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Glossary

CH ₄	Methane
CO	Carbon monoxide
CO ₂	Carbon dioxide
CO ₂ -e	Carbon dioxide and all other gasses
FC	Fuel consumption
EFC	Equivalent fuel consumption
HCVs	Heavy commercial vehicles
NO _x	Nitrogen oxides
NO ₂	Nitrogen dioxide
N ₂ O	Nitrous oxide
PM	Particulate matter
PM _{0.1}	Fine particulate matter less than 0.1 µm in diameter
PM _{1.0}	Fine particulate matter less than 1 µm in diameter
PM _{2.5}	Fine particulate matter less than 2.5 µm in diameter
PM ₁₀	Particulate matter less than 10 µm in diameter
TSP	Total suspended particulates
VEPM	Vehicle Emissions Prediction Model
VFEM	Vehicle Fleet Emissions Model
VKT	Vehicle kilometres travelled
%VKT	Percentage of vehicle kilometres travelled
VOC	Volatile organic compounds

1 Overview

The Vehicle Emissions Prediction Model (VEPM) has been developed by Waka Kotahi NZ Transport Agency (Waka Kotahi) and Auckland Council to predict emissions from vehicles in the New Zealand fleet under typical road and operating conditions. The model provides estimates that are suitable for air quality assessments and regional emissions inventories. Since its release in 2008, the VEPM has been successfully used in Auckland and around New Zealand to estimate vehicle emissions in air quality assessments for road projects. An important feature of the model is the ability to estimate changes to vehicle emissions in future years (from 2001 to 2050)¹.

The emission factor database that VEPM utilises to derive New Zealand-relevant factors is periodically updated with improved factors to reflect new technologies, emerging issues, and real-world effects. The previous version of VEPM (VEPM 6.3)¹ was released in March 2022. The upgraded VEPM 7.0 has been developed from an excel spreadsheet (VEPM 6.3) to a website interface, the benefits of this are:

- Improved run times, particularly when running multiple scenarios
- Reduced likelihood of unintended errors arising by knowingly or unknowingly changing Excel cells
- Increased confidence in the model outputs due to improved visibility of the calculation logic for the model developers
- Simpler annual updates
- Provisions of a database of model outputs, available as an input to other emissions calculation tools such as the Project Emissions Estimation Tool (PEET)².

There have been no technical changes between VEPM 6.3 and VEPM 7.0.

Following this introduction, this report is structured as follows:

- An overview of how to use VEPM 7.0 is given in section 2
- Section 3 provides an overview of the (Year and Speed) tab
- Section 4 provides an overview of the (Fleet Profile) tab
- Section 5 provides an overview of the right-hand side outputs of VEPM 7.0
- Section 6 includes how to use the bulk run feature of VEPM 7.0 including the bulk input process, populating the bulk input template, running of the bulk run and gives an overview of the bulk outputs.

¹ [Vehicle Emissions Prediction Model: VEPM 6.3 update technical report. Report prepared for Waka Kotahi NZ Transport Agency by Emission Impossible Ltd, April 2022.](#)

² [Project Emissions Estimation Tool \(PEET\) | Waka Kotahi NZ Transport Agency \(nzta.govt.nz\)](#)

2 Using VEPM

This section provides an overview of the instructions required for running VEPM 7.0 and details the various options available to users. Figure 2.1 shows a screenshot of VEPM 7.0 upon opening.

VEPM 7.0 can be used to calculate fleet weighted emissions factors for a single scenario or used for multiple calculations using the bulk run feature of VEPM.

Single calculation	Single calculations allow users to interact with the model in a simple and rapid way by adding in a single fleet scenario and receiving immediate results that are also able to be downloaded.
Bulk run	The bulk run feature of the model provides the functionality for users to perform multiple (between 1 to 1000) emission calculations at the same time. The bulk run feature allows users to repeat a run multiple times with incremental changes in one (or more) input parameters and is a beneficial tool for modellers and complex users.

There are five key steps to using VEPM 7.0 to calculate fleet weighted emission factors:

Step 1 – Opening VEPM 7.0	Open VEPM 7.0 Vehicle Emissions Prediction Model V7.0 (vepm.co.nz) . VEPM 7.0 works in all browser types. VEPM 7.0 will open as shown in Figure 2.1. When the VEPM 7.0 is opened default values are prepopulated and can be used for calculation.
Step 2 – Input data	To calculate the fleet weighted emissions for a single scenario, the user can make changes in the left-hand side (inputs) of the VEPM in the (Year & Speed) and (Fleet Profile) tabs. The tab that is highlighted grey indicates the tab that the user is currently editing (Figure 2.1). Together the (Year & Speed) and (Fleet Profile) inputs determine the fleet weighted emissions factors (outputs).
Step 3 – Input data - bulk run	The Bulk Run tab is used to upload and run multiple fleet weighted emission factors as described in Section Error! Reference source not found..
Step 4 – Calculating fleet weighted emissions factors	Clicking (Calculate) on the right-hand summary pane will produce a summary of fleet weighted emissions factors (outputs) on the right-hand side of the VEPM.
Step 5 – View output data	Output fleet weighted emissions factors can be viewed as a summary on VEPM 7.0, copied to clipboard or exported to an excel file.

Details of how to calculate unique fleet weight emissions factors is described in the following sections of this report.

Figure 2.1: Screen shot VEPM 7.0 upon opening

The screenshot shows the VEPM 7.0 interface with three tabs: 'Year & Speed', 'Fleet Profile', and 'Bulk Run'. The 'Fleet Profile' tab is highlighted in grey, indicating it is the active tab. The interface is divided into three main sections: left-hand side inputs, a central input area, and right-hand side outputs.

Left-hand side inputs: A box labeled 'Left-hand side inputs.' points to the 'Year & Speed' tab.

User can enter these three tabs: A box labeled 'User can enter these three tabs.' points to the 'Year & Speed', 'Fleet Profile', and 'Bulk Run' tabs.

When the tab is highlighted grey, this indicates the tab that the user is working in: A box labeled 'When the tab is highlighted grey, this indicates the tab that the user is working in.' points to the 'Fleet Profile' tab.

Right-hand side outputs: A box labeled 'Right-hand side outputs.' points to the 'Summary' section.

Default values are prepopulated upon opening of the tool: A box labeled 'Default values are prepopulated upon opening of the tool.' points to the input fields in the 'Fleet Profile' section.

Summary: A box labeled 'Summary' points to the 'Summary' section, which displays 'Results - fleet weighted emissions factors'.

Parameter	Value	Unit
CO	1.107	g/km
CO ₂ -e	232.000	g/km
VOC	0.071	g/km
NO _x	0.601	g/km
NO ₂	0.112	g/km
PM _{2.5}	0.021	Exhaust g/km
PM ₁₀	0.025	Brake&Tyre g/km
PM _{2.5}	0.013	Brake&Tyre g/km
FC	9.293	l/100km
CO ₂	229.094	g/km
N ₂ O	0.008	g/km
CH ₄	0.021	g/km

Export result to excel file: A box labeled 'Export result to excel file' points to the toggle switch.

Include detail breakdown: A box labeled 'Include detail breakdown' points to the toggle switch.

