Malaysia Climate Action Simulator (MCAS)

User's Guide

Table of Contents

Introduction 3

Technical Design 5

Sectoral coverage 5

Modification 5

Scenario and Ambition levels 5

Excel Spreadsheet Model 7

How the Excel Spreadsheet works (Using the main levers) 7

How the Excel Spreadsheet works (Using all the levers) 11

Creating your pathway in the spreadsheet 21

Webtool Model 15

How the webtool model works (using the main levers) 15

How the webtool model works (using all the levers) 17

Example Pathways 20

Limitations 22

Final remarks 24

Introduction

Climate change has been identified as an existential threat by the United Nations. Scientists warn that climate change is a key driver of extinction, and that it will affect all the aspects identified in the Sustainable Development Goals (SDGs).

The Paris Agreement, negotiated by 196 nations during the 2015 United Nations Climate Change Conference at Paris, France, is targeted to limit global warming to well below 2°C over the pre-industrial levels and pursue efforts to limit the temperature increase even further to 1.5°C. Under the agreement, each signatory needs to submit its own national plan, set targets for emissions reductions and specific pathways by which it aims to meet those targets. These plans and targets are also known as Nationally Determined Contributions (NDCs).

According to the NDC assessment done by the Climate Action Tracker, most of analyzed NDCs are considered "Insufficient", "Highly Insufficient" or "Critically Insufficient". Very few selected countries submitted NDC that aligns with the 2°C and 1.5°C aspirations of the Paris Agreement.

Malaysia has recently updated its NDC and it includes the following increased ambition:

1. The 45% of carbon intensity reduction by 2030 is unconditional;
2. The target is an increase of 10% from the earlier submission; and
3. The greenhouse gas (GHG) coverage is expanded to seven (7) GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3).

Although Malaysia has set a clear climate action target, there are many discussions, both in the policy forums and within the industry, as companies and individuals attempting to obtain clarifications on the following questions:

1. When will Malaysia's emissions peak and enter absolute emission reductions?
2. What does a low emissions pathway look like for Malaysia? How can we achieve carbon neutrality or net zero GHG emissions?
3. How can one specific sector (e.g. transport, energy or waste) contribute to the emissions target? What is the breakdown in percentage?
4. Which sectors should we focus on? Which ones are less important?
5. How much energy could we supply from different energy technologies?
6. If other sectors remain the same, how much CO_2 reduction can be achieved under the most ambitious renewable energy scenarios?
7. How do mitigation measures affect energy supply and land use?
8. What is the full potential of CO_2 reductions in Malaysia?

Simulations can be used to answer the questions above. In addition, a well-built, robust simulation tool can be used to explore and chart low emissions pathways for a nation. With these two reasons in mind, the Malaysia Climate Action Simulator (MCAS) is developed by Malaysian Green Technology and Climate Change Centre (MGTC).

Formerly known as the Malaysia 2050 Carbon Calculator but renamed to avoid carbon footprint calculator confusion, MCAS is developed using the modelling framework of the UK 2050 Carbon Calculator, with support from the UK Department of Business, Energy & Industrial Strategy (BEIS), Mott MacDonald, CLIMACT and Imperial College London (ICL). The UK 2050 Carbon Calculator,

published by the UK Department of Energy & Climate in 2010, has been used to explore the various options on how the UK can best meet energy needs while achieving the ambitious 80% GHG reduction target by 2050.

Fitted with Malaysia-specific data and modified to best reflect Malaysian circumstances, MCAS covers the five sectors outlined in the national greenhouse gas inventory. The five sectors are:

1. Energy
2. Industrial Processes & Product Use (IPPU)
3. Agriculture
4. Land Use, Land Use Change & Forestry (LULUCF)
5. Waste

MCAS comes in two versions: Excel (xxx) and Web Tool (xxx). The Excel version serves as the fundamental model that contains all the parameters, data and calculations, which can be arduous and daunting for new users to navigate and use. On the other hand, the Web Tool version offers a user-friendly alternative for users to explore.

As a scenario painter, MCAS can help users to explore the different low carbon technologies and their potential reduction contribution to the national emissions. Also, it allows users to develop their own pathways to achieve specific emissions reduction target while considering the available resources and priorities. Most importantly, it can serve as a platform for users to engage in discussions on the selection of low carbon opportunities and as a tool to raise climate change awareness among the general public. The following questions can be answered using MCAS:

1. What are the key sectors that contribute to the national GHG inventory?
2. Which sectors should we focus on? Which ones are less important?
3. Given the most ambitious scenarios, how much CO_2e reduction can be achieved?
4. If we focus solely on the energy sector, how much CO_2e reduction can be achieved?
5. What does a low emissions (e.g. carbon neutrality or net zero GHG emissions) pathway look like for Malaysia?

While not exhaustive on all aspects, this basic guide document aims to provide users an overview on how the MCAS Excel and Web Tool can be used. In addition, users can always refer to the original 2050 Calculator Spreadsheet: "How to" Guide for supporting information and understand the differences between the 2050 Calculator and MCAS.

Technical Design

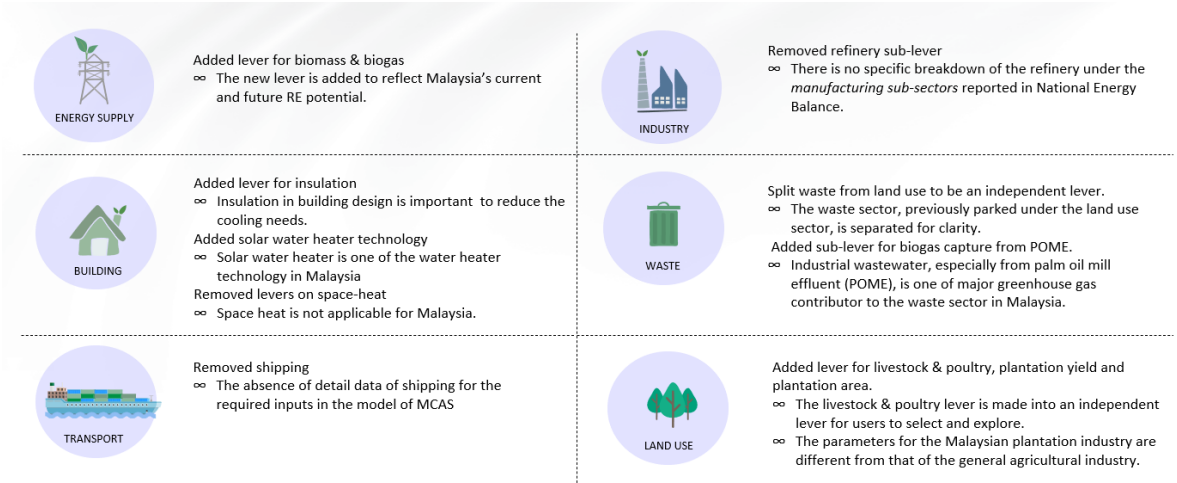
Sectoral coverage

MCAS covers almost all the GHG emission released by the energy, industrial processes and product use (IPPU), land use, land use change and forestry (LULUCF), agriculture and waste sector in Malaysia (i.e. Peninsular Malaysia, Sabah and Sarawak). In MCAS, mitigation solutions, known as levers, are grouped into seven (7) main categories, known as sectors.

SECTOR	TRANSPORT	BUILDINGS	INDUSTRY	CO_2 REMOVAL & GASES	ELECTRICITY SUPPLY	LAND USE & FORESTRY	WASTE
LEVER	Transport Demand	Building Temperature	Industrial Efficiency	Hydrogen Share	Solar	Farming Yield & Efficiency	Waste Reduction
	International Aviation	Building Insulation	Industry Electrification	Greenhouse Gas Removal	Biomass	Livestock & Poultry	
	Light Vehicles - Electric	District Heat Share	Industry Shift to Biomass	CCS Capture Rate	Biogas	Plantation Yield	
	Light Vehicles - Hydrogen	Heat Pump Share	Industry Shift to Gas		Nuclear	Plantation Area	
	Light Vehicles - Hybrid	Hybrid Pump Share	Industry CCS		Offshore & Onshore Wind	Forest Cover	
	Light Vehicles - Biofuel	Network - Heat Pump			Wave & Tidal		
	Heavy Vehicles - Electric	Heat Network - Biomass			Seasonal Storage		
	Heavy Vehicles - Hydrogen	Lighting and Appliances			Short Term Balancing		
	Heavy Vehicles - Hybrid				Gas with CCS		
	Heavy Vehicles - Biofuel						
	Aviation Efficiency						
	Aviation Biofuel						

Modification

To better reflect the national circumstances, several changes are made to the original model. The changes are as follows:



Scenario and Ambition levels

For each sector and lever, there are a total of four (4) scenarios. The four levels are intended to reflect the different potential future scenarios, specifically on the basis of progressively greater efforts or

