Defra

Expanding Defra's modelling capacity to assess wider impacts of air quality policy (AQ0961)

User Guide

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With Systra and Energy Saving Trust

Report for

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Document revisions

No.	Details	Date
1	User guide (v1 at completion of stage 2)	17/02/2015
2	User guide (v2 at Stage 3)	07/04/2015
3	User guide final	05/06/2015

Contents

1. Introduction

1.1 User Guide

This User Guide explains the functionality of the model as a step by step guide for an unfamiliar user. It guides the user on which inputs need to be entered and options that can be selected, explains the basis and source for the fixed input parameters and explains the output results that are produced. The model is also accompanied by a separate Technical Specification document which provides a more detailed description of the methods applied to calculate the impacts, the assumptions and limitations, as well as the structure and workings of the model. This User Guide does not therefore go into details of the assessment methodology or provide information on the formulas used in the model.

1.2 Scope of the model

The model can be used to assess the following impacts of air quality policies, when relevant to the intervention being assessed:

Table 1.1 Impacts covered within the model

Impact category	Impact	Definition	User inputs required	Output
Distributional impacts	Affordability for business	Change in business' disposable income.	Percentage of businesses impacted Average annualised cost of compliance per business Capital (transitional costs per businesses) Annual operating costs per business (optional) Percentage of businesses able to pass costs Percentage of compliance cost that could be passed Affordability thresholds	Number and percentage of businesses for which the costs of implementation of the measure will have a significant impact.
	Affordability for individuals	Change in households' disposable income.	Change in energy consumption per household Change in domestic fuel prices Capital cost per household for domestic energy use Years over which capital cost is annualised Age of cars affected by the policy Average car lifetime Capital cost per household	Average cost per household due to changes in transport patterns and price, change in domestic energy consumption and price and capital costs (i.e. scrappage schemes).

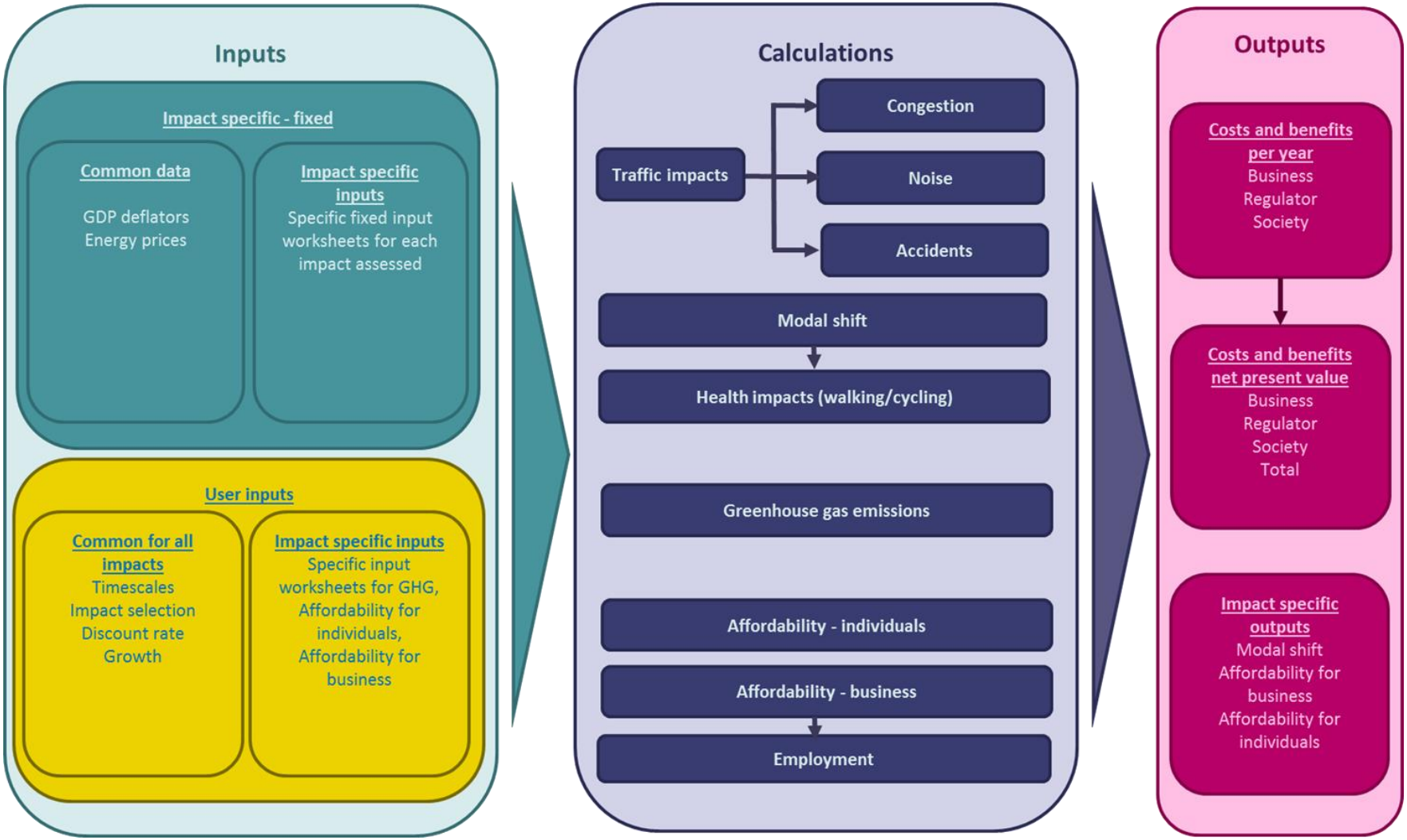
Impact category	Impact	Definition	User inputs required	Output
			Change in annual car travel per household Increase in road fuel prices Increase in public transport Increase in average fares per trip	
Economic impacts	Employment	Change in jobs	None – Calculated from Affordability for Businesses data	Number of jobs potentially affected
Environmental impacts	Greenhouse gases	Change in emissions of greenhouse gases.	Change in energy consumption (units vary depending on the fuel) Non-fuel GHG emissions (CO_2 eq) Rebound effects (per cent or absolute)	Monetised impact of the change in GHG emissions for traded and non-traded sectors. Also cost per tonne of CO_2e indicator.
Transport specific impacts	Congestion	Change in traffic congestion	Change in vehicle km Location of the change in vehicle km (optional)	Monetised impact of congestion.
	Safety - accidents	Change in accident rates		Monetised impact of accidents.
	Noise	Change in noise levels.		Monetised impact of noise.
	Modal shift	The change in trips made by alternative modes of transport in response to the scheme.		Change in the number of trips per mode of transport and area
	Health impacts from walking and cycling	Reduced morbidity through increased health and fitness from using active modes of transport.	Number of cycling and walking journeys due to the policy Average length of journey and speed A number of control options are populated by default but can be changed by the user.	Monetised impacts of health impacts.

2. General model description

2.1 Structure

The schematic diagram presenting key conceptual elements of the model is illustrated in Figure 2.1 below. The model operates in Microsoft Excel 2013.

Figure 2.1 Conceptualisation of the model



The model contains a number of Control sheets in which the user enters input data specific for the policy assessed or selects options from drop down lists. For the majority of impacts, there are dedicated Control sheets developed in the model. That is because there is generally little overlap in the user inputs required for the assessment of the different impacts and for some impacts there are a large number of input parameters required. The Control sheets are the main interface for the user.

There are subsequent data sheets containing fixed inputs. These should be updated by the user when updated underlying data sets are published. A Reference sheet provides a list of all the reference sources and weblinks of the fixed input data to assist the user in this updating process. Several fixed inputs for the calculations have been provided by Department for Transport specifically for this model. These sources are not expected to be available in the public domain in the future and as such the ability for the user to update them will rely on obtaining the data from DfT or other relevant stakeholders. Inputs for which this is the case have been clearly indicated in the model.

Both the user-defined and the fixed inputs tables require entry of data in the appropriate units, format, year etc. as per the headings and labels. Often the user is given the flexibility to choose from a selection of possible units when entering the inputs.

Calculations for the assessment of each impact are each presented in a separate sheet. There is little interaction between different impacts and so calculations are performed independently. An exception is the impacts of modal shift which is linked to health impacts of walking and cycling. Data from the Control and Inputs sheets are imported into the Calculation sheets, as relevant for the assessed impact, based on the options selected in the Control sheets. The next steps calculate the quantified values and then (where applicable) monetise these values, in accordance to the methods specified in the Technical Specification.

Intermediate outputs are presented for each impact showing the transitional and recurring costs and benefits separately for most impacts. This is to allow the user to extract these data, and when relevant add them to equivalent data on costs of other direct or indirect impacts which may be estimated using bespoke methods outside of this model. For certain impacts it is not possible to monetise the impact and therefore alternative, appropriate presentation of quantified impacts is presented. This is discussed in the sections on the individual impacts below.

The output costs and benefits, or other numerical results, for each impact are presented in a Results summary sheet so the user can see each of the impacts that are relevant for the measure assessed[1]. For impacts for which monetisation is possible, the net present value (NPV) of the costs (or benefits) for each impact is calculated and presented using a consistent approach to the Impact Assessment Calculator (BIS, 2013). Where possible the results distinguish between the impacts on the regulator, businesses and society. In the Control sheet, the user has the option to select different discount rates and assessment periods to suit the purpose of the appraisal.

The model is contained within a single file with no interlinked external spreadsheets.

A summary of the worksheets in the model is presented in Table 2.1. The model is structured using five types of sheets depending on their function and colour coded as displayed below.

[1] The costs are not summed up to avoid misleading a user into thinking that these costs are the total costs from all wider impacts. There are several impacts for which it has not been possible to develop a generic method to estimate the costs and in a regulatory impact assessment, depending on the policy lever under consideration, these costs may need to be calculated by other means.

Table 2.1 Worksheets in the model

Tab function	Sheet name	Description
Version log	Version	Provides a log of major changes during the development of the spreadsheet, a QA register and status and a colour key used across the model.
Instructions	Overview	Summary flow chart of the model
References	References	Register of reference sources used for fixed inputs
Control – user inputs	Control	Information, data and selection of inputs to be entered by the user Currently include inputs to be entered by user of the model for assessment of traffic related impacts
	Control-GHG	Additional control sheet to allow for large volume of inputs that may be entered by the user to assess impact on greenhouse gases.
	Control-BusinessAffordability	Additional control sheet to allow for large volume of information that may be entered for Business Affordability
	Control – Indiv Affordability	Additional control sheet to allow for large volume of information that may be entered for the assessment of Affordability for Individuals.
Fixed inputs	Inputs-Common data	Input data common to several impacts: - GDP deflators - Fuel prices - Ranges for the classification of final uncertainty
	Inputs-traffic	Input data to assess transport impacts: - Traffic shares by region and time - Marginal External Costs by region and time - Traffic by region, congestion band, area and road type - Marginal External Costs by congestion band and road type - Trip change per additional 1,000 car km change, by area type - Factors for health benefits impact
	Inputs-GHG	Input data for the assessment of GHG impacts: - Electricity emission factors - Average emission factors per sector - Gaseous, liquid and solid fuels emission factors - Transport emission factors (2014) - Fuel properties - Conversion factors from user input units to kWh for selected fuels (2014) - Conversion factors from user input units to litres of fuel for transport (kWh in the case of electric transport) (2014) and units after conversion - Carbon prices and sensitivities (low, central and high) for appraisal (£/tCO_2e) - Long-run variable costs of energy supply (LRVCs) - Retail energy prices
	Inputs-BusinessAffordability	Input data for affordability to business assessment: - Numbers, employees and turnover of businesses by industry division - Gross operating surplus and mixed income
	Inputs-Employment	Fixed inputs for the assessment of employment
	Inputs-AffordIndividuals	Fixed inputs for the assessment of individual affordability impacts
	Calculations-Congestion	Calculations for assessment of congestion

Tab function	Sheet name	Description
Calculations	Calculations-Noise	Calculations for assessment of noise
	Calculations-Accidents	Calculations for assessment of impacts on accidents
	Calculations-Modal Shift	Calculations for assessment of modal shift
	Calculations-Health Impacts (MS)	Calculations for assessment of health impacts of cycling linked to modal shift assessment
	Calculations-Health Impacts (SA)	Calculations for assessment of health impacts as a standalone assessment
	Calculations-GHG (central)	Calculations for assessment of greenhouse gases impact for the central scenarios.
	Calculations-GHG (low)	Calculations for assessment of greenhouse gases impact for the low scenarios.
	Calculations-GHG (high)	Calculations for assessment of greenhouse gases impact for the high scenarios.
	Calcs-BusinessAffordability (central)	Calculations for assessment of affordability to business for the central scenarios.
	Calcs-BusinessAffordability (low)	Calculations for assessment of affordability to business for the low scenarios.
	Calcs-BusinessAffordability (high)	Calculations for assessment of affordability to business for the high scenarios.
	Calcs-Employment (central)	Calculations for assessment of employment for the central scenario.
	Calcs-Employment (low)	Calculations for assessment of employment for the low scenario.
	Calcs-Employment (high)	Calculations for assessment of employment for the high scenario.
	Calcs-AffordIndiv(Transport)	Calculations for assessment of affordability for individuals for policies affecting household travelling patterns.
	Calcs-AffordIndiv(Domestic)	Calculations for assessment of affordability for individuals for policies affecting domestic use of fuel.
Outputs	Results-Congestion	Summary of costs and benefits by year for congestion impact
	Results-Noise	Summary of costs and benefits by year for noise impact
	Results-Accidents	Summary of costs and benefits by year for congestion impact
	Results-Modal shift	Summary of change in a number of trips by mode of transport and year Total change in the number of trips per mode for the whole appraisal period
	Results-Health Impacts	Summary of costs and benefits to human health from increased cycling presented for the assessment linked to modal shift and the standalone assessment (new users and existing uses)
	Results-GHG	Summary of total monetised costs and benefits for the GHG impact
	Results-BusinessAffordability	Summary of numbers and percentages of businesses with significant impact by company size and industry division
	Results-Employment	Summary of results for employment impact.
	Results-Indiv Affordability	Summary of results for assessment of affordability for individuals.
	Results-Summary	Aggregated summaries of main results for each impact

2.2 Colour key

Throughout the spreadsheet the following text colours are used to clearly indicate whether values in cells are typed inputs, cross linked values referenced from another part of the spreadsheet or calculated values (differentiating between main calculations and in-built cross checks). User-defined inputs should be entered in yellow shaded cells.

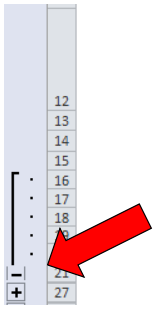
Table 2.2 Key for text colours used in the model

Key
User input variable
Blue = fixed inputs
Black = calculations
Green = direct cross reference
Red = warning
Grey = cross-checking

2.3 Spreadsheet functionality

"+" and "-" symbols in the margins of the worksheets (see example in Figure 2.2) can be clicked to expand or hide rows and columns. These have been included to compress the worksheets and hide cells that may be empty or redundant if not used in that assessment. Expanding rows or columns may be necessary to allow for entry of additional rows of data. Users are not expected to insert or delete rows from the model. However if new rows and columns are inserted in the model, both the User Guide and the Technical Specification for the model need to be updated with new cell references.

Figure 2.2 Expanding and hiding the rows in the spreadsheet



2.4 Spreadsheet protection

With the exception of the control tabs (**Control, Control-GHG, Control-BusinessAfford** and **Control-Affordindiv**) all the worksheets in the file have been protected. This is to avoid the user to inadvertently modify the equations and inputs. No password has been set to unprotect the sheets. If the user wants to make changes in a protected sheet he or she just needs to click on the button "Unprotect sheet" in the ribbon under the "Review" category.

3. Common parameters for the assessment of all impacts

3.1 Which impacts are assessed and where to find the relevant worksheets

Control sheet Rows 17:32 show the list of impacts covered by the model and provides a series of hyperlinks to the different sections assisting the user in navigating the model.

Impacts covered in this model

	Go to:					
Transport related impacts						
Congestion	Input (to enter)	Inputs (fixed)	Calculations	Results		
Safety / accidents	Input (to enter)	Inputs (fixed)	Calculations	Results		
Noise	Input (to enter)	Inputs (fixed)	Calculations	Results		
Modal shift	Input (to enter)	Inputs (fixed)	Calculations	Results		
Health impacts of walking and cycling	Input (to enter)	Inputs (fixed)	Calculations 1	Calculations 2	Results	
Environmental						
Greenhouse gas emissions	Input (to enter)	Inputs (fixed)	Calculations 1	Calculations 2	Calculations 3	Results
Distributional impacts						
Affordability for business	Input (to enter)	Inputs (fixed)	Calculations 1	Calculations 2	Calculations 3	Results
Employment		Inputs (fixed)	Calculations 1	Calculations 2	Calculations 3	Results
Affordability for individuals	Input (to enter)	Inputs (fixed)	Calculations 1	Calculations 2	Results	

3.2 How to describe the assessment

Control (C3:C8): Enter details of the assessment being undertaken. These cells are for the user records and to help keep track of different modelling rounds. They do not influence the functioning of the model. In cell C9 the user is reminded to check input data to understand the counterfactual built in the model.

Project / measure title:	Impact assessment of Measure A
Project ID / reference number:	3759-A
Date of assessment:	42297
Name of assessor:	Edward Teach
Version:	1.5
Description of measure:	Increase proportion of electric cars to 5%
Current status (counterfactual):	The user should check the relevant input data sheets to understand the basis for the counterfactual.

Although the values entered in these cells do not influence the results of model, it is good practice (and strongly advised) to fill them with meaningful information and follow a file naming convention based on the measure being modelled. A copy of the master file with default values should be kept separately in a safe folder.

3.3 How to define timescales for the assessment

Control sheet (C12:C15): Enter the current year, appraisal period start and end year and the year against which prices should be presented (inflated/deflated).

Timescales		
Current year	2014	
Measure start year	2020	
Assessment end year	2030	
Costs to be inflated/deflated to	2014	prices

The current year is the default year against which prices should be presented. A previous year can be entered to ensure the results are compliant with a broader assessment. For example, 2009 is to be used for the OITO Impact Assessment Calculator (BIS, 2014), or 2010 for WebTAG (DfT, 2014).

3.4 How to change the discount rate

Control "*Common data*" (C35): Select the discount rate from the drop down list of options: 3.5%, 7%, 10% or 15%. The default rate is 3.5%, consistent with HMT Green Book Guidance.

4. Inputs to the model

4.1 User inputs

The specific user inputs that are needed for an assessment using the wider impacts model, and instructions on how to enter them, are described in detail in sections 5 to 11 for each impact. Table 4.1 below presents an overview of all user inputs required in the model, highlighting where these are optional.

Table 4.1 User inputs to the wider impacts model

Impact	Comment	Necessary user input	Optional user input
Congestion **Safety** **Noise** **Modal shift**	Assessment of these four impacts require the same user inputs.	**Change in vehicle km** This does not distinguish between vehicle, fuel type or road type. **Location of the change** The user can determine whether the change of vkm appears in: Great Britain, England and Wales, England, Scotland, Wales, East Anglia, East Midlands, London, North East, North West, South East, South West, West Midlands or Yorks&Humber.	**Proportion of total traffic for different area types and road types (%)** Instead of selecting the location (see left), the user can specify where and on what type of roads the change in vkm is expected to happen exactly. The input needs to be in % and distinguish between **London, Inner and Outer Conurbations, Other Urban and Rural areas**, and between the road types: **Motorways, A Roads, Other roads**.
Health impacts of cycling and walking	This impact does not use change in vehicle kilometres.	**Number of cycling journeys per day as a result of the policy/measure** **Number of walking journeys per day as a result of the policy/measure**	**Average length of the cycling journey (km)** **Average length of the walking journey (km)** Other assumptions that can be modified are: Decay rate (%) Year decay starts Ramp up of health benefits (years) Number of days in the year on which cycling and walking occur Share of journeys that form part of a return trip Background annual growth (%)
Greenhouse gases	Inputs depend on the type of policy being assessed. For a given policy only a selection of the user inputs specified might be required. **For general policies:** Change in energy consumption. **For transport policies:** The inputs can be provided either as: overall change in the volume of transport fuel used as a result of the policy OR Change in vehicle kilometres for: cars, motorbikes, taxis Buses, rail	**General policy: Change in electricity and fuel consumption.** Units can be kWh, tonnes, litres or cubic meters (depending on the fuel type). **Transport policy (option 1): Change in transport fuels used (litres).** This can be provided for: petrol, diesel, aviation spirit, aviation turbine fuel. The inputs are in litres. **Transport policy (option 2): Change in vehicle kilometres or vehicle miles (user can select the unit in which it provides input) for:** • Cars • Motorbikes • Taxis • Rail	There are no optional inputs.

Impact	Comment	Necessary user input	Optional user input
		For **buses** and for **rail,** inputs are required in **passenger kilometres**. For taxis user can input either **vehicle kilometres or passenger kilometres.** The user has to enter inputs according to the vehicle type, sub-type and fuel type. **Change in non-fuel related GHG** **Rebound effect**	
Affordability for business **Employment**	The user has to enter the inputs **per sector affected** (see table below) and **per size of business** (no employees, micro, small, medium, large). No additional inputs are required for the employment assessment.	**Percentage of businesses impacted (%)** **Average annualised cost of compliance per business (£ per year)** **Percentage of businesses able to pass costs (%)** **Percentage of compliance cost that could be passed (%)**	**Affordability thresholds** Instead of entering the average annualised cost of compliance per business the user can enter: • Capital (transitional costs per business) • Annual operating costs per business If the above costs are entered the user has an option to specify the **annualisation timescale**. If not provided, default figures will be used.
Affordability on individuals	The user inputs required depend on the type of policy being assessed. For a given policy only a selection of the user inputs specified might be required.	**For assessment of policies affecting household's energy use:** **Change in energy consumption per household (% or kWh)** **Change in domestic fuel prices due to the application of the policy/measures (% or p/kWh)** **Capital cost per household (£)** **Years over which capital cost is annualised** **For assessment of policies affecting household's travel patterns:** **Age of cars affected by the policy** (for policies requiring a household to purchase new vehicle) **Capital cost per household** **Change in annual car travel per household** **Increase in road fuel prices due to the policy/measure** **Increase in public transport (trips per household)** **Increase in average fares per trip due to the application of the policy/measure**	**There are no optional user inputs.**

4.2 Fixed inputs

The wider impacts model uses multiple fixed inputs which provide underlying data for the calculations of the impacts. **Before using the model, it is advised that sources listed in the Reference worksheet are checked to ensure the input data are up to date. Sources may be updated with different frequency. When more recent data becomes available, the fixed inputs should be updated following the advice provided in the relevant sections of the Technical Specification.**

Each fixed input used in the model, together with a screenshot, full reference of the source of data, and where available a link to the relevant website, is provided in the Technical Specification for the model to guide the updating process when required.

It is recommended the fixed inputs are updated with the latest data as they become available. The model should remain valid in future years providing the fixed inputs are up-to-date. The majority of the fixed inputs are published on an annual basis, it is therefore recommended that if the reference source is more than one year old, the user checks for the most recent available release. As different data is published at different times of the year it is recommended that references sources are checked regularly. Wherever possible, the fixed inputs have been incorporated into the model in the same format as they appear in the original source. This means that when updating the fixed inputs, the user of the model can copy the information directly from the source to the model. When updating the fixed inputs, it is recommended that inputs used in the assessment of more than one impact are prioritised (e.g. GDP deflators).

5. Assessing impacts on congestion, noise and safety

This section explains the steps required to assess the impact of a measure on congestion, noise and safety. Assessment of these impacts follows the same methodology and hence are discussed together in this user guide. For a more detailed description of the method applied to calculate this impact please refer to section 4 of the Technical Specification document.

5.1 What are these impacts?

The wider impacts model monetises the impact of change in congestion, safety and noise due to increase / decrease in vehicle kilometres. The results provided by the wider impacts model for congestion, noise and accidents impacts can be either costs (positive values in case of increase in vehicle kilometres) or benefits (negative values in case of decrease in vehicle kilometres).

Congestion

Road traffic congestion increases journey time and emissions of CO_2 and air pollutants which have detrimental health effects. The main cause of congestion is that the volume of traffic is close to the maximum capacity of a road network. Congestion has an impact on both the speed of travel and on the reliability of travel conditions, with the latter to be of greatest concerns to individuals and businesses[2]. If congestion is removed by avoiding car journeys, the impacts of relieving congestion are dependent on the time and place of the avoided journey; benefits will be larger for travel at peak hours and in busy areas but lower for off-peak travel.

Safety/ accidents

A shift to public transport achieves benefits due to transfer to a more sustainable mode, but for active travel there is likely to be a significant increase in accident costs because walkers and cyclists are more vulnerable to road accidents. Specifically, the most vulnerable social groups to accidents are children, older and disabled people, pedestrians, cyclists and motorcyclists[3].

Noise

Noise pollution consistently ranks high on the list of citizens' concerns and it is estimated that over half of Europe's population is exposed to unacceptable noise levels[4]. Traffic is the most widespread source of environmental noise. It is recognised that relatively large changes in traffic flows are required to bring about significant changes in the noise levels in the long term. Exposure to high levels of noise can lead to adverse health effects such as sleep disturbance, disturbed cognitive functioning (learning and understanding), cardiovascular disease and mental health effects.

5.2 Which parts of the model are relevant for these impacts?

The assessment of this impact uses inputs from the **Control**, **Common data** and **Inputs-traffic** sheets. Calculations are carried out in the **Calculations-Congestion, Calculations-Noise and Calculations-Accidents** sheets. Results are presented in **Results-Congestion, Results -Noise and Results -Accidents** and summarised in **Results-Summary**.

[2] Transport Research Centre, European Conference of Ministers of Transport, Managing Urban Traffic Congestion
[3] Safety of Vulnerable Road Users, Organisation for Economic Co-operation and Development, 1998
[4] Traffic Noise Reduction in Europe, Health effects, social costs and technical and policy options to reduce road and rail traffic noise, CE Delft, August 2007

5.3 What parameters are required and how to input them?

User-defined inputs

Follow the steps in Section 3 in order to set common parameters for the assessment.

Input change in vehicle-kilometres

Control "*Table 1*" (rows 41:91): Enter data for the change in vehicle-kilometres expected to occur as a result of the measure. Enter data reference years as five year intervals for the appraisal period as a minimum. If the start or the end of the appraisal period falls between any five year intervals also include the five year interval before and after the start and end years of the appraisal period. This is necessary because the fixed inputs are only available for five year intervals. Examples are provided below.

Box 1	**Example of necessary inputs depending on the years in the appraisal period**
Example 1 Appraisal period: 2020-2030. Necessary data reference years: 2020, 2025 and 2030. Example 2 Appraisal period: 2022-2030. Necessary data reference years: 2020, 2025 and 2030. Example 3 Appraisal period: 2022-2032. Necessary data reference years: 2020, 2025, 2030 and 2035.	

By default, only the five year interval rows are displayed. If user inputs are available for individual years, this can also be entered. Rows for individual years within the interval can be displayed by expanding rows clicking in the adjacent '+' signs to the left of the table.

Column B "*Years*": Already populated up to 2035.

Column C "*Change in vehicle kilometres*"-"*Central*": Enter data for the change in vehicle kilometres expected to occur each year as a result of the measure. Values should be negative if there is a reduction in vehicle kilometres and positive if there is an increase. Values should represent a central or best case estimate.

Column D: E "*Change in vehicle kilometres*"-"*Low*" *and* "*High*": If a low and high scenario or uncertainty range is available these data should be entered to allow for an indication of the uncertainty range to be presented with the results of the assessment.

Column F "Uncertainty"-"Qualitative": If a numerical data range for uncertainty is not available, an estimate of the level of uncertainty associated with the central values should be selected. The resulting uncertainty score will be displayed in Column G. If a range is available, "not used" should be selected in these cells.

Column H "Comments": Comments can be entered for future reference, for example to support the qualitative uncertainty estimate selected.

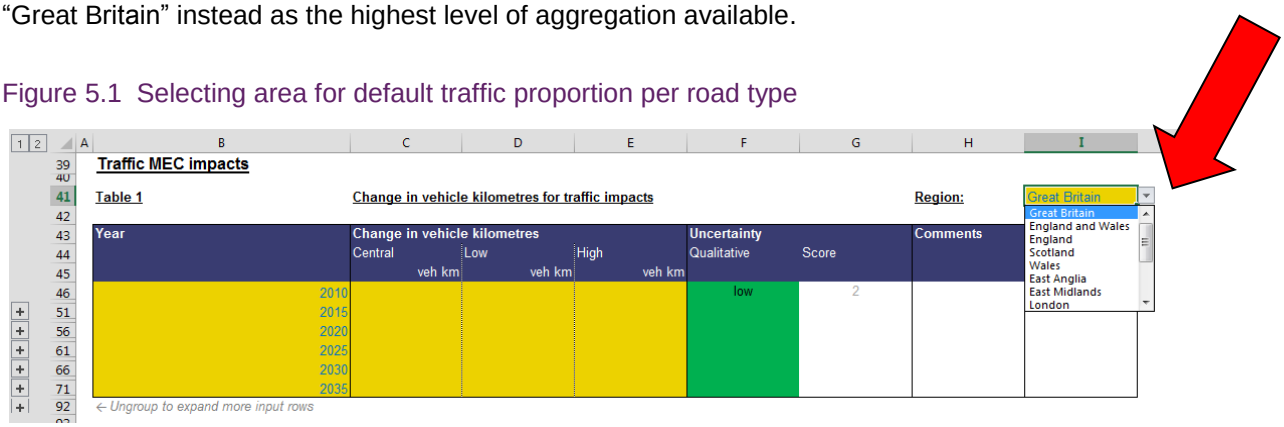
Column I "Reference": Enter a reference of the source or internal modelling from which the change in vehicle kilometres data have been taken.

Input proportion of total traffic for different area types and road types ***(OPTIONAL INPUT)***

Control "*Table 2 (Optional) Proportion of total traffic for different area types and road types*" (rows 94:107): Enter data for the expected locations of the traffic as a result of the measure for each five year interval. This should be expressed in per cent of total traffic (all road traffic). Average figures across all congestion bands should be entered. This input makes it possible to specify where the policy being assessed is expected to cause changes in the intensity of traffic (i.e, where the change in vehicle kilometres will occur). The following area types are used: London, Inner and Outer Conurbations, Other Urban, Rural; and the following road types are distinguished in these areas: Motorways, A-roads, Other Roads. All figures entered need to add up to 100% across all area types and road types.