Calculate: A box labeled 'Calculate' points to the 'Calculate' button.

Output fleet weighted emission factors can be exported to a downloadable excel file with the choice to include a detail breakdown of emission factors: A box labeled 'Output fleet weighted emission factors can be exported to a downloadable excel file with the choice to include a detail breakdown of emission factors.' points to the 'Calculate' button.

Only once you press 'calculate' will fleet weighted emission factors be calculated: A box labeled 'Only once you press 'calculate' will fleet weighted emission factors be calculated.' points to the 'Calculate' button.

An overview of fleet weighted emission factors appears here once clicking 'calculate': A box labeled 'An overview of fleet weighted emission factors appears here once clicking 'calculate'.' points to the 'Summary' section.

At the bottom of the interface, there are links for [User guide](#), [Contact us](#), [Precalculated dataset](#), [Version history](#), [Disclaimer](#), [Privacy policy](#), and [Terms of use](#).

3 Input data - Year & Speed

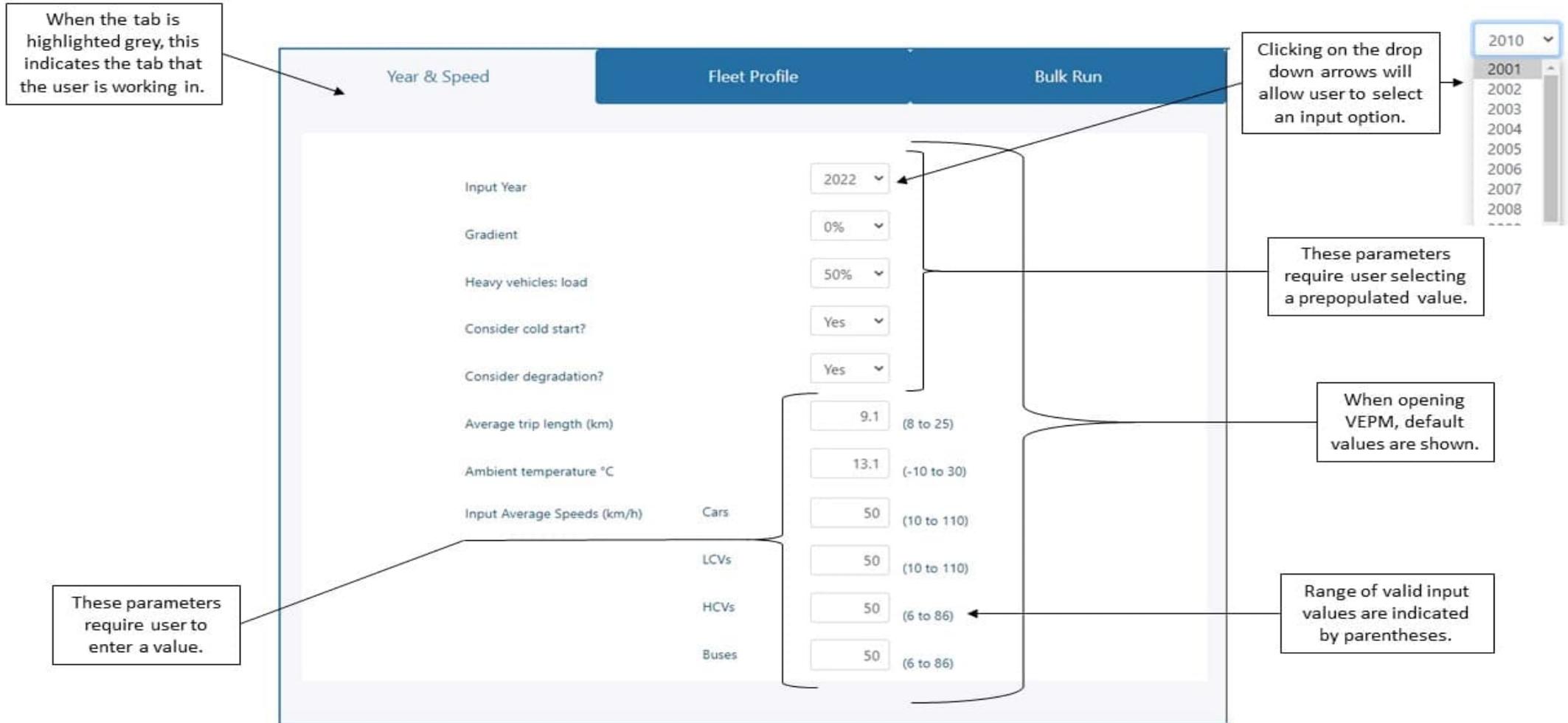
To calculate emissions for a single scenario, data is entered in the “Year & Speed” tab of VEPM 7.0 (Figure 3.1). When VEPM 7.0 is opened, default values are shown (which can be used for calculation).

To calculate fleet weighted emission for a single scenario, the user can follow the steps below to make changes in the left-hand side (inputs) of the “Year & Speed” tab.

- 1 VEPM 7.0 is prepopulated with default values upon opening.
- 2 Use the drop-down arrows to change the parameters (input year, gradient, heavy vehicle load, consider cold start? and consider degradation?). The input parameters are described in Section 3.1.
- 3 The following parameters (average trip length, ambient temperature and input average speeds), require the user to enter a value between the range of valid values, shown in parentheses next to the input box. The input parameters are described in Section 3.1. If a value is entered that is outside the valid input range an error message will show in the top right of the page and the model will automatically overwrite the input with the closest value within the valid range.

Figure 3.1 shows an annotated screenshot of the “Year & Speed” tab on VEPM 7.0.

Figure 3.1: Overview of the left-hand side (inputs) of the “Year & Speed” tab on VEPM 7.0.



3.1 Year & Speed input parameters

Details of the required input parameters of VEPM are the same as in previous versions of VEPM³ and are described as follows:

Year	The analysis year must be between 2001 and 2050. VEPM selects a pre-defined default fleet profile for the New Zealand fleet using the year selected.
Gradient	Road gradients between -6% and +6% can be selected in 2% increments.
Load	Loading factors for heavy commercial vehicles (HCVs) of 0%, 50% and 100% can be selected. The default loading factor is 50%.
Consider cold start?	When a vehicle is started from cold, emissions are substantially higher until the engine and catalyst warm up. Cold start emissions are estimated in the model for each vehicle class except HCVs. Cold start emissions are affected by the user-defined ambient temperature and the average trip length. Cold start emission factors are not available for HCVs. It is likely that commercial vehicles spend the majority of their life in use, hence cold start is not a significant factor in their operation.
Consider degradation?	The model allows the user to consider degradation effects of the vehicle fleet. Considering degradation will increase the fleet weight emissions factors as the model assumes that vehicles with higher mileage are more likely to degrade compared to vehicles with lower mileage. If the user chooses to ignore degradation effects, the results will reflect vehicles with 50,000km of accumulated mileage for cars and light duty vehicles, and no accumulated mileage (ie new) for heavy duty vehicles.
Average trip length (km)	The model allows the user to define average trip lengths. Trip length is used to calculate cold start emissions. For example, a shorter average trip length will result in higher average emissions because the proportion of the trip in cold start conditions is higher. The default value in VEPM is 9.1km.
Ambient temperature (°C)	The ambient temperature must be between -10 and 30°C. The ambient temperature affects cold start emissions, with higher emissions at lower temperatures. The default is set at 13.1°C to reflect an average winter temperature in Auckland. For specific times or day or year, or other locations, this variable should be adjusted.
Input average speeds (km/h)	Users are required to input average speeds which must be between 10 and 110 km/h for cars and light commercial vehicles (LCVs). Heavy commercial vehicles (HCVs) and buses speed range is based on load and gradient inputs. When the user changes the load and gradient, the minimum and maximum speed will be changed for HCVs and buses. Table 3.1 shows the speed range for HCVs and buses for various load and gradient inputs.