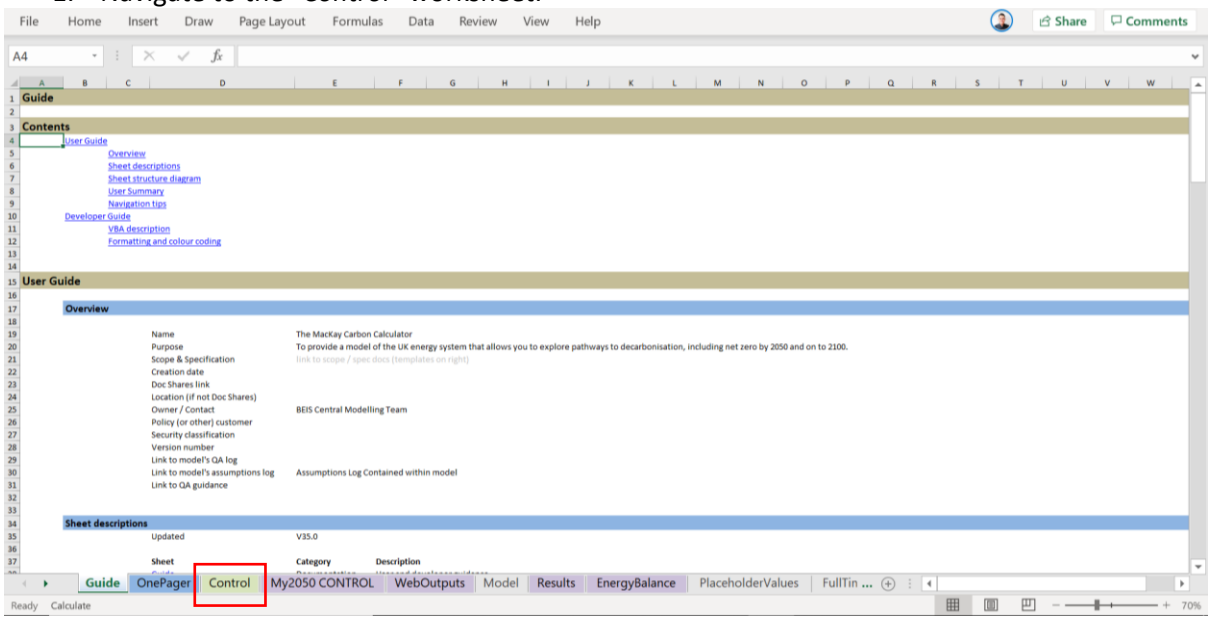
ambitions towards a low carbon future. For example, Level 1 represents a business-as-usual (BAU) approach towards climate change mitigation, with low effort and continuation of existing capacity, technology and no change in consumption behaviour. On the other hand, Level 4 represents the most ambitious scenario, with great efforts leading toward increase in renewable energy, advanced technology, and green lifestyle adoption. The ambition levels are explained in the following table:

Level 1	Level 2	Level 3	Level 4
Current ambition	**Increased ambition**	**Ambitious**	**Transformation**
Current legal measures, "BAU"	More extensive use of existing technologies	Significant effort based on rapid implementation of available technologies	Max implementation requiring fast deployment and, in some cases, some type of innovation
BAU = No additional policy intervention from 2016	Existing policies and planned initiatives	Additional mitigation measures implemented	Innovative, feasible and game-changing solutions

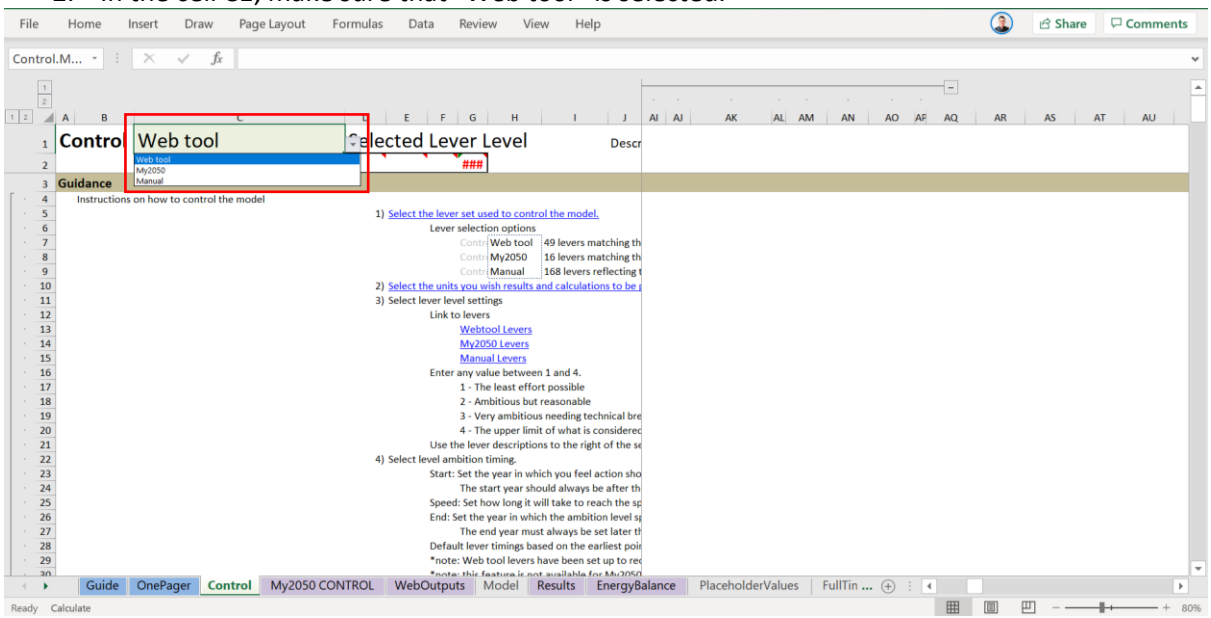
Excel Spreadsheet Model

How the Excel Spreadsheet works (Using the main levers)

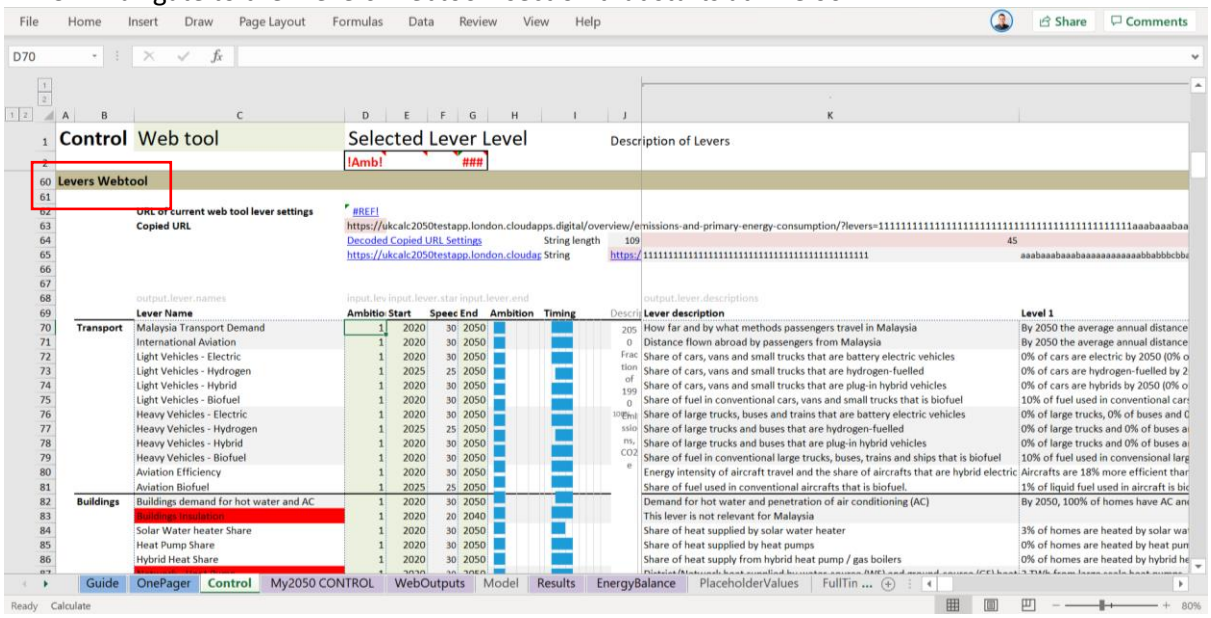
1. Navigate to the *"Control"* worksheet.



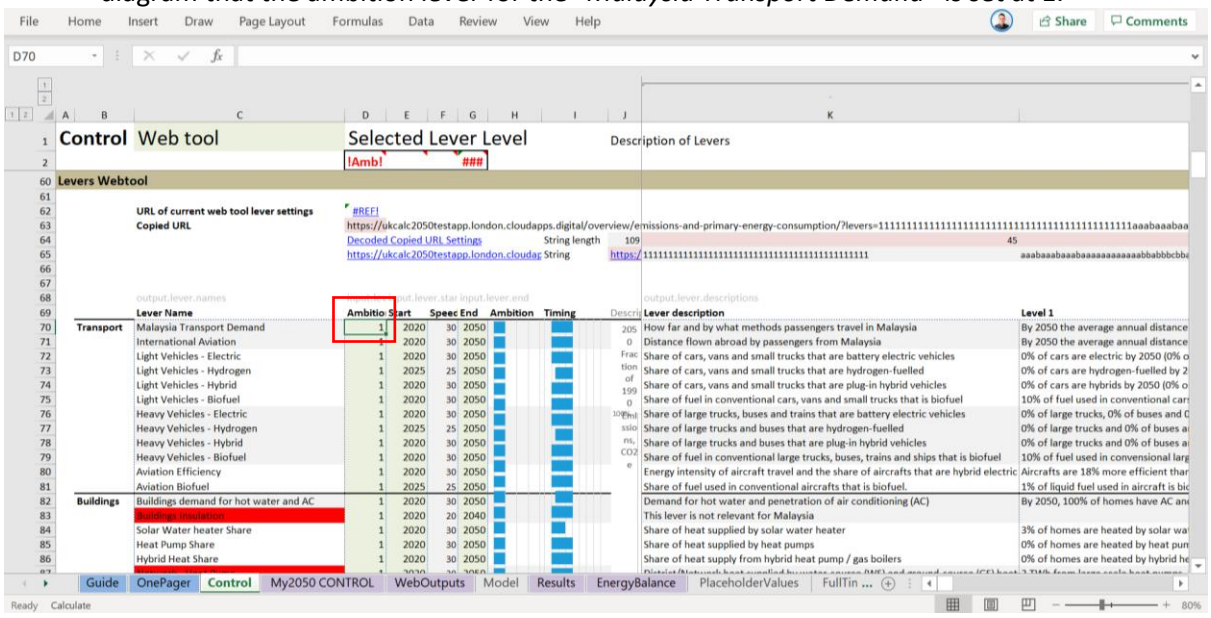
2. In the cell C1, make sure that *"Web tool"* is selected.