THIS INPUT IS OPTIONAL. If this data is not available, select the region for the assessment in cell I41 as appropriate. This will populate proportion of traffic in the **"Calculation-Congestion"** sheet with default figures. It should be noted that default values are not available at UK level, but the user can select data for "Great Britain" instead as the highest level of aggregation available.

Figure 5.1 Selecting area for default traffic proportion per road type



If the data on the resulting proportion of traffic is available follow these steps:

Go to **Control** "*Table 2 (Optional) Proportion of total traffic for different area types and road types"* (rows 99:107).

Column B "*Year*": Enter data reference years as five year intervals for the appraisal period. These should be the same as included in Table 1 (rows 46:91).

Column C, D, E: Enter data for the traffic proportions for different road types in London.

Column F, G, H: Enter data for the traffic proportions between different road types in Inner and Outer Conurbations. Please note that the values input in columns C: M need to add up to 100% in each assessment year.

Column I, J: Enter data for the proportion of traffic location between different road types in other urban areas

Columns K, L, M: Enter data for the proportion of traffic location between different road types in rural areas

Figure 5.2 Example of user inputs on the proportion of total traffic for different area types and road types

Table 2 (Optional) **Proportion of total traffic for different area types and road types** **Unit:**

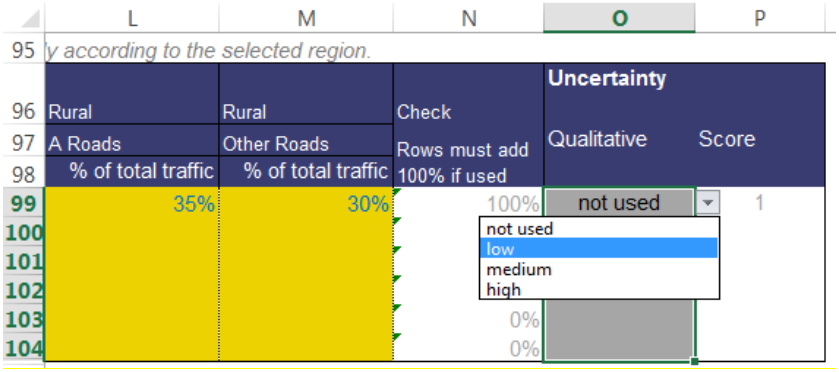
If the user does not specify the proportion of total traffic for area and road types, standard values will apply according to the selected region.

Year	London Motorways % of total traffic	London A Roads % of total traffic	London Other Roads % of total traffic	Inner and Outer Conurbations Motorways % of total traffic	Inner and Outer Conurbations A Roads % of total traffic	Inner and Outer Conurbations Other Roads % of total traffic
2010	50%	25%	25%			
2015	10%	10%	10%	10%	10%	
2020						
2025						
2030						
2035						

Column N "Check": This column contains an auto-check that adds up the percentage of traffic for each road type. If table 2 is used, this column should show 100% for each year containing data.

Column O "Uncertainty"-"Qualitative": Select the level of uncertainty associated with the values you entered from the drop down menu. The resulting uncertainty score will appear in Column P.

Figure 5.3 Selecting level of uncertainty for the traffic proportion per road type inputs



Fixed inputs

In addition to the discount rate explained in section 3, the assessment of congestion, noise and accidents impacts requires two other fixed inputs:

Proportion of total traffic for different area types and road types; and

Congestion Marginal External Costs (MEC) by road type.

These inputs do not need to be manipulated by the user in order to run the model. However, they should be updated whenever new data are available.

These data are presented in the **Inputs-traffic** worksheet. Click on the hyperlinks at the top of the sheet to navigate to the relevant table.

"*Proportion of total traffic for different area types and road types*" (rows 8:108): This presents the percentage of traffic by road and area type. The source for these data is DfT, 2014,WebTAG, Table A 5.4.1 - Traffic by region, congestion band, area type & road type. Traffic proportions in WebTAG are taken from traffic levels in National Transport Model (NTM) traffic database and forecasts. Traffic includes all road traffic except motorcycles (which are not included in NTM). Although the source reference data also includes information on congestion band, only the average is used in the Wider Impacts model. Values in this table will be used as default unless alternative values are entered in Table 2 of the Control tab. Figure 5.4 illustrates this input.

Figure 5.4 Proportion of total traffic for different area types and road types

Proportion of total traffic for different area types and road types

		2010LondonMo	2010LondonA	2010LondonOth	2010Inner and	2010Inner and	2010Inner and	2010Other Urba	2010Other Urba	2010Rural Motor	2010Rural A Ro	2010Rural Other Roads	2010
		2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	
		2010 Proportion of Total Traffic in each congestion band for different regions, area types and road types (1 d.p.)											
Region	Congestion band	London	London	London	Inner and Out	Inner and Out	Inner and Out	Other Urban	Other Urban	Rural	Rural	Rural	Grand Total
		Motorways	A Roads	Other Roads	Motorways	A Roads	Other Roads	A Roads	Other Roads	Motorways	A Roads	Other Roads	
	1	0.1%	0.3%	1.1%	0.7%	1.2%	3.9%	2.2%	8.1%	2.8%	11.4%	11.3%	**43.0%**
	2	0.2%	0.8%	0.7%	1.8%	2.2%	1.6%	4.4%	2.8%	6.5%	9.0%	1.7%	**31.6%**
	3	0.0%	1.0%	0.3%	1.7%	1.5%	0.8%	3.3%	1.1%	4.1%	2.2%	0.5%	**16.6%**
	4	0.0%	1.0%	0.3%	0.5%	1.2%	0.7%	1.9%	0.5%	0.6%	0.5%	0.3%	**7.5%**
	5	0.0%	0.3%	0.1%	0.0%	0.1%	0.1%	0.4%	0.0%	0.0%	0.0%	0.2%	**1.2%**
Great Britain	**Average**	**0.3%**	**3.5%**	**2.5%**	**4.6%**	**6.2%**	**7.1%**	**12.3%**	**12.5%**	**14.0%**	**23.1%**	**14.0%**	**100.0%**

"Congestion *Marginal External Costs (MEC) by road type*" (rows 110:141): This presents the Marginal External Cost per vehicle kilometre for different road types and areas. The unit is pence per veh-km in 2010 prices. The source for these data is DfT, January 2014, WebTAG Table A 5.4.2 - Marginal External Costs by road type and congestion band. Only the average for all congestion bands is used in the Wider Impacts model.

Figure 5.5 Marginal external costs (MEC) by road type

Marginal External Costs (MEC) by road type

2010 Marginal External Costs & Indirect Tax - Cars (pence per car km, 2010 prices, 1 d.p.)													
	Congestion band	London			Inner and Outer Conurbations			Other Urban		Rural			Weighted Average
Cost type		Motorways	A roads	Other Rds	Motorways	A roads	Other Rds	A roads	Other Rds	Motorways	A roads	Other Rds	Weighted Average
Congestion*	Average	0.1	67.1	46.4	2.8	34.2	23.8	13.2	10.8	1.1	2.2	2.7	11.5
Infrastructure	All	0.0	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1
Accident	All	0.0	3.0	3.0	0.0	3.0	3.0	3.0	3.0	0.0	0.7	0.7	1.6
Local Air Quality	All	0.3	0.3	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1
Noise	All	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.0	0.0	0.1	0.1
Greenhouse Gases	All	0.9	1.0	1.2	0.9	0.9	1.0	0.8	0.9	0.9	0.8	0.8	0.9
Indirect Taxation	All	-5.3	-5.6	-7.1	-5.2	-5.2	-5.7	-4.8	-5.4	-5.3	-4.8	-4.7	-5.1
Total		-3.8	66.1	44.1	-1.1	33.3	22.5	12.6	9.7	-3.2	-1.0	-0.3	9.2

A qualitative estimation of the uncertainty associated with each of these datasets is shown under each table. This is carried through into the calculations and the results. The current uncertainty classification was estimated by the model developers. The criteria behind the classification are detailed in the Technical Specification. If the data in the tables are updated the uncertainty can be amended accordingly by clicking and selecting from the drop-down menu.

These data tables have a consistent format with the original reference source (WebTAG). In case of an update of the reference source, the inputs should be updated accordingly by replacing the existing data with the updated data, keeping the same format. It is important that any new data added matches the years at the head of the table. Currently, WebTAG projections extend until 2035. Extra empty tables in grey have been added at the end of the fixed inputs (column CN) to allow for easy incorporation of data up to 2050 in future updates of the WebTAG tool. If the format of the reference sources (WebTAG) changes, then changes may also be required to the format of the corresponding Wider Impacts model data tables. In that case refer to the Technical Specification document for guidance on making structural changes to the model

5.4 What calculations are performed?

The sheets **Calculations-Congestion, Calculations-Noise, Calculations-Accidents** contain the calculations performed to assess the impact of the measure on congestion, noise and accidents. Changes should not be made to these sheets, unless the format of the input data is changed, in which case refer to the Technical Specification document for guidance.

Summary of inputs (rows 3 to 85): This provides a summary of the relevant inputs that are used in the calculations.

Calculations for these impacts follow two steps:

Step 1. Weighted average Congestion, Noise, Accidents MEC (rows 88:147): This calculates the weighted MEC for congestion using the average proportion of traffic by area and road type. Values are interpolated for all the years between the five year intervals.

Step 2. Discount costs over the appraisal period (row 148:433): The cost per kilometre for each category is multiplied by the number of vehicle kilometres removed in each year of the appraisal period, resulting in the average congestion, noise and accidents costs. In case no yearly user data has been input, this is extrapolated for every year and the relevant discount rate is applied. In the final step, the discounted congestion cost is inflated to show prices for the selected reference year (see Section 3).

Uncertainty is carried through the calculations. This is done using two parallel systems. On one side, calculations are done for the three uncertainty scenarios (low, central and high) as provided by the user. In addition, a qualitative scoring system considers the uncertainty of fixed inputs (and the user inputs if no low and high values are entered).

5.5 Where can I find the results for these impacts?

Main results

Results for congestion, noise and accidents impacts are detailed in the respective sheets **Results-Congestion, Results-Noise, Results-Accidents**. Rows 10:21 show the combined net impact to businesses, regulator and society/individuals. The input data for the impacts of congestion, noise and accidents do not allow for calculation of the disaggregated impacts of these different sectors. The uncertainty score for the assessment is show in cell D23.

Figure 5.6 presents an example of the detailed results table for congestion, noise and accidents. This table disaggregates impacts by costs and benefits, transitional and annual costs, by year and for each uncertainty scenario. In the case of congestion, noise and accidents, impacts are only annual as no transitional impacts arise. **All values are presented as NPV.** Costs and benefits are expressed in thousands of pounds for each year, presented in prices for the year specified by the user in the **Control** sheet (see Section 3). Costs are represented by positive numbers, whereas benefits are represented as negative numbers. The colour of the column also provides useful information for interpretation of the results being: current year, measure start year, appraisal end year.

Figure 5.6 Example of detailed results table for congestion

Combined impact (aggregation of impacts to businesses, regulator and society/individual)

This category is used when the impact cannot be directly associated with one single group.

Units:	£'000s		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Costs	Transition cost	Central																	
		Low																	
		High																	
	Annual cost	Central							0.69	0.36	0.05								
		Low							0.28	0.14	0.02								
		High							1.39	0.83	0.30								
Benefits	Transition benefit	Central																	
		Low																	
		High																	
	Annual benefit	Central										-0.24	-0.51	-0.76	-1.88	-2.92	-3.89	-4.79	-5.63
		Low										-0.10	-0.20	-0.31	-1.31	-2.25	-3.12	-3.94	-4.69
		High										-0.19	-0.64	-1.07	-2.98	-4.76	-6.41	-7.95	-9.38

For example shown in Figure 5.6 the current year is 2014, the measure is expected to start in 2020 and the appraisal period covers until 2030. The results indicate that the measure is expected to result in congestion costs for the first three years and then provide benefits from 2023. The table details different results for the three uncertainty scenarios considered. It should be noted that the values in the example are purely illustrative and the user is not expected to get similar results.

Additional results

Additional result from the assessment is the “Proportional change in vehicle km”, which is a weighted change in vehicle km, for each road type in five year interval for 2010-2035. These are presented in the **Calculations-Congestion** sheet in rows 455:498. These results present the number of kilometres travelled on each type of road in each location area, under three uncertainty scenarios.

Figure 5.7 Example results for the "Proportional change in vehicle km"

	Unit	Quantitative uncertainty	Year	London	London	London	Inner and Outer Conurbations	Inner and Outer Conurbations	Inner and Outer Conurbations	Other Urban	Other Urban	Rural	Rural	Rural
				Motorways	A Roads	Other Roads	Motorways	A Roads	Other Roads	A Roads	Other Roads	Motorways	A Roads	Other Roads
Weighted change in veh km	veh km	low	2010	-	-	-	-	-	-	-	-	-	-	-
Weighted change in veh km	veh km	high	2010	-	-	-	-	-	-	-	-	-	-	-
Weighted change in veh km	veh km	central	2010	-	-	-	-	-	-	-	-	-	-	-
Weighted change in veh km	veh km	low	2015	-	-	-	-	-	-	-	-	-	-	-
Weighted change in veh km	veh km	high	2015	-	-	-	-	-	-	-	-	-	-	-
Weighted change in veh km	veh km	central	2015	-	-	-	-	-	-	-	-	-	-	-
Weighted change in veh km	veh km	low	2020	- 15	- 175	- 125	- 230	- 305	- 350	- 610	- 620	- 710	- 1,160	- 700
Weighted change in veh km	veh km	high	2020	- 60	- 700	- 500	- 920	- 1,220	- 1,400	- 2,440	- 2,480	- 2,840	- 4,640	- 2,800
Weighted change in veh km	veh km	central	2020	- 30	- 350	- 250	- 460	- 610	- 700	- 1,220	- 1,240	- 1,420	- 2,320	- 1,400
Weighted change in veh km	veh km	low	2025	- 15	- 175	- 125	- 235	- 305	- 350	- 605	- 615	- 720	- 1,165	- 700
Weighted change in veh km	veh km	high	2025	- 60	- 700	- 500	- 940	- 1,220	- 1,400	- 2,420	- 2,460	- 2,880	- 4,660	- 2,800
Weighted change in veh km	veh km	central	2025	- 30	- 350	- 250	- 470	- 610	- 700	- 1,210	- 1,230	- 1,440	- 2,330	- 1,400
Weighted change in veh km	veh km	low	2030	-	-	-	-	-	-	-	-	-	-	-
Weighted change in veh km	veh km	high	2030	-	-	-	-	-	-	-	-	-	-	-
Weighted change in veh km	veh km	central	2030	-	-	-	-	-	-	-	-	-	-	-
Weighted change in veh km	veh km	low	2035	-	-	-	-	-	-	-	-	-	-	-
Weighted change in veh km	veh km	high	2035	-	-	-	-	-	-	-	-	-	-	-
Weighted change in veh km	veh km	central	2035	-	-	-	-	-	-	-	-	-	-	-
Weighted change in veh km	veh km	low	2040											
Weighted change in veh km	veh km	high	2040											
Weighted change in veh km	veh km	central	2040											
Weighted change in veh km	veh km	low	2045											
Weighted change in veh km	veh km	high	2045											
Weighted change in veh km	veh km	central	2045											
Weighted change in veh km	veh km	low	2050											
Weighted change in veh km	veh km	high	2050											
Weighted change in veh km	veh km	central	2050											

Summary results

The sheet **Results-Summary** display a summary of the results for all of the impacts assessed. Results for the assessment of the congestion impact are provided in rows 15:23. Results are presented as net present value of transitional, annual and total annualised costs and benefits, and the total net impact.

Results for the assessment of the noise impact are provided in rows 26:34. Results are presented as net present value of transitional, annual and total annualised costs and benefits, and the total net impact.

Results for the assessment of the accidents impact are provided in rows 37:45. Results are presented as net present value of transitional, annual and total annualised costs and benefits, and the total net impact.

Figure 5.8 illustrates an example of how the detailed results table may look like, using an example of congestion. It shows the sum of all **annual costs and benefits as Net Present Value expressed in thousands of pounds** and presented in prices for the year selected in **Control** sheet cell C15 (see Section 3.3)..

Figure 5.8 Example of summary results table for congestion.

Congestion

npv 2014 prices £'000s	Costs									Benefits									Total Net Present Value		
	Total Transition			Average Annual			Total annualised costs			Transition benefit			Annual benefit			Total annualised benefits					
	Central	Low	High	Central	Low	High	Central	Low	High	Central	Low	High	Central	Low	High	Central	Low	High	Central	Low	High
Impact to business																					
Impact to regulator																					
Impact to society																					
Total impact				1	0	3	1	0	3				- 21	- 16	- 33	- 21	- 16	- 33	-20	-15	-31

5.6 Limitations

- The MEC method does not take into account all of the responses available to those who switch mode (for example those changing destinations) or the effect of the initial change in traffic levels on costs and subsequent demand.
- The method assumes that the alternative journeys taken in the 'without scheme' and 'with scheme' scenarios have the same origin and destination area types. This simplifying assumption is necessary in the absence of a trip distribution model.
- Pro rata effects of vehicle km change by road type must be assumed. This approach cannot match the detailed localised accuracy of full transport modelling, but detailed modelling would greatly extend the scope and complexity of the wider impacts model.
- Congestion, Noise and Safety can be currently modelled up to 2035. This is because fixed inputs from WebTAG are only available up to this date. If future updates of WebTAG include data for further years, additional fixed and user inputs can be added. See the Technical Specification for further details.

6. Assessing impacts on Modal Shift

This section explains the steps required to assess the impact of a modal shift.

6.1 What are these impacts?

The approach used for estimating the modal shift impacts is consistent with WebTAG Unit 5.4. Modal shift impact uses estimates of changes in either decrease or increase in car kilometres and diversion factors based on the National Transport Model to calculate the total change in the number of trips made by each mode of transport (i.e. car, walking, cycling, bus or rail).

Traffic is a major source of air pollution; therefore an effective way to reduce air pollution is to remove traffic from the road network. Policies that reduce highway traffic vehicle kilometres will, all other things being equal, proportionately reduce polluting emissions and concentrations. Conversely, policies that increase vehicle kilometres will, all other things being equal, lead to proportionately increased emissions.

Personal motor vehicles consume more energy and emit more GHGs and CO_2 per passenger kilometre than other travel modes; this can effectively be reduced by restraining the growth in car use.

Public transport is considered favourably from a socially and economically sustainable point of view because it gives both higher mobility to people who don't have access to a private car and it is less expensive to provide additional capacity by expanding bus or rail services than building new roads or bridges. The development of new rail and/or bus services can be an effective measure for diverting car users to carbon-efficient modes while providing existing public transport users with upgraded service[5]. The prospect of reducing CO_2 emissions by switching from cars to non-motorised transport such as walking and cycling is dependent on local conditions.

A modal shift occurs when one mode (e.g. bus) has an advantage (including costs, flexibility, capacity etc.) in a similar market over another (e.g. car). These advantages can take various forms, such as costs, capacity, time, flexibility or reliability[6].

Specifically, a mode shift from car to active transport modes (cycling and walking) can provide benefits in terms of personal health, welfare costs and climate change[7].

The benefits of modal shift include[8]:

- Reduced congestion;
- Environmental improvements including air quality, noise, climate change;
- Health benefits from a more physically active population;
- Increased economic activity.

Steps required to undertake assessment of this impact are discussed in this User Guide. For a more detailed description of the method applied to calculate this impact please refer to relevant section of the Technical Specification.

[5] IPCC Fourth Assessment Report, Climate Change 2007: Working Group III: Mitigation of Climate Change
[6] The Geography of Transport Systems, Dr. Jean-Paul Rodrigue, Dept. of Global Studies & Geography, Hofstra University, New York, USA
[7] Can a mode shift to walking and cycling benefit health and climate?, James Woodcock and Felix Creutzig, The European Dahrendorf Debate Symposium, 2013
[8] The case for action by the Active Transport for Healthy Living Coalition, ADPH

6.2 Which parts of the model are relevant for these impacts?

The assessment of this impact uses inputs from the **Control** and **Inputs-traffic** sheets. Calculations are carried out in the **Calculations-ModalShift** sheet. Results are presented in **Results-Modal shift** and summarised in **Results-Summary**.

6.3 What parameters are required and how to input them?

User defined inputs

Follow the steps in Section 3 in order to set common parameters for the assessment.

User inputs required are **change in vehicle-kilometres** and **change in proportion of total traffic for different area types and road types (OPTIONAL INPUT)**. These can be referred to in section 4 covering assessment of impacts on congestion, noise and safety (specifically Section 5.3 concerning user inputs).

Fixed inputs

In addition to the user inputs, the assessment of modal shift impacts requires two other fixed inputs:

Average proportion[9] of traffic in each region for each road type and area type; and

Trip change per additional 1,000 car km change, by area type

These inputs do not need to be manipulated by the user in order to run the model. However, they should be updated whenever new data are available.

These data are presented in the **Inputs-traffic** worksheet. Click on the hyperlinks at the top of the sheet to navigate to the relevant table.

"*Average proportion of total traffic for different area types and road types*" (rows 8:109): This presents the percentage of traffic by road and area type. The source for these data is DfT, 2014,WebTAG, Table A 5.4.1 - Traffic by region, congestion band, area type & road type. Traffic proportions in WebTAG are taken from traffic levels in National Transport Model (NTM) traffic database and forecasts. Traffic includes all road traffic except motorcycles (which are not included in NTM). Although the source reference data also includes information on congestion band, only the average is used in the Wider Impacts model.

These data tables have a consistent format with the original reference source (WebTAG). In case of an update of the reference source, the inputs should be updated accordingly by replacing the existing data with the updated data, keeping the same format. It is important that any new data added matches the years at the head of the table. Currently, WebTAG projections extend until 2035. Extra empty tables in grey have been added at the end of the fixed inputs (column CN) to allow for easy incorporation of data up to 2050 in future updates of the WebTAG tool. If the format of the reference sources (WebTAG) changes, then changes may also be required to the format of the corresponding Wider Impacts model data tables. In that case refer to the Technical Specification document for guidance on making structural changes to the model.

"*Trip change per additional 1,000 car km change, by area type*" (rows 144:161): This presents the total number of trips for every additional 1,000 car kilometres travelled. The source data is provided by DfT National Transport Model (NTM) upon request. However it is unlikely that there is a need to update this table in the future.

[9] This is the average share of total road traffic per road type in a given area, across all congestion bands. The average for the default figures used in the model are calculated using data for congestion bands 1-5 (as used in the National Transport Model).

6.4 What calculations are performed?

The sheets **Calculations-Modalshift** contain the calculations performed to assess the impact of the measure on modal shift. **Changes should not be made to these sheets**, unless the format of the input data is changed, in which case refer to the Technical Specification document for guidance.

"*Summary of inputs*" (rows 3 to 40): This provides a summary of the relevant inputs that are used in the calculations.

Step 1. Aggregation and interpolation of the proportion of total traffic for different area types (rows 43:95): This combines the different road types (i.e. Motorways, A Roads and Other Roads) for the proportion of total traffic for different area types and road types. Values are interpolated for all the years between the five year intervals.

Step 2. Proportional change in vehicle km (row 98:243): This calculates the weighted change in vehicle kilometres for each area. This is also interpolated from the 5 years interval is no available data is provided for any given year.

Step 3. Calculation of the change in number of trips per transport area, transport type and scenario (row 246:387): The change in number of trips for each transport area and type) is calculated by the distributed change in car kilometres travelled is multiplied by the relevant factor (number of trips per 100 car km change) for each transport mode and area.

Uncertainty is carried through the calculations. This is done using two parallel systems. On one side, calculations are done for the three uncertainty scenarios (low, central and high) as provided by the user. In addition, a qualitative scoring system considers the uncertainty of fixed inputs (and the user inputs if no low and high values are entered).

6.5 Where can I find the results for these impacts?

Main results

Results for modal shift impacts are detailed in the respective sheets **Results-Modal Shift**. Two tables are presented:

Change in number of trip per year (row 7:28)

This show the impact in terms of the change in the number trips made by vehicle type (i.e. car, walking, cycling, bus or rail). This is provided on a yearly basis but not for area type (i.e. London, inner and outer conurbations, other urban and rural).

Total change in number of trips for the whole appraisal period (row 29:40)

Whereas the previous table does not provide the total change in number of trips by area type, the results provided for area types (i.e. London, inner and outer conurbations, other urban and rural) over the whole appraisal period are shown in this table.

Figure 6.1 presents an example of the two detailed results table for Modal Shift. The colour of the column provides useful information for interpretation of the results being: current year, measure start year, appraisal end year. The uncertainty score is presented cells E26 and E40.

Figure 6.1 Example of detailed results tables for Modal Shift

Change in number of trips per year

Unit:	Number of trips		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
	Car	Central						-265.94	-301.21	-336.49	-371.76	-407.04	-442.32	-991.35	-1540.39	-2089.42	-2638.46	-3187.49			
		Low						-177.29	-177.22	-177.15	-177.07	-177.00	-176.93	-672.79	-1168.65	-1664.52	-2160.38	-2656.24			
		High						-354.58	-407.52	-460.45	-513.38	-566.31	-619.24	-1557.89	-2496.54	-3435.19	-4373.84	-5312.49			
	Walk	Central						117.71	133.33	148.95	164.57	180.19	195.81	438.87	681.93	924.99	1168.05	1411.10			
		Low						78.47	78.44	78.41	78.38	78.35	78.32	297.84	517.36	736.88	956.40	1175.92			
		High						156.95	180.39	203.82	227.26	250.70	274.14	689.68	1105.22	1520.76	1936.30	2351.84			
	Cycle	Central						23.35	26.45	29.55	32.64	35.74	38.84	87.06	135.28	183.50	231.72	279.93			
		Low						15.57	15.56	15.55	15.55	15.54	15.54	59.09	102.63	146.18	189.73	233.28			
		High						31.13	35.78	40.43	45.08	49.73	54.38	136.81	219.25	301.69	384.12	466.56			
	Bus	Central						101.87	115.39	128.90	142.42	155.93	169.45	379.79	590.14	800.49	1010.83	1221.18			
		Low						67.91	67.89	67.86	67.83	67.81	67.78	257.75	447.73	637.70	827.67	1017.65			
		High						135.83	156.11	176.39	196.67	216.95	237.23	596.84	956.45	1316.07	1675.68	2035.29			
	Rail	Central						23.15	26.21	29.27	32.33	35.39	38.46	86.17	133.89	181.60	229.31	277.03			
		Low						15.43	15.42	15.41	15.40	15.39	15.38	58.48	101.57	144.67	187.76	230.86			
		High						30.87	35.46	40.06	44.65	49.24	53.84	135.41	216.99	298.56	380.14	461.72			

Total change in number of trips for the whole appraisal period

	Low				High				Central			
	London	Inner and Outer Conurbations	Other Urban	Rural	London	Inner and Outer Conurbations	Other Urban	Rural	London	Inner and Outer Conurbations	Other Urban	Rural
Car	-	- 1,818	- 1,699	- 5,868	-	- 3,892	- 3,640	-12,565	-	- 2,435	- 2,278	- 7,860
Walk	-	658	691	2,805	-	1,410	1,481	6,006	-	882	927	3,757
Cycle	-	152	136	537	-	325	291	1,149	-	203	182	719
Bus	-	701	628	2,267	-	1,500	1,346	4,854	-	938	842	3,036
Rail	-	307	245	264	-	657	524	566	-	411	328	354

For example shown in Figure 6.1 '*Change in number of trips per year*' table, the current year is 2015, the measure is expected to start in 2020. In the table '*Total change in number of trips for the whole appraisal period'* the measure is aggregated by summing the whole appraisal period, from 2015 until 2030 but is also separately segregated by area types (i.e. London, inner and outer conurbations, other urban and rural. Both tables detail different results for the three uncertainty scenarios (i.e. central, low and high) considered. It should be noted that the values in the example are purely illustrative and the user is not expected to get similar results.

Summary results

The sheet **Results-Summary** displays a summary of the results for all of the impacts assessed. Results for the assessment of the modal shift impact are provided in rows 48:56. Results present the **total change in number of trips for the whole appraisal period per each mode transport and area**.

Figure 6.2 Example of summary results table for Modal Shift

Modal shift

Total change in number of trips for the whole appraisal period	London			Inner and Outer Conurbations			Other Urban			Rural		
	Central	Low	High	Central	Low	High	Central	Low	High	Central	Low	High
Car	-	-	-	- 2,435	- 1,818	- 3,892	- 2,278	- 1,699	- 3,640	- 7,860	- 5,868	- 12,565
Walk	-	-	-	882	658	1,410	927	691	1,481	3,757	2,805	6,006
Cycle	-	-	-	203	152	325	182	136	291	719	537	1,149
Bus	-	-	-	938	701	1,500	842	628	1,346	3,036	2,267	4,854
Rail	-	-	-	411	307	657	328	245	524	354	264	566

6.6 Limitations

- The factors derived for this method were calculated from outputs of the Department for Transport (DfT) National Transport Model (NTM) which uses an aggregate demand model to

simulate travel behavioural responses for Great Britain. In common with all models, it must necessarily be incomplete and imperfect. Particular elements to note in this regard are:

- The tests used were based on responses in a forecast year (2020).
- The NTM base year and calibration is now somewhat out of date.
- Car km change can be caused by many factors. In this case the tests concerned the response to changes in fuel cost. While this does only impact car directly (as intended) it is essentially equivalent to a distance-based charge rather than an area-based charge (such as the Central London Congestion Charging Scheme or a Low Emissions Zone). Thus the behavioural response to a cost increases for destination choice while retaining the car mode is primarily to reduce distance driven rather than simply change destination (as a LEZ might induce) which may cause some unreliability in the application of the method to LEZ modelling or other AQ policy impacts.
- The changes in both car km and modal trips are calculated for all trips **from** a given area type to all destinations, rather than simply **within** an area type. This was the only way to ensure that no suppression of trips was included in the factors (since the tests caused a change in trips between intra-area and inter-area). The no suppression or generation of trips (zero deadweight loss) assumption was made to ensure consistent and fixed suppression rates regardless of the inputs. This assumption cannot be modified in the current version of the model (i,e, user cannot assess the policy under different suppression rate assumptions).