³ [Waka Kotahi NZ Transport Agency, 2020. Vehicle emissions prediction model \(VEPM 6.1\) user guide v4.0.](#)

Table 3.1: HCV and buses speed range for various load and gradient inputs

Load	Gradient	Speed Range (km/h)
0%	-6%	6 to 72
0%	-4%	6 to 75
0%	-2%	6 to 75
0%	0%	6 to 86
0%	2%	6 to 86
0%	4%	6 to 71
0%	6%	6 to 70
50%	-6%	6 to 72
50%	-4%	6 to 75
50%	-2%	6 to 75
50%	0%	6 to 86
50%	2%	6 to 84
50%	4%	6 to 65
50%	6%	6 to 50
100%	-6%	6 to 72
100%	-4%	6 to 75
100%	-2%	6 to 75
100%	0%	6 to 86
100%	2%	6 to 78
100%	4%	6 to 54
100%	6%	6 to 38

4 Input data - Fleet Profile

To calculate emissions for a single scenario, data is required to be inputted in the “Year & Speed” tab of VEPM additionally, optional inputs can be entered in the “Fleet Profile” tab for single scenario emissions calculations. Together, the “Year & Speed” and “Fleet Profile” inputs determine the fleet weighted emissions factors (outputs).

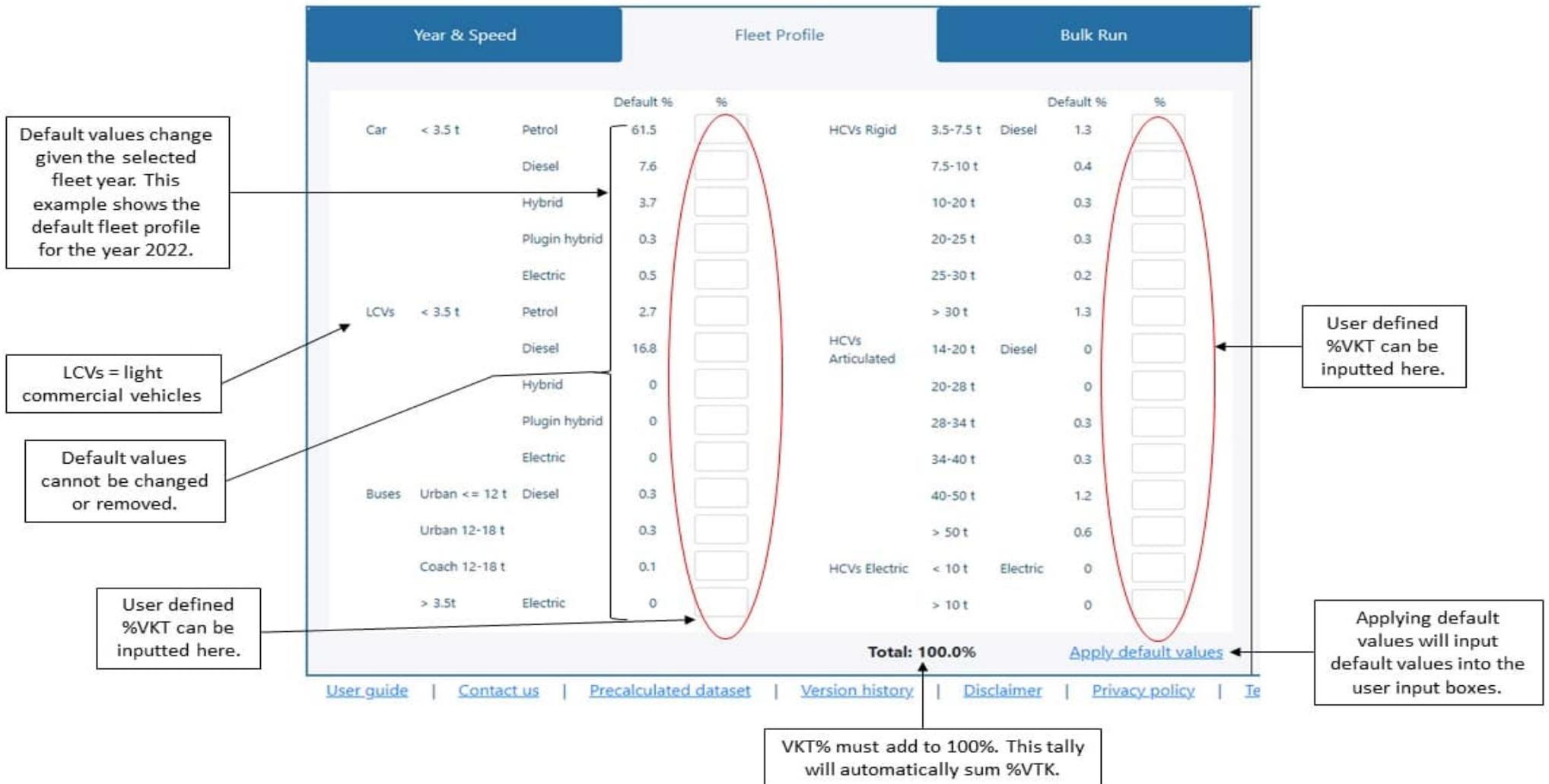
The “Fleet Profile” requires the percentage of vehicle kilometres travelled (%VKT) by each vehicle class to give an overview of the type, number, age and condition of vehicles on the road during the selected fleet year. Percentage of vehicle kilometres travelled (%VKT) by each vehicle class can be based on either user defined or default values. Wherever possible, site-specific data, or data from nearby locations should be used to estimate the proportion of diesel vehicles, particularly HCVs.

The default fleet profile is based on results from the Ministry of Transport vehicle fleet emissions model (VFEM). The VFEM output includes actual fleet data up to 2019, with projections out to 2050. For the selected year, the model will use the Ministry of Transport fleet profile for that particular year as the default values.⁴

Figure 4.1 shows an annotated screenshot of the “Fleet Profile” tab on VEPM 7.0.

⁴ [Waka Kotahi NZ Transport Agency, 2020. Vehicle emissions prediction model \(VEPM 6.1\) user guide v4.0.](#)

Figure 4.1: Overview of the left-hand side (inputs) of the "Fleet Profile" tab on VEPM 7.0.



To calculate fleet weighted emission for a single scenario, the user can follow the steps below to make changes in the left-hand side (inputs) of the "Fleet Profile" tab.