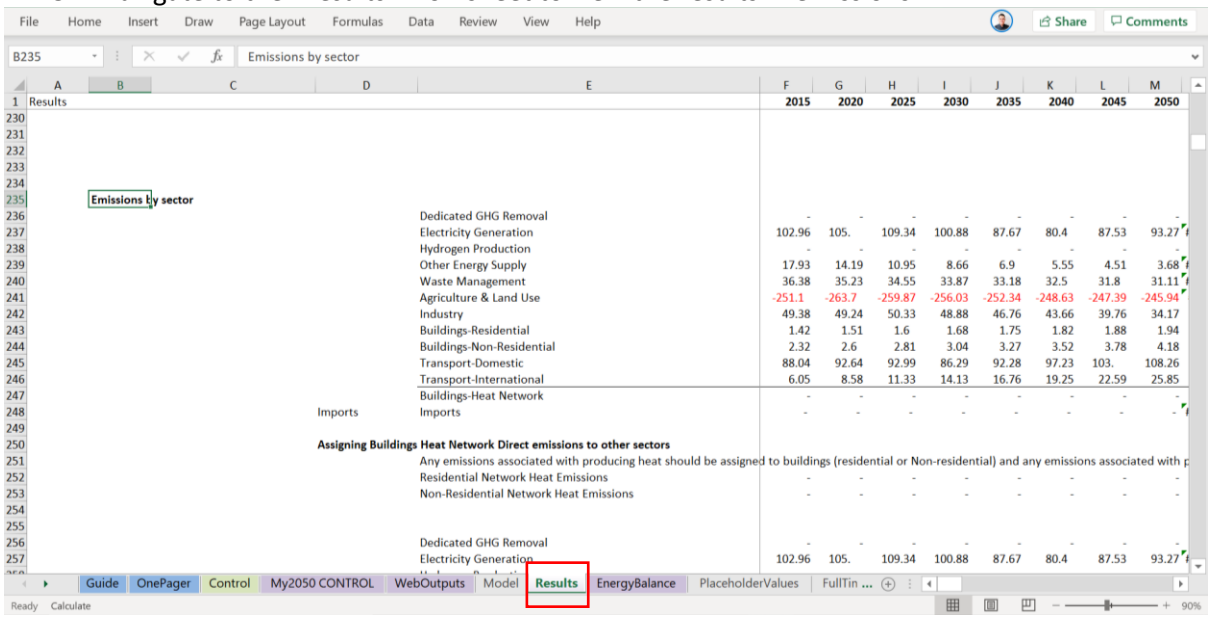
3. Navigate to the *"Levers Webtool"* section that starts at Line 60.



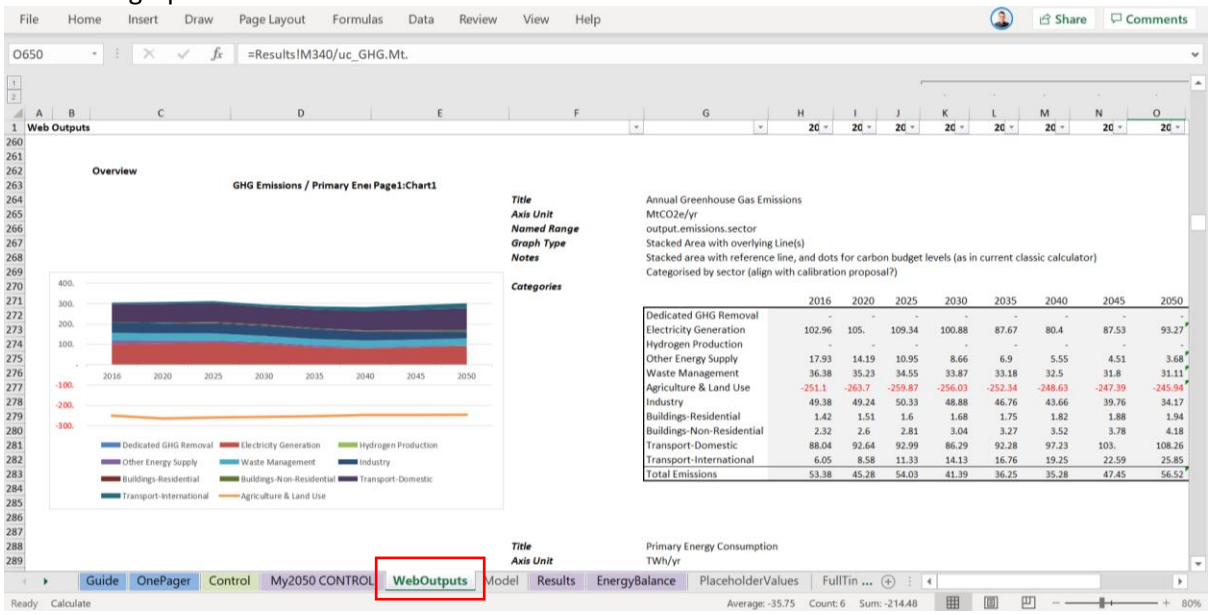
4. Change the value (ranging from 1 to 4) for the *Ambition* cells (column D) for each of the levers (Line 70 – 118). You may refer to column K for the description of the lever and column L to O for the description of each of the ambition level. For example, it is shown in the following diagram that the ambition lever for the *"Malaysia Transport Demand"* is set at 1.



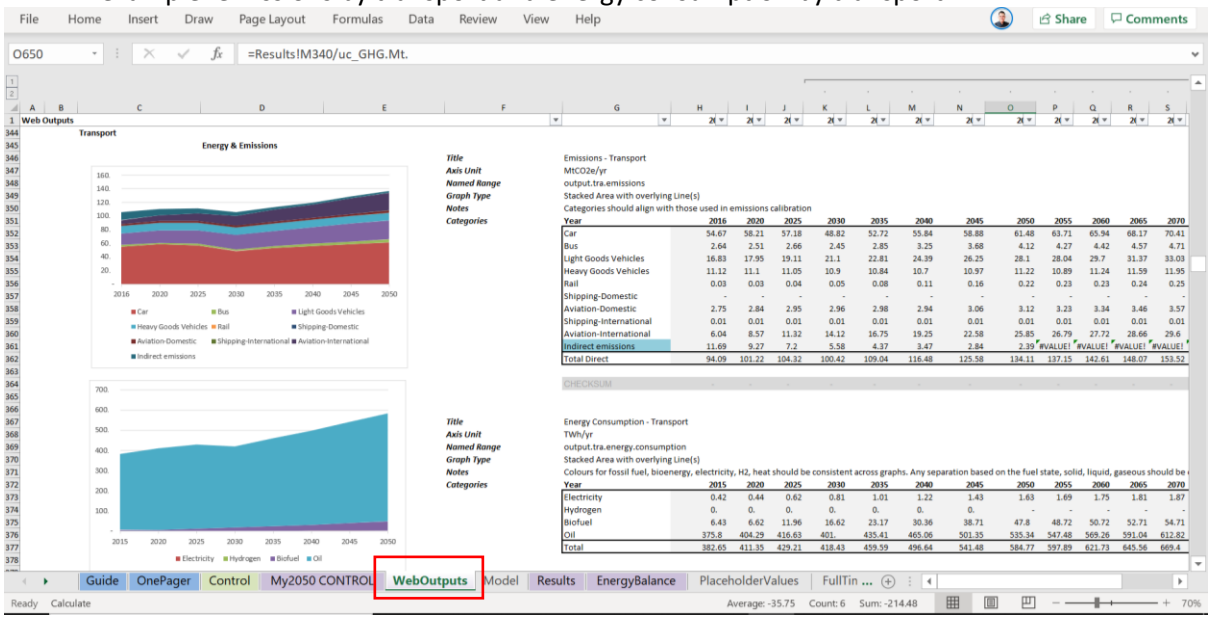
5. Navigate to the *"Results"* worksheet to view the results in emissions.



6. Otherwise, navigate to the *"WebOutputs"* worksheet to view the emissions results presented in graphs.

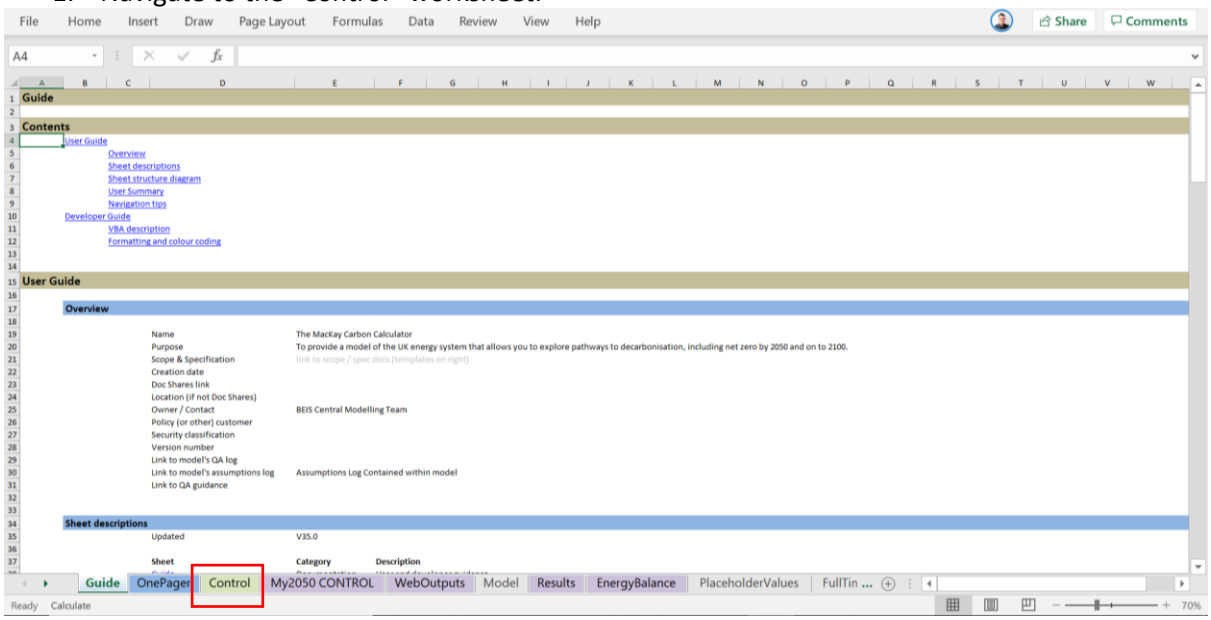


7. You may also explore the *"WebOutputs"* worksheet to view the results in other formats, for example: emissions by transport and energy consumption by transport.