- Nevertheless, the use of the NTM model has produced mode shift factors which are based on a much more comprehensive set of inputs than were available otherwise from a literature survey (as conducted earlier in this study). The NTM is also the source of the factors used in other impact calculations within this study as well as the official UK government National Road Traffic Forecasts. It therefore offers good consistency with other elements of the current model and national policymaking.

7. Assessing health impacts from cycling and walking

This section explains the steps required to assess the health impacts of a policy which results in a change in the number of cyclists and walkers, and/ or change in the distance travelled by a user by bike or walking. For a more detailed description of the method applied to calculate this impact please refer to the Technical Specification document.

7.1 What is this impact?

This model monetises the overall benefits to human health associated with increased number of people cycling and/or walking. To monetise these benefits the method uses the value of life saved. This is consistent with the DfT Use of Cycle & Walking Business Case Toolkit being developed by DfT.

7.2 Which parts of the model are relevant for these impacts?

The assessment of this impact uses inputs from the **Control** and **Inputs-traffic**. Calculations are carried out in the **Calculations-Health (MS-cycle), Calculations-Health (MS-walk), Calculations-Health (SA-cycle)** and **Calculations-Health (SA-walk)** sheets. Results are presented in **Results-Health Impacts** and summarised in **Results-Summary**.

7.3 What parameters are required and how to input them?

User-defined inputs

Follow the steps in Section 3 in order to set common parameters for the assessment.

User inputs for health impacts of cycling

Go to **Control** "*Table 3*" (rows 116:124):

Input number of cycling journeys per day

In **Control** "*Table 3"* rows 116:118 enter data for the number of cycling journeys per day associated with the policy or measure. Enter data in each row for each scenario (central, low, high). This input is used for the standalone assessment only.

*Input Average length of the cycling journey and Average cycling speed **(OPTIONAL INPUTS)***

These inputs are optional. In rows 119:121, enter the average length of the cycling journey in kilometres as a result of the policy or measure, one row for each scenario. In rows 122:124, enter data for the average cycling speed assumed in km/h. These two inputs are used to calculate the average cycling trip duration, both for the method linked to modal shift and for the standalone assessment. Although it is recommended to add these inputs, they are not mandatory. If left blank, default values on average trip length and speed from DfT TAG (which are based on National Travel Survey) will be applied.

In column AN, the user can select the qualitative uncertainty associated with these inputs from the drop down list.

Figure 7.1 Example of user inputs for assessment of health impacts of cycling

Health impacts of cycling and walking

Table 3 **User inputs for health impacts of cycling**

		2015	2016	2017	2018	2019
Number of cycling journeys per day as a result of the policy/measure	Central	1,000	1,000	1,000	1,000	1,000
	Low	500	500	500	500	500
	High	2,000	2,000	2,000	2,000	2,000
Average length of the cycling journey (km)	Central	5	5	5	5	5
	Low	2	2	2	2	2
	High	7	7	7	7	7
Average cycling speed (km/h)	Central	20	20	20	20	20
	Low	20	20	20	20	20
	High	20	20	20	20	20

User inputs for health impacts of walking

Go to **Control** "*Table 4*" (rows 131:139):

Input number of walking journeys per day

In rows 131:133, enter data for the number of walking journeys per day associated to the policy or measure. Enter data in each row for each scenario (central, low, high). This input is used for the standalone assessment only.

*Input average length of the walking journey and average walking speed **(OPTIONAL INPUTS)***

These inputs are optional. In rows 134:136, enter the average length of the walking journey in kilometres as a result of the policy or measure, one row for each scenario. In rows 137:139, enter data for the average walking speed assumed in km/h. These two inputs are used to calculate the average walking trip duration, both for the method linked to modal shift and for the standalone assessment. Although it is recommended to add these inputs, they are not mandatory. If left blank, default values on trip length and speed from TAG will be applied.

In columns AN, the user can select the qualitative uncertainty associated with these inputs from the drop down list.

Figure 7.2 Example of user inputs for assessment of health impacts of walking

Table 4 **User inputs for Health impacts of walking**

		2015	2016	2017	2018	2019
Number of walking journeys per day as a result of the policy/measure	Central	1,000	1,000	1,000	1,000	1,000
	Low	500	500	500	500	500
	High	2,000	2,000	2,000	2,000	2,000
Average length of the walking journey (km)	Central	3.0	3.0	3.0	3.0	3.0
	Low	1.0	1.0	1.0	2.0	2.0
	High	4.0	4.0	4.0	4.0	4.0
Average walking speed (km/h)	Central	5	5	5	5	5
	Low	5	5	5	5	5
	High	5	5	5	5	5

Other "control inputs for health benefits"

Modification of these inputs is optional but relevant cells cannot be left empty.

Go to **Control** "*Table 5*" (rows 142:152): In cell D146, enter data for the decay rate in per cent. This is the rate at which health benefits decay (i.e. after the end of the policy/measure). In cell D147, enter data for the

year that decay starts (i.e. when funding for a cycling scheme ends). In cell D148, enter the ramp up of health benefits in number of years. This is the number of years it takes for the measure/policy to achieve full potential. In cell D149 enter the number of days in the year that users will cycle. In D150 enter the same for walking. In cell D151 enter the share of journeys (both from walking and cycling) that form part of a return trip as a percentage. If annual economic growth is being considered, enter it in percentage in cell D152.

All the inputs in **Control** "*Table 5*" (rows 142:152) are **optional, but cells cannot be left empty**. If the user does not hold enough data to populate them, values described in the comments in columns G:H must be entered. In column E select the qualitative uncertainty associated with these inputs from the drop down list.

Figure 7.3 Example of user control inputs for health benefits

Table 5 **Control inputs for health benefits**

		Uncertainty		Comments
		Qualitative	Score	
Decay rate (%)	0%	not used	1	Default 0%
Year decay starts	2030	not used	1	Default: Assessment end year
Ramp up of health benefits (years)	5	not used	1	Default: 5
Number of days in the year that cycling would occur	260	not used	1	Default of 260 weekdays per year
Number of days in the year that walking would occur	365	not used	1	Default of 365 days per year
Share of journeys (both from walking and cycling) that form part of a return trip	90%	not used	1	This is to identify the number of users affected by the policy. Default is 90%.
Background annual growth (%)	0.00%	not used	1	Value of lives saved will grow at the defined rate. Default is zero.

Fixed inputs

In addition to the discount rate explained in section 3, the assessment of health impacts of cycling and walking requires a number of fixed inputs. This data is presented in **Inputs-traffic** worksheet (rows 169:180). Click on the hyperlinks at the top of the sheet to navigate to the relevant table. All default values for these parameters are sourced from DfT (2015) Investing in cycling and walking: the economic case for action toolkit.

Value of life **–** this is an economic value of life saved. This figure is based on values from WHO and is a European Region Average. Default values for this parameter are sourced from DfT (2015) Investing in cycling and walking: the economic case for action toolkit.

Mean proportion of England and Wales population aged 15-64 who die each year from all causes **–** this input is sourced from WHO European Detailed Mortality Database http://data.euro.who.int/dmdb/. For local assessments, this value can be updated with the local statistics. Default values for this parameter are sourced from DfT (2015) Investing in cycling and walking: the economic case for action toolkit.

Reduced relative risk index for cycling - The value used for cycling is from a Copenhagen study which puts a cap on the index at 0.28 for 1620km cycled annually per new user. WebTAG toolkit matched it to 36 minutes cycling per working day. Unless alternative studies of similar scope are identified, this input is not expected to be updated by the users in the future. Default values for this parameter are sourced from DfT (2015) Investing in cycling and walking: the economic case for action toolkit.

Reduced relative risk index for walking – Obtained from HEAT, WebTAG toolkit matched it to 21.5 minutes walking per working day. Default values for this parameter are sourced from DfT (2015) Investing in cycling and walking: the economic case for action toolkit.

Average cycling and walking trip length and duration – These inputs are used as a default value in case the user does not specify average distance and speed. They are both sourced from TAG Unit A5.1, citing data from the National Transport Survey and DMRB 11.8.3.

These inputs do not need to be manipulated by the user in order to run the model. However, they should be updated whenever new data are available.

A qualitative estimation of the uncertainty associated with each of these datasets is shown in column H. This is carried through into the calculations and the results. The current uncertainty classification was estimated by the model developers. If the data in the tables are updated the uncertainty can be amended accordingly by clicking and selecting from the drop-down menu.

Figure 7.4 Fixed inputs for "Health impacts of cycling"

Factors for health benefits impact

Factor	Value	Unit	Year	Uncertainty score		Source	Notes
Value of life	1,653,687	£	2010	low	2	16	
Mean proportion of England and Wales population ages 15-64 who die each year from all causes	0.24%	%	-	low	2	16	
Reduced relative risk index for cycling	0.28	-	-	medium	3	16	
Reference minutes cycled per day	36.00	minutes		not used	1	16	
Reduced relative risk index for walking	0.22	-	-	medium	3	16	
Reference minutes walked per day	21.50	minutes		not used	1	16	
Trip duration related data:							
- Average cycling trip length	3.9	km	2014	low	2	8	Apendix B
- Average cycling speed	20.0	km/h	2014	low	2	8	Apendix B
- Average walking trip length	1.2	km	2014	low	2	8	Apendix B
- Average walking speed	5.0	km/h	2014	low	2	8	Apendix B

7.4 What calculations are performed?

The sheets **Calculations-Health (MS-cycle), Calculations-Health (MS-walk), Calculations-Health (SA-cycle), Calculations-Health (SA-walk)** contain the calculations performed to assess the impact of the measure on health impacts of cycling. **Calculations-Health (MS-cycle)** and **Calculations-Health (MS-walk)** calculate the impact when linked to modal shift for cycling and walking respectively, and **Calculations-Health (SA-cycle)** and **Calculations-Health (SA-walk)** calculate the impact when the assessment is done independently from the modal shift impact. **Changes should not be made to these sheets**, unless the model needs a major revision, in which case refer to the Technical Specification document for guidance.

All calculation sheets for Health Impacts

"*Summary of inputs*" (rows 3 to 51): This provides a summary of the relevant inputs that are used in the calculations. If no user inputs are added for length duration and speed, default values are selected.

Calculations for these impacts include the following steps:

Step 1. Calculate minutes travelled per user per cycling day (rows 54:74): In this step the average minutes cycled per day per user are calculated.

Step 2. Calculate minutes travelled per average working weekday (rows 77:95): This step calculates the total minutes cycled per user per average working day.

Step 3. Calculate the adjusted "Reduced relative risk" for the study (rows 98:117): This step calculates the reduced relative risk index for users cycling as a result of the policy.

Step 4. Calculate expected deaths in the population affected by the policy (rows 120:139): This step calculates the number of deaths that could occur from all causes among cycling users

Step 5. Calculate number of lives saved from physical activity (row 142:160): This step calculates the number of cyclists that will have reduced risk of dying due to increased physical activity.

Step 6. Monetise value of lives saved from physical activity (row 163:190): This step assigns a monetary value to the lives saved due to greater physical activity

Step 7. Discount value of lives saved over the appraisal period (row 193:214): In this step discounted monetised value of lives saved is calculated by multiplying discount factor by undiscounted value per year. Growth, decay and ramp up are also applied.

Steps are the same for the 4 modules (sheets) involved in this impact. Uncertainty is carried through the calculations. This is done using two parallel systems. On one side, calculations are done for the three uncertainty scenarios (low, central and high) as provided by the user. In addition, a qualitative scoring system considers the uncertainty of fixed inputs (and the user inputs if these are entered).

7.5 Where can I find the results for this impact?

Main results

Results are detailed in the sheet **Results-Health Impacts**. Hyperlinks in rows 3:6 lead to the different results tables. Rows 8:25 show the combined costs and benefits from cycling calculated in the assessment linked to the modal shift assessment. The same is presented for walking in rows 26:43. Rows 44:61 show the combined costs and benefits from cycling for the standalone assessment of the impact. Rows 62:78 show the same for walking. Underneath each results table, the results qualitative uncertainty is provided.

Figure 7.5 presents an example of the detailed results table for health impacts of cycling linked to the modal shift assessment. This table disaggregates impacts by costs and benefits, transitional and annual costs, by year and for each uncertainty scenario. In the case of health impacts costs and benefits are only annual as no transitional impacts arise. **All values are presented as NPV.** Costs and benefits are expressed in thousands of pounds for each year, presented in the prices year specified by the user in the **Control** sheet (see Section3.3). Costs are represented by positive numbers, whereas benefits are represented as negative numbers. The colour of the column also provides useful information for interpretation of the results being: current year, measure start year, appraisal end year.

Figure 7.5 Example of detailed results table for health impacts of cycling

8	Impact to society / individual - Modal shift approach: Cycling																		
9																			
10	Units:	£'000s	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
11	Costs	Transition cost	Central																	
12			Low																	
13			High																	
14		Annual cost	Central																	
15			Low																	
16			High																	
17	Benefits	Transition benefit	Central																	
18			Low																	
19			High																	
20		Annual benefit	Central					-0.01	-0.01	-0.02	-0.02	-0.03	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	
21			Low					0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	
22			High					-0.02	-0.03	-0.05	-0.06	-0.06	-0.06	-0.05	-0.05	-0.05	-0.05	-0.05	
23																			
24	Results qualitative uncertainty score:		64																

For example shown in Figure 7.5 the current year is 2015, the measure is expected to start in 2020 and the appraisal period covers until 2030. The table details different results for the three uncertainty scenarios considered. It should be noted that the values in the example are purely illustrative and the user is not expected to get similar results.

Summary results

The sheet **Results-Summary** display a summary of the results for all of the impacts assessed. Results for the assessment of the health impacts of cycling are provided in rows 59:67. Results are presented as total impact on business, regulator and society under each uncertainty scenario, with the total **NPV expressed in thousands of pounds** presented in columns U, V and W. Costs and benefits are presented in prices for the year selected in **Control** sheet cell C15 (see Section 3.3).

Figure 7.6 illustrates an example of the detailed results table for impacts on health.

Figure 7.6 Summary results table for health impacts

Health impacts of cycling

npv 2014 prices £'000s	Costs								
	Total Transition			Average Annual			Total annualised costs		
	Central	Low	High	Central	Low	High	Central	Low	High
Impact to business Impact to regulator Impact to society				-	-	-			
Total impact				-	-	-	-	-	-

Benefits									Total Net Present Value		
Transition benefit			Annual benefit			Total annualised benefits					
Central	Low	High	Central	Low	High	Central	Low	High	Central	Low	High
			- 43,058	- 28,083	- 89,129						
			- 43,058	- 28,083	- 89,129	- 43,058	- 28,083	- 89,129	- 43,058	- 28,083	- 89,129

7.6 Limitations

- The method used is likely to produce conservative estimates as it does not account for disease-related benefits.
- The method does not take into consideration differences in the intensity of cycling or the possibility that less well-trained individuals may benefit more from the same amount of cycling.
- The age groups who are evaluated using the method are adults, mainly because the most commonly studied disease end-points such as coronary heart attack or death are rare in children.
- The method should not be used in population with high physical activity levels as the result could possibly underestimate the effect in very sedentary population groups.

8. Assessing impact on greenhouse gases

This section explains the steps required to assess the impact of a measure on greenhouse gases. For a more detailed description of the method applied to calculate this impact please refer to the Technical Specification document.

8.1 What is this impact?

The wider impacts model monetises the impact on greenhouse gases as a result of change in energy consumption or vehicle kilometres.

This impact assesses the net change in GHG emissions resulting from a policy. The impact is first quantified (expressed in CO_2 eq) and then monetised (£). Monetisation of the changes allows deriving the total net present value (NPV) associated with carbon and energy usage, and assessing the cost-effectiveness of measures from this perspective. As part of the assessment, change in energy use is also monetised. Valuation of energy use is only recommended when a policy does not have an impact on the functioning of the energy market, for example through changes in energy prices. For policies where this is the case, detailed modelling is required for the purpose of appraisal.

8.2 Which parts of the model are relevant for this impact?

The assessment of this impact uses inputs from the **Control-GHG**, **Common data** and **Inputs-GHG** sheets. Calculations are carried out in the **Calculations-GHG (central), Calculations-GHG (low) and Calculations-GHG (high)** sheets. Results are presented in **Results-GHG** and summarised in **Results-Summary**.

8.3 What parameters are required and how to input them?

User defined inputs

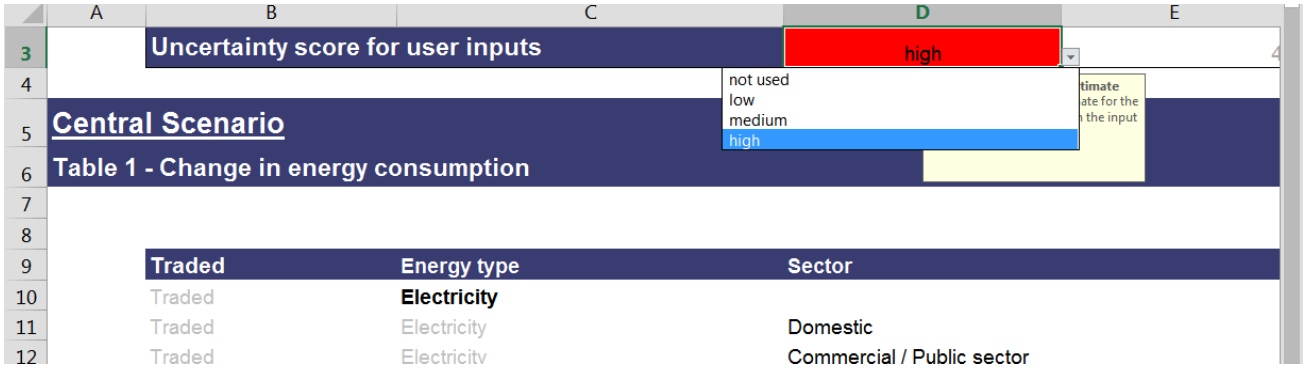
Follow the steps in Section 3 in order to set common parameters for the assessment. Then go to sheet **Control-GHG**.

Select the uncertainty scenario

There are two ways to reflect the uncertainty of the inputs for the GHG assessment:

- **Quantitative** –The inputs for the model have been generated for three scenarios (low, central, high), as it is described below:
  - For central scenario, input data in **Control-GHG** Rows 5-96
  - For low scenario, input data in **Control-GHG** row 97-188.
  - For high scenario, input data in **Control-GHG** row 189-278
- **Qualitative** – if there is only one set of inputs for the model (i.e. single scenario) select the uncertainty scenario from cell D3 (either low, medium or high). This uncertainty score will be carried through the assessment. In the figure below, the example “Not used” is picked to demonstrate to how to select from the dropdown menu in cell D3.

Figure 8.1 Selecting qualitative uncertainty score



Input change in energy use

As described above there are separate input tables for the three uncertainty scenarios. The following section describes the steps based on the selection of central scenario but the same steps apply to remaining uncertainty scenarios.

If qualitative uncertainty is used, only **Central scenario** tables need to be completed by the user (**Control-GHG** Rows 5-96).

Enter change in energy use in the traded and non-traded sectors

This input is relevant only to assessment of measures affecting electricity consumption or fuel consumption in the traded and non-traded sectors. If the measure does not affect electricity or the fuels listed in the model, leave blank.

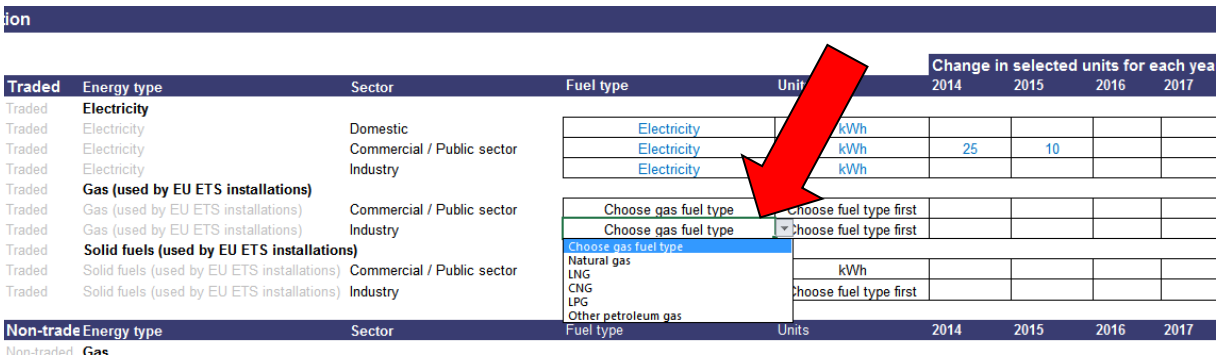
The values entered should be a "net" change in energy use. These should already be reduced of potential impact of a rebound effect. E.g. if the anticipated change in energy use is 100kWh, and the expected rebound effect is 10%, the user should enter 90kWh into Table 1. See section on the rebound effect below.

Control- GHG *Table 1: Change in energy consumption* (Rows 5:45): Enter data for the change in energy consumption per sector for each year of the assessment. For guidance on how to distinguish between traded and non-traded sectors refer to the DECC (2014), Valuation of energy use and greenhouse gas (GHG) emissions, Supplementary guidance to the HM Treasury Green Book on Appraisal and Evaluation in Central Government.

In Rows 10:19 input data for the "Traded" sectors (all electricity change, and change in fuels used by EU ETS installations). Note hydrocarbon oils have not been included for traded emissions in order to be consistent with DECC IAG tool. All electricity inputs must be provided in kWh.

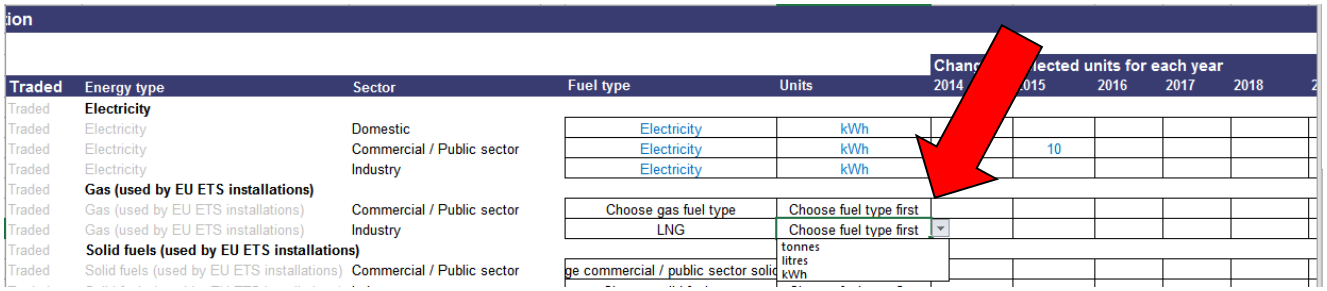
For different types of fuels, first select the type of fuel from the drop down list in Column F, as illustrated in Figure 8.2 below.

Figure 8.2 User inputs for the traded sector and selection of the types of gas used



Choose unit type in Column G, as illustrated in Figure 8.3.

Figure 8.3 Unit selection for entering the change in energy use



Repeat these steps for the change in energy use for "non-traded" sectors in Rows 21:33.

Enter change in use of road transport fuels or change in vehicle kilometres travelled

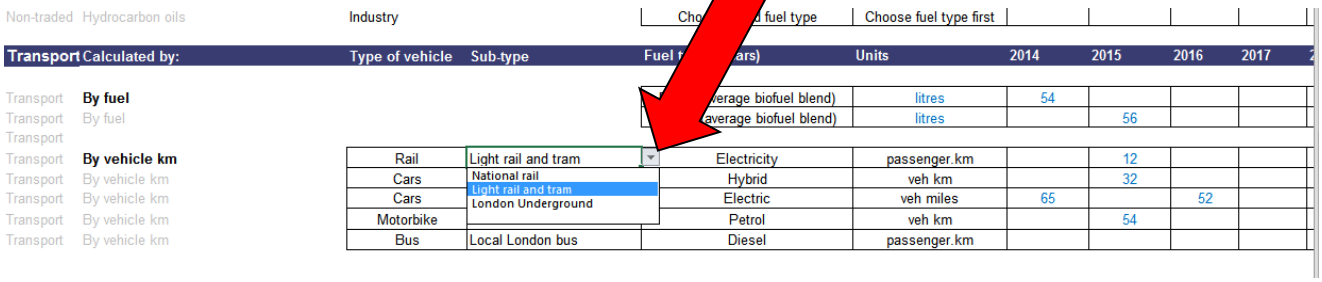
This input is relevant only to assessment of measures affecting road fuel consumption or changing the number of vehicle kilometres. If the measure does not affect transport, leave blank.

As explained above the values entered should be a "net" change in energy use / vehicle kilometres (these should already be reduced of potential impact of a rebound effect).

For the policy measures resulting in changes in transport, enter the change either by fuel in Rows 37:38, or by vehicle km in Rows 40:44. Change in transport fuel use must be provided in litres and fuel type selected in Column F.

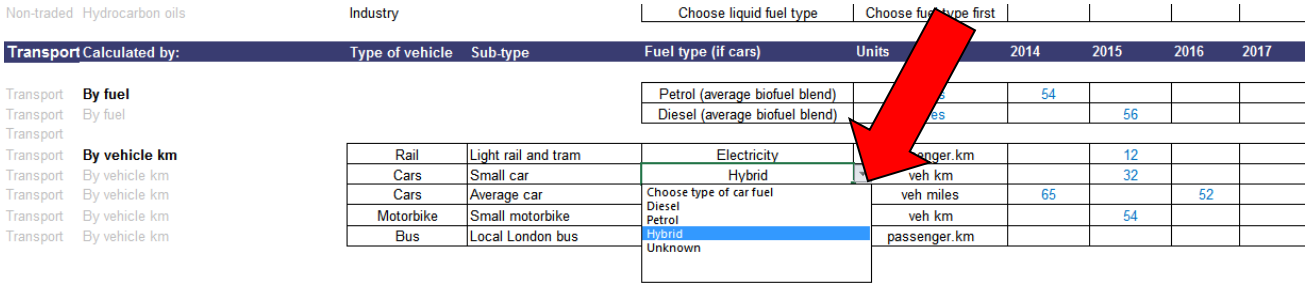
To enter data by vehicle kilometre for each transport mode, first select the type of transport mode from the drop down list in Column D. Then select sub-type of from the drop down list in Column E.

Figure 8.4 Selecting transport mode sub-type in column E



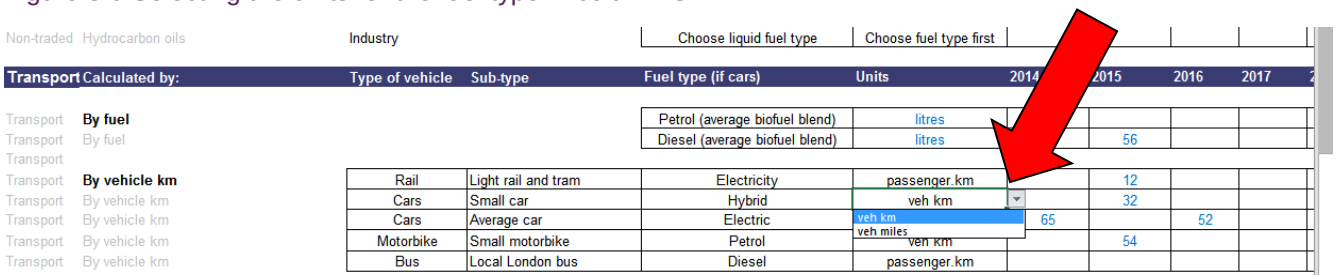
Then select the fuel type in Column F. Only cars offer multiple options. However, it is important one option is selected.

Figure 8.5 Selecting the fuel type in column F



Finally in Column G select from the drop down list the units in which you are entering the data. One option for type, sub-type, fuel and unit must be selected (even if e.g. only one fuel is available for a given mode of transport, this must be selected).

Figure 8.6 Selecting the units for the fuel type in column G

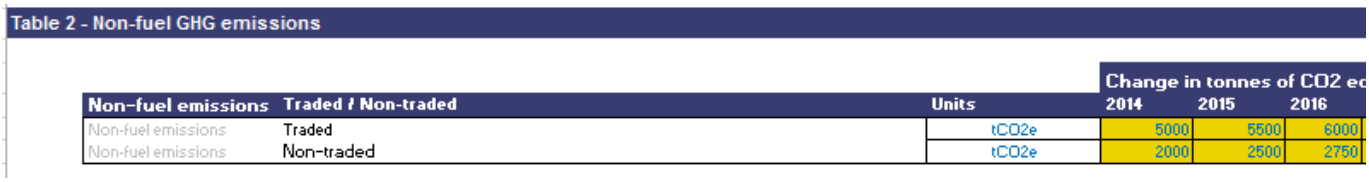


Enter change in non-fuel related GHG

This input is relevant only to assessment of measures which may affect GHG emissions linked to changes other than in energy use. If the measure does not have impact on non-energy related GHG emissions, input zero.

Control- GHG *Table 2*:*"Non-fuel GHG emissions*" in Rows 47:52: enter change in GHG emissions not resulting from the change in fuels (e.g. change in embedded carbon). This change needs to be provided for the traded and non-traded sector, and needs to be expressed in tonnes of CO_2 eq.

Figure 8.7 Entering the change in non-fuel related GHG emissions



Enter information on the estimated rebound effect

This input is relevant only to assessment of measures which may have a rebound effect. If the measure is not expected to have a rebound effect or the rebound effect is unknown, populate the inputs with zero.

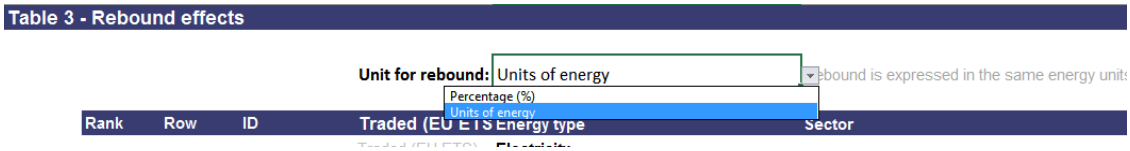
If policy is expected to result in a rebound effect, the figure entered needs to be consistent with the assumptions made when calculating net change in energy use. Using example above, if the anticipated change in energy use is 100kWh, and the expected rebound effect is 10%, the user should enter 90kWh into Table 1 and 10% or 10kWh in Table 3.