- 1 Percentage of vehicle kilometres travelled (VKT) by each vehicle class can be based on either user defined or default values. When VEPM is opened default %VKT is prepopulated and based off the selected fleet year (in the "Year & Speed" tab).
- 2 The user can enter site-specific %VKT into the white boxes next to the default values. User defined %VKT should be used wherever possible to give accurate site-specific outputs.
- 3 When user defined values are inputted, the %VKT must add to 100%. If the %VKT does not add to 100% the model will not calculate, and an error message will pop up. The tally at the bottom right of the online VEPM automatically sums %VKT for ease for the user.
- 4 Where a user defined value is not specified (but the %VKT adds to 100%) the VEPM will assume the value to be 0%.
- 5 When no values are entered into the user defined %VKT the model will use default values. Additionally, after entering in user defined %VKT the user can click "Apply default values" to apply the default values for that fleet year.

5 Right-hand side: Outputs

This section gives instructions for the right-hand side outputs of the model. Figure 5.1 shows an annotated screenshot of the right-hand side outputs of VEPM 7.0.

Figure 5.1: Overview of the right-hand side output of the VEPM 7.0.

Summary [Copy to clipboard](#)

Calculation Completed

Results - fleet weighted emissions factors

CO	1.107	g/km
CO ₂ -e	232.000	g/km
VOC	0.071	g/km
NO _x	0.601	g/km
NO ₂	0.112	g/km
PM _{2.5}	0.021	Exhaust g/km
PM ₁₀	0.025	Brake&Tyre g/km
PM _{2.5}	0.013	Brake&Tyre g/km
FC	9.293	l/100km
CO ₂	229.094	g/km
N ₂ O	0.008	g/km
CH ₄	0.021	g/km

Export result to excel file

Include detail breakdown

Calculate

Export result to excel file

Include detail breakdown

A message will pop up after clicking 'calculate' when calculation is completed.

Copying to clipboard will copy the summary results to the users clipboard for pasting into text.

Exporting results to an excel file will download an excel file of the emission results. To export results to excel file click on the toggle button. The toggle will turn blue when selected for.

Users can select whether or not the exported results excel file should include a detailed breakdown of vehicle fleet type. This can only be selected for when 'export results to excel file' is turned on. The toggle will turn blue when selected for.

A summary of the results is given after clicking 'calculate'. Results are bolded once calculation is complete.

Once the input data is entered the following instructions can be used to navigate the right-hand side (outputs) of VEPM 7.0.

- 1 Once the scenario values are inputted, the user must click "Calculate" for calculation of fleet weighted vehicle emissions
- 2 Copying to clipboard will automatically copy the results summary including: CO, CO₂-e, VOC, NO_x, NO₂, PM_{2.5}, PM₁₀, PM_{2.5}, FC, CO₂, N₂O and CH₄
- 3 (Exporting results to an excel file) will download an export file (see Figure 5.2). This file is taken from the previous spreadsheet version of the model (VEPM 6.3) and will present the input parameters the user has selected, an overview of the results and fleet emission factors sheet, which includes a detailed breakdown of emission factors for the selected fleet year. To export results to an excel file click the toggle next to "Export result to an excel file" the toggle

will turn blue when this feature is selected for. The user must click "Calculate" for calculation of emissions to occur and for the excel file to download

- 4 Users can select whether the exported results excel file includes a detailed breakdown of vehicle fleet type (Figure 5.3). Including a detailed breakdown allows the user to view the following vehicle fleet parameters:

Year, Fleet, EfMethod, Category, Fuel Type, Segment, Standard, StandardOrigin, Technology, Mode, Pollutant, Speed, SlopePercent, LoadPercent, ColdStart, Degradation, Temperature, AveTripLength, RatioFleet, AgeYears, VktCummulative, FuelId, FuelCorrFactor, FuelRealWorldCorrFactor, DegradationCorrFactor, GradientCorrFactor, ColdStartPenalty, EfHot and EfTotal.

The detailed breakdown can only be selected when "Export results to excel file" is turned on. To include a detailed breakdown, click the toggle next to "Export result to an excel file" the toggle will turn blue when this feature is selected for. Again, the user must click "Calculate" for calculation of emissions to occur and for the downloaded excel file to include a detailed breakdown.

Figure 5.2 shows a screenshot of the exported results to an excel file excluding detailed breakdown while Figure 5.3 shows a screenshot of the exported results as an excel file including a detailed breakdown.

Figure 5.2: Exporting results to an excel file - excluding detailed breakdown

Vehicle Emissions Prediction Model 6.3

See VEPM user guide for instructions
User input required in white cells (year and speed)
User input optional in grey cells

Input Year: **2025**

Optional input: fleet profile

	Weight category	Fuel type	% of VKT	
			Default values	Optional user entry
Cars	<3.5t	Petrol	57.833%	
		Diesel	7.366%	
		Hybrid	6.749%	
		Plugin hybrid	0.570%	
		Electric	1.020%	
LCVs	<3.5t	Petrol	2.677%	
		Diesel	17.000%	
		Hybrid	0.054%	
		Plugin hybrid	0.012%	
		Electric	0.070%	
HCVs Rigid	3.5-7.5t		1.238%	
	7.5-10t		0.539%	
	10-20t	Diesel	0.302%	

Input: average speeds km/h

	User entry	Valid range
Cars	80	10 to 110
LCVs	80	10 to 110
HCVs	50	
Buses	50	

Optional Inputs

	Default values	Optional user entry	Options
Average trip length (km)	9.1	20.0	8 to 25
Ambient temperature °C	13.1	18.0	-10 to 30
Consider cold start?	yes	yes	yes/no
Consider degradation?	yes	yes	yes/no
Gradient	0%	4%	±2, 4, 6%
Heavy vehicles: load	0%	0%	0, 50, 100%

Results - fleet weighted emissions factors

CO	CO ₂ -e	VOC	NO _x	NO ₂	PM _{2.5} exhaust	PM _{2.5} Brake&Tyre	PM _{2.5} Brake&Tyre	FC	CO ₂	N ₂ O	CH ₄
g/km	g/km	g/km	g/km	g/km	g/km	g/km	g/km	l/100km	g/km	g/km	g/km
1.817	238.8	0.028	1.027	0.245	0.0294	0.0151	0.0086	9.5	237.3	0.004	0.010

Carbon dioxide equivalent
CO₂-e = CO₂ + (298 x N₂O) + (25 x CH₄)

The excel results sheet shows what input parameters were selected for calculation.

The excel results sheet gives an overview of the emission results.