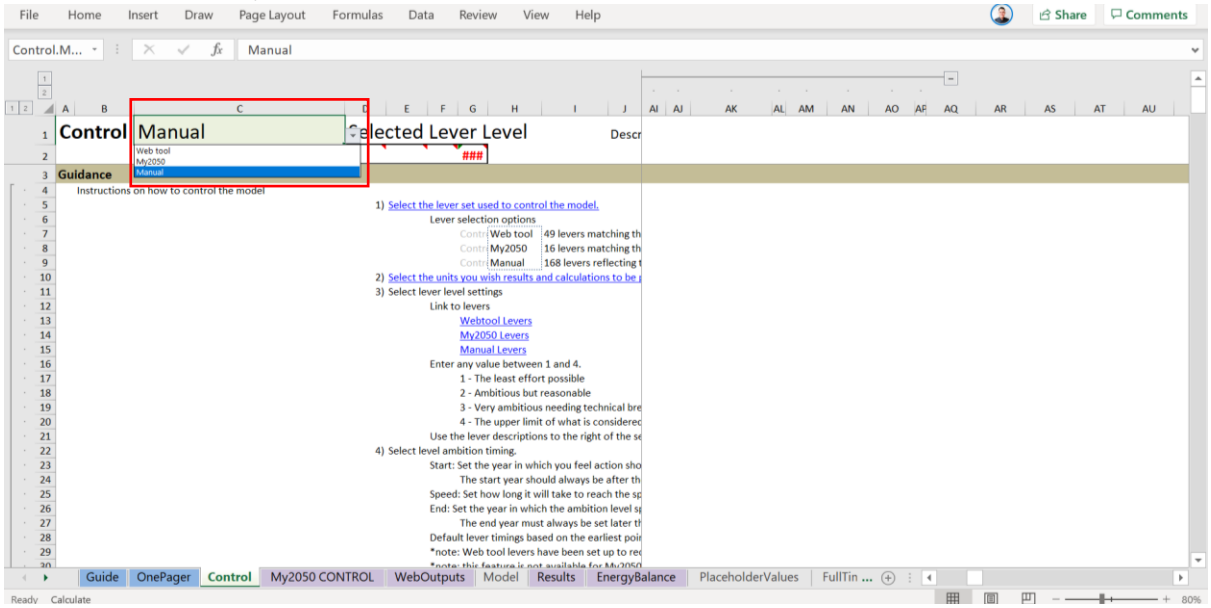


How the Excel Spreadsheet works (Using all the levers)

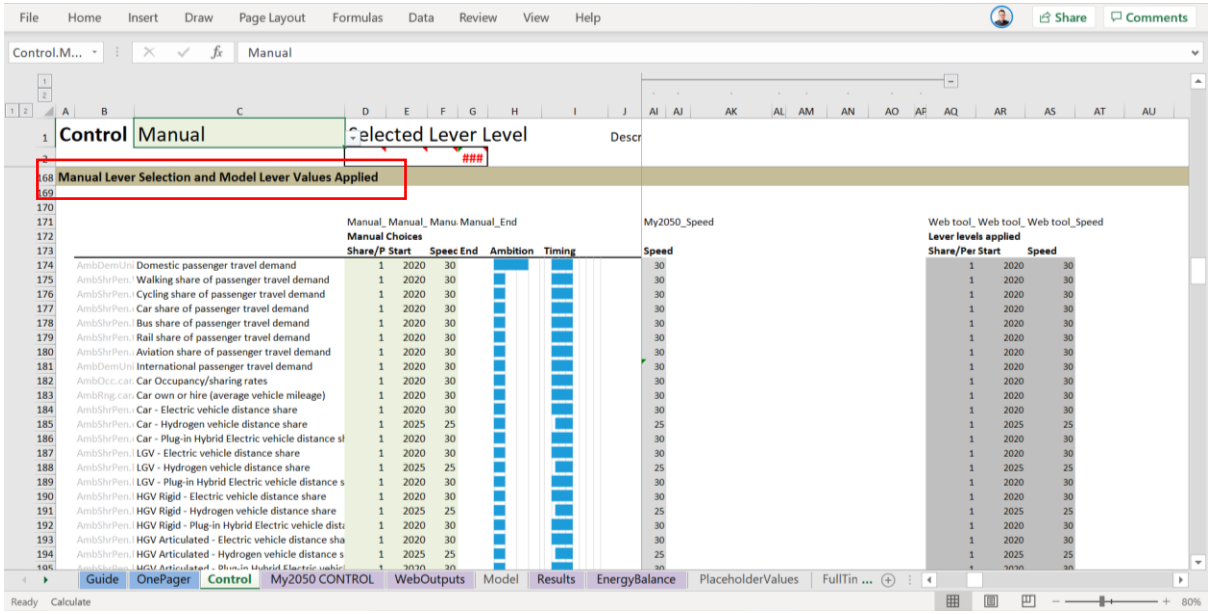
1. Navigate to the *"Control"* worksheet.



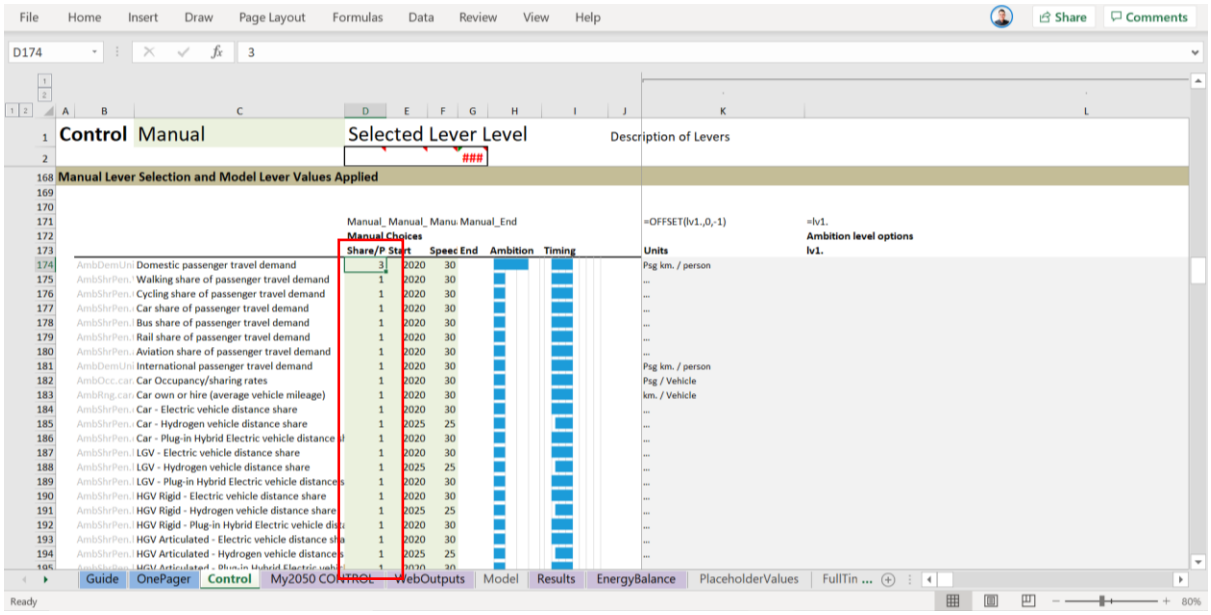
2. In the cell C1, make sure that *"Manual"* is selected.



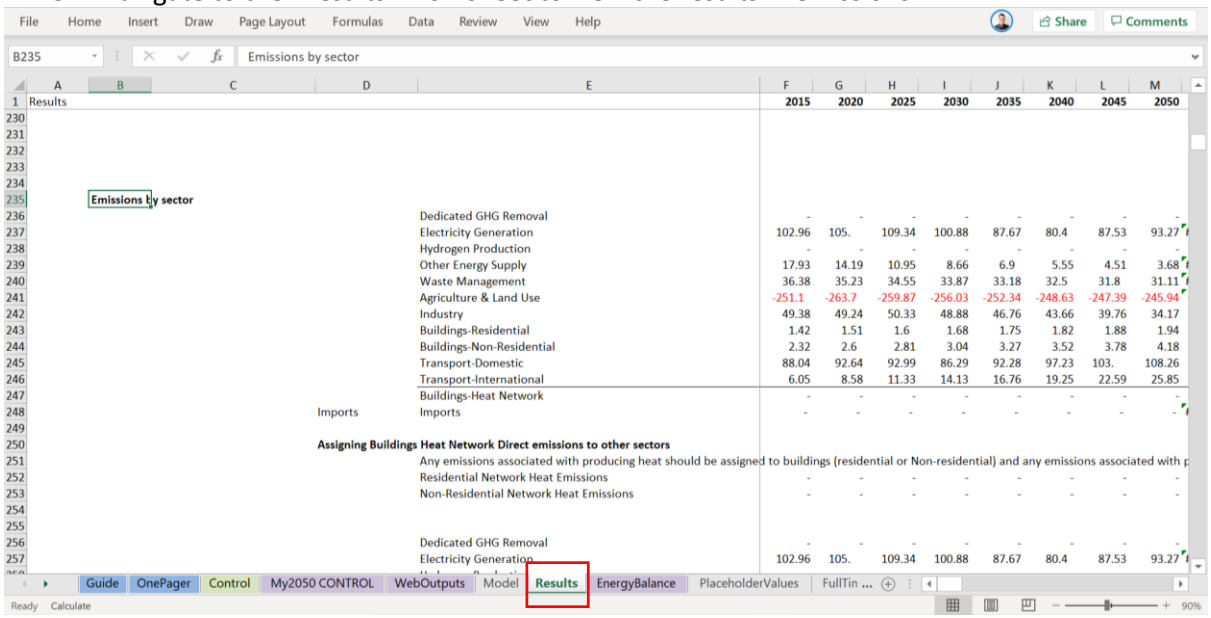
3. Navigate to the *"Manual Lever Selection and Model Lever Values Applied"* section that starts at line 168.