If the policy is expected to result in a rebound effect, the user can enter this effect either as a percentage of the gross change in energy or as an absolute quantity (e.g. GWh or litres). These are generally based on assumptions of behavioural change which is inherently uncertain. For more information on the calculation of rebound effects and their limitations please refer to the DECC's guidance[10].

Control- GHG *Table 3:* "*Rebound effects"* enter the potential rebound effect. In cell C57 select from the drop-down menu the unit in which you are entering the rebound effect information – the model accepts inputs in per cent or units of energy.

10 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/360044/2014_Background_Documentation_to_DECC_HMT_Supplementary_Appraisal_Guidance.pdf

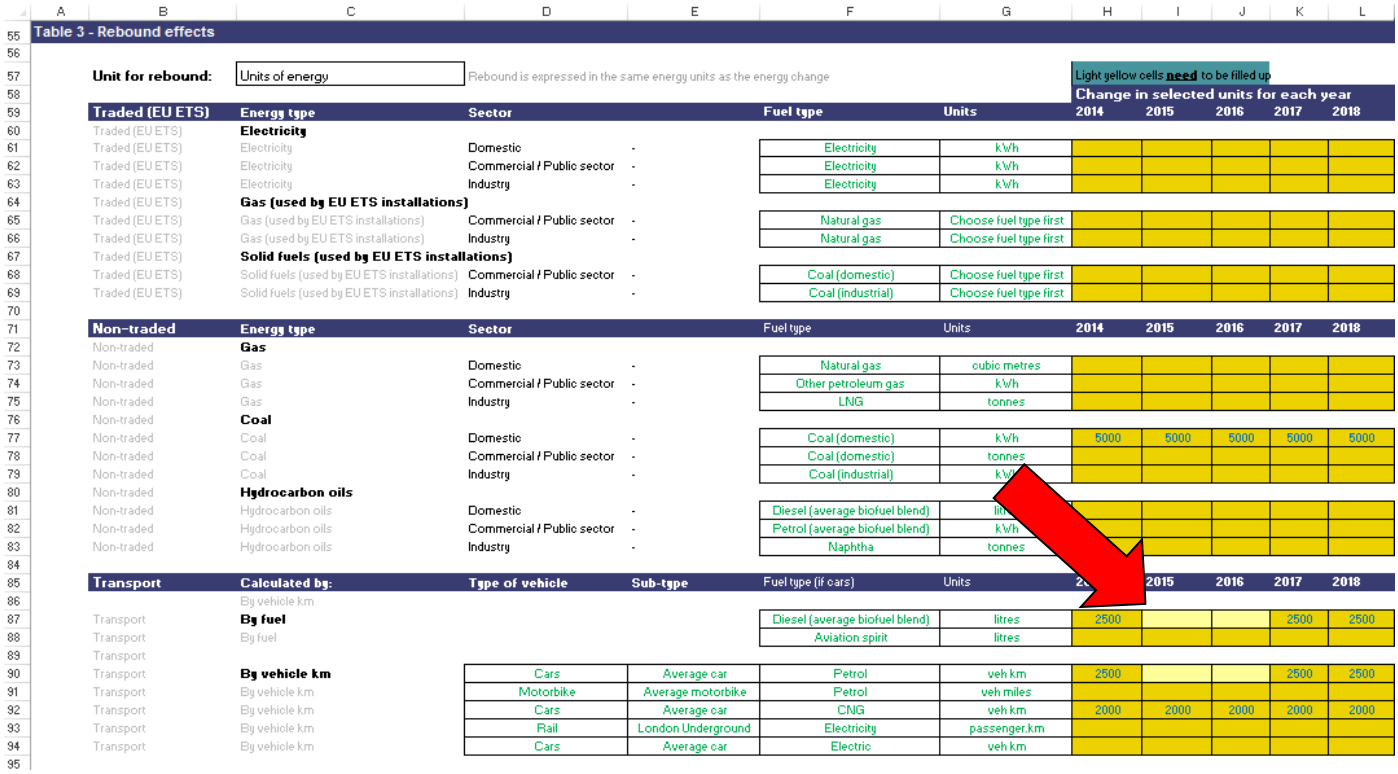
Figure 8.8 Selecting the units for inputs on the rebound effect



Rows 55:94 and Columns F: G will be automatically pre-populated with the information on sectors and fuels affected by the policy which were entered in **Control- GHG** *Table 1: "Change in energy consumption".* In Columns H: AR enter the size of the anticipated rebound effect for each affected year.

Rebound effect should be entered for each cell for which the change in fuel was also entered in Table 1. If data are missing, the cells with missing information will be highlighted in light yellow as illustrated in Figure 8.9 below.

Figure 8.9 Selecting the units for inputs on the rebound effect



Fixed inputs

In addition to the discount rate explained in section 3, the assessment of GHG impacts requires the following fixed inputs:

Electricity emission factors

Average emissions factor by sector

Gaseous, liquid and solid fuel emission factors

Transport emission factors (2014)

Fuel properties

Conversion factors from user input units to kWh for selected fuels (2014)

Conversion factors from user input units to litres of fuel for transport (kWh in the case of electric transport) (2014) and units after conversion

Carbon prices and sensitivities (low, central, high) for appraisal (£/t CO_2 eq)

Long-run variable costs of energy supply (LRVCs)

Retail fuel prices

These inputs do not need to be manipulated by the user in order to run the model. However, they should be updated whenever new data are available.

These data are presented in the **Inputs-GHG** worksheet. Click on the hyperlinks at the top of the sheet to navigate to the relevant table.

"Electricity emission factors" (rows 14:120): The electricity emissions factors from 2010 to 2100 ($kgCO_2e/kWh$, long-run marginal, consumption based emission factors) are based on Table 1. This table is available in DECC Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal, Data tables 1-20: supporting the toolkit and the guidance, 2 October 2014.

"Average emission factors per sector" (rows 121:148): The converting fuel types to CO_2 and CO_2e (emissions factors) are based on Table 2a. The table provides the average emission factors in each sector for solid fuels and oil. This table is available in DECC Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal, Data tables 1-20: supporting the toolkit and the guidance, 2 October 2014. All GHG includes CO_2, CH_4 and N_2O and sectors use different mixes of solid fuels and oil products..

"Gaseous, liquid and solid fuels emission factors" (rows 149:270): The emission factors have been downloaded from http://www.ukconversionfactorscarbonsmart.co.uk/ (Defra, DECC, Ricardo-AEA, CarbonSmart, 2014. Greenhouse Gas Conversion Factor Repository). The reporting type used is Reporting type: "Give me everything", Table: "Fuels",Scope 1, Version 1.2

"Transport emission factors" (rows 271:352): The emission factors have been downloaded from http://www.ukconversionfactorscarbonsmart.co.uk/ (Defra, DECC, Ricardo-AEA, CarbonSmart, 2014. Greenhouse Gas Conversion Factor Repository). The reporting type used is Reporting type: "Give me everything", Table: "Business travel-land", Scope 3, Version 1.2

"Fuel properties" (rows 353:403): The data have been downloaded from http://www.ukconversionfactorscarbonsmart.co.uk/ (Defra, DECC, Ricardo-AEA, CarbonSmart, 2014. Greenhouse Gas Conversion Factor Repository). The reporting type used is Reporting type: "Give me everything", Table: "Fuel properties - 2014", Version 1.0

*"Carbon prices and sensitivities (low, central and high) for appraisal (£/tCO_2e)" (*rows 475:580*), "long-run variable costs of energy supply (LRVCs)"*(rows 583: 691*) and "Retail fuel prices"* (rows 694 – 802): These inputs are available in DECC Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal, Data tables 1-20: supporting the toolkit and the guidance, 2 October 2014, Table 3: Carbon prices and sensitivities 2008-2100 for appraisal, 2014 £/tCO_2e and Tables 9-13: Long-run variable costs of energy supply (LRVCs).

The **Inputs-GHG** worksheet contains some calculations using the fixed inputs. **Cells containing these calculations should not be changed or manipulated**. These are:

"Conversion factors from user input units to kWh for selected fuels (2014)" (rows 404:431) – these provide conversion factors based on fuel properties and carbon emission factors.

Conversion factors from user input units to litres of fuel for transport (kWh in the case of electric transport) (2014) and units after conversion (rows 433:473).

A qualitative estimation of the uncertainty associated with each of these datasets is shown under each table. This is carried through into the calculations and the results. The current uncertainty classification was estimated by the model developers. If the data in the tables are updated the uncertainty can be amended accordingly by clicking and selecting from the drop-down menu.

These data tables have a consistent format with the original reference sources as provided above. In case of an update of the reference source, the inputs should be updated accordingly by replacing the existing data with the updated data, keeping the same format. If the format of the reference sources changes, then changes may also be required to the format of the corresponding Wider Impacts Model data tables. In that case refer to the Technical Specification document for guidance on making structural changes to the model.

8.4 What calculations are performed?

The sheets **Calculations-GHG (central), Calculations-GHG (low) and Calculations-GHG (high)** contains the calculations performed to assess the impact of the measure on greenhouse gas emissions. **Changes should not be made to these sheets**, unless the format of the input data is changed, in which case refer to the Technical Specification document for guidance.

"*Summary of inputs*" (Rows 3 to 215): This provides a summary of the relevant inputs that are used in the calculations.

Calculations for this impact follow eight steps:

Step 1. Quantify net changes in GHG emissions (rows 219:265): Fuel- specific emissions factors are applied to the net energy changes inserted by the user. Emission factors based on vehicle km are also applied where relevant.

Step 2. Monetise the net changes in GHG emissions (traded and non-traded)(rows 268:314) by applying the carbon prices (expressed as £/tCO_2e) to total quantified changes in emissions (Mt CO_2e):

- To the traded sector the Traded Price of Carbon (TPC).
- To the non-traded sector the Non-Traded Price of Carbon (NTPC).

Step 3. Conversion of energy change from input units to kWh or litres (rows 317: 361) by converting energy change user inputs into the necessary units, given that future energy price projections are either issued in kWh for electricity, gas and coal or litres for liquid fuels.

Step 4. Conversion of rebound effects from input units to kWh or litres (rows 364: 408) by converting rebound effect inputs into the necessary units, given that future energy price projections are issued either in kWh for electricity, gas and coal or litres for liquid fuels.

Step 5. Monetisation of energy change (rows 411:455) by applying the long-run variable costs of energy supply (LRVCs) to monetise changes in energy use

Step 6. Monetisation of rebound effects (rows 458:502) by applying retail fuel prices to monetise direct rebound effects (e.g. comfort taking).

Step 7. Discount and deflate monetised value of GHG emissions (rows 505:556) by discounting the monetised net changes in GHG emissions for traded and non-traded sectors using the relevant discount rate from the inflation table (rows 514:516, column H).

Step 8. Discount and deflate monetised value of change in energy consumption (rows 559:601) by discounting the monetised change in energy consumption using the relevant discount rate from the inflation table (rows 514:516, column H).

Step 9. Discount and deflate monetised value of rebound effects (rows 604:646) by discounting the monetised rebound effects from projected retail energy prices using the relevant discount rate from the inflation table (rows 514:516, column H).

Uncertainty is carried through the calculations. This is done using two parallel systems:

- Calculations are done for all three uncertainty scenarios (low, medium and high) as provided by the user.
- A qualitative scoring system considers the uncertainty of fixed inputs (and the user inputs if no low and high values are entered).

8.5 Where can I find the results for this impact?

Main results

Results for GHG impacts are detailed in the **Results-GHG** sheet, these are:

- Net carbon emissions in kilotonnes CO_2e (Rows 9:28)
- Discounted monetised value of carbon emissions (Rows 31:50)
- Discounted monetised value of change in energy consumption (Rows 53:69)
- Discounted monetised value of rebound effects (Rows 72:88)
- Total monetised impact (Rows 91:110)

The five tables, (Rows 9:110) provides the net carbon impact and discounted monetised values.

Figure 8.10 presents an example of the detailed results table for GHG. This table disaggregates impacts by costs and benefits, transitional and annual costs, by year and for each uncertainty scenario. Costs and benefits are expressed in **Net Present Value in thousands of pounds** for each year, presented in the prices year specified by the user in the **Control** sheet (see Section3.3). Costs are represented by positive numbers, whereas benefits are represented as negative numbers.

The colour of the column provides useful information for interpretation of the results being: current year, measure start year, appraisal end year. Where no data has been entered for some years, the respective cells in the table will show "No data".

Figure 8.10 Examples of detailed results table for GHG

Net carbon emissions in ktonnes CO_2e

(minus indicates an emissions saving)

Units: thousand tonnes		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Traded	Central						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Low						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	High						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-traded	Central						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Low						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	High						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Transport	Central						0.38	0.38	0.38	0.38	0.38	0.38	0.00	0.00	0.00	0.00	0.00
	Low						0.38	0.38	0.38	0.38	0.38	0.38	0.00	0.00	0.00	0.00	0.00
	High						0.38	0.38	0.38	0.38	0.38	0.38	0.00	0.00	0.00	0.00	0.00
Non-fuel emissions	Central						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Low						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	High						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total CO2e	Central						0.38	0.38	0.38	0.38	0.38	0.38	0.00	0.00	0.00	0.00	0.00
	Low						0.38	0.38	0.38	0.38	0.38	0.38	0.00	0.00	0.00	0.00	0.00
	High						0.38	0.38	0.38	0.38	0.38	0.38	0.00	0.00	0.00	0.00	0.00

Discounted monetised value of carbon emissions

(minus indicates benefits)

Units: £k (2014 prices)		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Traded	Central						0.01	0.03	0.04	0.05	0.06	0.06	0.07	0.07	0.07	0.06	0.06
	Low						0.00	0.01	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	High						0.10	0.11	0.11	0.12	0.12	0.12	0.12	0.12	0.11	0.10	0.09
Non-traded	Central						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Low						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	High						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Transport	Central						21.27	20.89	20.51	20.14	19.77	19.40	0.00	0.00	0.00	0.00	0.00
	Low						10.63	10.45	10.26	10.07	9.88	9.70	0.00	0.00	0.00	0.00	0.00
	High						31.90	31.34	30.77	30.21	29.65	29.10	0.00	0.00	0.00	0.00	0.00
Non-fuel emissions	Central						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Low						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	High						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total CO2e	Central						21.28	20.92	20.56	20.19	19.83	19.46	0.07	0.07	0.07	0.06	0.06
	Low						10.63	10.45	10.27	10.09	9.91	9.73	0.03	0.03	0.03	0.03	0.03
	High						32.00	31.44	30.89	30.33	29.77	29.22	0.12	0.12	0.11	0.10	0.09

As shown in the example results table, Figure 8.10, the current year is 2015, the measure is expected to start in 2020 and the appraisal period covers the years up until 2030. It should be noted that the values in the examples above are purely illustrative and the user is not expected to get similar results.

Summary results

The sheet **Results-Summary** display a summary of the results for all of the impacts assessed. Changes are not required for this sheet. Results for the assessment of the GHG are provided in Rows 70:75. Results are presented as net present value of transitional, annual and total annualised costs and benefits, and the total net impact.

Figure 8.11 illustrates an example of how the detailed results table may look like for GHG. It shows the sum of all **annual costs and benefits as Net Present Value expressed in thousands of pounds** presented in prices for the year selected in **Control** sheet cell C15 (see Section 3.3).

Figure 8.11 Example of summary results table.

GHG

npv 2014 prices	Change in emissions Thousand tonnes CO2e			Total monetised impact NPV £k (2014 prices)			Comments
	Central	Low	High	Central	Low	High	
Total impact	2.30	2.30	2.30	416	302	602	

8.6 Limitations

- The methodology is restricted to identify changes in energy consumption as a result of a policy, and how this is reflected in changed GHG emissions. Changes related to non-fuel GHG emissions (e.g. formation of CO2 through use of limestone in wet scrubbing) are not captured in the methodology. The change in the level of non-fuel GHG emissions will be variable depending on the technology or measure used and the sector to which it applies (i.e. how this leads to changes in process emissions). A bespoke quantification on the basis of specific evidence would therefore be more suitable than the use of a generic model results of which would involve high levels of uncertainty. If data on net changes in non-fuel GHG emissions are available, the user of the model will be able to input them so that they are valued alongside energy related GHG emissions.
- The model is not designed to calculate the embedded carbon associated with policies (unless the net energy change accounts for this) due to the high levels of uncertainty associated in such assessments and low availability of data on materials used.

9. Assessing impacts on affordability for businesses

This section explains the steps required to assess the impact of a measure on affordability for businesses. For a more detailed description of the method applied to calculate this impact please refer to section 8 of the technical specification document.

9.1 What is this impact?

The wider impacts model quantifies the impact on business affordability as a result of additional costs of compliance with the policy under assessment.

This impact measures whether businesses are able to meet ("afford") the costs resulting from the impacts of a given policy or measure. The impact is assessed by comparing the policy cost, per business, against the level of financial resources available to the business (e.g. ratio of policy cost to Gross Operating Surplus - GOS). Costs to a given business can include compliance costs associated, for instance, with making technical changes such as installing abatement equipment, as well as administrative costs associated with the regulation, such as applying for a permit. In order to account for distributional effects, the assessment considers different size of businesses.

9.2 Which parts of the model are relevant for these impacts?

The assessment of this impact uses inputs from the **Control- BusinessAfford**, **Common data** and **Inputs-BusinessAfford** sheets. Calculations are carried out separately for each scenario (central/low/high) in the sheets **Calcs-BusinessAfford (central), Calcs-BusinessAfford (low) and Calcs-BusinessAfford (high)** respectively. Results are presented in **Results-BusinessAffordability**.

9.3 What parameters are required and how to input them?

User-defined inputs

Follow the steps in Section 3 in order to set common parameters for the assessment.

Annualisation timescale, affordability thresholds and user qualitative uncertainty

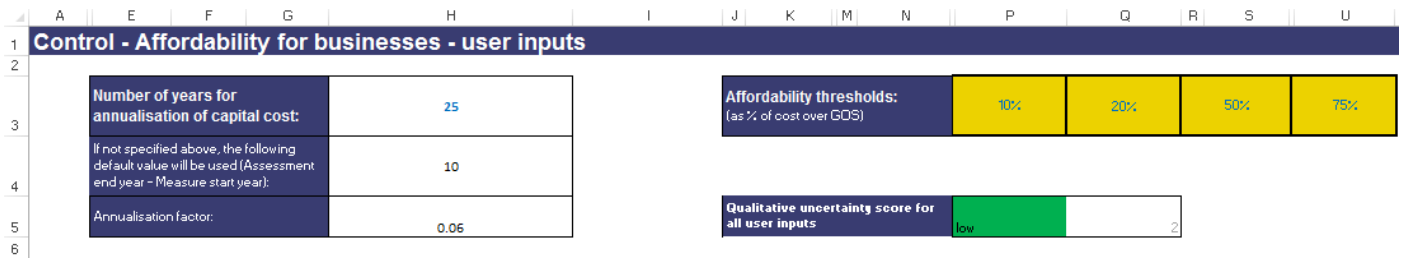
Control-BusinessAfford "*Number of years for annualisation of capital cost*" (E3:H5) **(OPTIONAL)**: **This input is optional. If not provided, default figures will be used.** If using capital (transitional) costs for businesses as an input, enter the number of years to be used in the annualisation of the capital costs in Cell H3. If this cell is left blank the model will use the appraisal period displayed in Cell H4 as the default annualisation period. The appraisal period is calculated as *Assessment end year* minus *Measure start year* as defined in Section 3. Cell H5 displays the annualisation factor derived from the selected number of years.

Control-BusinessAfford "*Affordability thresholds*" (J3:U3) **(OPTIONAL)**: **This input is optional. If not provided, default figures will be used**. Enter the ratio (policy costs compared to business GOS) above which the measure could be considered difficult to afford (or unaffordable) for the businesses in that division/size. The model allows for four different thresholds to be applied. By default, 10%, 20%, 50% and 75% are applied but these can be changed by the user. Calculated costs will be compared to these thresholds to show the number (and proportion) of business affected under each of them.

Control-BusinessAfford "Qualitative *uncertainty score for all user inputs*" (J5:Q5): If a numerical data range for uncertainty is not available, an estimate of the level of uncertainty associated with the central values should be selected in Cell P3. The resulting uncertainty score will be displayed in Cell Q3. If a quantitative range is available and the user has input the central, low and high estimates, "not used" should be selected in this cell.

The three inputs described above are common to all the scenarios (central, low and high).

Figure 9.1 Selecting the annualisation period, affordability thresholds and qualitative uncertainty



Input sector specific data

In order to account for uncertainty in a quantitative manner, the analysis is divided in three scenarios: Central, Low and High. The structure and format of the inputs are identical for the three scenarios, being the input tables for the three scenarios located in the sheet **Control-BusinessAfford**. The description below uses the central scenario as an example (starting in Row 7) but it also applies to scenarios low (Row 565) and high (Row 1123).

Control-BusinessAfford "*Table 1. Business sector selection and input data (central scenario)*" (Row 11)

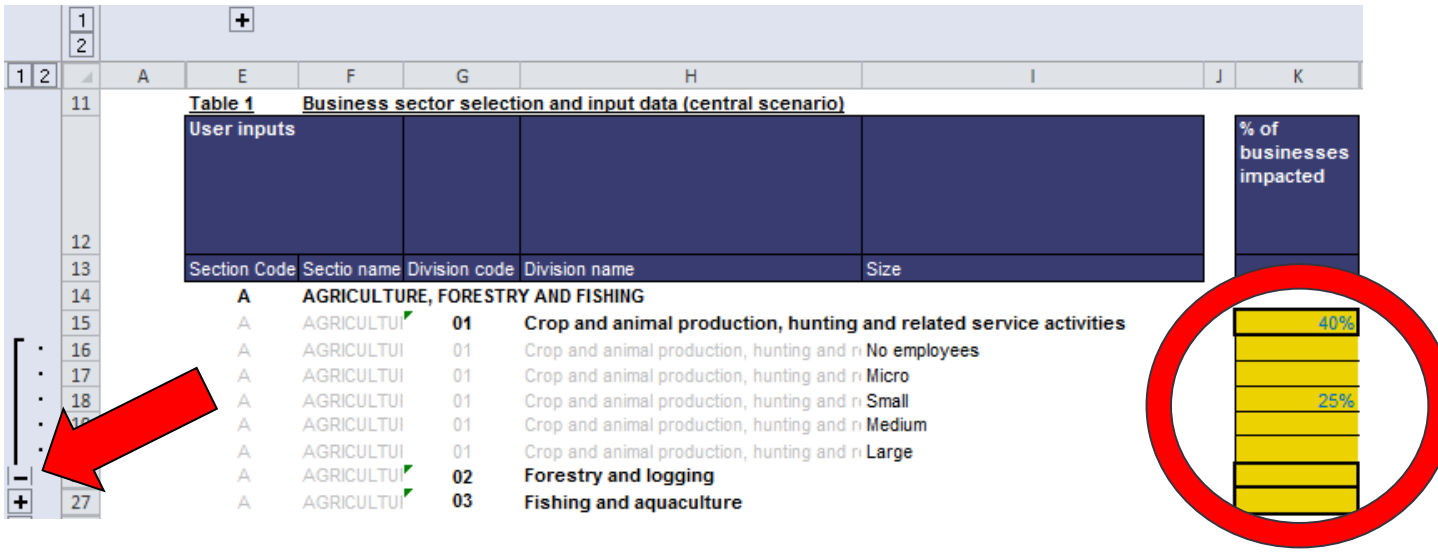
There are three levels of disaggregation in the analysis of businesses. They are business section (characterised by a letter following the NACE codes – E.g. A: Agriculture, Forestry and Fishing), business division (characterised by a 2-digit code – E.g. 02: Forestry and logging) and business size (e.g. micro, small, etc.).

The user can operate either at division or size level. If the user has data at division level, this has to be input in the rows with a thick black border (e.g. rows 15, 21, 27, etc.). If the user has data for a specific business size, s/he can click the plus symbol to the left to expand the rows and add data in the relevant cells. This applies to all the inputs in the input table.

An example is provided in Figure 9.2 (central scenario). In this example the user has provided a value of 40% at division level in Cell K15, then clicked in the plus symbol to the left and provided a value of 25% for small businesses (Cell K18). This means that the value of 40% will be applied to all business sizes within that division excepting small businesses, which have their own specific value.

The user needs to add data for all the divisions that are expected to be affected by the policy measure.

Figure 9.2 Adding inputs at division and business size level.



The model is originally designed to compare the same business divisions and size categories between the three scenarios (central, low and high). However, if the user wants to compare different divisions/sizes

between scenarios, **add a zero in column K for those divisions/sizes that do not take part in one of the scenario analysis instead of leaving it blank.** This way, that row will be still carried through the calculations and results.

Enter percentage of businesses impacted

Column K "*% of businesses impacted*": Enter an estimation of the percentage of businesses that would be impacted by the measure (see figure above).

Enter compliance costs

Negative costs (i.e. benefits) should not be entered by the user into the Control-BusinessAfford worksheet. The assessment method has been designed only to assess the impact of compliance costs on business affordability.

The model offers two mutually exclusive options for entering compliance costs per business (do not input both).

Option 1: Average annualised cost.

Column N "*Average annualised cost of compliance per business*": Enter the average total annualised cost per business of applying the air quality measure in thousand pounds per year. This figure must consider all costs and does not differentiate between transitional and operational costs.

Option 2: Capital (transitional) and operational (annual) costs

Column P "*OR Capital (transitional) cost per business*": Enter the one-off capital (transitional) cost per business in thousand pounds.

Column Q "*AND Annual operating cost per business*": Enter the annual operational cost per business, in thousand pounds per year.

Figure 9.3 Input capital and operating costs per business OR average annual cost per business

% of businesses impacted	Average annualised cost of compliance per business	OR Capital (transitional) cost per business	AND Annual operating cost per business	% of businesses able to pass costs	% of compliance cost that could be passed
	£k/year	£k	£k/year	%	%
40%	4.20			40%	30%
10%		500.00	23.00	30%	20%

Enter capacity of passing / absorbing costs

Column S "*% of businesses able to pass costs*": Enter the percentage of businesses within that division/size that would be able to pass through a portion (or all) of the additional costs to the next stage in the supply chain and/or to the final consumer.

Column U "*% of compliance cost that could be passed*": For those businesses able to pass costs downstream, enter the average proportion of additional costs that would be passed. If no businesses within that division/size is able to pass costs (i.e. Column S = zero), then enter zero.

Figure 9.4 Example of completed input table for "Affordability for businesses".

Table 1 Business sector selection and input data (central scenario)

User inputs					% of businesses impacted	Average annualised cost of compliance per business	OR Capital (transitional) cost per business	AND Annual operating cost per business	% of businesses able to pass costs	% of compliance cost that could be passed
Section Code	Sectio name	Division code	Division name	Size		£k/year	£k	£k/year	%	%
A	AGRICULTURE, FORESTRY AND FISHING									
A	AGRICULTL	01	Crop and animal production, hunting and related service activities		40%	4.20			40%	30%
A	AGRICULTL	01	Crop and animal production, hunting and	No employees						
A	AGRICULTL	01	Crop and animal production, hunting and	Micro			65.00	300.00	25%	15%
A	AGRICULTL	01	Crop and animal production, hunting and	Small	25%	2.00			25%	15%
A	AGRICULTL	01	Crop and animal production, hunting and	Medium						
A	AGRICULTL	01	Crop and animal production, hunting and	Large						
A	AGRICULTL	02	Forestry and logging		10%		500.00	23.00	30%	20%
A	AGRICULTL	03	Fishing and aquaculture							

Fixed inputs

In addition to the default appraisal period explained in section 3, the assessment of impacts on affordability for businesses requires two other fixed inputs:

Number of businesses in the private sector and their associated employment and turnover, by number of employees and industry division, UK, start 2013; and

Gross operating surplus and mixed income, 2012.

These inputs do not need to be manipulated by the user in order to run the model. However, they should be updated whenever new data are available.

These data are presented in the **Inputs-BusinessAfford** worksheet. Click on the hyperlinks at the top of the sheet to navigate to the relevant table.

"Number of businesses in the private sector and their associated employment and turnover, by number of employees and industry division, UK" (rows 6:1558): This large table represents the number of businesses, their employment and turnover. This information is disaggregated by industry division and business size (derived from number of employees). The source for these data is Department for Business Innovation and Skills, October 2013, Business Population Estimates for the UK and Regions, Table 6 - UK Divisions. The number of businesses and their turnover are the only indicators that have been used to assess this impact.

"Gross operating surplus and mixed income" (rows 1559:1675): This presents the Gross Operating Surplus (GOS) by industry divisions (or group of industry divisions). The GOS is the capital available to incorporated companies which allows them to repay their creditors, to pay taxes and eventually to finance all or part of their investment. It is used as a relevant indicator as to how much money a business has available to face an increase in costs before capital charges.

A qualitative estimation of the uncertainty associated with each of these datasets is shown under each table. This is carried through into the calculations and the results. The current uncertainty classification was estimated by the model developers. If the data in the tables are updated the uncertainty can be amended accordingly by clicking and selecting from the drop-down menu.

These data tables have a consistent format with the original reference sources. In case of an update of the reference source, the inputs should be updated accordingly by replacing the existing data with the updated data, keeping the same format. It is important that any new data added matches the years at the head of the table. If the format of the reference sources changes, then changes may also be required to the format of the corresponding Wider Impacts model data tables. In that case refer to the Technical Specification document for guidance on making structural changes to the model

9.4 What calculations are performed?

The sheets **Calcs-BusinessAfford (central), Calcs-BusinessAfford (low), Calcs-BusinessAfford (high)** contain the calculations performed to assess the impact of the measure on affordability for businesses for each uncertainty scenario. Changes should not be made to these sheets, unless the format of the input data is changed, in which case refer to the Technical Specification document for guidance.

