and use public transport. This will affect two-time periods - morning (peak) and afternoon (inter-peak), so two scenarios have to be modelled.	3.14	0.67	-2.47	TRUE	FALSE	FALSE	FALSE	TRUE	FALSE	FALSE	TRUE	Inter-pe	Minor	Rural		

## 1.25 Freight servicing plans

### Intervention details

Intervention name

Brief description of intervention (max 255 characters)

Undertake freight servicing and delivery plans with a shopping centre. Currently all delivery journeys are made during peak time. The aim is to move all delivery journeys to off peak.

### 1. What time period will be affected?

Describe the time period that will be affected:

Please specify:

If the intervention will affect more than one time period, then you may need to create multiple scenarios (one for each time period).

#### Time period

The intervention affects peak and off-peak time periods.

But, unusually, there is no need to create two scenarios as there is a 100% shift i.e.

Pre-intervention – all journeys in peak time at a specific speed.

Post-intervention – all journeys in off-peak time at a different speed.

### 2. What type of area will be affected?

If the intervention will affect more than one road type or area, then you will need to create multiple scenarios (one for each road type / area).

Select the road type that will be affected:

Select the type of area that will be affected:

Select the region that will be affected:

Select the year that will be affected:

### 3. Which transport modes will be affected by your transport intervention?

Please tick all transport modes which will be affected:

<input type="checkbox"/> Cars	<input checked="" type="checkbox"/> LGVs	<input type="checkbox"/> Buses/coaches	<input type="checkbox"/> Trains
<input type="checkbox"/> Taxis	<input checked="" type="checkbox"/> HGVs	<input type="checkbox"/> Motorcycles	<input type="checkbox"/> Walking/cycling

#### Affected modes

All freight affected, so LGV and HGV checkboxes selected.

#### Vehicle mix

Default national mix used from 2011.

### 5. How will the distance change?

Pre-intervention				Post-intervention			
Mode	Daily distance per vehicle (km)	# vehicles	Days affected per year	Mode	Daily distance per vehicle (km)	# vehicles	Days affected per year
Cars				Cars			
Taxis				Taxis			
LGVs	8	40	312	LGVs	8	40	312
Rigid HGVs	8	40	312	Rigid HGVs	8	40	312
Artic HGVs	8	20	312	Artic HGVs	8	20	312
Buses				Buses			
Coaches				Coaches			
Motorcycles				Motorcycles			
Trains*				Trains			
Walking				Walking			
Cycling				Cycling			

Effect of intervention

#### Distance in local authority area

- The intervention will not affect the distance travelled, so the pre-intervention table is the same as the post-intervention table.
- Own research suggests 100 freight movement per day (40% LGV, 40% Rigid HGVs and 20% Artic HGVs)
- Assumed freight delivers 6 days per week so  $6 * 52 = 312$  days affected per year
- Average distance is 4km to the shopping centre, once reaching the city network. So total distance, in this area, per day is  $4\text{km} * 2 = 8\text{km}$



## 6. How will the speed of vehicles change?

Help me

**Pre-intervention**

Data used: Own

Mode	Speed (Km / hr)	Emission (g CO <sub>2</sub> / km)
Cars		
Taxis		
LGVs	24.0	241.96
Rigid HGVs	24.0	939.30
Artic HGVs	24.0	1367.70
Buses		
Coaches		
Motorcycles		
Trains		
Walking		
Cycling		



**Post-intervention**

Data used: Own

Mode	Speed (Km / hr)	Emission (g CO <sub>2</sub> / km)
Cars		
Taxis		
LGVs	30.0	215.18
Rigid HGVs	30.0	841.65
Artic HGVs	30.0	1232.74
Buses		
Coaches		
Motorcycles		
Trains		
Walking		
Cycling		

*Emissions from walking and cycling are taken to be negligible*

### Change in total CO<sub>2</sub> emissions

-0.02 thousand tonnes CO<sub>2</sub> (a net saving)

Carbon reduction is based only on the specific travel in the city region

### Change in speed

Pre-intervention will be during peak time and post-intervention will be during off-peak time. So speed will be higher during post-intervention stage.