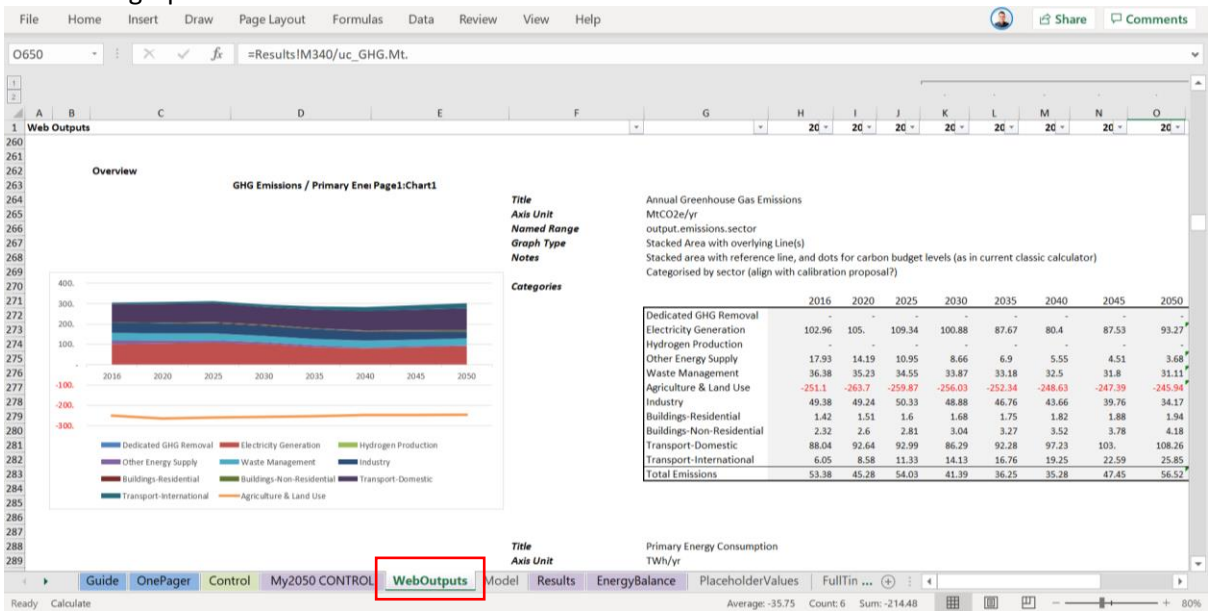
4. Change the value (ranging from 1 to 4) for the "*Share/Penetration"* cells (column D) for each of the levers (Line 174 – 341). You may refer to column K for the units of the lever and column L to O for the parameter used for each of the ambition level. For example, it is shown in the following diagram that the ambition lever for the *"Domestic passenger travel demand"* sub-lever is set at 3.



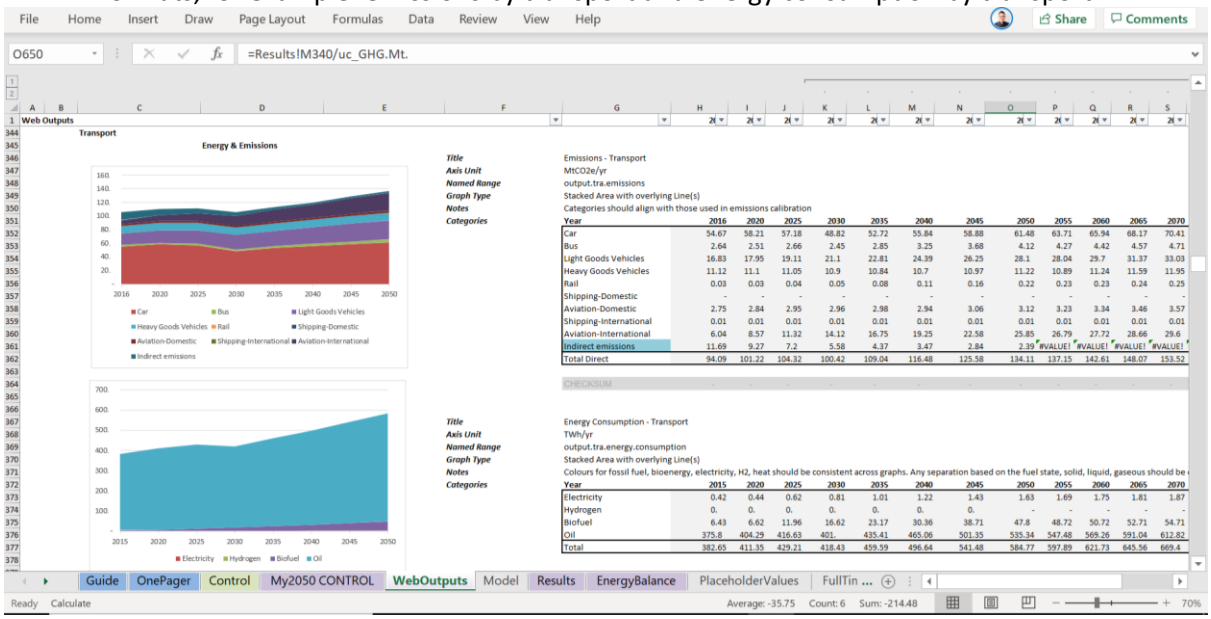
5. Navigate to the *"Results"* worksheet to view the results in emissions.



6. Otherwise, navigate to the *"WebOutputs"* worksheet to view the emissions results presented in graphs.



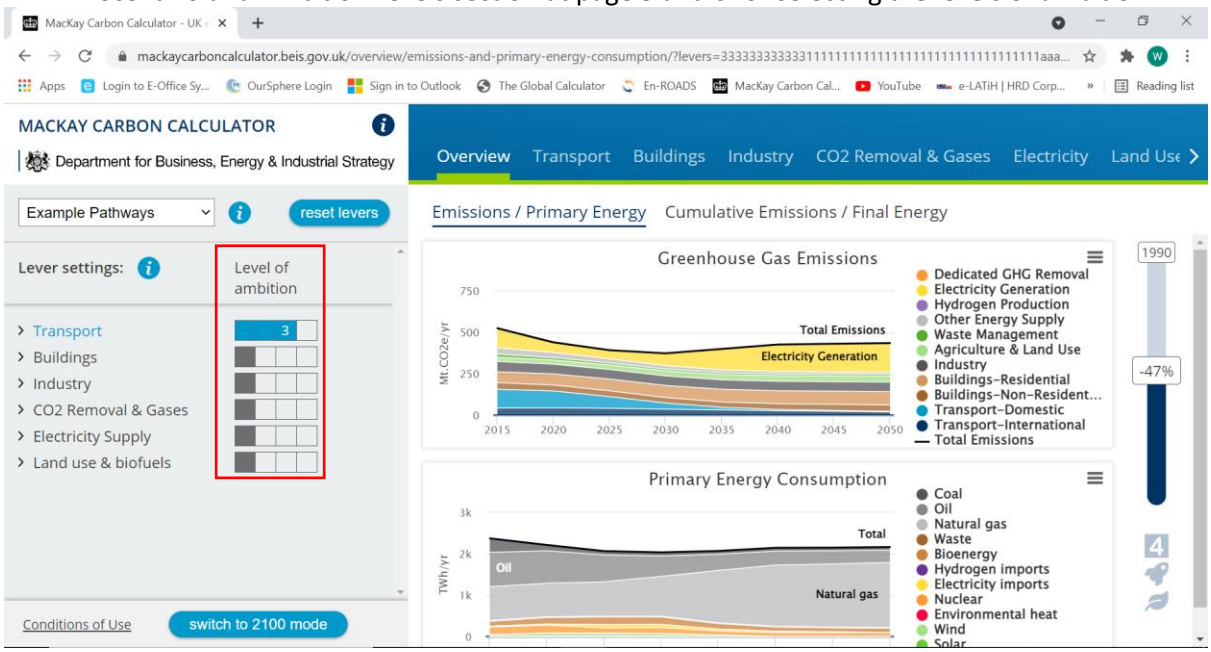
7. You may also explore the rest of the *"WebOutputs"* worksheet to view the results in other formats, for example: emissions by transport and energy consumption by transport.