"*Summary of inputs*" (rows 3 to 203): This provides a summary of the relevant inputs that are used in the calculations. Each row represents a unique combination of industry division and business size. By default only the first 30 rows or inputs are displayed. Click the cross symbol to the left of Rows 101 and 201 to display more rows.

Calculations for these impacts are divided in two main steps:

Step 1. Standardise GOS to UK division level and calculate GOR at division level (rows 206:331): Gross operating rate (GOR) is calculated as the proportion of total GOS to total turnover, at industry division level. For some industry divisions, the original GOS data is provided in a different aggregation level (i.e. provided at sub-division level or aggregated with other divisions). In such cases proportion of total GOS to total turnover is an average figure based on the sub-division level data. .

Step 2. Calculation of cost as a proportion of GOS for businesses (row 332:447): This step calculates the ratio of costs / GOS for businesses differentiating between those able to pass costs and those unable to do so. This uses the inputs from the summary input and *Step 1,* and involves the following calculations:

- Calculation of the average GOS at size category level for each division.
- Calculation of the number of businesses affected.
- Calculations of cost as proportion of GOS.
- Calculation of the above factors for businesses able to pass on costs to their customers – lower impact on affordability is expected for businesses that are able to pass on a share of the additional costs of a policy to their customers.

Uncertainty is carried through the calculations. This is done using two parallel systems. On one side, calculations are done for the three quantitative scenarios in separate spreadsheets (low, central and high) as provided by the user in the impact control sheet. In addition, a qualitative scoring system considers the uncertainty of fixed inputs (and the user inputs if no low and high values are entered or as a complementary value). This qualitative score is propagated through the calculations and assigned a category (low, medium, high) in the results tab.

9.5 Where can I find the results for these impacts?

Main results

Results for impacts on affordability for businesses are detailed in sheet **Results-BusinessAffordability**. This sheet includes results for the three uncertainty scenarios (central, low and high). Results are displayed in Rows 7 to 44 by default. If more divisions/sizes were are being analysed, expand rows by clicking on the cross symbol next to row 109.

Columns C:G: Show a summary of the divisions and business sizes being considered.

Columns I:U: Provide an extract of the intermediate outputs from the calculation sheets for the three scenarios.

Columns W:Z: Provide the final output of total number of businesses that will be significantly impacted by division/size in the central scenario under each of the affordability thresholds. This is done by comparing cost (as a proportion of GOS) for each size category with the thresholds specified in the control tab. The same is shown for the low and high scenarios in columns AF:AI and AO:AR respectively. Note thresholds are common for the three scenarios.

Columns AA:AD: Provide the proportion of impacted businesses compared to the total number of businesses in that division/size for the central scenario under each of the affordability thresholds. Columns AJ:AM and AS:AV do the same for the low and high scenario respectively.

Figure 9.5 presents an example of the results table for business affordability under the central scenario. Please note that columns showing intermediate results (Columns I:U) are not shown in the figure below for

clarity but are available in the model. This example shows the number of potentially impacted businesses and the proportion they represent against the total number of businesses under each threshold.

Figure 9.5 Extract of an example results table for business affordability.

Units: Number of businesses and % of total businesses in the division/size category

Impact specific inputs					Central scenario							
					Number of businesses with significant impact				% of businesses with significant impact			
Section Code	Section name	Division code	Division name	Size	Threshold 0.1	Threshold 0.2	Threshold 0.5	Threshold 0.75	Threshold 0.1	Threshold 0.2	Threshold 0.5	Threshold 0.75
									%	%	%	%
A	AGRICULTURE, FORESTRY AI	01	Crop and animal production, hunti	No employees	42,538	42,538	29,776	-	50%	50%	35%	0%
A	AGRICULTURE, FORESTRY AI	01	Crop and animal production, hunti	Micro	14,313	-	-	-	30%	0%	0%	0%
A	AGRICULTURE, FORESTRY AI	01	Crop and animal production, hunti	Small	-	-	-	-	0%	0%	0%	0%
A	AGRICULTURE, FORESTRY AI	01	Crop and animal production, hunti	Medium	-	-	-	-	0%	0%	0%	0%
A	AGRICULTURE, FORESTRY AI	01	Crop and animal production, hunti	Large	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data
A	AGRICULTURE, FORESTRY AI	02	Forestry and logging	No employees	4,824	4,824	4,824	4,824	40%	40%	40%	40%
A	AGRICULTURE, FORESTRY AI	02	Forestry and logging	Micro	550	385	-	-	40%	28%	0%	0%
A	AGRICULTURE, FORESTRY AI	02	Forestry and logging	Small	-	-	-	-	0%	0%	0%	0%
A	AGRICULTURE, FORESTRY AI	02	Forestry and logging	Medium	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data
A	AGRICULTURE, FORESTRY AI	02	Forestry and logging	Large	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data

Figure 9.5 also shows some final results as *No data* or *Insufficient data*. *No data* means that no more rows have been included in the analysis. *Insufficient data* means that either the user has not entered some of the required inputs or that the fixed input data that is publicly available do not hold records for that specific division/size.

The qualitative uncertainty category associated with the final result can be found in row 110.

Summary results

The sheet **Results-Summary** display a summary of the results for all of the impacts assessed. Changes are not required for this sheet. Results for the assessment of the affordability for individuals are provided in Rows 78:88. Results present number of businesses in affected sectors, number of businesses with significant impact and percentage of businesses in affected sectors with significant impact under each of the specified thresholds and scenarios. The results are disaggregated by the size of business.

Figure 9.6 illustrates an example of how the detailed results table for the central scenario may look like for the assessment of affordability for business.

Figure 9.6 Example summary results of the assessment of affordability for business

Business affordability

Size	Number of businesses in affected sectors	Central							
		Number of businesses with significant impact (by threshold)				% of businesses in affected sectors with significant impact (by threshold)			
		10%	20%	50%	75%	10%	20%	50%	75%
No employees	97,135	47,362	47,362	34,600	4,824	49%	49%	36%	5%
Micro	49,085	14,863	385	0	0	30%	1%	0%	0%
Small	3,165	0	0	0	0	0%	0%	0%	0%
Medium	330	0	0	0	0	0%	0%	0%	0%
Large	50	0	0	0	0	0%	0%	0%	0%
Total	149,765	62,225	47,747	34,600	4,824	42%	32%	23%	3%

9.6 Limitations

- For this impact the model can handle a maximum of 94 rows, that is, unique combinations of industry division and sizes.
- The default thresholds in the model have been used to provide the user with a range of possible impacts. These thresholds are assumptions which have not been validated by evidence in the literature, having not been contained in the literature identified, or through direct liaison with businesses, due to the resource constraints of this project. Determination of

what is considered “affordable” for a business is dependent on the economic activity of the business and its size. It is advisable that in order to obtain results specific for a given sector affected by the policy, the affordability thresholds are determined by the user through industry surveys or defined on the basis of previous studies.

- The model can provide the number of businesses that would be impacted and an estimate of the degree of this impact at division and business size level. However, in reality different businesses within the same division and size will be impacted to a different degree. This level of detail cannot be captured by the generic modelling undertaken in the wider impacts model.
- Official government guidelines lack clear recommendations on the type of the indicator to use for the assessment of business affordability. In the absence of clear guidelines, GOS was selected as a measure of the resources available to businesses for making investments. Use of GOS is not unpinned by specific economic theory, however in the absence of readily available data on companies’ profits, GOS was considered the best available indicator. GOS information was only available at a UK division level, and not per business size category.
- For some business sectors, publicly available data from the fixed inputs (employment figures, turnover, GOS) is limited, being sometimes not disclosed and marked as confidential. This is particularly relevant for data on large businesses in sectors where only a few large companies operate.

10. Assessing impacts on employment

This section explains the steps required to assess the impact of a measure on employability. For a more detailed description of the method applied to calculate this impact please refer to the Technical Specification document.

10.1 What is this impact?

The Wider Impacts Model quantifies the impact on employment as a result of additional costs of compliance with the policy under assessment.

This assessment provides an initial simplified assessment of the scale of potential impact of the policy on employment figures per economic sector (NACE division level). . The assessment uses **two separate methods** to provide potential estimates of the scale of impact:

- Method A: Scale of the impact is estimated by calculating the equivalent number of jobs the policy could affect.
- Method B: Scale of the impacts is estimated by calculating how many jobs could potentially be lost as a result of the policy.

As described below, the two methods are not linked to each other and hence the results of the calculations for these methods should either be read separately, or taken as an indication of the possible range.

The results of the assessment could assist the user in answering the following questions:

- *How labour intensive are the industries affected by the air quality measures?* The answer to this question can be informed by the results of the calculation of “Labour cost as a share of total turnover (%)”.
- *How many jobs could potentially be affected if the businesses in these sectors face an increase in production costs?* The answer to this question can be informed by the results of the calculation of “Equivalent number of jobs”.
- *How many jobs would be at risk (i.e. could potentially be lost), if the businesses are forced to cut jobs in light of the disproportionate increase in production costs?* The answer to this question can be informed by the results of the calculation of “Number of jobs potentially lost”.

The calculations for this impact use the information entered by the user for the assessment of affordability for business.

10.2 Which parts of the model are relevant for this impact?

The assessment of this impact uses inputs from the **Control** and **Inputs-Employment** sheets. Calculations are carried out in the **Calculations-Employment (central), Calculations- Employment (low)** and **Calculations- Employment (high)** sheets. Results are presented in **Results- Employment** and summarised in **Results-Summary**.

10.3 What parameters are required and how to input them?

User defined inputs

Follow the steps in Section 3 and Section 8 (Assessing impacts on affordability for businesses) in order to set the parameters for the assessment. **No additional user inputs need to be entered to assess employment impacts. The assessment method has been designed only to assess the impact of costs**

of compliance on employment (i.e. the negative values should not be entered in the worksheet Control-BusinessAfford).

Fixed inputs

In addition to the default appraisal period explained in section 3, the assessment of impacts on employment requires one other fixed input. These inputs do not need to be manipulated by the user in order to run the model. However, the data should be updated whenever new data are available. This fixed input is presented in the **Inputs-Employment** worksheet.

Annual business survey data (rows 5:505): This large table represents business turnover, approximate gross value added at basic prices (aGVA), capital expenditure, employment costs, number of enterprises and total stocks and work in progress. This information is disaggregated by industry division. The source of the data is extracted from the Office for National Statistics, 2013 Provisional results. Each industry division is derived from the standard Industrial Classification (SIC) (2007). Data regarding turnover, number of employments and employment costs are the data that have been used to assess the impact to employment.

A qualitative estimation of the uncertainty associated with each of these datasets is shown under the table. This is carried through into the calculations and the results. The current uncertainty classification was estimated by the model developers. If the data in the tables are updated the uncertainty can be amended accordingly by clicking and selecting from the drop-down menu.

These data tables have a consistent format with the original reference sources. In case of an update of the reference source, the inputs should be updated accordingly by replacing the existing data with the updated data, keeping the same format. It is important that any new data added matches the years at the head of the table. If the format of the reference sources changes, then changes may also be required to the format of the corresponding Wider Impacts model data tables. In that case refer to the Technical Specification document for guidance on making structural changes to the model

10.4 What calculations are performed?

The sheets **Calculations-Employment (central), Calculations- Employment (low)** and **Calculations-Employment (high)** sheets contain the calculations performed to assess the impact of the measure on employment for each uncertainty scenario. **Changes should not be made to these sheets**, unless the format of the input data is changed, in which case refer to the Technical Specification document for guidance.

Both methods A and B for the assessment of the potential employment impact share the following aspects:

Summary of inputs at company size category level (rows 3:190): The two tables, "Figures from "*Affordability for businesses*" (rows 5:102) and "*Employment fixed inputs – 2013*" (row 105:190) provide a summary of the relevant inputs that are used in the calculations. Each row represents a unique combination of industry division and business size. By default only the first 30 rows or inputs are displayed. Click on the cross symbol to the left of Rows 101 and 189 to display more rows.

It should be noted that the underlying employment and turnover data from BIS provides information on employment in businesses classed as "No employees". Examining the data demonstrated that employment figures are generally greater than the number of businesses in that category across the sectors. This suggests that businesses in this size category have at least one employee (presumably reflecting self-employment or one or more owners). For that reason, assessment of the impact on employment includes impacts on companies categorised as "No employees". If the user of the model wants to exclude these companies from the assessment, zero cost to business for that business size category should be entered in "**Control-BusinessAfford".**

Step 1. Derive inputs from ABS and BIS data (rows 194:295): Fixed inputs are used here to calculate the additional parameters used in the calculation via methods A and B. Specifically the following parameters are derived in this step:

- Total employment cost per employee (£k)

- Labour cost as a share of total turnover (%)
- Share of businesses that are employers (%)

Calculations for method A:

Step 2. Calculate absolute impact on employment (rows 298:419): This step calculates the equivalent number of jobs for the sector in columns I:L by dividing the annualised cost of compliance of the policy measure per business (user input to the model) by the total cost to business of employing one employee. The equivalent number of jobs per business (able and unable to pass on cost) is then multiplied by the total number of businesses that are expected to be affected by the compliance costs (which is a result of from the business affordability assessment).

Calculations for method B:

Step 2. Calculate absolute impact on employment (rows 298:419): This step calculates the absolute reduction in employment per sector in columns N:V. In this method it is assumed that all compliance costs of the policy will directly translate into an increase in non-wage labour costs. The elasticity of labour demand to changes in non-wage labour cost of -0.5 is assumed. This implies that for each 1% increase in labour costs employment falls by 0.5%.

The percentage change in non-wage labour costs is calculated by dividing total annualised compliance cost per business (user input) by total employment cost per business at a size level[11]. The resulting change in non-wage labour costs is then halved (because of the elasticity of labour demand of -0.5) to obtain the potential percentage change in employment figures. This percentage is then applied to the total number of employees in a given sector to provide total number of potential jobs lost in sectors affected by the policy.

Uncertainty is carried through the calculations. This is done using two parallel systems. On one side, calculations are done for the three uncertainty scenarios in separate spreadsheets (low, central and high) as provided by the user in the impact control sheet. In addition, a qualitative scoring system considers the uncertainty of fixed inputs (and the user inputs if no low and high values are entered or as a complementary value).

10.5 Where can I find the results for these impacts?

The model generates two sets of results that are **not directly comparable** with each other because they are calculated using two different methods:

The results of the employment assessment obtained from the Wider Impacts Model should be interpreted with caution. The model provides only theoretical values to inform users' thinking on what the potential impacts might be. In reality, the impacts of environmental policy on employment may be significantly lower.

Common results for Methods A and B

Results for impacts on employment are detailed in sheet **Results-Employment**. This sheet includes results for the three uncertainty scenarios (central, low and high). Results are displayed in Rows 8 to 40 by default. If more divisions/sizes were are being analysed, expand rows by clicking on the cross symbol next to row 92.

Columns C-F: Show a summary of the industry types and divisions affected by the policy.

Columns G: Provides the labour cost as a share of total turnover by industry divisions. Information is derived from the **Inputs-BusinessAfford** worksheet.

[11] Derived using ONS (2013) total employment cost and BIS (2013) data on the number of businesses and total number of employees per size of business.

Results for method A:

Columns H-J: Provide the equivalent number of jobs in businesses unable to pass costs as a result of the policy/measure per industry division. This is shown for each of the uncertainty scenarios.

Columns K-M: Provide the equivalent number of jobs in businesses able to pass costs as a result of the policy/measure per industry division. This is shown for each of the uncertainty scenarios.

Columns N-P: Sum the equivalent number of jobs in businesses that are both able and unable to pass costs as per industry division.

Columns Q-S: Indicate the proportion that job figures from columns N-P represent over total employment within the industry division.

The results do not provide information on whether the jobs will be lost/gained or moved from one sector to another. They provide the number of jobs the additional compliance costs are equal to by simply comparing an additional cost to business as a result of the policy with the average employment cost in a given economic sector.

Results for method B:

Columns U-W: Provide the number of jobs potentially lost in businesses unable to pass costs per industry division.

Columns X-Z: Provide the number of jobs potentially lost in businesses able to pass costs per industry division.

Columns AA-AC: Sum the number of jobs potentially lost (worst case scenario) in businesses able and unable to pass costs per industry division.

Columns AD-AF: Indicate the proportion that job figures from columns AA-AC represent over total employment within the industry division

The results present only the number of potential jobs lost. The assumptions made for this method assume that if faced with extra costs, employers will decide to cut jobs. Hence the figures presented show the worst case scenario. This method cannot be used to assess impacts of any subsidies (i.e. where there is a negative cost (benefit) to business).

Figure 10.1 presents an example of the results table for employment. Rows have been split in two images for illustrative purposes. This example shows the number of potentially impacted number of jobs in an affected sector and the total number of jobs potentially lost.

Figure 10.1 Extracts of an example results table for Employment.

	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
8					Labour cost as a share of total turnover by industry division	Equivalent number of jobs in businesses unable to pass costs per sector			Equivalent number of jobs in businesses able to pass costs per sector			Total equivalent number of jobs per sector			% of employment in the sector		
9	Impact specific inputs					Central	Low	High	Central	Low	High	Central	Low	High	Central	Low	High
10	Section Code	Section name	Division code	Division name	%	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number
11	A	AGRICULTURE, FORESTRY AN	01	Crop and animal produ	17%	3,367	3,928	6,313	595	655	631	3,962	4,583	6,945	1%	1%	2%
12	A	AGRICULTURE, FORESTRY AN	02	Forestry and logging	21%	113	85	187	24	22	32	137	107	219	1%	1%	1%
13	H	TRANSPORTATION AND STOF	50	Water transport	15%	17	15	21	4	5	2	21	20	23	0%	0%	0%
14	No data	No data	No data	No data	No data	-	-	-	-	-	-	-	-	-	-	-	-
15	No data	No data	No data	No data	No data	-	-	-	-	-	-	-	-	-	-	-	-
16	No data	No data	No data	No data	No data	-	-	-	-	-	-	-	-	-	-	-	-

	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
8	Number of jobs potentially lost in businesses unable to pass costs per sector			Number of jobs potentially lost in businesses able to pass costs per sector			Total number of jobs potentially lost (worst case scenario)			Jobs potentially lost (worst case scenario) as % of employment in the sector		
9	Central	Low	High	Central	Low	High	Central	Low	High	Central	Low	High
10	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number
11	4,483	5,230	8,406	792	872	841	5,275	6,102	9,247	1%	2%	2%
12	511	383	843	109	99	145	620	482	988	3%	2%	5%
13	33	29	40	7	9	4	40	37	44	0%	0%	0%
14	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-	-	-

Figure 10.1 also shows some final results as "*No data*" meaning that no more rows have been included in the analysis.

The qualitative uncertainty category associated with the final result can be found in row 93.

Summary results

The sheet **Results-Summary** display a summary of the results for all of the impacts assessed. Changes are not required for this sheet. Results for the assessment of the impact on employment are provided in Rows 91:98. Results present two types of information:

1. The number of equivalent jobs impacted in the affected sectors and the percentage of potentially affected jobs as a share of total employment in affected sectors

2. The total number of jobs potentially lost as a results of policy implementation in the affected sectors and the percentage of potential jobs lost as a share of total employment in the affected sectors.

The results are disaggregated by the different uncertainty scenarios. Figure 10.2 illustrates an example of how the detailed results table may look like for the assessment of employment

Figure 10.2 Example summary results of the assessment of employment

Employment

Employment impact	Scenario			Comments
	Central	Low	High	
Number of equivalent jobs in affected sectors	20,509,914	69,439	67,561	
Potentially affected jobs as a share of total employment in affected sectors (%)	23	0.08	0.08	
Number of jobs potentially lost in affected sectors (worst case scenario)	27,816,222	130,244	127,805	
Potentially lost jobs (worst case scenario) as a share of total employment in affected sectors (%)	32	0.15	0.15	

10.6 Limitations

- Method A calculates "equivalent number of jobs" by comparing the costs of the policy to business with costs of employment. The assessment method does not allow determining whether the resulting jobs affected will be lost/gained or just moved across the sectors. If the cost to business is negative (e.g. benefit per business as a result of a subsidy), the result of the assessment of impacts on employment in terms of "equivalent number of jobs" will show as a benefit (negative values). Nevertheless the assessment method has not been designed to assess impacts of negative cost, therefore negative costs should not be entered by the user into the Control-BusinessAfford worksheet.

- Method B is not appropriate to capture any increase in employment. The underlying assumptions made in this method allow only the potential jobs lost to be calculated. Hence if the user inputs negative costs to business in 'Control-BusinessAfford' (e.g. benefit per business as a result of a new subsidy), the impact on employment will not be calculated (results will display as "-").

- The model for this impact can handle a maximum of 91 rows, that is, unique combinations of industry division and sizes. If the user selects divisions and business size categories in excess of 91, the user will need to split the assessment in two different files and merge the outputs separately.
- The model can provide the number of equivalent jobs in affected sectors that would be impacted and an estimation of the number of jobs lost. However, in reality different businesses within the same division and size will have employment impacted to different degrees, which cannot be captured in the model.
- The underlying employment and turnover data from BIS provide information on employment in businesses classed as “No employees”. Examining the data demonstrates that employment figures are generally greater than the number of businesses in that category across the sectors. This suggests that businesses in this size category have at least one employee (presumably reflecting self-employment or one or more owners). For that reason assessment of the impact on employment includes impacts on companies categorised as “No employees”. If the user of the model wants to exclude these companies from the assessment, zero cost to business for that business size category should be entered in the model.
- There is no evidence of applying the elasticity of labour demand to changes in non-wage labour costs in the context of environmental legislation. Furthermore despite the elasticity figure has been used for the purpose of calculations by GWP in the Impact Assessment of Workplace Pension Reform (2010), results of the consultation supporting the impacts assessment states that only 7% of employers affected would consider absorbing costs through restructuring its workforce. The calculations made in the model do not at any point consider potential responses by businesses to increased productions costs (other than passing costs onto customers which is a user input to the model).
- No consideration is given to displacement and hence the model does not attempt to calculate net employment effects.
- The method does not assess the impacts further down the supply chain for the affected sectors.
- It focuses solely on cost to business and not on potential employment benefits that can be gained in the economy.

11. Assessing impacts on affordability for individuals

This section explains the steps required to assess the impact of a measure on affordability for individuals. For a more detailed description of the method applied to calculate this impact please refer to relevant section of the technical specification document.

11.1 What is this impact?

The wider impacts model quantifies the impact on households' disposable income (for households in each income quintile) as a result of additional costs of compliance with the policy under assessment.

This impact measures whether households are able to meet ("afford") the costs resulting from a given policy or measure. The impact consists of two modules:

- **Transport**: this is used to assess policies resulting in either change in travelling patterns of a household (e.g. change in car kilometres travelled) or price of transport (e.g. change in public transport fares, change in prices of transport fuels). This module can also be used to assess affordability of capital costs (e.g. linked to purchasing new vehicles as a result of car scrappage scheme) for average household in each income quintile.
- **Domestic**: this is used to assess policies resulting in either change in electricity / fuel used for domestic heating, heating and hot water or total energy used (e.g. as a result of energy efficiency measures) or price of electricity / fuel. This module can also be used to assess affordability of capital costs (e.g. linked to purchasing new domestic boilers, installing microgeneration or energy efficiency measures such as insulation) for average household in each income quintile.

Before proceeding with the assessment it is important to understand the concept of "average household" per income quintile which forms the basis for the assessment:

- **Transport**: average household in the model is assumed to travel by petrol and diesel car, and use all types of public transport. In the underlying data the actual travel patterns for households in a given income quintile are averaged out across the sample. In reality, it is expected that some households will not own the car, or will only own a petrol or a diesel car. It is also possible that some households do not use public transport at all or rely only on one mode of public transport (e.g. rail) rather than both rail and bus.
- **Domestic**: average household in the model is assumed to use electricity, gas and other fuels for the purpose of space and water heating. In reality, it is expected that some households will only rely on a single fuel (e.g. electricity only) or on two fuels (e.g. electricity and gas).

The concept of "average household" in each income quintile reflects therefore an average behaviour of households in a given income quintile, rather than behaviour of a single household with specific characteristics. This should be considered when interpreting the results of the assessment.

The affordability of a policy for an "average household" is assessed by comparing the change in costs of travel / domestic energy use resulting from a policy, against:

a) The counterfactual costs of travel / domestic energy use – that is the costs incurred by households before the policy is put in place.

b) Average level of disposable income available to average household per income quintile.

Costs per household can include capital costs associated, for instance, with one off expenditure as a results of changing legislation (e.g. purchase of new boiler, new vehicle, etc.) as well as annual costs resulting from either change in energy usage or unit energy price.

11.2 Which parts of the model are relevant for these impacts?

The assessment of this impact uses inputs from the **Control-AffordIndiv,** and **Inputs-AffordIndividuals** sheets. Calculations are carried out in the **Calcs-AffordIndiv(Transport) and Calcs-AffordIndiv(Domestic)** sheets. Results are presented in **Results-AffordIndiv** and summarised in **Results-Summary**.

11.3 What parameters are required and how to input them?

User-defined inputs

Follow the steps in Section 3 in order to set common parameters for the assessment.

Inputs for the assessment of the affordability for individuals for "domestic" scenarios

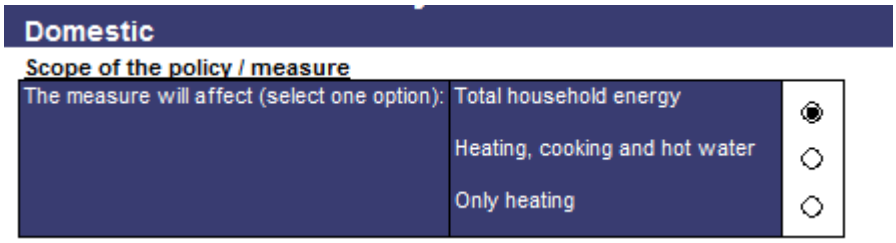
This input is relevant only to assessment of measures affecting domestic energy use. If the measure does not affect domestic energy use, leave blank.

For the assessment of impacts on affordability for individuals under the "**domestic**" setting, go to **Control-AffordIndiv** tables 1 to 4 (rows 2:56).

Specify the scope of the policy or measure

Control-BusinessAfford "*Scope of the policy/measure*" (C4:C6): Depending on what the measure will affect, the appropriate option must be selected in this table. Options include "Total household energy", "Heating, cooking and hot water" or "Only heating".

Figure 11.1 Example of scope of the policy/measure options for users to select



Total household energy is the aggregate of both the "heating, cooking and hot water" and "only heating". The "heating, cooking and hot water" option refer to energy consumption from household activities. "Only heating" option refers to just the household heating system as a whole such as central heating.

Input change in energy consumption per household

This input is relevant only to assessment of measures affecting levels of domestic energy consumption. If the measure does not affect domestic energy consumption, leave blank.

Control "*Table 1"* (rows 8:24): Select the input units from the drop down menu in cell C10, choosing between percentage change or kWh. Depending on the unit selected, further instructions are provided in cell C11 (e.g. enter inputs as numbers between 0 and 100, not in excel % format). After selecting the units, fill Table 1 (rows 13:24). Four input sections are provided, one for each fuel type (electricity, gas, coal and oil). Enter data for the change in energy consumption expected to occur as a result of the measure per household for each year of the assessment period (Columns D - AM "*Years*"). If the measure/policy is only affecting some fuels, rows for fuels not affected must be left blank. For any decrease in change, negative values should be provided. The input data here will be compared to forecasted data for household weekly expenditure on electricity, gas and other fuel in the calculation sheet. Quantitative estimates can be provided for central, low,

and high uncertainty scenarios in individual rows. Qualitative uncertainty score can be selected in column AN.

Figure 11.2 Example of the change in energy consumption per household

Table 1 **Change in energy consumption per household for each fuel type due to application of the policy/mesure** (change in

Unit: % *Enter percentages as numbers between 1 and 100*

Enter negative values for decreases

	Scenario	2015	2016	2017	2018	2019	2020	2021	2022
change in **electricity** consumption	Central	10	10	10	10	10	10	10	10
	Low	5	5	5	5	5	5	5	5
	High	20	20	20	20	20	20	20	20
change in **gas** consumption	Central								
	Low								
	High								
change in **coal** consumption	Central								
	Low								
	High								
change in **oil** consumption	Central								
	Low								
	High								

Input change in domestic fuel prices due to the application of the policy/measures. **This input is relevant only to assessment of measures affecting prices of domestic fuels. If the measure does not affect domestic fuel prices, leave blank.**

Control "*Table 2"* (rows 26:42): Select the input units from the drop down menu in cell C28, choosing between percentage change or p/kWh. Depending on the unit selected, further instructions are provided in cell D28.

After selecting the units, enter expected percentage change in domestic fuel prices for either electricity, gas, coal and oil prices to occur as a result of the measure for each year of the assessment period (Columns D - AM "*Years*"). The input data here will be compared to forecasted domestic energy prices on energy prices in the calculation sheet. For any decrease in change, negative values should be entered. If the measure/policy is only affecting some fuels, rows for fuels not affected must be left blank. Quantitative estimates can be provided for central, low, and high uncertainty scenarios in individual rows. Qualitative uncertainty score can be selected in column AN.

Figure 11.3 Example of the change in domestic fuel prices due to the application of the policy/measure

Table 2 **Change in domestic fuel prices due to the application of the policy/measure** (change in p/kWh

Unit: % *Enter percentages as numbers between 1 and 100*

Enter negative values for decreases

	Scenario	2015	2016	2017	2018	2019	2020
change in **electricity** prices	Central	10	10	10	10	10	10
	Low	5	5	5	5	5	5
	High	20	20	20	20	20	20
change in **gas** prices	Central	10	10	10	10	10	10
	Low	5	5	5	5	5	5
	High	20	20	20	20	20	20
change in **coal** prices	Central	100	100	100	100	100	100
	Low	5	5	5	5	5	5
	High	20	20	20	20	20	20
change in **oil** prices	Central	10	10	10	10	10	10
	Low	5	5	5	5	5	5
	High	20	20	20	20	20	20

Input capital cost per household - Unit: £

This input is relevant only to assessment of measures which will require households to invest e.g. in energy efficiency measures. If the measure is not associate with capital cost, leave blank.