## 1.26 Introduce two way access for freight

### Intervention details

Intervention name

Brief description of intervention (max 255 characters)

### 1. What time period will be affected?

Describe the time period that will be affected:

If the intervention will affect more than one time period, then you may need to create multiple scenarios. (one for each time period).

### 2. What type of area will be affected?

If the intervention will affect more than one road type or area, then you will need to create multiple scenarios. (one for each road type / area).

Select the road type that will be affected:

Select the type of area that will be affected:

Select the region that will be affected:

Select the year that will be affected:

### 3. Which transport modes will be affected by your transport intervention?

Please tick all transport modes which will be affected:

**Vehicle mix**  
Default national mix used from 2011.

<input type="checkbox"/> Cars	<input checked="" type="checkbox"/> LGVs	<input type="checkbox"/> Buses/coaches	<input type="checkbox"/> Trains
<input type="checkbox"/> Taxis	<input checked="" type="checkbox"/> HGVs	<input type="checkbox"/> Motorcycles	<input type="checkbox"/> Walking/cycling

**Affected modes**  
All freight affected, so LGV and HGV checkboxes selected

## 5. How will the distance change?

**Pre-intervention**

Mode	Daily distance per vehicle (km)	# vehicles	Days affected per year
Cars			
Taxis			
LGVs	8	40	312
Rigid HGVs	8	40	312
Artic HGVs	8	20	312
Buses			
Coaches			
Motorcycles			
Trains*			
Walking			
Cycling			

\*For trains: vehicles=carriages



**Post-intervention**

Mode	Daily distance per vehicle (km)	# vehicles	Days affected per year
Cars			
Taxis			
LGVs	4	40	312
Rigid HGVs	4	40	312
Artic HGVs	4	20	312
Buses			
Coaches			
Motorcycles			
Trains			
Walking			
Cycling			

**Pre-intervention distance**

- Average distance=8km (4km \* 2) in old system
- Assume LGVs and HGVs travel 6 days per week, so 52\* 6 = 312 days affected per year
- Assume 100 freight movements per day (40% LGVs, 40% Rigid HGVs and 20% Artic HGVs)

**Post-intervention distance**

- 4km saved in new system

**6. How will the speed of vehicles change?**

Help me

**Pre-intervention**

Data used: Own		
Mode	Speed (Km / hr)	Emission (g CO <sub>2</sub> / km)
Cars		
Taxis		
LGVs	24.0	241.96
Rigid HGVs	24.0	939.30
Artic HGVs	24.0	1367.70
Buses		
Coaches		
Motorcycles		
Trains		
Walking		
Cycling		



**Post-intervention**

Data used: Own		
Mode	Speed (Km / hr)	Emission (g CO <sub>2</sub> / km)
Cars		
Taxis		
LGVs	28.0	222.50
Rigid HGVs	28.0	871.14
Artic HGVs	28.0	1276.29
Buses		
Coaches		
Motorcycles		
Trains		
Walking		
Cycling		

*Emissions from walking and cycling are taken to be negligible*

**Change in total CO<sub>2</sub> emissions**

**-0.10 thousand tonnes CO<sub>2</sub> (a net saving)**

Total emissions pre-intervention  thousand tonnes CO<sub>2</sub>

Total emissions post-intervention  thousand tonnes CO<sub>2</sub>

***Change in speed***

The new route will be HGV only, so the speed will increase.

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Local Authority Basic Carbon Tool

# A Guide to Carbon Appraisal

V1.0

February 2011

## A Guide to Carbon Appraisal

- This summary complements the basic information in the tool about how to do carbon appraisal for transport interventions, it condenses the information in WebTAG unit 3.3.5, and also clarifies where methodologies and tools are available across the full suite of DfT guidance.
- WebTAG Unit 3.3.5 deals primarily with how to evaluate and assess changes in carbon emissions - between 'with scheme' and 'without scheme' scenarios – as caused by changes in fuel consumption. Although the principles of assessment and valuation are consistent across transport modes (as set out in the tool), different methodologies and tools have been developed to deal with road and rail based interventions.