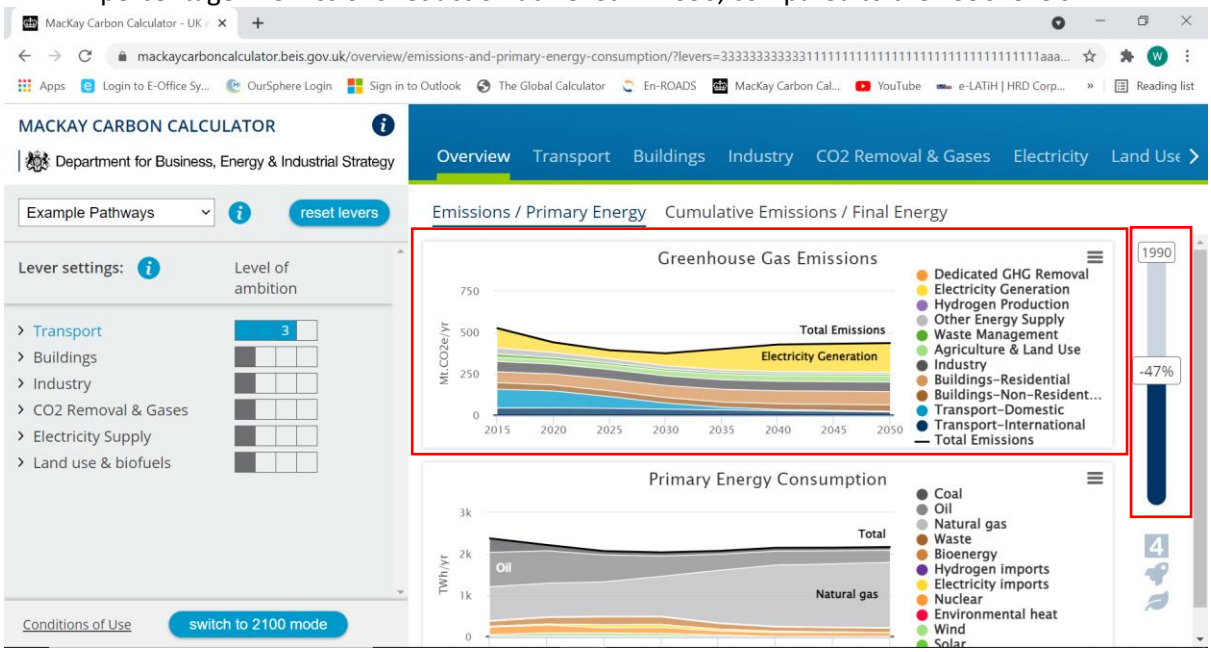
Webtool Model

How the webtool model works (using the main levers)

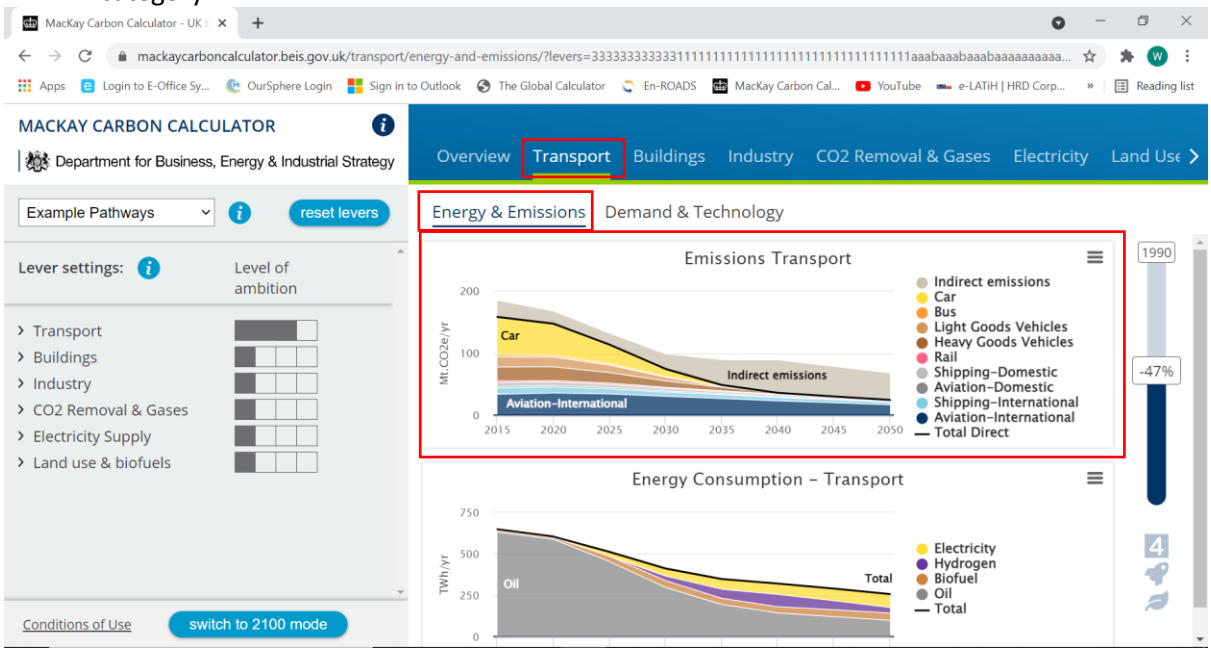
1. Select the *"Level of ambition"* (ranging from 1 to 4) for each of the main levers. See the *Scenario and Ambition Levels section* at page 5 and 6 for selecting the levels of ambition.



2. Emissions by sources will be displayed right away. The scale at the far right shows the percentage in emissions reduction achieved in 2050, compared to the 1990 levels.

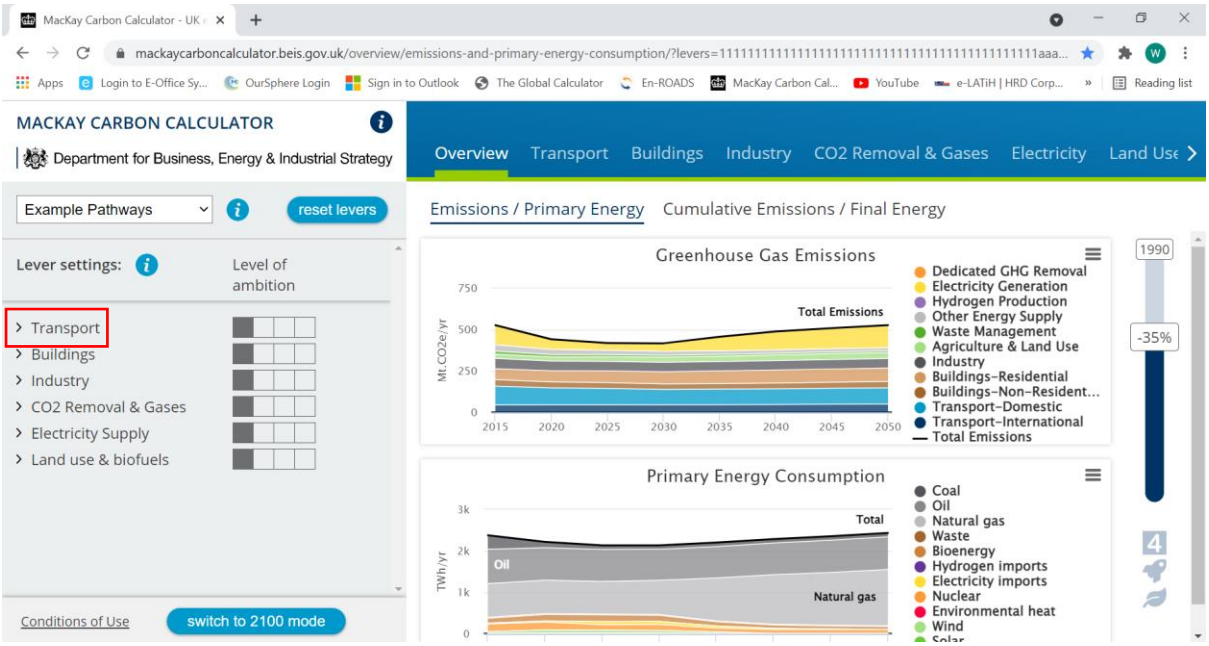


3. You may also explore the *"Transport"* tab to view the results in other formats, for example: emissions by transport and energy consumption by transport under the *"Energy & Emissions"* category.

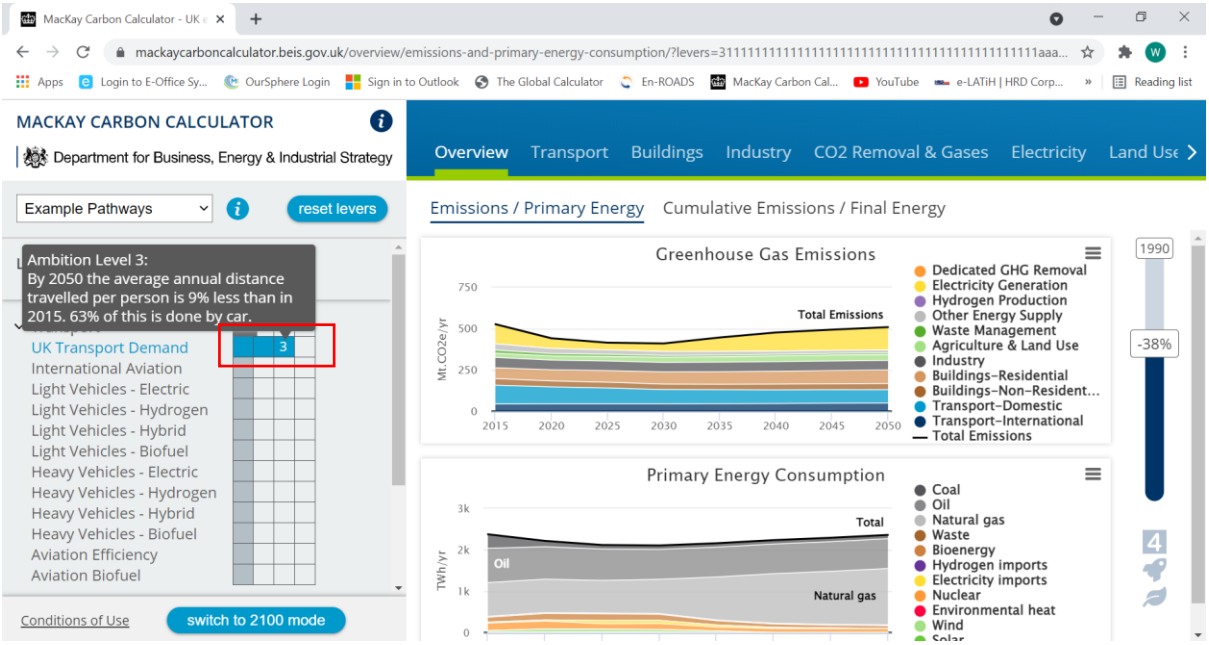


How the webtool model works (using all the levers)