Emission factors

Fleet: 2025	VKT %	CO g/km	CO ₂ -e g/km	VOC g/km	NO _x g/km	NO ₂ g/km	PM _{2.5} Exhaust g/km	PM _{2.5} Brake & Tyre g/km	PM _{2.5} Brake & Tyre g/km	FC l/100km	CO ₂ g/km	N ₂ O g/km	CH ₄ g/km
Fleet average emissions factors	100.00	1.8168	238.8	0.0284	1.0271	0.2445	0.0294	0.0151	0.0086	9.4875	237.3	0.0044	0.0095
Light vehicle fleet average emission factors	81.551	1.7863	169.6010	0.0221	0.7589	0.2213	0.0182	0.0123	0.0070	6.9882	168.7290	0.0024	0.0085
Petrol Cars	57.833	2.5666	166.6	0.0267	0.1777	0.0062	0.0042	0.0108	0.0062	7.0838	165.9	0.0015	0.0123
Diesel Cars	7.366	0.0602	195.8	0.0087	1.2588	0.4884	0.0712	0.0108	0.0062	7.3305	194.3	0.0051	0.0003
Petrol LCVs	2.677	5.4855	169.0	0.0632	0.5562	0.0214	0.0090	0.0169	0.0098	7.1341	167.1	0.0054	0.0136
Diesel LCVs	16.999	0.1479	212.5	0.0165	2.9223	0.9901	0.0528	0.0169	0.0098	7.9592	210.9	0.0051	0.0002
Hybrid (Cars and LCVs)	6.803	0.0198	98.1	0.0006	0.0180	0.0005	0.0012	0.0138	0.0080	4.1815	97.9	0.0002	0.0050
Plug-in hybrid (Cars and LCVs)	0.582	0.0095	47.1	0.0003	0.0087	0.0003	0.0006	0.0138	0.0080	2.0071	47.0	0.0001	0.0024
Electric	1.090	0.0000	0.0	0.0000	0.0000	0.0000	0.0000	0.0138	0.0080	0.0000	0.0	0.0000	0.0000
Heavy vehicle fleet average emission factors	5.914	2.3029	1225.5	0.1183	4.8865	0.5528	0.1928	0.0598	0.0334	45.8530	1215.3	0.0324	0.0242
Diesel Rigid 3.5-7.5 t	1.236	0.5826	484.0	0.0513	1.8509	0.2111	0.0649	0.0292	0.0156	18.1011	479.7	0.0129	0.0173
Diesel Rigid 7.5-10 t	0.339	1.3544	749.6	0.1138	3.4164	0.3923	0.1277	0.0292	0.0156	28.1221	745.3	0.0120	0.0272
Diesel Rigid 10-20 t	0.302	1.5791	984.5	0.1584	4.2319	0.4810	0.1652	0.0498	0.0251	36.8325	976.2	0.0253	0.0318
Diesel Rigid 20-25 t	0.506	2.3204	1236.5	0.1548	5.6151	0.6460	0.2150	0.0556	0.0292	46.3432	1228.2	0.0248	0.0363
Diesel Rigid 25-30 t	0.130	2.3298	1302.2	0.1202	4.8504	0.5480	0.1966	0.0615	0.0333	48.8117	1293.7	0.0267	0.0241
Diesel Rigid > 30 t	1.227	3.0049	1456.2	0.1044	4.9795	0.5482	0.2067	0.0673	0.0374	54.4447	1443.0	0.0432	0.0187
Diesel Articulated 14-20 t	0.034	1.9455	1006.8	0.2356	6.0778	0.7001	0.2585	0.0615	0.0333	37.6528	997.9	0.0257	0.0498
Diesel Articulated 20-28 t	0.047	2.3928	1299.7	0.1393	6.0317	0.6919	0.2487	0.0673	0.0374	48.7166	1291.2	0.0258	0.0337
Diesel Articulated 28-34 t	0.270	2.3832	1368.2	0.1420	6.3408	0.7242	0.2531	0.0673	0.0374	51.1545	1355.8	0.0387	0.0345
Diesel Articulated 34-40 t	0.236	2.7749	1481.6	0.1718	7.1074	0.8173	0.2802	0.0732	0.0415	55.4057	1468.4	0.0412	0.0382
Diesel Articulated 40-50 t	1.184	2.9822	1560.4	0.1455	6.4193	0.7296	0.2541	0.0790	0.0456	58.3854	1546.9	0.0432	0.0273
Diesel Articulated >>0 t	0.600	3.5936	1854.7	0.1590	7.2114	0.8127	0.2810	0.0849	0.0497	69.4559	1840.8	0.0445	0.0255
Electric HCVs	0.034	0.0000	0.0	0.0000	0.0000	0.0000	0.0000	0.0395	0.0203	0.0000	0.0	0.0000	0.0000
Bus fleet average emission factors	0.735	1.7795	1086.1	0.1045	4.0303	0.4553	0.1476	0.0408	0.0209	40.6436	1077.2	0.0275	0.0269
Diesel Urban Buses Midi <=15 t	0.289	1.4846	893.1	0.0727	2.8498	0.3069	0.1129	0.0292	0.0156	33.3270	883.3	0.0310	0.0253
Diesel Urban Buses Standard 15-18 t	0.331	2.0052	1259.5	0.1314	4.9178	0.5659	0.1716	0.0498	0.0251	47.1812	1250.5	0.0279	0.0305
Diesel Coaches Standard <=18 t	0.083	2.6100	1495.1	0.1491	6.1953	0.7113	0.2308	0.0498	0.0251	56.1055	1487.0	0.0250	0.0286
Electric Buses	0.033	0.0000	0.0	0.0000	0.0000	0.0000	0.0000	0.0292	0.0156	0.0000	0.0	0.0000	0.0000

Carbon dioxide equivalent
CO₂-e = CO₂ + (298 x N₂O) + (25 x CH₄)

This summary emission results is what is shown on the online VEPM.

The excel results sheet includes a breakdown of emission factors for selected fleet year.