### 2.1 Road based Interventions

- Information on fuel consumption for various vehicle types, at different speeds, and the carbon content of different road transport fuel types can be found in WebTAG 3.5.6 Value of Time and Operating Costs. This can be applied to a variety of interventions, e.g. reducing speed limits, road widening, and dynamic hard-shoulder running.
- Carbon values can be placed on changes in CO<sub>2</sub>, using the values for an additional tonne of CO<sub>2</sub> that has been derived from the June 2010 DECC guidance on 'Valuation of Energy Usage and Green House Gas Emissions for Appraisal and Evaluation'<sup>2</sup> This provides guidance on carbon valuation in UK policy appraisal based on the estimated abatement costs per tonne of CO<sub>2</sub> equivalent to achieve emissions targets. These values differ between CO<sub>2</sub> emitted from a sector within the Emissions Trading Scheme (ETS), and those not. The ETS caps emissions within the traded sector, so changes in emissions in any specific part of the traded sector will not result in overall reductions in emissions.
- The CO<sub>2</sub> emitted due to electricity generation is "traded", whereas the CO<sub>2</sub> emitted by burning petrol and diesel (and other fuel types) is "non-traded". As most transport interventions input into the tool are likely to decrease the vehicle km travelled by petrol and diesel vehicles, we recommend you use the central non-traded value of CO<sub>2</sub>. However, if your intervention actually results in fewer vehicle km travelled by electric cars or electric trains please refer to the carbon appraisal method for electric trains below.

### 2.2 Rail interventions

- Analysts should use best available evidence, or seek advice from the DfT, on emission factors. For diesel trains, CO<sub>2</sub> impacts of a potential intervention can be estimated, and converted into a monetary value, as with road schemes. For electric trains, it should be highlighted that the cost of the electricity consumed is an important

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<sup>2</sup> [http://www.decc.gov.uk/assets/decc/statistics/analysis\\_group/122-valuationenergyuseggemissions.pdf](http://www.decc.gov.uk/assets/decc/statistics/analysis_group/122-valuationenergyuseggemissions.pdf)

consideration. The cost of electricity is computed in three steps – the electricity requirements are first estimated for the ‘with scheme’ and ‘without scheme’, this is then multiplied by the electricity prices which include the ETS allowance price. The resultant cost of electricity consumption is then accounted for in the same way as other costs in appraisal (see WebTAG Unit 3.5.9 The Estimation and Treatment of Scheme Costs). Because the ETS allowance price reflecting the cost of CO<sub>2</sub> is incorporated in the cost of electricity consumption, no further allowance for the cost of CO<sub>2</sub> is needed.

## 2.3 Other tools produced by the Department for Transport

### *Early Assessment and Sifting Tool*

- This tool has been developed as a decision support tool for options sifting of more complex multi-modal projects. It consists of decision trees to help promoters identify and present evidence on options in a clear and consistent format. It also provides information to help promoters form an early view of how options perform and compare. The tool itself does not make recommendations and is not intended to be used for making funding decisions.

### *Trip End Model Program (TEMPRO)*

TEMPRO (the Trip End Model Presentation program) provides the Department’s standard assumptions for growth in travel demand. The forecasts are provided in terms of demographic data (Planning Data and Car Ownership), trips to and from each location (Trip Ends), and traffic forecasts which can be used to provide a growth factor for vehicles when not using a formal model. The level of spatial detail provided is typically several zones within each Local Authority/District area (2,496 zones for Great Britain).

The data used in TEMPRO is taken from the National Trip End Model (NTEM) and the National Transport Model (NTM). The TEMPRO software and associated NTEM and NTM datasets can be downloaded for free from the TEMPRO website, [www.dft.gov.uk/tempro](http://www.dft.gov.uk/tempro).