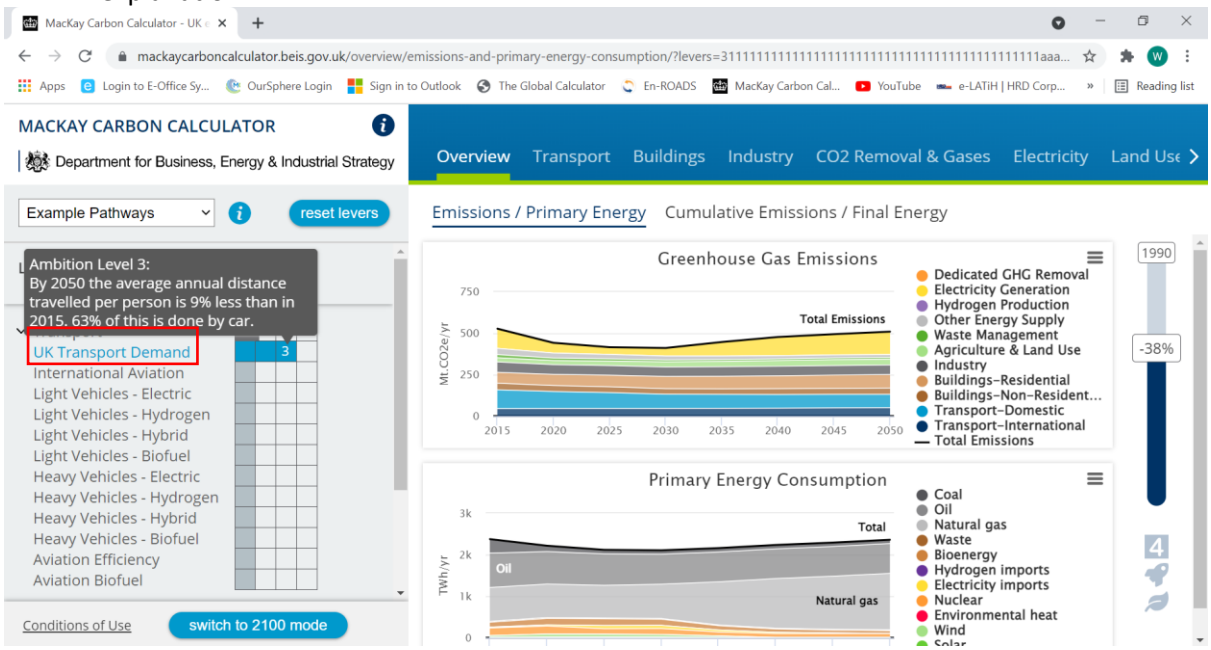
1. Click the main lever to reveal all its levers.

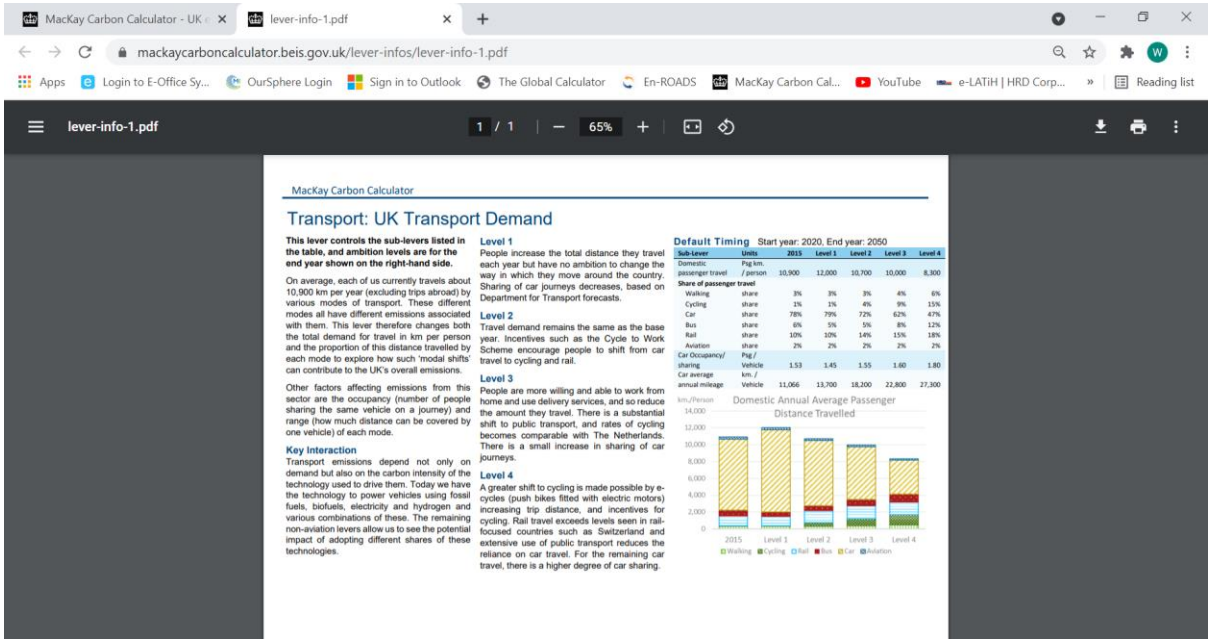


2. For each of the levers, you may hover over the boxes to read on the short description of the specific level of ambition. Select the *"Level of ambition"* (ranging from 1 to 4) for each of the sub-levers.