Control "*Table 3"* (rows 44:49): Enter data for the capital costs per household in pounds in column D. This is the one-off capital cost in pounds that an average household will incur as a result of the policy expressed in current prices. If the quantitative values for different uncertainty scenarios are available enter central, low and high estimates in Rows 47, 48 and 49 respectively. Qualitative uncertainty scenario can be selected from the dropdown menu in column E. The resulting uncertainty score will appear in Column F.

Figure 11.4 Example of the capital cost per household

Table 3 **Capital cost per household) - Unit: £**

	Scenario	2020	Qualitative uncertai	Score
Capital cost per household (£)	Central	2,000	not used	1
	Low	1,500		
	High	3,000		

Input years over which capital cost is annualised

Control "*Table 4"* (rows 51:56): Enter the number of years over which capital cost is annualised in column D.

If the quantitative values for different uncertainty scenarios are available enter central, low and high estimates in Rows 54, 55 and 56 respectively. Qualitative uncertainty scenario can be selected from the dropdown menu in column E. The resulting uncertainty score will appear in Column F.

Figure 11.5 Example of the years over which capital cost is annualised

Table 4 **Years over which capital cost is annualised**

	Scenario		Qualitative uncertai	Score
Years	Central	3	not used	1
	Low	1		
	High	5		

Inputs for the assessment of the affordability for individuals for "transport" scenarios

This input is relevant only to assessment of measures which will affect households transport patterns. If the measure does not affect passenger transport, leave blank.

For the assessment of impacts on affordability for individuals under the "**Transport**" setting, go to **Control-AffordIndiv** tables 4 to 11 (rows 46:170).

Input age of cars affected by the policy

This input is relevant only to assessment of measures that may require households to purchase new vehicles. Otherwise, leave blank.

Control "*Table 5"* (rows 61:64): This input is necessary to assess the cost and affordability of those policies that may encourage households to purchase new vehicles (i.e. scrappage schemes). If no scrappage schemes are being assessed, Tables 5 and 6 do not need to be filled.

Indicate the age of vehicles that will be affected by the policy in columns C –I for the years between "up to 2 years" to "over 13 years" in terms of "Yes" or "No" selections. In row 66, the average lifetime of a car is pre-populated with a default value of 13 years but this can be modified by the user

Figure 11.6 Example of the age of cars affected by the policy

Table 5 **Age of cars affected by the policy**

Age of vehicles affected by the policy	Up to 2 years	2 to 4 years	4 to 6 years	6 to 8 years	8 to 10 years	0 to 13 years	)ver 13 years
	No	No	No	No	Yes	Yes	Yes

Average car lifetime in the absence of measure/policy:	13	*Default 13 years*

Input capital cost per household - Unit: £

This input is relevant only to assessment of measures that may require households to purchase new vehicles. Otherwise, leave blank.

Control "*Table 6"* (rows 68:76): Enter capital costs in pounds per household in current year prices for petrol or diesel car. This is the one-off cost paid by an average household associated with the measure or policy (e.g. for a scrappage scheme enter the cost of a car minus any incentives or subsidies). If the quantitative values for different uncertainty scenarios are available enter central, low and high estimates for petrol car or diesel car (rows 71:76). If only single set of values is available enter data for "central" scenario only and select the qualitative uncertainty scenario from the dropdown menu in column E. The resulting uncertainty score will appear in Column F.

Figure 11.7 Example of the capital cost per household

Table 6 **Capital cost per household (i.e. cost of a car) - Unit: £**

	Scenario	Measure applies in 2020	Qualitative un Score	
Petrol car	Central	10,000	not used	1
	Low	8,000		
	High	13,000		
Diesel car	Central	12,000	not used	1
	Low	9,000		
	High	20,000		

Input change in annual car travel per household

This input is relevant only to assessment of measures that will change the number of kilometres travelled by households by different types of car. Otherwise, leave blank.

Control "*Table 7"* (rows 78:91): Select the unit in which the input will be required in cell C80. Input can be provided in either miles, kilometres or as a percentage. Change in annual car travel per household should be entered for diesel, petrol and electric car for each year of the assessment period (Columns D - AM "*Years*"). If % change is selected as unit, rows for electric cars will grey and not inputs will be considered as it is assumed no commercial electric cars were available in the counterfactual. For any decrease in change, negative values should be entered. Inputs can be entered for central, low and high scenario. Qualitative uncertainty can be selected in column AN.

Figure 11.8 Example of the change in annual car travel per household

Unit: % *Enter percentages as numbers between 1 and 100*

	Scenario	2015	2016	2017	2018	2019
Petrol car	Central	500	500	500	500	500
	Low	200	200	200	200	200
	High	700	700	700	700	700
Diesel car	Central	500	500	500	500	500
	Low	-200	-500	200	200	200
	High	700	700	700	700	700
Electric car	Central	500	500	500	500	500
	Low	200	200	200	200	200
	High	700	700	700	700	700

Input increase in road fuel prices due to the policy/measure

This input is relevant only to assessment of measures that will change the price of petrol or diesel fuel. Otherwise, leave blank.

Control "*Table 8"* (rows 93:103): Select the unit in which the input will be provided in cell C80. Input can be provided in either p/litre or as a percentage. Increase in road fuels has to be entered separately for petrol and diesel vehicles. If the cost of road fuel decreases as a result of the policy the inputs should be entered as negative values. Inputs can be entered for central, low and high scenario. Qualitative uncertainty can be selected in column AN.

Figure 11.9 Example of the change in annual car travel per household table

Table 9 Increase in road fuel prices due to the policy/measure *Enter negative values for decreases*

Unit: p/litre *2013 prices*

	Scenario	2015	2016	2017	2018	2019	2020
Petrol	Central	500	500	500	500	500	500
	Low	200	200	200	200	200	200
	High	700	700	700	700	700	700
Diesel	Central	500	500	500	500	500	500
	Low	200	200	200	200	200	200
	High	700	700	700	700	700	700

Input increase in public transport (trips per household)

This input is relevant only to assessment of measures that will affect the number of trips made by households by public transport. Otherwise, leave blank.

Control "*Table 9"* (rows 105:139): First select the unit in which the input will be provided in cell C107. Input can be provided in either in "Number of trips" or as a percentage. Increase in public transport trips needs to be entered separately for buses and rail for each year of the assessment period (Columns D - AM "*Years*"). If percentages are used, enter natural numbers between 1 and 100. If the number of trips decreases as a result of the policy the inputs should be entered as negative values. If the quantitative values for different uncertainty scenarios are available enter central, low and high estimates for buses or rail. Alternatively (or complementary) select the qualitative uncertainty in column AN. Collapsed rows are not operational and are provided to facilitate further improvements in the model.

Figure 11.10 Example of the increase in public transport trips per household

Table 9 **Annual increase in public transport (trips per household)** *Enter negative*

Unit: % *Enter percentages as numbers between 1 and 100*

	Scenario	2015	2016	2017	2018	2019
Buses (total)	Central	5	5	5	5	5
	Low	3	3	3	3	3
	High	7	7	7	7	7
Rail (total) (including Underground, metros and trams)	Central	5	5	5	5	5
	Low	3	3	3	3	3
	High	7	7	7	7	7

Input increase in average fares per trip due to the application of the policy/measure

This input is relevant only to assessment of measures that will affect the price of trips by public transport. Otherwise, leave blank.

Control "*Table 10"* (rows 141:175): Select the unit in which the input will be provided in cell C143. Enter the increase in average price of fares per trip expected as a result of the measure for each year of the assessment period (Columns D - AM "*Years*"). This can be either in "p/trip" or as a percentage. Increase in fares of public transport trips needs to be entered separately for buses and rail. For any decrease in change, negative values should be provided. If the quantitative values for different uncertainty scenarios are available enter central, low and high estimates for buses or rail. Alternatively (or complementary) select the qualitative uncertainty in column AN. Collapsed rows are not operational and are provided to facilitate further improvements in the model.

Figure 11.11 Example of the increase in average fares per trip due to the application of the policy/measure

Table 10 **Increase in average fares per trip due to the application of the p** *Enter negative*

Unit: p/trip *2013 prices*

	Scenario	2015	2016	2017	2018	2019
Buses	Central	10	10	10	10	10
	Low	5	5	5	5	5
	High	15	15	15	15	15
Rail (including Underground, metros and trams)	Central	10	10	10	10	10
	Low	5	5	5	5	5
	High	15	15	15	15	15

Fixed inputs

In addition to the discount rate explained in section 3, the assessment of affordability for individual impacts require the following fixed inputs:

Annual mileage of 4-wheeled cars,and vehicles per household by fuel type and household income quintile: England, 2013.

Proportion of petrol to diesel vehicles ownership by income quintile, 2013

Travel per person per year by household income quintile and main mode / mode: England, 2013

Distance travelled per household per different mode of transport and by income quintiles, 2013

Average trip length (miles/trip), 2013

Number of trips per household per year, 2013

Proportion of vehicles by vehicle age and household income quintile: England, 2013

Income and source of income by disposable equivalised income quintile group, 2013

Projected residential energy demand

Household weekly expenditure on electricity, gas and other fuel per income decile, 2013

Domestic energy consumption by end use and fuel, in primary energy equivalents, 2013

Household annual average consumption of electricity, gas and other fuels per income quintiles, 2013

Average public transport fare price per trip

Detailed household expenditure by disposable income decile group, UK, 2013

Conversion factors

These inputs do not need to be manipulated by the user in order to run the model. However, they should be updated whenever new data are available.

These data are presented in the **Inputs-AffordIndividuals** worksheet. Click on the hyperlinks at the top of the sheet to navigate to the relevant table.

"Annual mileage of 4-wheeled car and vehicles per household by fuel type and household income quintile: England, 2013" (rows 19-29): The annual mileage and total number of vehicles per household of all 4-wheeled cars by fuel types and household income quintiles are set out in this table. The source of data for this is from Department for Transport, 2014, National Travel Survey, Vehicle mileage and occupancy (NTS09), table NTS0902, sheet: 0902.

"Proportion of petrol to diesel vehicles ownership by income quintile, 2013" (rows 41-50): The percentage proportion of petrol to diesel vehicles were derived from annual mileage of 4-wheeled cars, and vehicles per household by fuel type and household income quintile: England, 2013.

"Travel per person per year by household income quintile and main mode / mode: England, 2013" (rows 61-88): The total number of trips and distance (miles) per person per year by transport modes are set out in this table by household quintile. Data source was taken from Department for Transport, 2014, National Travel Survey, Travel by car availability, income, ethnic group, household type and NS-SEC (NTS07), table NTS0705.

"Distance travelled per household per different mode of transport and by income quintiles, 2013" (rows 102-119): Distance travelled (miles) per household per year by transport mode is provided by income quintiles. Department for Transport, 2014, National Travel Survey, Travel by car availability, income, ethnic group, household type and NS-SEC (NTS07), table NTS0705 (edit) - Table data was provided by Department for Transport specifically for this model.

"Average trip length (miles/trip), 2013 " (rows 132-143): Average trip length by household income quintile for various transport mode is derived from table NTS0705 of Department for Transport, 2014, National Travel Survey, Travel by car availability, income, ethnic group, household type and NS-SEC (NTS07) data.

"Number of trips per household per year, 2013" (rows 155-167):The calculated number of trips per household per year by quintiles was derided from table NTS0705 of Department for Transport, 2014, National Travel Survey, Travel by car availability, income, ethnic group, household type and NS-SEC (NTS07) data.

"Proportion of vehicles by vehicle age and household income quintile: England, 2013" (rows 178-187): This data is based on the results of the National Travel Survey. It has been provided on request from the NTS team at Department for Transport for the purpose of this project. This information is not part of the NTS official data published by the DfT each year. Therefore updating this information with future results of the survey will only be possible if this data is requested again from the DfT.

"Income and source of income by disposable equivalised income quintile group, 2013" (rows 198-217): This data is sourced from the Office for National Statistics, Table 3.11E, Family Spending Survey 2014. It is part of statistical release published each year and is expected to be published in the same format in the future years.

"Projected residential energy demand" (rows 230-244): Residential energy demand for different energy types were taken from DECC Updated Energy & Emissions Projections - September 2014. Annex F: Final energy

demand / Existing Policies Scenario using existing policies scenario. Energy type ratios as compared to 2013 are calculated from source data against the data for 2013.

"Household weekly expenditure on electricity, gas and other fuel per income decile, 2013" (rows 256-264): The weekly expenditure on electricity, gas and other fuel per income decile was taken from Office for National Statistics, Family Spending, 2014 Edition., table 3.1 - Section 4.4 in rows 147:150.

"Domestic energy consumption by end use and fuel, in primary energy equivalents, 2013" (rows 279-284): Domestic energy consumption by end use and fuel was taken from the DECC Energy Consumption in the UK (ECUK), 2014 Update, Chapter 3: Domestic data tables, Table 3.02. Only data for 2013 has been included in this model. The percentage share of each fuel type by end use is derived from the 2013 data extracted.

"Household annual average consumption of electricity, gas and other fuels per income quintiles, 2013" (rows 297-304): The household annual average consumption data are derived using Household weekly expenditure, number of weeks per year and energy price. "Other fuels" are spilt into solid fuels and petroleum fuel. Solid fuels have been assumed as coal and petroleum fuel as burning oil. Burning oil prices are given by litres so a conversion factor can be applied to provide data in kWh.

"Average public transport fare price per trip" (rows 317-325): Average public transport fare price is derived using costs provided in NTM data. This data is provided by DfT specifically for the purpose of this project. Test year used under this model is 2020. Price base is unknown and is therefore assumed to be 2010, and this assumption is reflected in the uncertainty scenarios. "Rail" includes London Underground and metro/trams around the country. "Bus" includes local and non-local transport.

"Detailed household expenditure by disposable income decile group, UK, 2013" (rows 340-353): Household expenditure by disposal income data are taken from Office for National Statistics, Family Spending, 2014 Edition.

"*Conversion factors"* (rows 364-367): Conversion factors from miles to kilometres and total number of weeks per year.

A qualitative estimation of the uncertainty associated with each of these datasets is shown under each table. This is carried through into the calculations and the results. The current uncertainty classification was estimated by the model developers. If the data in the tables are updated the uncertainty can be amended accordingly by clicking and selecting from the drop-down menu in each fixed input data.

Figure 11.12 An example of fixed inputs for the impact on affordability for individuals showing data uncertainty score

Annual mileage of 4-wheeled cars, and vehicles per household by fuel type and household income quintile: England, 2013.

	Annual mileage (miles)				Vehicles per household			
	Petrol	Diesel	All 4-wheeled cars	Unweighted sample size (all cars)	Petrol	Diesel vheeled cars		Unweighted sample size (household
Lowest real income level	5,600	8,300	6,400	867	0.38	0.15	0.53	1,583
Second level	6,100	9,500	7,000	1,290	0.58	0.22	0.79	1,609
Third level	6,300	9,200	7,100	1,561	0.72	0.26	0.98	1,592
Fourth level	7,200	11,200	8,500	1,841	0.81	0.37	1.18	1,558
Highest real income level	7,300	12,700	9,300	1,790	0.76	0.43	1.19	1,480
All income levels	6,700	10,700	7,900	7,349	0.65	0.29	0.93	7,822

Unit:	miles	
Reference:	10	
Data uncertainty score:	low	2
Comments:		

These data tables have a consistent format with the original reference sources as provided above. In case of an update of the reference source, the inputs should be updated accordingly by replacing the existing data with the updated data, keeping the same format. If the format of the reference sources changes, then changes may also be required to the format of the corresponding Wider Impacts Model data tables. In that case refer to the Technical Specification document for guidance on making structural changes to the model.

11.4 What calculations are performed?

The sheets **Calcs-AffordIndiv(Transport)** and **Calcs-AffordIndiv(Domestic)** contains the calculations performed to assess the impact of the measure on affordability for individuals. **Calcs-AffordIndiv(Transport)** calculates the impact on individuals when link to the affordability of various modes of transport for travel, and **Calcs-AffordIndiv(Domestic)** calculates the impact on the affordability for individuals on various energy usage within each household. Changes should **not** be made to these sheets, unless the format of the input data is changed, in which case refer to the Technical Specification document for guidance.

Calculations for the impact on affordability on individuals are undertaken in separate sheets for "Transport" and "Domestic" and both follow eleven steps.

Calculations – Affordability for Individuals (Transport)

Calcs-AffordIndiv(Transport) sheet "*Summary of inputs*" (rows 3 to 290): This provides a summary of the relevant inputs that are used in the calculations.

For the **Calcs-AffordIndiv(Transport),** calculations are made for the different transport mode including petrol car, diesel car, bus and rail. The eleven steps in this sheet include:

Step 1. Calculate counterfactual travel costs per household (rows 294:393): This step calculates counterfactual travel expenditure on a typical household for each quintile, transport mode and year of the assessment

Steps 2. Calculate scenario travel / number of trips (rows 396:514): This step calculates the future scenario travel per household as a result of the policy, in miles for cars and in number of trips for public transport.

Step 3. Calculate scenario fuel prices / trip fare (rows 517:552): by calculating future fuel prices for cars and future trip fares for public transport as a result of the policy or measure.

Step 4. Calculate scenario travel costs (rows 555:673): This step calculates the future scenario travel costs for an average household and for each transport mode. It takes into account changes in mileage / number of trips, fuel and fares prices as well as costs of vehicle maintenance.

Step 5. Calculate expenditure change (rows 676:790): This step calculates the difference between the new and counterfactual expenditure per mode of transport and income quintile

Step 6. Calculate percentage expenditure change on counterfactual (rows 793:905): This step calculates the percentage change in expenditure relative to the counterfactual expenditure for each transport mode per quintile.

Step 7: Total expenditure change per average household by quantile (rows 908:938): This is a sum of total change in energy expenditure in an average household per quantile.

Step 8. Calculate the percentual change on expenditure to counterfactual by quintile (rows 941:973): Percentage change is calculated for the total change in expenditure relative to the counterfactual (i.e. total costs to average household before introduction of a policy) by income quintile. The percentage change is applied to the sum of total household expenditure on a yearly basis.

Step 9. Calculate the percentual change on expenditure to income (rows 976:1005): This step calculates the percentage change in travel expenditure relative to the average disposable income per household in each income quintile.

Step 10. Calculate the affordability of capital expenditure" (rows 1008:1089): This calculates the capital cost associated with the policy per income quintile in a year and divides this cost by total annual disposable income in each income quintile. This step takes into account the cost difference of early purchase a new vehicle before the incumbent vehicle reaches expected full service life by vehicle type (diesel or petrol).

Calculations – Affordability for Individuals (Domestic)

Calcs-AffordIndiv(Domestic) sheet "*Summary of inputs*" (rows 3 to 106): This provides a summary of the relevant inputs that are used in the calculations.

For the **Calcs-AffordIndiv(Domestic),** calculations are made for the different fuel types including electricity, gas, coal and oil. The eleven calculation steps in this sheet are:

Step 1. Calculate counterfactual energy costs (rows 110:148): This step calculates the counterfactual expenditure on energy per average household in each income quintile for each year of the assessment.

Step 2. Calculate scenario energy consumption per household (rows 150:233): This step calculates the scenario future energy consumption as specified by the user in the inputs. It also takes into account baseline projections and the selected scope of the analysis (i.e. whether the policy assessed affects total energy consumption of a households, or energy used for space and water heating only).

Step 3. Calculate scenario energy prices (rows 237:264): In this step scenario energy prices are calculated using the inputs entered by the user. This applies only if a policy is expected to have an impact on domestic energy prices.

Step 4. Calculate scenario energy costs (rows 268:349): This step calculates new expenditure on fuels in each year of the assessment by multiplying scenario energy consumption per household (step 2) by scenario energy prices (step 3)

Step 5. Calculate expenditure change (rows 352:433): This calculates the absolute difference between the new and counterfactual expenditure.

Step 6. Calculate percentage expenditure change on counterfactual (rows 436:469): This step calculates the percentage change in expenditure, relative to the counterfactual expenditure per fuel. This provides the relative change in cost for each fuel type. Proportional change by fuel is the same for all quantiles.

Step 7. Total expenditure change per average household by quantile (rows 472:499)*:* This sums the total change in energy expenditure for an average household for each income quantile

Step 8, Calculate the percentual change on expenditure to counterfactual by quintile (rows 502:531): This step calculates the percentage change between the counterfactual and the scenario for each quintile.

Step 9. Calculate the percentual change on expenditure to income (rows 534:563): This step calculates the percentage change in energy expenditure relative to the quintile's average annual income. The percentage change is applied to the sum of household expenditure on an annual basis.

Step 10. Distribute capital transitional cost across the years (rows 566:595): This step distributes the capital cost across the relevant number of years depending on the number of years entered by the used (e.g. if a policy has a transition period).

Step 11. Calculate the affordability of capital expenditure (rows 598:627): This step divides the annual capital cost by total annual disposable income in each income quintile.

Uncertainty is carried through the calculations. This is done using two parallel systems:

- Calculations are done for all three uncertainty scenarios (low, medium and high) as provided by the user.
- A qualitative scoring system considers the uncertainty of fixed inputs (and the user inputs if no low and high values are entered).

11.5 Where can I find the results for these impacts?

Main results

The sheet **Results-AffordIndiv** details the results on impacts on affordability for individuals. It includes results for both "Transport" and "Domestic" impacts for the affordability on individuals. The tables are set out as follows:

Transport:

- Annual costs/benefits due to change in travel expenditure per household
- Percentage of change in annual travel expenditure over disposable income
- Transitional (capital) costs for households in transport (i.e. scrappage scheme)

Domestic:

- Change in domestic energy expenditure per household (transitional and annual)
- Percentage of change in domestic energy expenditure over disposable income (transitional and annual)

Total affordability for individuals

- Total change in household expenditure per income quintile

Results are presented as cost and benefits of transitional and annual impacts by income quintiles under three uncertainty scenarios (central, low and high) over the assessment period. Where there are four transport modes (i.e. petrol car, diesel car, bus and rail) shown in **Calcs-AffordIndiv(Transport)** and four energy types (i.e. electricity, gas, coal and oil) calculated in **Calcs-AffordIndiv(Domestic),** these are aggregated within the respective results tables in the **Results-AffordIndiv** sheet. A summary of all aggregated costs and benefits for both "transport" and "domestic" are presented the final results table. Costs and benefits are expressed in **Net Present Value in pounds** for each year, presented in the prices year specified by the user in the **Control** sheet (see Section3.3). The colour of the column also provides useful information for interpretation of the results being: current year, measure start year, appraisal end year.

The five results tables are displayed in the following rows and figures respectively:

Annual costs/benefits due to change in travel expenditure per household (rows 14:46)

Figure 11.13 Example results of the annual cost/benefits due to change in travel expenditure

Annual costs/benefits due to change in travel expenditure per household

Units:	£ per household		Quintile	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Annual travel expenditure	Annual cost	Central	1st						108	105	102	100	97	94	92	90	87	85	83
			2nd						93	90	88	86	84	82	80	78	76	74	72
			3rd						90	88	86	84	82	80	78	76	74	72	70
			4th						95	93	91	89	87	85	83	81	79	77	75
			5th						113	111	108	105	103	100	98	96	93	91	89
		Low	1st						47	45	44	42	41	40	39	37	36	35	34
			2nd						41	39	38	37	36	35	34	33	32	31	30
			3rd						40	38	37	36	35	34	33	32	31	30	29
			4th						42	41	40	38	37	36	35	34	33	32	31
			5th						49	48	46	45	44	42	41	40	38	37	36
		High	1st						219	214	208	203	198	193	188	183	179	174	170
			2nd						194	190	185	181	177	173	169	165	161	157	154
			3rd						191	186	182	178	174	170	166	162	158	155	151
			4th						203	199	194	190	186	182	178	174	170	166	163
			5th						238	232	227	222	217	212	207	202	197	193	188
	Annual benefit	Central	1st																
			2nd																
			3rd																
			4th																
			5th																
		Low	1st																
			2nd																
			3rd																
			4th																
			5th																
		High	1st																
			2nd																
			3rd																
			4th																
			5th																

Percentage of change in annual travel expenditure over disposable income (row 48:80)

Figure 11.14 Example summary results of the percentage of change in travel expenditure over disposable income

Percentage of change in annual travel expenditure over disposable income

Units:	% of disposable income		Quintile	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Travel expenditure over disposable income	Annual cost	Central	1st						1.2%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%
			2nd						0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
			3rd						0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
			4th						0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
			5th						0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
		Low	1st						0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.6%
			2nd						0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.3%
			3rd						0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
			4th						0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
			5th						0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
		High	1st						2.5%	2.5%	2.6%	2.6%	2.6%	2.6%	2.7%	2.7%	2.7%	2.7%	2.7%
			2nd						1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.3%	1.3%	1.3%
			3rd						0.8%	0.8%	0.8%	0.8%	0.8%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%
			4th						0.6%	0.6%	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%
			5th						0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%
	Annual benefit	Central	1st																
			2nd																
			3rd																
			4th																
			5th																
		Low	1st																
			2nd																
			3rd																
			4th																
			5th																
		High	1st																
			2nd																
			3rd																
			4th																
			5th																

Transitional (capital) costs for households in transport (i.e. scrappage scheme) (row 83:92)

Figure 11.15 Example of the transitional (capital) costs for households in transport

Transitional (capital) costs for households in transport (i.e. scrappage scheme)

All transitional cost due to scrappage scheme is assumed to occur in the first year of the policy

	Average additional cost due to early purchase, per income category in NPV			Additional cost as percentage of annual household disposable income			Total capital investment in NPV			Total capital investment as percentage of annual household disposable income		
Quintile	Central	Low	High	Central	Low	High	Central	Low	High	Central	Low	High
1st	1,167	914	1,656	12%	9%	17%	11,384	8,921	16,161	116%	91%	165%
2nd	1,150	903	1,626	6%	5%	9%	11,339	8,895	16,029	60%	47%	85%
3rd	1,151	903	1,623	4%	3%	6%	11,323	8,888	15,968	43%	34%	60%
4th	1,039	813	1,486	3%	2%	4%	11,310	8,847	16,178	31%	24%	45%
5th	846	660	1,225	1%	1%	2%	11,207	8,739	16,233	18%	14%	26%

Transitional capital cost for transport (i.e. scrappage scheme) is assumed to occur in the first year of the policy and is therefore not presented in a yearly basis.

Change in domestic energy expenditure per household (transitional and annual) (row 96:158)

Figure 11.16 Example summary results of the change in domestic energy expenditure per household

Change in domestic energy expenditure per household (transitional and annual)

Units:	£ per household		Quintile	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Costs	Transition cost	Central	1st																
			2nd																
			3rd																
			4th																
			5th																
		Low	1st																
			2nd																
			3rd																
			4th																
			5th																
		High	1st																
			2nd																
			3rd																
			4th																
			5th																
	Annual cost	Central	1st						56	56	54	51	51	49	49	48	47	47	45
			2nd						61	61	59	56	56	54	55	53	52	52	51
			3rd						67	67	65	62	61	59	59	58	56	57	55
			4th						74	73	71	67	67	64	65	63	61	62	60
			5th						94	93	89	84	83	79	79	77	75	75	73
		Low	1st						25	25	24	23	24	23	23	22	22	22	22
			2nd						28	28	28	27	27	26	26	26	25	25	25
			3rd						30	30	30	28	29	28	28	27	27	27	26
			4th						32	33	32	31	31	30	30	30	29	29	28
			5th						39	39	38	37	37	36	36	35	35	35	34
		High	1st						102	103	101	97	97	95	96	93	91	92	90
			2nd						115	116	115	110	111	107	109	106	104	105	102
			3rd						123	125	123	117	118	115	116	113	111	112	109
			4th						134	135	133	127	128	124	126	123	120	121	118
			5th						160	161	158	152	152	148	149	145	143	144	140

Percentage of change in domestic energy expenditure over disposable income (transitional and annual) (row 160:222)

Figure 11.17 Example summary results of the percentage of change in domestic energy expenditure over disposable income

Percentage of change in domestic energy expenditure over disposable income (transitional and annual)

Units:	% of disposable income		Quintile	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Costs	Transitional cost	Central	1st																
			2nd																
			3rd																
			4th																
			5th																
		Low	1st																
			2nd																
			3rd																
			4th																
			5th																
		High	1st																
			2nd																
			3rd																
			4th																
			5th																
	Annual cost	Central	1st						0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%
			2nd						0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
			3rd						0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
			4th						0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%
			5th						0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
		Low	1st						0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.4%	0.4%
			2nd						0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
			3rd						0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%
			4th						0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
			5th						0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
		High	1st						1.2%	1.2%	1.3%	1.3%	1.3%	1.3%	1.4%	1.4%	1.4%	1.5%	1.5%
			2nd						0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.8%	0.8%	0.8%	0.9%	0.9%
			3rd						0.5%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.7%	0.7%
			4th						0.4%	0.4%	0.5%	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
			5th						0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.4%	0.4%

Total change in household expenditure per income quintile (rows 225:287)

Figure 11.18 Example summary results of the total change in household expenditure

Total change in household expenditure per income quintile

For scrappage scheme, only the additional cost associated to early purchase of a car is added. NOT the total cost of the car.