Figure 5.3: Exporting results to an excel file - including detailed breakdown

1	YearFleet	EfMethod	Category	FuelType	Segment	Standard	StandardOrigin	Technology	Mode	Pollutant	Speed	SlopePercent	LoadPercent	ColdStart	Degradation	Temperature	AvgTripLength	RatioFleet	AgeYear
2	2025	EUR	BUS	Diesel	Coaches Standard <=18 t	Euro I	Euro I	-	Urban Off Peak	CH4	50	4	0	True	True	18	20	1.8885350607313672E-05	28
3	2025	EUR	BUS	Diesel	Coaches Standard <=18 t	Euro II	Euro II	-	Urban Off Peak	CH4	50	4	0	True	True	18	20	1.4718194136136063E-05	24
4	2025	EUR	BUS	Diesel	Coaches Standard <=18 t	Euro III	Euro III	-	Urban Off Peak	CH4	50	4	0	True	True	18	20	5.686839171864631E-05	20
5	2025	EUR	BUS	Diesel	Coaches Standard <=18 t	Euro IV	Euro IV	SCR	Urban Off Peak	CH4	50	4	0	True	True	18	20	8.212039213899008E-05	15
6	2025	EUR	BUS	Diesel	Coaches Standard <=18 t	Euro V	Euro V	EGR	Urban Off Peak	CH4	50	4	0	True	True	18	20	0.00014480298402908895	6
7	2025	EUR	BUS	Diesel	Coaches Standard <=18 t	Euro V	Euro V	SCR	Urban Off Peak	CH4	50	4	0	True	True	18	20	0.0004344090080939215	6
8	2025	EUR	BUS	Diesel	Urban Buses Midi <=15 t	Euro I	Euro I	-	Urban Off Peak	CH4	50	4	0	True	True	18	20	0.00010319661106333842	28
9	2025	EUR	BUS	Diesel	Urban Buses Midi <=15 t	Euro II	Euro II	-	Urban Off Peak	CH4	50	4	0	True	True	18	20	2.2381043295758815E-05	24
10	2025	EUR	BUS	Diesel	Urban Buses Midi <=15 t	Euro III	Euro III	-	Urban Off Peak	CH4	50	4	0	True	True	18	20	1.2490417433679696E-05	20
11	2025	EUR	BUS	Diesel	Urban Buses Midi <=15 t	Euro IV	Euro IV	SCR	Urban Off Peak	CH4	50	4	0	True	True	18	20	0.00010647828365543845	15
12	2025	EUR	BUS	Diesel	Urban Buses Midi <=15 t	Euro V	Euro V	EGR	Urban Off Peak	CH4	50	4	0	True	True	18	20	0.000537124951378073	6
13	2025	EUR	BUS	Diesel	Urban Buses Midi <=15 t	Euro V	Euro V	SCR	Urban Off Peak	CH4	50	4	0	True	True	18	20	0.0016113748728031041	6
14	2025	EUR	BUS	Diesel	Urban Buses Standard 15 - 18 t	Euro I	Euro I	-	Urban Off Peak	CH4	50	4	0	True	True	18	20	7.554153311144891E-05	28
15	2025	EUR	BUS	Diesel	Urban Buses Midi <=15 t	Euro V	Euro V	EGR	Urban Off Peak	CO	50	4	0	True	True	18	20	0.000537124951378073	6
16	2025	EUR	BUS	Diesel	Urban Buses Midi <=15 t	Euro V	Euro V	SCR	Urban Off Peak	CO	50	4	0	True	True	18	20	0.0016113748728031041	6
17	2025	EUR	BUS	Diesel	Urban Buses Standard 15 - 18 t	Euro I	Euro I	-	Urban Off Peak	CO	50	4	0	True	True	18	20	7.554153311144891E-05	28
18	2025	EUR	BUS	Diesel	Urban Buses Standard 15 - 18 t	Euro II	Euro II	-	Urban Off Peak	CO	50	4	0	True	True	18	20	5.8872757875659366E-05	24
19	2025	EUR	BUS	Diesel	Urban Buses Standard 15 - 18 t	Euro III	Euro III	-	Urban Off Peak	CO	50	4	0	True	True	18	20	0.0002274735855434701	20
20	2025	EUR	BUS	Diesel	Urban Buses Standard 15 - 18 t	Euro IV	Euro IV	SCR	Urban Off Peak	CO	50	4	0	True	True	18	20	0.00032848149388042076	15
21	2025	EUR	BUS	Diesel	Urban Buses Standard 15 - 18 t	Euro V	Euro V	EGR	Urban Off Peak	CO	50	4	0	True	True	18	20	0.0005792120481296651	6
22	2025	EUR	BUS	Diesel	Urban Buses Standard 15 - 18 t	Euro V	Euro V	SCR	Urban Off Peak	CO	50	4	0	True	True	18	20	0.0017376361070512256	6
23	2025	EUR	BUS	Diesel	Coaches Standard <=18 t	Euro I	Euro I	-	Urban Off Peak	EC	50	4	0	True	True	18	20	1.8885350607313672E-05	28
24	2025	EUR	BUS	Diesel	Coaches Standard <=18 t	Euro II	Euro II	-	Urban Off Peak	EC	50	4	0	True	True	18	20	1.4718194136136063E-05	24
25	2025	EUR	BUS	Diesel	Coaches Standard <=18 t	Euro III	Euro III	-	Urban Off Peak	EC	50	4	0	True	True	18	20	5.686839171864631E-05	20
26	2025	EUR	BUS	Diesel	Coaches Standard <=18 t	Euro IV	Euro IV	SCR	Urban Off Peak	EC	50	4	0	True	True	18	20	8.212039213899008E-05	15
27	2025	EUR	BUS	Diesel	Coaches Standard <=18 t	Euro V	Euro V	EGR	Urban Off Peak	EC	50	4	0	True	True	18	20	0.00014480298402908895	6
28	2025	EUR	BUS	Diesel	Coaches Standard <=18 t	Euro III	Euro III	-	Urban Off Peak	N2O	50	4	0	True	True	18	20	5.686839171864631E-05	20
29	2025	EUR	BUS	Diesel	Coaches Standard <=18 t	Euro IV	Euro IV	SCR	Urban Off Peak	N2O	50	4	0	True	True	18	20	8.212039213899008E-05	15
30	2025	EUR	BUS	Diesel	Coaches Standard <=18 t	Euro V	Euro V	EGR	Urban Off Peak	N2O	50	4	0	True	True	18	20	0.00014480298402908895	6
31	2025	EUR	BUS	Diesel	Coaches Standard <=18 t	Euro V	Euro V	SCR	Urban Off Peak	N2O	50	4	0	True	True	18	20	0.0004344090080939215	6
32	2025	EUR	BUS	Diesel	Urban Buses Midi <=15 t	Euro I	Euro I	-	Urban Off Peak	N2O	50	4	0	True	True	18	20	0.00010319661106333842	28
33	2025	EUR	BUS	Diesel	Urban Buses Midi <=15 t	Euro II	Euro II	-	Urban Off Peak	N2O	50	4	0	True	True	18	20	2.2381043295758815E-05	24
34	2025	EUR	BUS	Diesel	Urban Buses Midi <=15 t	Euro III	Euro III	-	Urban Off Peak	N2O	50	4	0	True	True	18	20	1.2490417433679696E-05	20
35	2025	EUR	BUS	Diesel	Urban Buses Midi <=15 t	Euro IV	Euro IV	SCR	Urban Off Peak	N2O	50	4	0	True	True	18	20	0.00010647828365543845	15
36	2025	EUR	BUS	Diesel	Urban Buses Midi <=15 t	Euro V	Euro V	EGR	Urban Off Peak	N2O	50	4	0	True	True	18	20	0.000537124951378073	6
37	2025	EUR	BUS	Diesel	Urban Buses Midi <=15 t	Euro V	Euro V	SCR	Urban Off Peak	N2O	50	4	0	True	True	18	20	0.0016113748728031041	6
38	2025	EUR	BUS	Diesel	Urban Buses Standard 15 - 18 t	Euro I	Euro I	-	Urban Off Peak	N2O	50	4	0	True	True	18	20	7.554153311144891E-05	28
39	2025	EUR	BUS	Diesel	Urban Buses Standard 15 - 18 t	Euro II	Euro II	-	Urban Off Peak	N2O	50	4	0	True	True	18	20	5.8872757875659366E-05	24

VEPM Fleet emission factors

Vehicle Type Breakdown



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6 Input data - Bulk Run

The bulk run feature of VEPM provides the option for users to perform multiple runs between 1 to 1000 runs at the same time. The bulk run allows users to repeat a run multiple times with an incremental change in one (or more) parameters. Additionally, the precalculated emission factors feature provides pre-generated results for 1,979,600 common scenarios. The logic for the precalculated results is described further in the hyperlink on VEPM 7.0 highlighted in Figure 6. below.