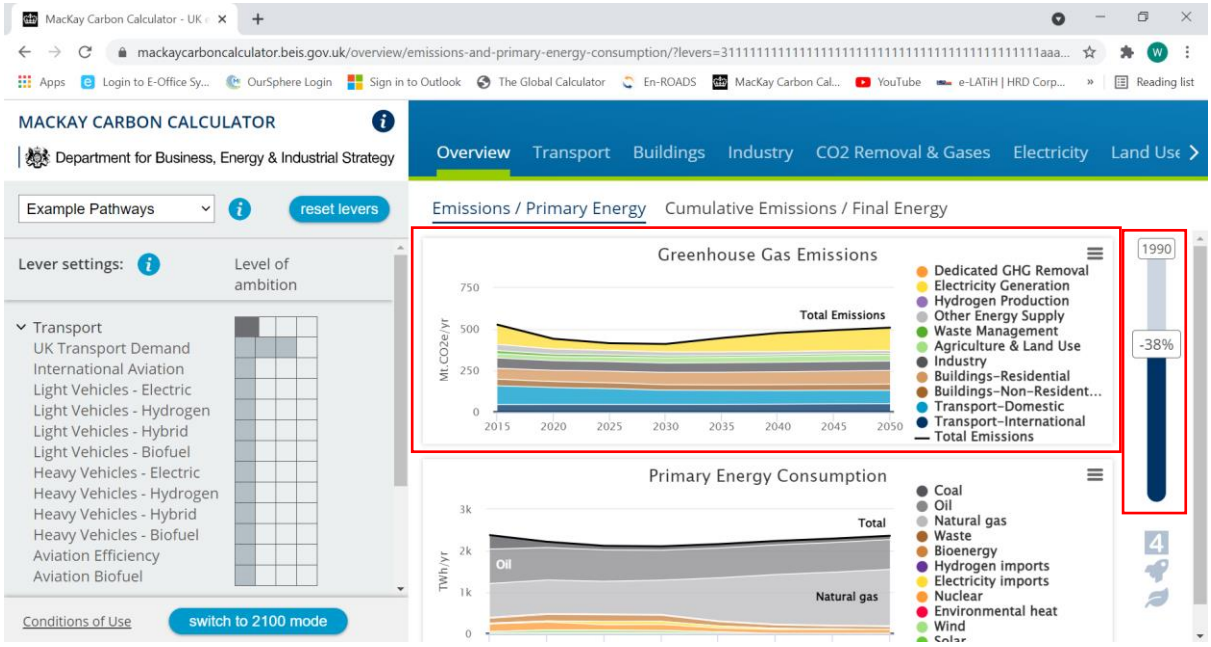


3. Otherwise, you can click the lever to access its one-pager for detailed description and explanation.

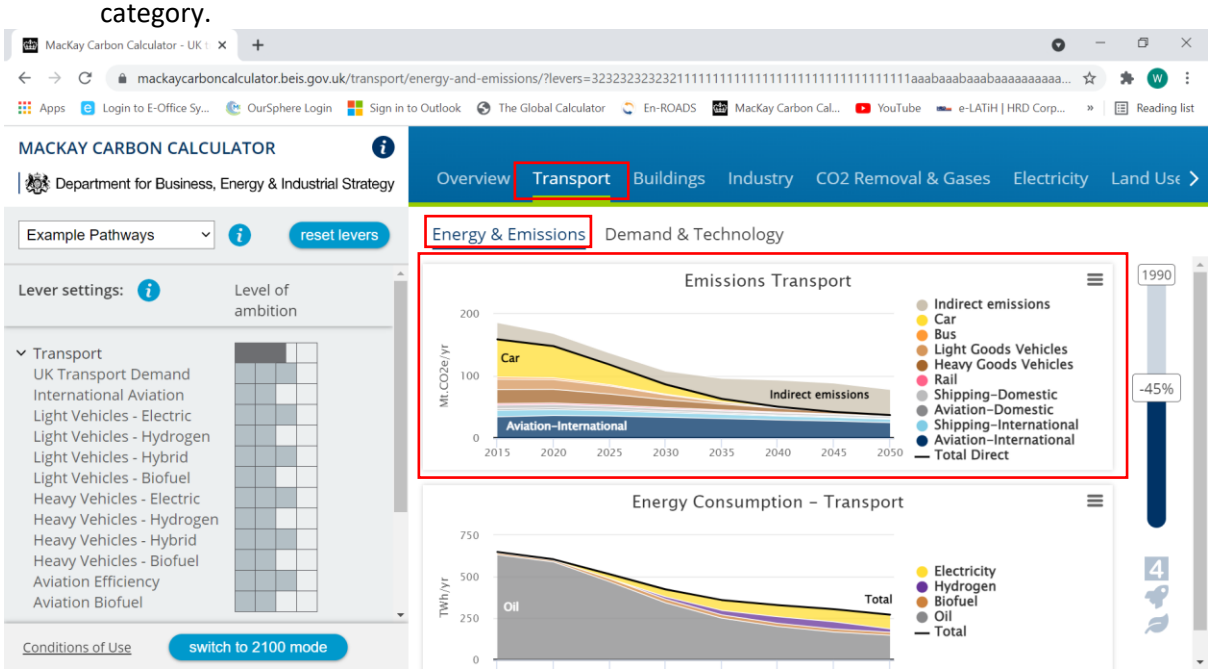




4. Emissions by sources will be displayed right away. The scale at the far right shows the percentage in emissions reduction achieved in 2050, compared to the 1990 levels.



5. You may also explore the *"Transport"* tab to view the results in other formats, for example: emissions by transport and energy consumption by transport under the *"Energy & Emissions"* category.

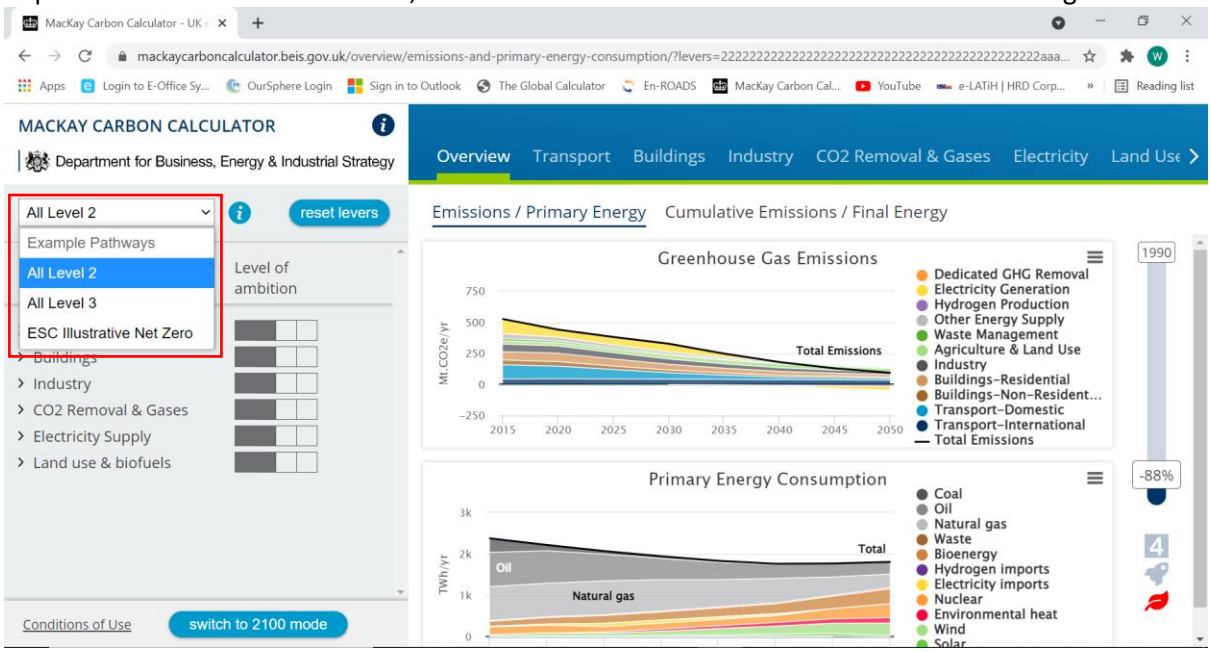


Example Pathways

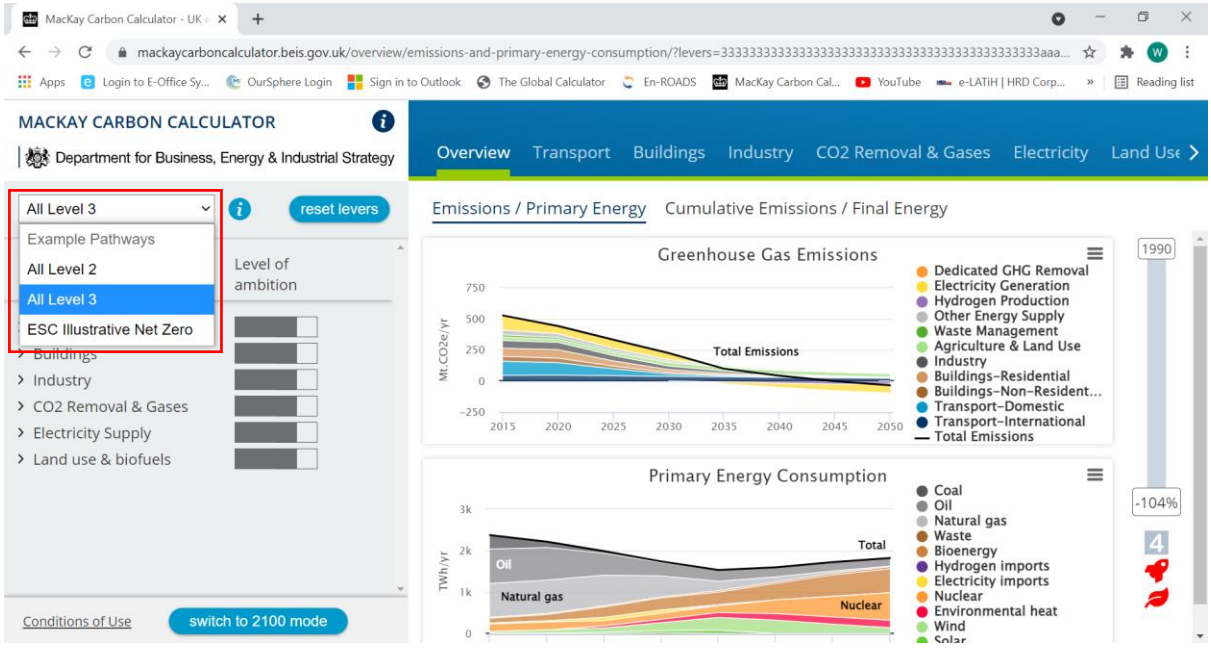
Using the Example Pathways option in the webtool

All the levers are set at level 1 by default. The results displayed are that of a future scenario in 2050 if a business-as-usual approach is taken since 2016.

From the "*Example Pathways*" option, users can choose to set all the levers at level 2 and examine the impacts on the national emissions, if increased ambition is taken to address climate change.



In addition, assuming ambitious actions have been taken since 2016, users can set all the levers at Level 3 using the "*Example Pathways*" option and look at the potential reduction in the national emissions.



Creating your pathway in the spreadsheet

To create your own pathway, users can follow the following instruction:

1. Go to the *"Control"* worksheet and enter your pathway choice into column T, starting from line 70 to 118. You can 'copy' and 'paste' an example pathway (choosing one from columns Q to S) or enter your own. You can use decimals.

2. Press F9 to activate the Calculator

3. For tips on how to make a good pathway, see: the "Create your pathway" section at: http://www.decc.gov.uk/en/content/cms/tackling/2050/calculator_on/calculator_on.aspx

Source: 2050 Calculator Spreadsheet: "How to" Guide

Key Assumptions and Limitations

Transport

Buildings

Industry

Removal

Electricity Supply

Land use

	Assumptions
1.	Any technological breakthrough that will lead to a significant increase in farming yield is not expected, and that any increase in yield is progressive.
2.	Increase in yield can be achieved at a nationwide scale (e.g. industrial players and small stakeholders).
3.	The current crops in Malaysia are expected to remain "dominant" (i.e. not replaced by other crops).
4.	The proportion of protein sources and diet remain the same (e.g. no drastic switch to plant-based protein by 2050).
5.	Palm oil demand is driven by increasing demand for food, chemical products and bioenergy (e.g. biofuel, biomass and biogas).
6.	Any available unused lands that are freed up using the levers will be prioritized for conversion to forest lands (through reforestation or afforestation efforts).

	Limitations
1.	Much of the national data has been aggregated due to how the original 2050 Calculator model is structured. For example: Coconut and cocoa are both categorized as "cropland" in the MCAS model.
2.	Climate change impacts on the agricultural production is not modelled.
3.	Future imports and exports of resources (e.g. livestock, crops and biofuel) have not been modelled due to lack of data.
4.	

Waste

	Limitations

1.	Many of the existing waste-to-energy technologies are unavailable or in the pilot stage in Malaysia, so it is difficult to design levels of ambition based on the information currently available.
2.	
3.	
4.	

Question

If you have any specific question on the Excel or Webtool model, please feel free to contact the MCAS team. The team will respond as soon as possible.

Kindly refer to the contacts listed on the website (x).