Units:	£ per household		Quintile	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Costs	Transition cost	Central	1st	-	-	-	-	-	1,017	-	-	-	-	-	-	-	-	-	-
			2nd	-	-	-	-	-	1,003	-	-	-	-	-	-	-	-	-	-
			3rd	-	-	-	-	-	1,003	-	-	-	-	-	-	-	-	-	-
			4th	-	-	-	-	-	905	-	-	-	-	-	-	-	-	-	-
			5th	-	-	-	-	-	737	-	-	-	-	-	-	-	-	-	-
		Low	1st	-	-	-	-	-	797	-	-	-	-	-	-	-	-	-	-
			2nd	-	-	-	-	-	786	-	-	-	-	-	-	-	-	-	-
			3rd	-	-	-	-	-	787	-	-	-	-	-	-	-	-	-	-
			4th	-	-	-	-	-	708	-	-	-	-	-	-	-	-	-	-
			5th	-	-	-	-	-	575	-	-	-	-	-	-	-	-	-	-
		High	1st	-	-	-	-	-	1,443	-	-	-	-	-	-	-	-	-	-
			2nd	-	-	-	-	-	1,417	-	-	-	-	-	-	-	-	-	-
			3rd	-	-	-	-	-	1,415	-	-	-	-	-	-	-	-	-	-
			4th	-	-	-	-	-	1,295	-	-	-	-	-	-	-	-	-	-
			5th	-	-	-	-	-	1,068	-	-	-	-	-	-	-	-	-	-
	Annual cost	Central	1st	-	-	-	-	-	164	161	157	151	148	144	141	137	134	132	128
			2nd	-	-	-	-	-	153	151	147	142	140	136	135	131	128	126	123
			3rd	-	-	-	-	-	157	155	151	145	143	139	137	133	130	129	125
			4th	-	-	-	-	-	169	166	162	156	154	149	147	143	140	139	135
			5th	-	-	-	-	-	208	204	197	189	186	180	177	172	168	166	161
		Low	1st	-	-	-	-	-	71	70	68	66	65	63	62	60	58	57	56
			2nd	-	-	-	-	-	69	68	66	64	63	61	60	58	57	56	54
			3rd	-	-	-	-	-	70	69	67	65	64	62	61	59	58	57	55
			4th	-	-	-	-	-	75	74	72	69	68	66	65	64	62	61	59
			5th	-	-	-	-	-	88	87	85	82	80	78	77	75	73	72	70
		High	1st	-	-	-	-	-	321	316	309	300	295	287	284	276	270	266	259
			2nd	-	-	-	-	-	310	306	300	291	287	280	277	271	265	262	255
			3rd	-	-	-	-	-	314	311	305	295	292	284	282	275	269	266	260
			4th	-	-	-	-	-	337	334	327	317	314	306	304	296	290	287	280
			5th	-	-	-	-	-	398	394	385	373	369	359	356	347	340	337	328

Although not presented in the results section, the model also calculates the percentage change of travel and domestic expenditure separately over the counterfactual. They can be found in Step 8 of the calculations in **Calcs-AffordIndiv(Transport)** (rows 941:973) for transport costs and **Calcs-AffordIndiv(Domestic)** (rows 502:531) for domestic. These provides useful information to the model user (i.e. see which income quintiles will incur in a cost over 10% against the counterfactual, as recommended by WebTAG).

Summary results

The sheet **Results-Summary** display a summary of the results for all of the impacts assessed. Changes are not required for this sheet. Results for the assessment of the affordability for individuals are provided in Rows 101:111. Results summary presents cost and benefits in **Net Present Value in thousands of pounds** per household per income quintile, under the three uncertainty scenarios (central, low and high). Both costs and benefits are presented in prices for the year selected in **Control** sheet cell C15 (see Section 3.3). They are disaggregated into transitional, annual and total (sum of the two). The capital cost of transport (i.e. car scrappage scheme) in the summary results, only considers the additional cost of early purchase. For results that considers total capital investment, this can be found in the **Results- AffordIndiv.** Average impact costs are shown in row 111 and the total net present values are provided for in columns U, V and W.

Figure 11.19 illustrates an example of how the detailed results table may look like for the assessment of affordability for business.

Figure 11.19 Example summary results of the assessment of affordability for individuals

Affordability for individuals

npv per income quintile	Costs									Benefits									Total Net Present Value			Comments
2014 prices	Total Transition			Average Annual			Total costs			Transition benefit			Annual benefit			Total benefits						
£000s	Central	Low	High	Central	Low	High	Central	Low	High	Central	Low	High	Central	Low	High	Central	Low	High	Central	Low	High	
1st	1.0	0.8	1.4	1.6	0.7	3.2	2.6	1.5	4.6	0	0	0	0	0	0	0.0	0.0	0.0	2.6	1.5	4.6	For capital cost of transport (i.e. car scrappage scheme) only the additional cost of early purchase is considered here. NOT the total cost of the car. For results considering total capital investment, please see the detailed impacts sheet.
2nd	1.0	0.8	1.4	1.5	0.7	3.1	2.5	1.5	4.5	0	0	0	0	0	0	0.0	0.0	0.0	2.5	1.5	4.5	
3rd	1.0	0.8	1.4	1.5	0.7	3.2	2.5	1.5	4.6	0	0	0	0	0	0	0.0	0.0	0.0	2.5	1.5	4.6	
4th	0.9	0.7	1.3	1.7	0.7	3.4	2.6	1.4	4.7	0	0	0	0	0	0	0.0	0.0	0.0	2.6	1.4	4.7	
5th	0.7	0.6	1.1	2.0	0.9	4.0	2.7	1.4	5.1	0	0	0	0	0	0	0.0	0.0	0.0	2.7	1.4	5.1	
Average impact	0.93	0.73	1.33	1.66	0.73	3.36	2.60	1.46	4.69	-	-	-	-	-	-	-	-	-	2.60	1.46	4.69	

11.6 Limitations

- The method used has been developed specifically for the purpose of the wider impacts model. While the comparison of scenario and counterfactual costs forms core of methods used in other tools assessing distributional impacts on households (e.g. DIMPSA model), the method is not directly comparable with methods used elsewhere.
- The results of the assessment present possible impact on average household in each income quintile – the concept of average household has been described in the introduction to the impact. As such real impacts across households in a specific income quintile may be higher or lower than presented by the model results. For example if a policy affects prices of diesel, households in each income quantile which do not own a diesel car would not be affected and hence there would be no impact on their affordability (impact will be lower than presented in the results). On the other hand, if a household owns more than an average number of diesel cars, the real impact on household's affordability may be higher than presented by the model.
- Due to the limitations above, the results should primarily be used to identify whether a policy is likely to have disproportionate impact on a specific income group. The model takes into consideration differences between income quintiles (e.g. in average car ownership, average consumption of energy, average use of public transport) however it does not provide further disaggregation of the results on specific user groups in a given income quintile (e.g. households with or without a car, households using gas for space heating, households using electricity for space heating etc.). It should therefore be primarily used a screening tool to establish whether distributional impacts of the policy assessed should be investigated in more detail.

12. How to interpret uncertainty

Two different systems are used to assess uncertainty:

The quantitative system is based on three uncertainty scenarios: central (or best), low and high estimates. If data are entered for all three scenarios in each of the control sheets (user inputs), the results will display the final impact for each scenario. The low and high values will provide an indication of the uncertainty range associated with the central (or best) estimate. This system allows for sensitivity tests between scenarios. In most cases, the same calculations will be applied to the three scenarios and the difference in the results will be only due to the different user inputs. However, in those cases where fixed inputs are available for different uncertainty scenarios (e.g. future energy and carbon prices for the assessment of GHG), the difference between scenarios also considers different fixed inputs.

The qualitative scenario is based on uncertainty indicators attributed to each of the inputs. Every fixed input has a qualitative uncertainty category associated with it (low, medium or high). These have been assigned by default by the developers of the model but it can be changed in the relevant input sheet. Users may give a qualitative uncertainty score to user inputs. Scores linked with these categories are carried through the calculations and a weighted system displays the uncertainty category associated with the final results. Details about the methodology can be found in the Technical Specification. If quantitative low and high inputs values are not entered, then a qualitative uncertainty indicator should be selected when entering the central estimate for the variable inputs. In that case, the final uncertainty indicator reflects the combined uncertainty associated with user and fixed inputs as a whole. The qualitative uncertainty system can also be used in combination with the quantitative one as a supporting measurement of uncertainty.

Appendix A

This appendix contains a series of case studies including inputs and outputs to serve as examples for the user. The same inputs were also used to conduct the final testing of the model. The following case studies are included:

- Example 1. Transport related impacts:
  - Input 1a: Congestion, Noise, Accidents, Modal shift, Health impacts of cycling and walking (linked to modal shift)
  - Input 1b: Health impacts of cycling and walking (as a standalone assessment)
  - Results: Transport related impacts
- Example 2. Greenhouse gases
  - Input 2a: Transport policy
  - Input 2b: Domestic policy
  - Results: Greenhouse gases
- Example 3: Affordability for businesses and employment
  - Input 3: Affordability for businesses and employment
  - Results: Affordability for businesses
  - Results: Employment
- Example 4. Affordability for individuals:
  - Input 4a: Transport policy
  - Input 4b: Scrappage scheme
  - Input 4c: Domestic policy
  - Results

Example 1. Transport related impacts

Input 1a: Congestion, Noise, Accidents, Modal shift, Health impacts of cycling and walking (linked to modal shift)

A particular policy aimed at reducing car traffic in London is expected to reduce vehicle-km by 2,880 million each year (equivalent to 10% of the annual traffic of 28.8 billion vehicle kilometres in the first year of the policy). To reflect high uncertainty in this estimates, the low and high uncertainty scenarios have been defined by applying 50% uncertainty factor, thus resulting in 1,440 and 4,320 million vehicle-km for low and high scenarios respectively.

- Current year: 2014
- Measure start year: 2015
- Assessment end: 2025
- Costs to be inflated to: 2010

The above inputs will be the same for all exercises

- Region: London
- Change in vehicle kilometres:

	Central	Low	High
2010	0	0	0
2015	-2,880,000,000	-1,440,000,000	-4,320,000,000
2020	-2,880,000,000	-1,440,000,000	-4,320,000,000
2025	-2,880,000,000	-1,440,000,000	-4,320,000,000

Input 1b: Health impacts of cycling and walking (as a standalone assessment)

This exercise assumes improvements to London network of canal towpaths, cycle lanes and pedestrian areas, providing access to major industrial business parks, city centre and amenity areas. Improving levels of commuter use is a particular priority.
The measure is expected to encourage between 0.5% (low scenario) and 1% (high scenario) of Londoners to cycle and the same proportion to walk; 0.75% change is assumed for the central scenario. The population of London is assumed to be constant in all years of the policy (at 8 million) and it is further assumed that one new user is equivalent to one new return journey by bike or walked. Hence the annual change in the number of trips cycling and walking is equal to 64,000 in each year of the policy. The following inputs are entered in the model:

- Number of cycle journeys due to the policy.

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Central	64,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000
Low	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000

High	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000

- Number of walking journeys

	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Central	64,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000	64,000
Low	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000
High	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000

- Cycling and walking distance and speed are assumed as default. No need to input.
- Rest of inputs (i.e. Table 5 - Control inputs for health benefits) left as default.

Results: Transport related impacts

The model offered the following results.

For each impact, benefits are presented as negative figures, costs are presented as positive figures. The results show that the assessed scheme will lead to an annual benefit from reduced congestion. Benefits are incurred from the first year of the policy (2015) until 2025 when the period for the appraisal of costs and benefits of the policy finishes. All values are presented as NPV.

Results - Congestion

This worksheet contains the following results:
Combined impact (aggregation of impacts to businesses, regulator and society/individual)

Colour key: Current year; Measure start year; Appraisal end year

Combined impact (aggregation of impacts to businesses, regulator and society/individual)

This category is used when the impact cannot be directly associated with one single group.

Units: £'000s			2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Costs	Transition cost	Central												
		Low												
		High												
	Annual cost	Central	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data
		Low	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data
		High	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data
Benefits	Transition benefit	Central												
		Low												
		High												
	Annual benefit	Central	No data	-1727026.09	-1770268.23	-1808610.84	-1842335.84	-1871711.68	-1896993.95	-1961022.45	-2018551.20	-2069946.60	-2115557.66	-2155716.82
		Low	No data	-863513.04	-885134.11	-904305.42	-921167.92	-935855.84	-948496.98	-980511.22	-1009275.60	-1034973.30	-1057778.83	-1077858.41
		High	No data	-2590539.13	-2655402.34	-2712916.26	-2763503.76	-2807567.53	-2845490.93	-2941533.67	-3027826.80	-3104919.89	-3173336.48	-3233575.23

Results - Noise

This worksheet contains the following results:
Combined impact (aggregation of impacts to businesses, regulator and society/individual)

Colour key: Current year; Measure start year; Appraisal end year

Combined impact (aggregation of impacts to businesses, regulator and society/individual)

This category is used when the impact cannot be directly associated with one single group.

Units: £'000s			2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Costs	Transition cost	Central												
		Low												
		High												
	Annual cost	Central	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data
		Low	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data
		High	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data
Benefits	Transition benefit	Central												
		Low												
		High												
	Annual benefit	Central	No data	-5565.22	-5377.02	-5195.19	-5019.51	-4849.77	-4685.76	-4980.04	-5243.05	-5494.18	-5716.72	-5917.93
		Low	No data	-2782.61	-2688.51	-2597.59	-2509.75	-2424.88	-2342.88	-2490.02	-2624.53	-2747.09	-2858.36	-2958.97
		High	No data	-8347.83	-8065.53	-7792.78	-7529.26	-7274.65	-7028.65	-7470.06	-7873.58	-8241.27	-8575.08	-8876.90

Results - Accidents

This worksheet contains the following results:

Combined impact (aggregation of impacts to businesses, regulator and society/individual)

Colour key: Current year; Measure start year; Appraisal end year

Combined impact (aggregation of impacts to businesses, regulator and society/individual)

This category is used when the impact cannot be directly associated with one single group.

Units:	£'000s		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Costs	Transition cost	Central												
		Low												
		High												
	Annual cost	Central	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data
		Low	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data
		High	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data
Benefits	Transition benefit	Central												
		Low												
		High												
	Annual benefit	Central	No data	-85392.70	-84033.17	-82667.94	-81298.95	-79928.01	-78556.83	-77184.26	-75814.69	-74449.49	-73089.92	-71737.16
		Low	No data	-42696.35	-42016.58	-41333.97	-40649.48	-39964.01	-39278.41	-38592.13	-37907.35	-37224.74	-36544.96	-35868.58
		High	No data	-128089.04	-126049.75	-124001.91	-121948.43	-119892.02	-117835.24	-115776.39	-113722.04	-111674.23	-109634.87	-107605.74

Modal shift:

In the following results, existing trips which are removed due to the policy are presented as negative figures, new trips added as a result of the policy are presented as positive figures.

The first table presents change in number of car trips for *each year* of the policy. The results show that in *each year* of the policy the number of trips by car will be reduced. The second table adds together the figures presented in the first table and presents the changes as number of car trips *per area* across all years of the policy. The assessed scheme is only applied to London, hence the columns presenting results for other areas are blank. The results show the total number of trips by car which will be removed as a result of the policy. The reduced number of trips by car are replaced by new trips added to other transport modes: walking, cycling, bus and rail. There is no overall reduction in the number of trips (i.e. number of removed trips by car = sum of the new trips in other transport modes).

Results - Modal shift

This worksheet contains the following results:

Colour key: Current year; Measure start year; Appraisal end year

Change in number of trips per year

Unit: Number of trips

		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Car	Central		-41249884.60	-41249884.60	-41249884.60	-41249884.60	-41249884.60	-41249884.60	-41249884.60	-41249884.60	-41249884.60	-41249884.60	-41249884.60
	Low		-20624942.30	-20624942.30	-20624942.30	-20624942.30	-20624942.30	-20624942.30	-20624942.30	-20624942.30	-20624942.30	-20624942.30	-20624942.30
	High		-61874826.90	-61874826.90	-61874826.90	-61874826.90	-61874826.90	-61874826.90	-61874826.90	-61874826.90	-61874826.90	-61874826.90	-61874826.90
Walk	Central		6826823.82	6826823.82	6826823.82	6826823.82	6826823.82	6826823.82	6826823.82	6826823.82	6826823.82	6826823.82	6826823.82
	Low		3413411.91	3413411.91	3413411.91	3413411.91	3413411.91	3413411.91	3413411.91	3413411.91	3413411.91	3413411.91	3413411.91
	High		10240235.73	10240235.73	10240235.73	10240235.73	10240235.73	10240235.73	10240235.73	10240235.73	10240235.73	10240235.73	10240235.73
Cycle	Central		2085438.01	2085438.01	2085438.01	2085438.01	2085438.01	2085438.01	2085438.01	2085438.01	2085438.01	2085438.01	2085438.01
	Low		1042719.01	1042719.01	1042719.01	1042719.01	1042719.01	1042719.01	1042719.01	1042719.01	1042719.01	1042719.01	1042719.01
	High		3128157.02	3128157.02	3128157.02	3128157.02	3128157.02	3128157.02	3128157.02	3128157.02	3128157.02	3128157.02	3128157.02
Bus	Central		14431499.32	14431499.32	14431499.32	14431499.32	14431499.32	14431499.32	14431499.32	14431499.32	14431499.32	14431499.32	14431499.32
	Low		7215749.66	7215749.66	7215749.66	7215749.66	7215749.66	7215749.66	7215749.66	7215749.66	7215749.66	7215749.66	7215749.66
	High		21647248.98	21647248.98	21647248.98	21647248.98	21647248.98	21647248.98	21647248.98	21647248.98	21647248.98	21647248.98	21647248.98
Rail	Central		17935369.41	17935369.41	17935369.41	17935369.41	17935369.41	17935369.41	17935369.41	17935369.41	17935369.41	17935369.41	17935369.41
	Low		8967684.70	8967684.70	8967684.70	8967684.70	8967684.70	8967684.70	8967684.70	8967684.70	8967684.70	8967684.70	8967684.70
	High		26903054.11	26903054.11	26903054.11	26903054.11	26903054.11	26903054.11	26903054.11	26903054.11	26903054.11	26903054.11	26903054.11

Results qualitative uncertainty score:	4

Total change in number of trips for the whole appraisal period

	Low				High				Central			
	London	Inner and Outer Conurbations	Other Urban	Rural	London	Inner and Outer Conurbations	Other Urban	Rural	London	Inner and Outer Conurbations	Other Urban	Rural
Car	-226,874,365	-	-	-	- 680,623,096	-	-	-	- 453,748,731	-	-	-
Walk	37,547,531	-	-	-	112,642,593	-	-	-	75,095,062	-	-	-
Cycle	11,469,909	-	-	-	34,409,727	-	-	-	22,939,818	-	-	-
Bus	79,373,246	-	-	-	238,119,739	-	-	-	158,746,492	-	-	-
Rail	98,644,532	-	-	-	295,933,595	-	-	-	197,289,063	-	-	-

Health impacts of walking and cycling – Assessment linked to Modal Shift:

This assessment is used for appraisal of health impacts associated with removal of vehicle kilometres from the roads, and switching to active transport modes (walking or cycling). This assessment is linked directly to the removal of vehicle kilometres entered by the user in Table 1 in the Control worksheet and to the results of the modal shift assessment (specifically number of new trips cycles and new trips walked).

These tables present the results of the health impact assessment of the trips diverted from car to cycling and walking (as presented in the table above). Benefits are presented as negative figures, costs are presented as positive figures. The results show that the assessed scheme will lead to an annual benefit from improved health due to the switch to active transport modes (cycling and walking). Benefits are incurred from the first year of the policy (2015) until 2025 when the period for the appraisal of costs and benefits of the policy finishes. All values are presented as NPV.

Impact to society / individual - Modal shift approach: Cycling

Units:	£'000s		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Costs	Transition cost	Central												
		Low												
		High												
	Annual cost	Central												
		Low												
		High												
Benefits	Transition benefit	Central												
		Low												
		High												
	Annual benefit	Central		-390.44	-754.48	-1093.45	-1408.63	-1701.24	-1643.71	-1588.12	-1534.42	-1482.53	-1432.40	-1383.96
		Low		-195.22	-377.24	-546.72	-704.31	-850.62	-821.85	-794.06	-767.21	-741.27	-716.20	-691.98
		High		-585.66	-1131.72	-1640.17	-2112.94	-2551.86	-2465.56	-2382.19	-2301.63	-2223.80	-2148.60	-2075.94

Results qualitative uncertainty score:	432	Low

Impact to society / individual - Modal shift approach: Walking

Units:	£'000s		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Costs	Transition cost	Central												
		Low												
		High												
	Annual cost	Central												
		Low												
		High												
Benefits	Transition benefit	Central												
		Low												
		High												
	Annual benefit	Central		-3.28	-2310.04	-3347.88	-4312.89	-5208.81	-5032.67	-4862.48	-4698.05	-4539.18	-4385.68	-4237.37
		Low		-597.72	-1155.02	-1673.94	-2156.45	-2604.40	-2516.33	-2431.24	-2349.02	-2269.59	-2192.84	-2118.68
		High		-1793.17	-3465.06	-5021.83	-6469.34	-7813.21	-7549.00	-7293.72	-7047.07	-6808.76	-6578.52	-6356.05

Health impacts of walking and cycling – Standalone assessment:

The standalone assessment should be used for appraisal of policies aimed at increasing the number of journeys cycled or walked (i.e. when the user knows the intended number of new journeys by active modes of transport). It is not linked to the removal of vehicle kilometres entered by the user in Table 1 in the Control worksheet.

The tables below present the results of the health impact assessment of the policy (using inputs 1b above) which are separate to the modal shift results (using inputs 1a above) presented in the previous table.

The scheme results in a greater number of cycling and walking journeys. The health benefits associated with the new trips are presented as negative figures, costs are presented as positive figures. Benefits are incurred from the first year of the policy (2015) until 2025 when the period for the appraisal of costs and benefits of the policy finishes. All values are presented as NPV.

Impact to society / individual - Standalone approach: Cycling

Units:	£'000s		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Costs	Transition cost	Central												
		Low												
		High												
	Annual cost	Central												
		Low												
		High												
Benefits	Transition benefit	Central												
		Low												
		High												
	Annual benefit	Central		-4373.53	-8451.27	-12248.21	-15778.70	-19056.40	-18411.98	-17789.35	-17187.78	-16606.55	-16044.97	-15502.39
		Low		-2733.46	-5282.04	-7655.13	-9861.69	-11910.25	-11507.49	-11118.34	-10742.36	-10379.09	-10028.11	-9688.99
		High		-5466.91	-10564.08	-15310.27	-19723.37	-23820.50	-23014.97	-22236.69	-21484.72	-20758.19	-20056.22	-19377.99

Results qualitative uncertainty score:	24	Low

Impact to society / individual - Standalone approach: Walking

Units:	£'000s		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Costs	Transition cost	Central												
		Low												
		High												
	Annual cost	Central												
		Low												
		High												
Benefits	Transition benefit	Central												
		Low												
		High												
	Annual benefit	Central		-4090.57	-7904.48	-11455.77	-14757.84	-17823.48	-17220.75	-16638.41	-16075.76	-15532.13	-15006.89	-14499.41
		Low		-2556.61	-4940.30	-7159.86	-9223.65	-11139.68	-10762.97	-10399.01	-10047.35	-9707.58	-9379.31	-9062.13
		High		-5113.21	-9880.61	-14319.72	-18447.30	-22279.35	-21525.94	-20798.01	-20094.70	-19415.17	-18758.62	-18124.27

Example 2. Greenhouse gases

Two examples are set here. The first one is to assess a policy aiming at reducing GHG from traffic and the second from fuel combustion, in this case, in the domestic sector.

Input 2a: Transport policy example

This exercise calculates the impact on GHG resulting from the reduced traffic in London. The same number of car-km is used and it is assumed that 69% of them are from petrol cars and 31% from diesel.

- Change in vehicle kilometres (every year in the period 2015-2025):

	Petrol	Diesel
Central	- 1,987,200,000	- 892,800,000
Low	- 993,600,000	- 446,400,000
High	- 2,980,800,000	- 1,339,200,000

- Vehicle type: Average car
- No rebound effects anticipated

Input 2b: Fuel consumption example

This exercise calculates the impact on GHG resulting from a policy which encourages households to switch from using coal to natural gas. The objective of the policy is for coal no longer to be used in the domestic sector after 2025. It is assumed that all households using coal would switch to using natural gas.

- Change in fuel use for each year 2015-2025

	Natural gas (kWh)	Coal (tonnes)
Central	236,100,000	- 28,170
Low	157,400,000	- 18,780
High	314,800,000	- 37,560

- Non-traded emission.
- Sector: Domestic
- No rebound effects anticipated

Results: Greenhouse gases

The model offered the results illustrated below. No results for rebound effects are shown as this example assumed no rebound effects are occurring.

The following results tables present the results for two examples simultaneously – results related to inputs 2a are shown in the transport sector, results related to inputs 2b are shown in the non-traded sector. The case

study did not include any change in energy use in the traded sector hence no results are presented for this category.

The first table demonstrates the emission reductions of GHG expressed in ktonnes of CO_2e. The negative values represent a reduction in emissions, the positive values represent an increase in emissions. The emission reductions are presented for traded and non-traded sector, transport and non-fuel emissions. The total emission reductions across all sectors are presented in the final row of the table (Total CO_2e).

Net carbon emissions in ktonnes CO_2e

(minus indicates an emissions saving)

Units: thousand tonnes		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Traded	Central		-	-	-	-	-	-	-	-	-	-	-
	Low		-	-	-	-	-	-	-	-	-	-	-
	High		-	-	-	-	-	-	-	-	-	-	-
Non-traded	Central		- 37	- 37	- 37	- 37	- 37	- 37	- 37	- 37	- 37	- 37	- 37
	Low		- 24	- 24	- 24	- 24	- 24	- 24	- 24	- 24	- 24	- 24	- 24
	High		- 49	- 49	- 49	- 49	- 49	- 49	- 49	- 49	- 49	- 49	- 49
Transport	Central		- 551	- 551	- 551	- 551	- 551	- 551	- 551	- 551	- 551	- 551	- 551
	Low		- 275	- 275	- 275	- 275	- 275	- 275	- 275	- 275	- 275	- 275	- 275
	High		- 826	- 826	- 826	- 826	- 826	- 826	- 826	- 826	- 826	- 826	- 826
Non-fuel emissions	Central		-	-	-	-	-	-	-	-	-	-	-
	Low		-	-	-	-	-	-	-	-	-	-	-
	High		-	-	-	-	-	-	-	-	-	-	-
Total CO2e	Central		- 587	- 587	- 587	- 587	- 587	- 587	- 587	- 587	- 587	- 587	- 587
	Low		- 300	- 300	- 300	- 300	- 300	- 300	- 300	- 300	- 300	- 300	- 300
	High		- 875	- 875	- 875	- 875	- 875	- 875	- 875	- 875	- 875	- 875	- 875

The second table presents the value of GHG emissions savings in '000 £. This is calculated by applying a carbon price to the emission reductions presented above. Results are presented separately for traded and non-traded sector, for transport and non-fuel emissions. Total value of the GHG emissions saved is presented in the final row of the table (Total CO_2e). Negative values indicate the benefits, positive values indicate the costs. All values are NPV.

Discounted monetised value of carbon emissions

(minus indicates benefits)

Units: £k (2010 prices)		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Traded	Central		-	-	-	-	-	-	-	-	-	-	-
	Low		-	-	-	-	-	-	-	-	-	-	-
	High		-	-	-	-	-	-	-	-	-	-	-
Non-traded	Central		- 2,024	- 1,985	- 1,946	- 1,909	- 1,872	- 1,836	- 1,803	- 1,771	- 1,739	- 1,706	- 1,674
	Low		- 675	- 662	- 649	- 636	- 624	- 612	- 601	- 590	- 580	- 569	- 558
	High		- 4,048	- 3,970	- 3,893	- 3,818	- 3,744	- 3,672	- 3,606	- 3,542	- 3,477	- 3,413	- 3,349
Transport	Central		- 30,527	- 29,937	- 29,359	- 28,791	- 28,235	- 27,689	- 27,199	- 26,710	- 26,223	- 25,738	- 25,256
	Low		- 7,632	- 7,484	- 7,340	- 7,198	- 7,059	- 6,922	- 6,800	- 6,677	- 6,556	- 6,435	- 6,314
	High		- 68,686	- 67,358	- 66,057	- 64,780	- 63,529	- 62,301	- 61,197	- 60,097	- 59,001	- 57,911	- 56,827
Non-fuel emissions	Central		-	-	-	-	-	-	-	-	-	-	-
	Low		-	-	-	-	-	-	-	-	-	-	-
	High		-	-	-	-	-	-	-	-	-	-	-
Total CO2e	Central		- 32,551	- 31,922	- 31,305	- 30,700	- 30,107	- 29,525	- 29,002	- 28,481	- 27,961	- 27,445	- 26,931
	Low		- 8,306	- 8,146	- 7,988	- 7,834	- 7,683	- 7,534	- 7,401	- 7,268	- 7,135	- 7,003	- 6,872
	High		- 72,733	- 71,328	- 69,950	- 68,598	- 67,272	- 65,972	- 64,804	- 63,639	- 62,479	- 61,324	- 60,176

The third table presents the value of energy saved as a result of the policy in thousands of pounds. Negative values indicate the benefits, positive values indicate the costs. All values are NPV.

Discounted monetised value of change in energy consumption

(minus indicates benefits)

Units: £k (2010 prices)		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Traded	Central		-	-	-	-	-	-	-	-	-	-	-
	Low		-	-	-	-	-	-	-	-	-	-	-
	High		-	-	-	-	-	-	-	-	-	-	-
Non-traded	Central		- 5,280	- 5,037	- 5,081	- 5,155	- 5,066	- 4,785	- 4,525	- 4,259	- 4,005	- 3,764	- 3,534
	Low		- 4,085	- 3,972	- 3,875	- 3,794	- 3,717	- 3,632	- 3,528	- 3,408	- 3,292	- 3,181	- 3,073
	High		- 5,585	- 5,463	- 5,170	- 4,906	- 4,661	- 4,411	- 4,174	- 3,949	- 3,733	- 3,519	- 3,314
Transport	Central		- 101,049	- 94,222	- 90,023	- 87,958	- 85,851	- 84,928	- 83,675	- 82,481	- 81,272	- 80,051	- 78,883
	Low		- 47,267	- 45,363	- 43,491	- 41,694	- 40,008	- 38,350	- 36,796	- 35,303	- 33,834	- 32,457	- 31,135
	High		- 187,267	- 184,474	- 181,657	- 179,064	- 176,438	- 173,785	- 171,331	- 168,844	- 166,330	- 163,991	- 161,620
Total	Central		- 106,329	- 99,259	- 95,103	- 93,113	- 90,917	- 89,713	- 88,201	- 86,740	- 85,277	- 83,815	- 82,418
	Low		- 51,352	- 49,335	- 47,366	- 45,487	- 43,725	- 41,983	- 40,323	- 38,711	- 37,126	- 35,638	- 34,208
	High		- 192,852	- 189,937	- 186,827	- 183,970	- 181,099	- 178,197	- 175,506	- 172,793	- 170,063	- 167,510	- 164,935

The final table presents the total monetised impact of the policy. This is the sum of the discounted monetised value of carbon emissions and discounted monetised value of change in energy consumption. Negative values indicate the benefits, positive values indicate the costs. All values are expressed as NPV in thousands of pounds.