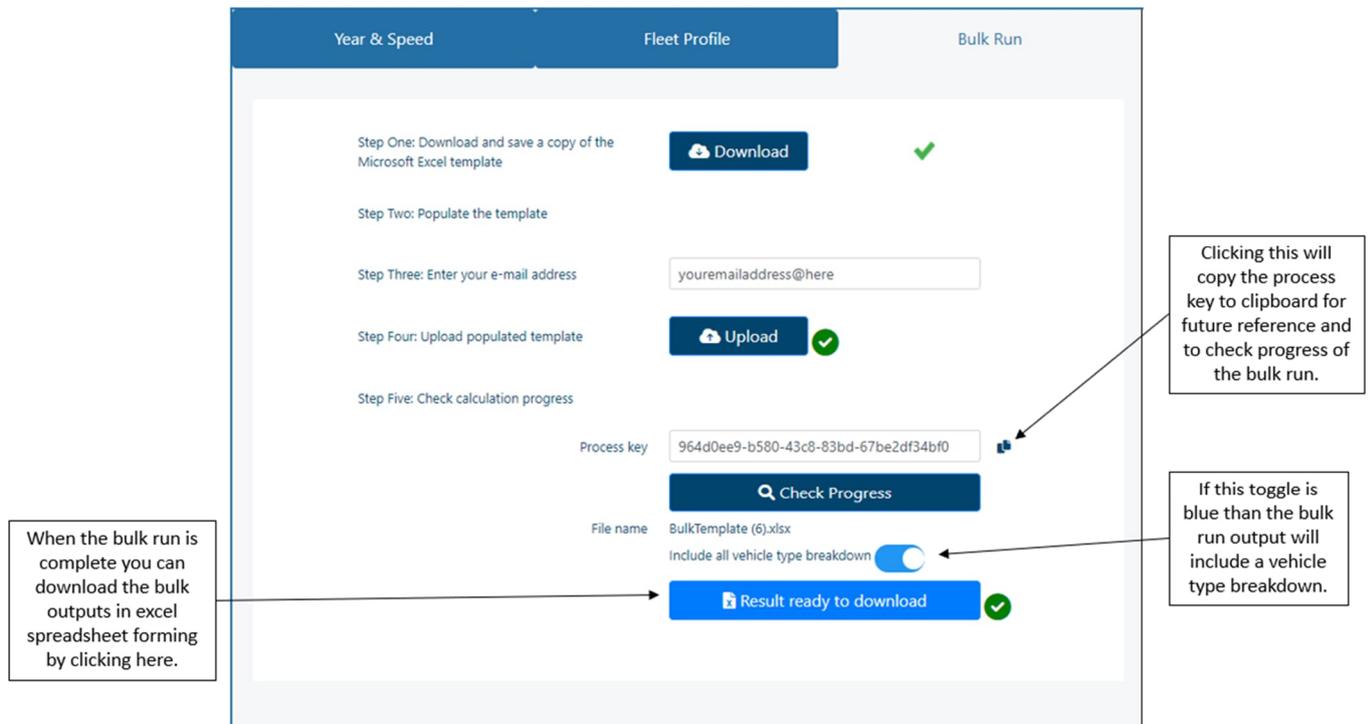
Figure 6. shows a screenshot of the left-hand side "inputs" of the bulk run tab when opening. Error! Reference source not found. shows an example of a populated bulk run input.

Figure 6.1: Overview of the left-hand side (inputs) of the Bulk Run tab on VEPM 7.0

The screenshot shows the 'Bulk Run' tab interface with the following elements and callouts:

- Navigation Tabs:** 'Year & Speed', 'Fleet Profile', and 'Bulk Run'.
- Text:** 'Some users may prefer to download the complete set of [precalculated emission factors](#) (0.5 Gb SQLite database)'.
Step One: Download and save a copy of the Microsoft Excel template.
Step Two: Populate the template.
Step Three: Enter your e-mail address.
Step Four: Upload populated template.
Step Five: Check calculation progress.
- Buttons:** 'Download', 'Upload', and 'Check Progress'.
- Input Fields:** An email address field and a 'Process key' field.
- Callout Boxes:**
 - Top right: 'Precalculated result enables user to view fleet weighted emission factors for common scenarios. The logic for this is described in the hyperlink.'
 - Middle right: 'Click here to download and save a copy of the bulk input spreadsheet.'
 - Bottom right: 'Click here to upload the populated bulk input template.'
 - Bottom right: 'For large bulk runs VEPM 7.0 make take longer to process. Use the process key to check the progress of the bulk run.'
 - Left side: 'Once the bulk input spreadsheet is downloaded the user must populate the template.'
 - Bottom left: 'After uploading the prepopulated bulk input VEPM 7.0 will generate process key for use as a reference.'

Figure 6.2: Example of a populated bulk run input on VEPM 7.0



There are four key steps required to carry out a bulk run to calculate fleet weighted emission factors for multiple scenarios in VEPM 7.0.

Step 1 – Bulk input

In the “Bulk Run” tab, click to download and save a copy of the bulk input spreadsheet (see Figure 6.).

Figure 6.1 shows what the downloaded bulk input template will look like upon opening, ready to be populated with bulk run inputs.

Step 2 – Populating the bulk input template

Firstly, the user may need to enable editing in the downloaded bulk input spreadsheet to input scenarios.

Similar to previous versions of VEPM, users are required to input run number, year and average speed for cars, LCVs, HCVs and buses. Notes are embedded on the bulk input spreadsheet for guidance of the range of valid input values for each parameter (see Figure 6.1).

Optional parameters, highlighted in blue in Figure 6.1, can also be inputted in the bulk input worksheet. Similarly, notes are embedded on the bulk input spreadsheet for the range of valid input values for each optional parameter.

for future reference, you can copy this to clipboard by clicking the copy icon next to the process key (see Error! Reference source not found.).

To check the progress of the bulk run, enter the unique process key and click "Check Progress".

Step 3.6 - Complete

When the bulk run is complete selecting (Result ready to download) to download the bulk run output spreadsheet.

Step 4 – Bulk run outputs

Bulk run allows users to perform multiple runs automatically. Run parameters are inputted into the bulk input sheet (as described in steps 1 to 3), and results are presented in the bulk run output worksheet (see step 3.6).

Emission factors for CO, CO₂-e, VOC, NO_x, NO₂, NO₂, N₂O, PM exhaust, PM₁₀, FC, PM_{2.5}, PM_{2.5}, FC, CO₂, CH₄, EC and PM_{2.5} are provided according to the bulk inputs. If the Vehicle Type Breakdown checkbox had been selected by the user on the Bulk Input worksheet, then the remaining columns in the Bulk Output worksheet will also be populated. Figure 6.3 presents the Bulk Outputs for the example input data shown in

Figure 6.2.

Figure 6.2: Example bulk input spreadsheet.