Users are also advised to read WebTAG Unit 3.15.2 so that they are aware of the caveats with the data. In particular, users should be aware that the trip end forecasts represent “reference case” growth between two years, assuming that there is no change in travel time or the cost of travel (e.g. due to a new transport intervention or increased congestion). Also, the split of trip ends by mode is based on travel diary surveys from a wide area, and does not take into account the accessibility of each spatial area by each mode.

Please note that TEMPRO cannot be used to appraise carbon.



## 2.4 Using the tool to assess the impact of Behavioural Change

To estimate the change in carbon emissions, the key input in the carbon tool is an estimation of the change in speeds a particular intervention may result in. This will need to take into account any changes in traffic. For example, an intervention which is forecast to reduce car trips and congestion, will be somewhat offset by an increase in car traffic that is likely to be “attracted” by the lower congestion brought about by the intervention.

A local authority may have access to information that can help determine changes in average speeds and traffic flows. This could be from a local transport model. Where such local data is available it is recommended that this should be used as an input in the carbon tool.

In the absence of any local data, the DfT is able to provide illustrative estimates of a change in road speeds for given percentage changes in car trips / traffic on particular roads in particular areas. These estimates could be used as default assumptions for a local authority in the absence of better local information.

The figures in the table below provide illustrative figures for changes in average speed by Area Type and by Road Type for an approximate 50% reduction in education based trips. These figures may be useful to help analyse the impact on carbon for school- based travel plans which are likely to impact on the level of car traffic in a particular area. For illustrative purposes, the figures could be adjusted to reflect different levels of car trip reductions.

For example, a local authority in a big urban area might want to know what the impact of a school based travel plan is on a scheme which helps reduce 10% of Education based car trips on a minor road. The change in average speed on a minor road in a big urban area following an approximate 50% reduction in Education based trips is equal to 0.1km per hour. This would imply a 10% reduction in education based car trips would be equal to an average speed change of around 0.02km per hour. This could then be used as an input in carbon tool to help assess the change in carbon emissions.

Please note that the figures below should be viewed as illustrative figures only and do not represent DfT views on the impact on speeds following a reduction in car trips.

Time period	Area Type	Road type	Change in total speed (kms per hour)
Morning peak	Conurbations	Major	0.36
Morning peak	Urban	Major	0.34
Morning peak	Rural	Major	0.07
Morning peak	Conurbations	Minor	0.17
Morning peak	Urban	Minor	0.14
Morning peak	Rural	Minor	0.06
Average	Conurbations	Major	0.34
Average	Urban	Major	0.29
Average	Rural	Major	0.03
Average	Conurbations	Minor	0.17
Average	Urban	Minor	0.13
Average	Rural	Minor	0.03

## 2.5 How to Reduce Emissions at the Local Level

Reducing carbon emissions from transport at the local level can generally be delivered by:

- **Technological change e.g. purchasing more fuel efficient vehicles**

Assuming the cost of operating a particular vehicle remains the same, technological change is unlikely to impact significantly on road traffic speeds. This is because in the absence of any change in the relative cost of operating such a vehicle, the overall level of demand following this technological change will remain unchanged. This means carbon savings will be achieved solely through the change in technology and not through a change in traffic speeds.

However, if the cost of operating a particular vehicle falls following a technological change – perhaps because a vehicle becomes more fuel efficient – while all other costs remain the same, then this form of technological change will impact on traffic speeds. This is because the cost of operating that vehicle will effectively fall and will therefore increase the demand for travel by this particular mode. An increase in demand will increase overall congestion and traffic. This will mean the change in carbon emissions will not only be from the change in technology but also through the change traffic and change in average speeds.

- **Behavioural change e.g. switching to ‘greener’ forms of transport;**

If behavioural change leads to people switching to different modes of transport then there will be an impact on demand and traffic speeds.

For example, behavioural measures aimed at encouraging the use of more sustainable modes of transport will inevitably lead to lower levels of car traffic. Lower levels of car traffic will therefore also reduce overall congestion. Lower congestion will increase average speeds and will therefore enable existing traffic to travel at more fuel efficient speeds. This means carbon savings from behavioural change measures will come through the change in traffic and through the change in average speeds.