Total monetised impact

(minus indicates benefits)

Units: £k (2010 prices)		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Traded	Central		-	-	-	-	-	-	-	-	-	-	-
	Low		-	-	-	-	-	-	-	-	-	-	-
	High		-	-	-	-	-	-	-	-	-	-	-
Non-traded	Central		- 7,304	- 7,022	- 7,027	- 7,064	- 6,938	- 6,620	- 6,328	- 6,029	- 5,743	- 5,470	- 5,209
	Low		- 4,759	- 4,634	- 4,524	- 4,430	- 4,341	- 4,244	- 4,129	- 3,998	- 3,872	- 3,750	- 3,631
	High		- 9,633	- 9,432	- 9,063	- 8,724	- 8,405	- 8,083	- 7,781	- 7,490	- 7,210	- 6,932	- 6,663
Transport	Central		- 131,576	- 124,159	- 119,381	- 116,749	- 114,085	- 112,617	- 110,874	- 109,191	- 107,495	- 105,789	- 104,140
	Low		- 54,899	- 52,847	- 50,831	- 48,892	- 47,067	- 45,273	- 43,596	- 41,980	- 40,390	- 38,892	- 37,450
	High		- 255,952	- 251,833	- 247,714	- 243,844	- 239,967	- 236,086	- 232,529	- 228,941	- 225,331	- 221,902	- 218,447
Non-fuel emissions	Central		-	-	-	-	-	-	-	-	-	-	-
	Low		-	-	-	-	-	-	-	-	-	-	-
	High		-	-	-	-	-	-	-	-	-	-	-
Total CO2e	Central		- 138,880	- 131,181	- 126,408	- 123,813	- 121,024	- 119,238	- 117,203	- 115,221	- 113,239	- 111,259	- 109,349
	Low		- 59,658	- 57,481	- 55,355	- 53,322	- 51,407	- 49,517	- 47,724	- 45,978	- 44,262	- 42,642	- 41,081
	High		- 265,585	- 261,265	- 256,776	- 252,568	- 248,372	- 244,169	- 240,310	- 236,432	- 232,541	- 228,834	- 225,111

Example 3. Affordability for businesses and employment

Methodologies for appraisal of affordability for businesses and associated employment impact have been designed to assess the impact of cost to the business. Hence negative values (corresponding to benefits) should not be entered in the user inputs.

Input 3: Affordability (business) and employment

A new policy is being considered which will result in a new licence for crop and animal production. Larger enterprises need to do a more complex appraisal incurring in more costs. This appraisal is valid for a maximum of 25 years. The licence needs to be renewed on a yearly basis. Impacts on affordability for businesses and employment are calculated using the same set of inputs.

- Number of years for annualisation of capital cost: 25 (for the three scenarios)
- Central scenario:

	% of businesses impacted	Capital (transitional) cost per business (£k)	Annual operating cost per business (£k/ year)	% of businesses able to pass costs	% of compliance cost that could be passed
01 Crop and animal production, hunting and related service activities					
No employees	100%	20	5	0	0
Micro	100%	20	5	0	0
Small	100%	20	5	0	0
Medium	100%	50	10	100	30
Large	100%	50	10	100	30

- Low scenario:

	% of businesses impacted	Capital (transitional) cost per business (£k)	Annual operating cost per business (£k/ year)	% of businesses able to pass costs	% of compliance cost that could be passed
01 Crop and animal production, hunting and related service activities					
No employees	100%	30	5	0	0
Micro	100%	30	5	0	0
Small	100%	30	5	0	0
Medium	100%	75	10	100	30
Large	100%	75	10	100	30

- High scenario:

	% of businesses impacted	Capital (transitional) cost per business (£k)	Annual operating cost per business (£k/ year)	% of businesses able to pass costs	% of compliance cost that could be passed
01 Crop and animal production, hunting and related service activities					
No employees	100%	20	50	0	0
Micro	100%	20	50	0	0
Small	100%	20	50	0	0
Medium	100%	50	100	100	30
Large	100%	50	100	100	30

Results: Affordability for businesses

The model offered the following results for the impact in affordability for businesses.

Columns A:U

Starting from the left, the table below shows the NACE section code and name, division code and division name, followed by the category for size of the business. Cost as % of GOS provides an indication of an impact that the policy in question may have on businesses across the sectors affected by the policy. The results are presented per size of a business, and can therefore be used to compare the scale of the impacts on SMEs and large companies. Results are provided separately for businesses able to pass on costs and unable to pass on costs. In this example, businesses with no employees, micro and small businesses are unable to pass on costs to their customers. For that reason results for these businesses are only presented in column I and J (Cost as % of GOS for businesses unable to pass costs). Columns L:N (Cost as % of GOS for businesses able to pass costs) for these businesses show zero impact.

Impact on affordability for businesses

Description: Comparison of cost as proportion of GOS and affordability threshold

Units: Number of businesses and % of total businesses in the division/size category

Affordability thresholds:	10%	20%	50%	75%

Impact specific inputs					Cost as % of GOS for businesses unable to pass costs			Cost as % of GOS for businesses able to pass costs			Number of businesses unable to pass costs			Number of businesses able to pass costs		
Section Code	Section name	Division code	Division name	Size	Central	Low	High	Central	Low	High	Central	Low	High	Central	Low	High
					%	%	%	%	%	%						
A	AGRICULTURE, FORESTRY	01	Crop and animal production, hu	No employees	40.5%	44.5%	334.0%	0.0%	0.0%	0.0%	85,075	85,075	85,075	-	-	-
A	AGRICULTURE, FORESTRY	01	Crop and animal production, hu	Micro	8.6%	9.5%	71.1%	0.0%	0.0%	0.0%	47,710	47,710	47,710	-	-	-
A	AGRICULTURE, FORESTRY	01	Crop and animal production, hu	Small	1.5%	1.7%	12.7%	0.0%	0.0%	0.0%	3,045	3,045	3,045	-	-	-
A	AGRICULTURE, FORESTRY	01	Crop and animal production, hu	Medium	0.7%	0.8%	5.8%	0.2%	0.2%	1.7%	-	-	-	325	325	325
A	AGRICULTURE, FORESTRY	01	Crop and animal production, hu	Large	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data	-	-	-	50	50	50
No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data
No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data

Impact on affordability for businesses

Description: Comparison of cost as proportion of GOS and affordability threshold

Units: Number of businesses and % of total businesses in the division/size category

Affordability thresholds:	10%	20%	50%	75%

Impact specific inputs					Cost as % of GOS for businesses unable to pass costs			Cost as % of GOS for businesses able to pass costs			Number of businesses unable to pass costs			Number of businesses able to pass costs		
Section Code	Section name	Division code	Division name	Size	Central	Low	High	Central	Low	High	Central	Low	High	Central	Low	High
					%	%	%	%	%	%						
A	AGRICULTURE, FORESTRY AND	01	Crop and animal production, hunti	No employees	41%	44%	334%	41%	0%	0%	85,075	85,075	85,075	-	-	-
A	AGRICULTURE, FORESTRY AND	01	Crop and animal production, hunti	Micro	9%	9%	71%	9%	0%	0%	47,710	47,710	47,710	-	-	-
A	AGRICULTURE, FORESTRY AND	01	Crop and animal production, hunti	Small	2%	2%	13%	2%	0%	0%	3,045	3,045	3,045	-	-	-
A	AGRICULTURE, FORESTRY AND	01	Crop and animal production, hunti	Medium	1%	1%	6%	1%	0%	2%	-	-	-	325	325	325
A	AGRICULTURE, FORESTRY AND	01	Crop and animal production, hunti	Large	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data	-	-	-	50	50	50
No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data
No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data

Columns W:AW

Further to the right, starting from column W, the model presents the number of businesses with significant impact. Whether an impact is significant is determined by applying a threshold value specified by the user. Businesses with the cost as % of GOS greater than the threshold will be considered as significantly impacted and will be included in the total number of businesses significantly impacted. The results are displayed for four different threshold levels.

Where the underlying data is not available to undertake the assessment (e.g. GOS figures are not available) the results table show “Insufficient data”. Where no information has been entered by the user, the results table show “No data”.

Columns W:AM

Central scenario							
Number of businesses with significant impact				% of businesses with significant impact			
Threshold 0.1	Threshold	Threshold	Threshold	Threshold	Threshold	Threshold	Threshold
				%	%	%	%
85,075	85,075	-	-	100%	100%	0%	0%
-	-	-	-	0%	0%	0%	0%
-	-	-	-	0%	0%	0%	0%
-	-	-	-	0%	0%	0%	0%
Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data
No data	No data	No data	No data	No data	No data	No data	No data
No data	No data	No data	No data	No data	No data	No data	No data

Low scenario							
Number of businesses with significant impact				% of businesses with significant impact			
Threshold 0.1	Threshold	Threshold	Threshold	Threshold 0.1	Threshold	Threshold	Threshold
				%	%	%	%
85,075	85,075	-	-	100%	100%	0%	0%
-	-	-	-	0%	0%	0%	0%
-	-	-	-	0%	0%	0%	0%
-	-	-	-	0%	0%	0%	0%
Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data
No data	No data	No data	No data	No data	No data	No data	No data
No data	No data	No data	No data	No data	No data	No data	No data

Columns AO:AW

High scenario							
Number of businesses with significant impact				% of businesses with significant impact			
Threshold 0.1	Threshold 0.2	Threshold 0.5	Threshold 0.75	Threshold 0.1	Threshold 0.2	Threshold 0.5	Threshold 0.75
				%	%	%	%
85,075	85,075	85,075	85,075	100%	100%	100%	100%
47,710	47,710	47,710	-	100%	100%	100%	0%
3,045	-	-	-	100%	0%	0%	0%
-	-	-	-	0%	0%	0%	0%
Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data
No data	No data	No data	No data	No data	No data	No data	No data

Results: Employment

The model offered the following results for the impact in employment.

Columns A:S

This part of the table presents the results of assessments using Method A. It shows that in the "Crop and animal production sector", 17% of business' turnover is used to cover the costs of labour. The costs of compliance with the proposed policy is equivalent to 23,182 jobs (central scenario) across the businesses of all sizes which are unable to pass costs. However only 40 jobs could be affected in businesses able to pass costs onto customers in that sector. The results do not show how the sector will be affected, e.g. whether the jobs will be lost, gained or moved from one sector to another. Total equivalent number of jobs per sector is a sum of the two previous figures. The final column presents the total equivalent number of jobs, divided by the total employment figure in a given sector. These results are a sum of impacts across all business sizes in a sector.

Impact on employment at division level

Impact specific inputs				Labour cost as a share of total turnover by industry division	Equivalent number of jobs in businesses unable to pass costs per sector			Equivalent number of jobs in businesses able to pass costs per sector			Total equivalent number of jobs per sector			% of employment in the sector		
Section Code	Section name	Division code	Division name	%	Central	Low	High	Central	Low	High	Central	Low	High	Central	Low	High
					Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number
A	AGRICULTURE, FORESTRY AN	01	Crop and animal produ	17%	23,182	25,446	191,073	40	45	318	23,222	25,491	191,392	6%	7%	49%
No data	No data	No data	No data	No data	-	-	-	-	-	-	-	-	-	-	-	-

Columns T:AF

This part of the table presents the results of assessments using Method B. It shows that if all businesses in the "Crop and animal production sector", will decide to recover their costs through the job cuts, 30,924 jobs may be lost in that sector (total figure is a sum of results for businesses unable to pass costs and businesses able to pass costs). The final column presents the total equivalent number of jobs, divided by the total employment figure in a given sector. These results are a sum of impacts across all business sizes in a sector. **This result represents the worst case scenario and it is not a subset of results obtained using method A.**

Number of jobs potentially lost in businesses unable to pass costs per sector			Number of jobs potentially lost in businesses able to pass costs per sector			Total number of jobs potentially lost (worst case scenario)			Jobs potentially lost (worst case scenario) as % of employment in the sector		
Central	Low	High	Central	Low	High	Central	Low	High	Central	Low	High
Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number
30,877	33,892	254,500	46	52	368	30,924	33,944	254,867	8%	9%	65%
-	-	-	-	-	-	-	-	-	-	-	-

Example 4. Affordability for individuals

Three examples are set here. The first one is to assess a policy which results in an increase in domestic gas prices. The second is for a car scrappage scheme. The third is for a change in transport fuel prices.

Input 4a: Domestic policy example

Following the case as used above for GHG assessment (Example 2), households are expected to stop using coal by 2025 and switch to natural gas. As a result, gas prices for domestic consumers are expected to increase. Given that coal only represents around 1% of domestic energy consumption in the UK and gas is near 70%, the complete substitution of coal by gas will result in only a slight increase of average gas consumption[12]. This measure will affect fuel use for heating, cooking and hot water.

The following inputs should be entered into the model:

- Scope of the policy/measure: Heating, cooking and hot water.
- Change in annual energy consumption per household (in % - for each year between 2015-2025) (Table 1 in **Control-AffordIndiv**):

	Natural gas (%)	Coal (%)
Central	1	-75
Low	0.7	-50
High	1.4	-100

- Change in fuel price (in %, for each year between 215-2025) (Table 2 in **Control-AffordIndiv**):

	Gas
Central	4
Low	2
High	6

- No capital cost for energy consumption are anticipated hence input tables 3 and 4 in **Control-AffordIndiv** do not need to be completed.

Input 4b: Scrappage scheme

A car scrappage scheme is implemented, targeting diesel cars older than 8 years.

- Age of cars affected by the policy (Table 5 in **Control-AffordIndiv)**

8 to 10 years	10 to 13 years	Over 13 years
Yes	Yes	Yes

[12] As an internationally traded commodity, such a small change in demand may have no impact at all on gas prices, however for the purpose of demonstrating the functionality of the model this example is taken.

- Average car lifetime (13 by default) (Table 5 in **Control-AffordIndiv**)
- Capital cost per household (Table 6 in **Control-AffordIndiv**)

	Petrol	Diesel
Central	0	17,000
Low	0	15,000
High	0	20,000

Input 4c: Transport example

In order to discourage use of diesel vehicles, it is proposed to increase the fuel duty on diesel by 10p per litre. Fuel duty on petrol would not be affected.

This is combined with the campaign in Input 1a to reduce traffic in London by 10% (2,880 million vehicle kilometres per year) compared to the current volume of traffic. If we assume that 70% of this reduction in traffic will affect household car journeys (with the remaining 30% corresponding to business trips), this results in London households reducing traffic by 2,016 million km per year.

Assuming 8 million population and an average household of 2.5 people, this leads to an estimated 3.2 million households in London. Therefore, each household in London will on average be reducing car travel by 630 km per year (2,016 mill / 3.2 mill). Assuming a split of petrol:diesel cars of 69%:31%, the campaign is expected to remove an average of 435 km for petrol cars and 195 km for diesel cars in each household.

To reflect high uncertainty in these estimates, the low and high uncertainty scenarios have been defined by applying 50% uncertainty factor, thus resulting in a reduction for petrol cars of 218 and 653 km for low and high scenarios respectively. For diesel cars the low and high scenarios would be 98 and 293 km respectively per household.

Following the assumptions above the user needs to enter the inputs detailed below:

- Change in annual car travel per household (km) – Hybrid is left blank (Table 7 in **Control-AffordIndiv**)

	Scenario	Change in car travel (each year between 2015-2025)
Petrol car	Central	- 435
	Low	- 218
	High	- 653
Diesel car	Central	- 195
	Low	- 98
	High	- 293

- Increase in road fuel prices due to policy (Table 8. All scenarios, every year between 2015-2025)

Petrol	Diesel
0 p/litre	10 p/litre

- No increase in public transport use or fares are anticipated hence input tables 9 and 10 in **Control-AffordIndiv** do not need to be completed.

Results: Affordability for individuals

The model gives the results illustrated in the figures below. In the spreadsheet, Rows 14:46 show the annual costs (rows 17:31) and benefits (Rows 32:46) due to change in travel expenditure. In the example, it can be observed that depending on the scenario, for some income quintiles the measures will result in costs (positive values) while for others it will be benefits (negative values). In the rows corresponding to annual costs, blank cells indicate these income quintiles will experience benefits. In the rows corresponding to annual benefits, blank cells indicate these income quintiles will experience costs. For example, in the low scenario the policy will result in costs for all quintiles. On the contrary, the high scenario will result in benefits. For the central scenario only the 4th and 5th quintiles will be negatively affected, resulting in benefits for the three quintiles with lower incomes.

The explanation for this is that there are two parallel measures affecting travel expenditure that partially counteract each other. On one hand the increase in the price of diesel affects more noticeably those sectors of the population that drive more often (higher income) while the decrease in car use and its associated savings are assumed to be the same for all households. Similarly, the increase in fuel cost is the same across scenarios while the change in car use varies, leading to differences between scenarios.

Transport
Annual costs/benefits due to change in travel expenditure per household

Units:	£ per household		Quintile	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Annual travel expenditure	Annual cost	Central	1st												
			2nd												
			3rd												
			4th		1	1	1	0							
			5th		13	13	12	12	11	10	9	8	7	7	6
		Low	1st		5	5	5	4	4	4	4	3	3	3	3
			2nd		6	6	6	6	5	5	5	5	4	4	4
			3rd		5	5	5	4	4	4	4	4	3	3	3
			4th		15	14	14	13	13	12	12	11	11	10	10
			5th		24	23	22	22	21	20	19	19	18	17	17
		High	1st												
			2nd												
			3rd												
			4th												
			5th												
	Annual benefit	Central	1st		-12	-11	-11	-11	-11	-11	-12	-12	-12	-12	-12
			2nd		-10	-10	-9	-10	-10	-10	-10	-10	-11	-11	-11
			3rd		-12	-12	-11	-11	-11	-12	-12	-12	-12	-12	-12
			4th						0	-1	-1	-2	-2	-2	-3
			5th												
		Low	1st												
			2nd												
			3rd												
			4th												
			5th												
		High	1st		-59	-58	-57	-57	-56	-56	-55	-55	-54	-53	-53
			2nd		-57	-56	-56	-55	-55	-55	-54	-54	-53	-52	-52
			3rd		-60	-59	-58	-58	-57	-57	-56	-56	-55	-54	-54
			4th		-42	-41	-41	-41	-41	-41	-41	-41	-41	-41	-41
			5th		-24	-25	-25	-26	-26	-27	-27	-27	-27	-28	-28

In the results spreadsheet, rows 48:80 display the percentage change in annual travel expenditure over disposable income. We can observe that the calculated costs and benefits actually represent a very small proportion compared to the average disposable income, with the lowest income households proportionally benefited the most.

Percentage of change in annual travel expenditure over disposable income

Units:	% of disposable income		Quintile	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Travel expenditure over disposable income	Annual cost	Central	1st												
			2nd												
			3rd												
			4th		0.0%	0.0%	0.0%	0.0%							
			5th		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
		Low	1st		0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
			2nd		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
			3rd		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
			4th		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
			5th		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
		High	1st												
			2nd												
			3rd												
			4th												
			5th												
	Annual benefit	Central	1st		-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%
			2nd		-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%
			3rd		0.0%	0.0%	0.0%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%
			4th						0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
			5th												
		Low	1st												
			2nd												
			3rd												
			4th												
			5th												
		High	1st		-0.6%	-0.6%	-0.7%	-0.7%	-0.7%	-0.7%	-0.7%	-0.7%	-0.8%	-0.8%	-0.8%
			2nd		-0.3%	-0.3%	-0.3%	-0.3%	-0.4%	-0.4%	-0.4%	-0.4%	-0.4%	-0.4%	-0.4%
			3rd		-0.2%	-0.2%	-0.2%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%
			4th		-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.2%	-0.2%	-0.2%	-0.2%
			5th		0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%

Capital costs associated with the scrappage scheme are displayed in the spreadsheet in rows 83:92. These show the additional cost per household and quintile in columns D:F (i.e. the cost associated with the early purchase of the new vehicle only). Columns G:I show these costs compared to the annual disposable income per quintile.

In the spreadsheet, columns J:L present (in NPV) capital costs associated with the scrappage scheme, taking into consideration the full cost of replacing the vehicle (rather than only additional cost as described in the previous paragraph) – see "Total capital investment in NPV" in the figure below. Columns M:O present these capital cost as proportion of households' disposable income – see "Total capital investment as percentage of annual household disposable income" in the figure below. .

Transitional (capital) costs for households in transport (i.e. scrappage scheme)

All transitional cost due to scrappage scheme is assumed to occur in the first year of the policy

£ per household	Average additional cost due to early purchase, per income category in NPV			Additional cost as percentage of annual household disposable income			Total capital investment in NPV			Total capital investment as percentage of annual household disposable income		
Quintile	Central	Low	High	Central	Low	High	Central	Low	High	Central	Low	High
1st	539	476	634	6%	5%	6%	5,262	4,643	6,191	54%	47%	63%
2nd	505	446	594	3%	2%	3%	4,980	4,394	5,859	26%	23%	31%
3rd	490	433	577	2%	2%	2%	4,825	4,257	5,676	18%	16%	21%
4th	524	462	616	1%	1%	2%	5,701	5,030	6,707	16%	14%	19%
5th	485	428	571	1%	1%	1%	6,428	5,672	7,563	10%	9%	12%
Transport qualitative uncertainty score:				160	Low							

In the spreadsheet rows 95:222 show results related to domestic energy consumption. The change in domestic energy expenditure per household can be found in rows 96:158. This is shown separately for costs and benefits, as well as for transitional and annual. In this example, no transitional costs were considered so it appears blank. Regarding operational costs, we can observe that for some quintiles there are only benefits during the first few years despite the user inputs being constant across the assessment period. This is because the model considers future projections in fuel prices. Differences between quintiles are due to the households using different fuel mixes depending on their incomes.

Domestic
Change in domestic energy expenditure per household (transitional and annual)

Units:	£ per household		Quintile	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Costs	Transition cost	Central	1st												
			2nd												
			3rd												
			4th												
			5th												
		Low	1st												
			2nd												
			3rd												
			4th												
			5th												
		High	1st												
			2nd												
			3rd												
			4th												
			5th												
	Annual cost	Central	1st		4	5	7	8	8	8	9	10	10	10	10
			2nd		12	13	14	14	14	14	14	14	14	14	14
			3rd		8	10	11	12	12	12	13	14	13	14	14
			4th		7	9	11	12	12	12	14	14	14	15	15
			5th				3	5	7	8	10	12	12	14	14
		Low	1st		0	1	2	3	3	4	4	5	5	5	5
			2nd		5	6	7	7	7	7	7	7	7	7	7
			3rd		2	4	5	5	5	6	6	7	7	7	7
			4th		1	3	4	5	5	6	6	7	7	7	7
			5th						1	2	4	5	5	6	7
		High	1st		7	10	12	13	13	13	15	15	15	16	16
			2nd		19	20	22	22	21	21	22	22	21	22	21
			3rd		14	16	18	19	19	19	20	21	20	21	21
			4th		13	16	18	19	20	20	21	22	22	23	22
			5th			3	8	11	13	15	18	20	20	22	22
Benefits	Transition benefits	Central	1st												
			2nd												
			3rd												
			4th												
			5th												
		Low	1st												
			2nd												
			3rd												
			4th												
			5th												
		High	1st												
			2nd												
			3rd												
			4th												
			5th												
	Annual benefit	Central	1st												
			2nd												
			3rd												
			4th												
			5th		-6	-1									
		Low	1st												
			2nd												
			3rd												
			4th												
			5th		-8	-4	-2	0							
		High	1st												
			2nd												
			3rd												
			4th												
			5th		-3										

In the spreadsheet in rows 163:222, the costs from domestic energy consumption detailed above are compared against the average disposable income of households for each quintile. Where a value of 0.0% is displayed this is because the value is less than 0.05%.

Percentage of change in domestic energy expenditure over disposable income (transitional and annual)

Units:	% of disposable income		Quintile	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Costs	Transitional cost	Central	1st												
			2nd												
			3rd												
			4th												
			5th												
		Low	1st												
			2nd												
			3rd												
			4th												
			5th												
		High	1st												
			2nd												
			3rd												
			4th												
			5th												
	Annual cost	Central	1st		0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%
			2nd		0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
			3rd		0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
			4th		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%
			5th				0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
		Low	1st		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%
			2nd		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%
			3rd		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
			4th		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
			5th						0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
		High	1st		0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
			2nd		0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%
			3rd		0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
			4th		0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
			5th			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%
Benefits	Transitional benefit	Central	1st												
			2nd												
			3rd												
			4th												
			5th												
		Low	1st												
			2nd												
			3rd												
			4th												
			5th												
		High	1st												
			2nd												
			3rd												
			4th												
			5th												
	Annual benefit	Central	1st												
			2nd												
			3rd												
			4th												
			5th		0.0%	0.0%									
		Low	1st												
			2nd												
			3rd												
			4th												
			5th		0.0%	0.0%	0.0%	0.0%							
		High	1st												
			2nd												
			3rd												
			4th												
			5th		0.0%										

Finally, rows 228:287 show the total costs and benefits for households in NPV, summing the change in expenditure in energy consumption, travel expenditure and capital costs associated with domestic energy and scrappage schemes. For the scrappage scheme, only the cost associated with early purchase (not the total cost of the car) is included.

Total change in household expenditure per income quintile

For scrappage scheme, only the additional cost associated to early purchase of a car is added. NOT the total cost of the car.

Units:	£ per household		Quintile	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Costs	Transition cost	Central	1st	-	539	-	-	-	-	-	-	-	-	-	-
			2nd	-	505	-	-	-	-	-	-	-	-	-	-
			3rd	-	490	-	-	-	-	-	-	-	-	-	-
			4th	-	524	-	-	-	-	-	-	-	-	-	-
			5th	-	485	-	-	-	-	-	-	-	-	-	-
		Low	1st	-	476	-	-	-	-	-	-	-	-	-	-
			2nd	-	446	-	-	-	-	-	-	-	-	-	-
			3rd	-	433	-	-	-	-	-	-	-	-	-	-
			4th	-	462	-	-	-	-	-	-	-	-	-	-
			5th	-	428	-	-	-	-	-	-	-	-	-	-
		High	1st	-	634	-	-	-	-	-	-	-	-	-	-
			2nd	-	594	-	-	-	-	-	-	-	-	-	-
			3rd	-	577	-	-	-	-	-	-	-	-	-	-
			4th	-	616	-	-	-	-	-	-	-	-	-	-
			5th	-	571	-	-	-	-	-	-	-	-	-	-
	Annual cost	Central	1st	-	4	5	7	8	8	8	9	10	10	10	10
			2nd	-	12	13	14	14	14	14	14	14	14	14	14
			3rd	-	8	10	11	12	12	12	13	14	13	14	14
			4th	-	7	10	12	12	12	12	14	14	14	15	15
			5th	-	13	13	15	17	17	18	19	20	20	21	20
		Low	1st	-	5	6	7	7	7	7	8	8	8	8	8
			2nd	-	12	12	13	12	12	12	12	12	12	12	11
			3rd	-	7	8	9	10	10	10	10	10	10	10	10
			4th	-	16	17	18	18	18	18	18	18	18	18	17
			5th	-	24	23	22	22	22	22	23	23	23	24	23
		High	1st	-	7	10	12	13	13	13	15	15	15	16	16
			2nd	-	19	20	22	22	21	21	22	22	21	22	21
			3rd	-	14	16	18	19	19	19	20	21	20	21	21
			4th	-	13	16	18	19	20	20	21	22	22	23	22
			5th	-	-	3	8	11	13	15	18	20	20	22	22
Benefits	Transition benefits	Central	1st	-	-	-	-	-	-	-	-	-	-	-	-
			2nd	-	-	-	-	-	-	-	-	-	-	-	-
			3rd	-	-	-	-	-	-	-	-	-	-	-	-
			4th	-	-	-	-	-	-	-	-	-	-	-	-
			5th	-	-	-	-	-	-	-	-	-	-	-	-
		Low	1st	-	-	-	-	-	-	-	-	-	-	-	-
			2nd	-	-	-	-	-	-	-	-	-	-	-	-
			3rd	-	-	-	-	-	-	-	-	-	-	-	-
			4th	-	-	-	-	-	-	-	-	-	-	-	-
			5th	-	-	-	-	-	-	-	-	-	-	-	-
		High	1st	-	-	-	-	-	-	-	-	-	-	-	-
			2nd	-	-	-	-	-	-	-	-	-	-	-	-
			3rd	-	-	-	-	-	-	-	-	-	-	-	-
			4th	-	-	-	-	-	-	-	-	-	-	-	-
			5th	-	-	-	-	-	-	-	-	-	-	-	-
	Annual benefit	Central	1st	-	- 12	- 11	- 11	- 11	- 11	- 11	- 12	- 12	- 12	- 12	- 12
			2nd	-	- 10	- 10	- 9	- 10	- 10	- 10	- 10	- 10	- 11	- 11	- 11
			3rd	-	- 12	- 12	- 11	- 11	- 11	- 12	- 12	- 12	- 12	- 12	- 12
			4th	-	-	-	-	-	- 0	- 1	- 1	- 2	- 2	- 2	- 3
			5th	-	- 6	- 1	-	-	-	-	-	-	-	-	-
		Low	1st	-	-	-	-	-	-	-	-	-	-	-	-
			2nd	-	-	-	-	-	-	-	-	-	-	-	-
			3rd	-	-	-	-	-	-	-	-	-	-	-	-
			4th	-	-	-	-	-	-	-	-	-	-	-	-
			5th	-	- 8	- 4	- 2	- 0	-	-	-	-	-	-	-
		High	1st	-	- 59	- 58	- 57	- 57	- 56	- 56	- 55	- 55	- 54	- 53	- 53
			2nd	-	- 57	- 56	- 56	- 55	- 55	- 55	- 54	- 54	- 53	- 52	- 52
			3rd	-	- 60	- 59	- 58	- 58	- 57	- 57	- 56	- 56	- 55	- 54	- 54
			4th	-	- 42	- 41	- 41	- 41	- 41	- 41	- 41	- 41	- 41	- 41	- 41
			5th	-	- 28	- 25	- 25	- 26	- 26	- 27	- 27	- 27	- 27	- 28	- 28