Run number	Required Inputs					% VKT Light Duty Vehicles <					
	Year	Speed Car	Speed LCV	Speed HCV	Speed BUS	Car petrol	Car diesel	Car hybrid	Car plugin hybrid	Car electric	LCV petrol
1	2038	10	10	13	13						
2	2030	11	11	14	14						
3	2038	12	12	15	15						
4	2029	13	13	13	13						
5	2002	14	14	14	14						
6	2026	15	15	15	15						
7	2012	16	16	16	16						
8	2042	17	17	17	17						
9	2016	18	18	18	18						
10	2024	19	19	19	19						
11	2046	20	20	20	20						
12	2021	21	21	21	21						
13	2017	22	22	22	22						
14	2044	23	23	23	23						
15	2034	24	24	24	24						
16	2012	25	25	25	25						
17	2008	26	26	26	26						
18	2045	27	27	27	27						
19	2013	28	28	28	28						
20	2017	29	29	29	29						
21	2001	30	30	30	30						
22	2017	31	31	31	31						
23	2034	32	32	32	32						
24	2037	33	33	33	33						
25	2006	34	34	34	34						
26	2047	35	35	35	35						
27	2005	36	36	36	36						
28	2006	37	37	37	37						
29	2046	38	38	38	38						
30	2019	39	39	39	39						
31	2025	40	40	40	40						
32	2045	41	41	41	41						
33	2040	42	42	42	42						
34	2008	43	43	43	43						
35	2035	44	44	44	44						

Figure 6.3: Example bulk output worksheet for inputs presented in Figure 6.4.

Run number	CO	CO2e	VOC	NOx	NO2	N2O	PM Exhaust	PM10	FC	CO2	CH4	EC	PM25
1	0.219986	272.155	0.010248	0.406488	0.071179	0.005646	0.006482	0.026375	11.0178	270.299	0.006936	3.992834	0.013938
2	0.493418	355.7325	0.035478	0.710344	0.131658	0.006784	0.017431	0.028079	14.42541	353.4001	0.012429	5.2227	0.014912
3	0.283929	292.7373	0.011068	0.461147	0.082458	0.005746	0.008085	0.029376	11.76644	290.7945	0.009221	4.285741	0.015633
4	0.821386	372.0612	0.050179	1.09993	0.19006	0.006941	0.024918	0.026491	14.99389	369.6737	0.01276	5.452325	0.014012
5	22.93564	464.0385	2.042445	2.794023	0.255833	0.035103	0.198053	0.02706	18.41345	451.3929	0.087398	6.669526	0.014369
6	2.098805	491.1906	0.063229	1.477333	0.289479	0.007089	0.046127	0.029773	19.46551	488.7779	0.012011	7.168219	0.015876
7	18.1553	450.5799	0.669211	2.435968	0.340124	0.012398	0.135205	0.026105	18.04454	445.7913	0.043759	6.570823	0.013817
8	0.121452	170.0053	0.006003	0.226083	0.036383	0.004922	0.003161	0.027758	6.858037	168.3883	0.006008	2.486768	0.014712
9	2.776695	334.4745	0.335686	0.679792	0.104616	0.010686	0.049925	0.029768	13.57904	330.5613	0.029146	4.894927	0.01589
10	0.968997	308.6651	0.087365	0.711843	0.126537	0.007241	0.02556	0.026521	12.50277	306.1614	0.013829	4.52522	0.014032
11	0.140455	152.5933	0.005515	0.194883	0.034497	0.004113	0.003106	0.027646	6.0179	151.2697	0.003921	2.217735	0.01464
12	2.339916	414.2716	0.147795	1.260114	0.219686	0.008141	0.050479	0.030108	16.49476	411.2977	0.021912	6.044967	0.016069
13	5.944263	372.5938	0.269783	1.546556	0.274095	0.010516	0.072046	0.026504	14.90981	368.7289	0.029246	5.433196	0.014031
14	0.373648	258.158	0.008122	0.359251	0.085976	0.004518	0.006652	0.027702	10.0503	256.675	0.005462	3.744797	0.014676
15	0.195165	217.2879	0.011625	0.230383	0.04536	0.006342	0.005812	0.029544	8.820535	215.1233	0.010987	3.183661	0.015736
16	3.484946	273.8706	0.457697	0.539434	0.07033	0.011969	0.049245	0.026105	11.11074	269.3177	0.039448	3.993428	0.013817
17	6.351793	293.9963	0.728678	0.920537	0.101772	0.01444	0.081048	0.027776	11.84029	288.2142	0.059159	4.267946	0.014769
18	0.147255	154.3292	0.00541	0.169627	0.032935	0.004325	0.003358	0.029083	6.078579	152.915	0.005013	2.241314	0.01545
19	5.751593	316.2284	0.435375	1.340586	0.185463	0.012728	0.074092	0.026193	12.67266	311.3348	0.044025	4.596989	0.013863
20	5.096836	387.0613	0.240416	1.680302	0.290332	0.011097	0.073064	0.028256	15.33766	382.9246	0.033192	5.625777	0.015027
21	25.73103	454.2921	1.393394	5.698146	0.500518	0.033791	0.277205	0.028453	17.59195	441.7805	0.097673	6.47876	0.015162
22	1.258567	238.3129	0.191724	0.284458	0.045452	0.010181	0.023183	0.026504	9.677476	234.6412	0.025507	3.478944	0.014031
23	0.196856	191.0517	0.009936	0.236945	0.04636	0.006241	0.005017	0.027991	7.736144	188.9589	0.009314	2.795133	0.014857
24	0.210196	185.4571	0.007919	0.265442	0.050283	0.005852	0.004755	0.029417	7.460679	183.4997	0.008544	2.70848	0.015659
25	6.74367	260.1044	0.711327	1.211024	0.12014	0.014403	0.078418	0.025883	10.41404	254.1789	0.065333	3.760762	0.013695
26	0.14434	137.4201	0.00433	0.144874	0.031969	0.003918	0.002676	0.027616	5.354123	136.1688	0.003346	1.989189	0.01462
27	14.19635	379.4208	0.786645	3.583005	0.360269	0.014641	0.167319	0.028973	14.88779	373.2002	0.074305	5.476058	0.015452
28	15.76734	316.3773	0.687133	3.098761	0.316025	0.014587	0.150125	0.025883	12.50437	310.3491	0.067253	4.567887	0.013695
29	0.051043	78.57557	0.002245	0.066407	0.010599	0.004092	0.000775	0.027646	3.146634	77.28072	0.003015	1.141193	0.01464
30	1.167784	220.4643	0.127096	0.324503	0.055956	0.008664	0.01846	0.030278	8.92888	217.2804	0.024084	3.217843	0.016167
31	0.687199	217.3011	0.05239	0.410961	0.078441	0.007477	0.013332	0.026515	8.787893	214.6332	0.017595	3.174984	0.014028
32	0.132789	117.1387	0.004123	0.1344	0.027661	0.004279	0.002456	0.027341	4.618227	115.7753	0.003535	1.698764	0.014501
33	0.295412	219.1123	0.007286	0.297652	0.068323	0.00531	0.005756	0.028588	8.609726	217.3502	0.007187	3.182324	0.015247
34	9.33539	278.7205	0.493276	2.162596	0.242019	0.013749	0.108389	0.02513	11.0382	273.1867	0.057463	4.024446	0.013356
35	0.84526	312.1579	0.012655	0.873024	0.220834	0.006167	0.013229	0.026607	12.22447	310.0387	0.011126	4.532966	0.014197

