Vehicle Emissions Prediction Model (VEPM 7.1): User Guide

NZ Transport Agency Waka Kotahi

February 2025

Table of contents

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
EMEP/EEA	European Monitoring and Evaluation Programme/European Environment Agency
HCVs	Heavy commercial vehicles
LCVs	Light commercial vehicles
NOx	Nitrogen oxides
NO_2	Nitrogen dioxide
N_20	Nitrous oxide
NZTA	NZ Transport Agency Waka Kotahi
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
PM10	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 Introduction

The NZ Transport Agency Waka Kotahi (NZTA) Vehicle Emissions Prediction Model (VEPM) predicts emissions from vehicles in the New Zealand fleet under typical road, traffic and operating conditions. An important feature of the model is the ability to estimate changes to vehicle emissions in future years (from 2001 to 2050).

VEPM provides emission factors (the quantity of pollutants emitted per kilometre driven) that are suitable for air quality assessments, greenhouse gas assessments and emissions inventories.

This VEPM User Guide provides instructions for running VEPM.

Additional information for VEPM users including discussion of the limitations and appropriate application of VEPM is provided in the technical report[1]. The technical report also describes the detailed methodology and assumptions for calculation of emission factors in VEPM 7.1

1.1 Structure of this guide

This user guide is structured as follows:

- An overview of how to use VEPM 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
- Section 6 includes how to use the bulk run feature of VEPM 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 7.1 Technical Report, January 2025. Available at: www.nzta.govt.nz

2 Using VEPM

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

VEPM 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.

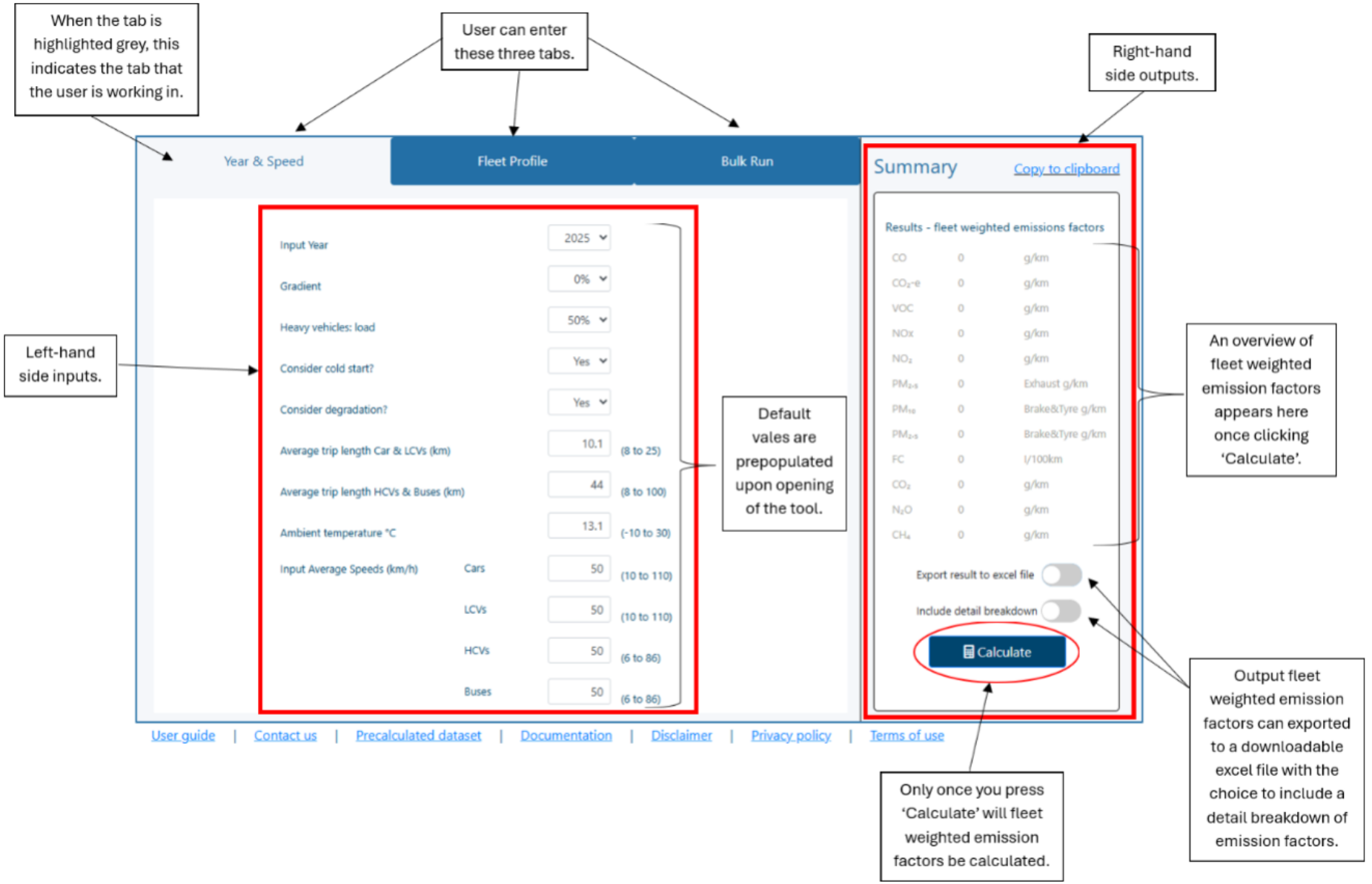
Single calculation	Single calculations allow users to interact with the model in a simple and rapid way by adding in a single fleet scenario and receiving immediate results that are also able to be downloaded.
Bulk run	The bulk run feature of the model provides the functionality for users to perform 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 to calculate fleet weighted emission factors:

Step 1 – Opening VEPM	Open VEPM Vehicle Emissions Prediction Model (vepm.co.nz). VEPM 7.1 works in all browser types. VEPM 7.1 will open as shown in Figure 2.1. When the VEPM 7.1 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 6.
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, 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 user guide.

Figure 2.1: Screen shot VEPM 7.1 upon opening



3 Input data - Year & Speed

To calculate emissions for a single scenario, data is entered in the “Year & Speed” tab of VEPM (Figure 3.1). When VEPM 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 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.

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

3.1 Input parameters on the Year & Speed tab

Details of the required input parameters of VEPM 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. Vehicle emissions can be significantly affected by road gradient. **It is recommended that site-specific data should be used wherever possible, and that gradient should be carefully considered in defining road segments for calculation of emissions.** Users should be aware that depending on the gradient and the pollutant being considered, the increase in emissions uphill tends to be significantly greater than the corresponding reduction in emissions going downhill. This means, it cannot be assumed that the increase in emissions due to uphill sections will be cancelled out by the effects of the corresponding downhill sections if the region over which emissions are being assessed has a net zero change in elevation.
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 affected by the user-defined ambient temperature and the average trip length. **To avoid overestimation of cold start emissions, users should omit cold start for calculation of emission factors outside urban areas.**
Consider degradation?	The model includes some allowance for degradation of emissions over time. This option allows the user to ignore degradation effects.
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 10.1km for light duty vehicles and 44km for heavy duty vehicles.
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.

Average speed data is often derived from traffic models. **24-hour or 1-hour resolution speed data is appropriate for estimation of emissions with VEPM**. The most appropriate option will depend on the nature and scale of the project, the pollutant being assessed, and the availability of good quality data. In general, it is recommended that 1-hour temporal resolution data should be used if good quality 1-hour data is available. However, using VEPM with higher resolution speed data (i.e. less than 1 hour) is generally not recommended.

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).

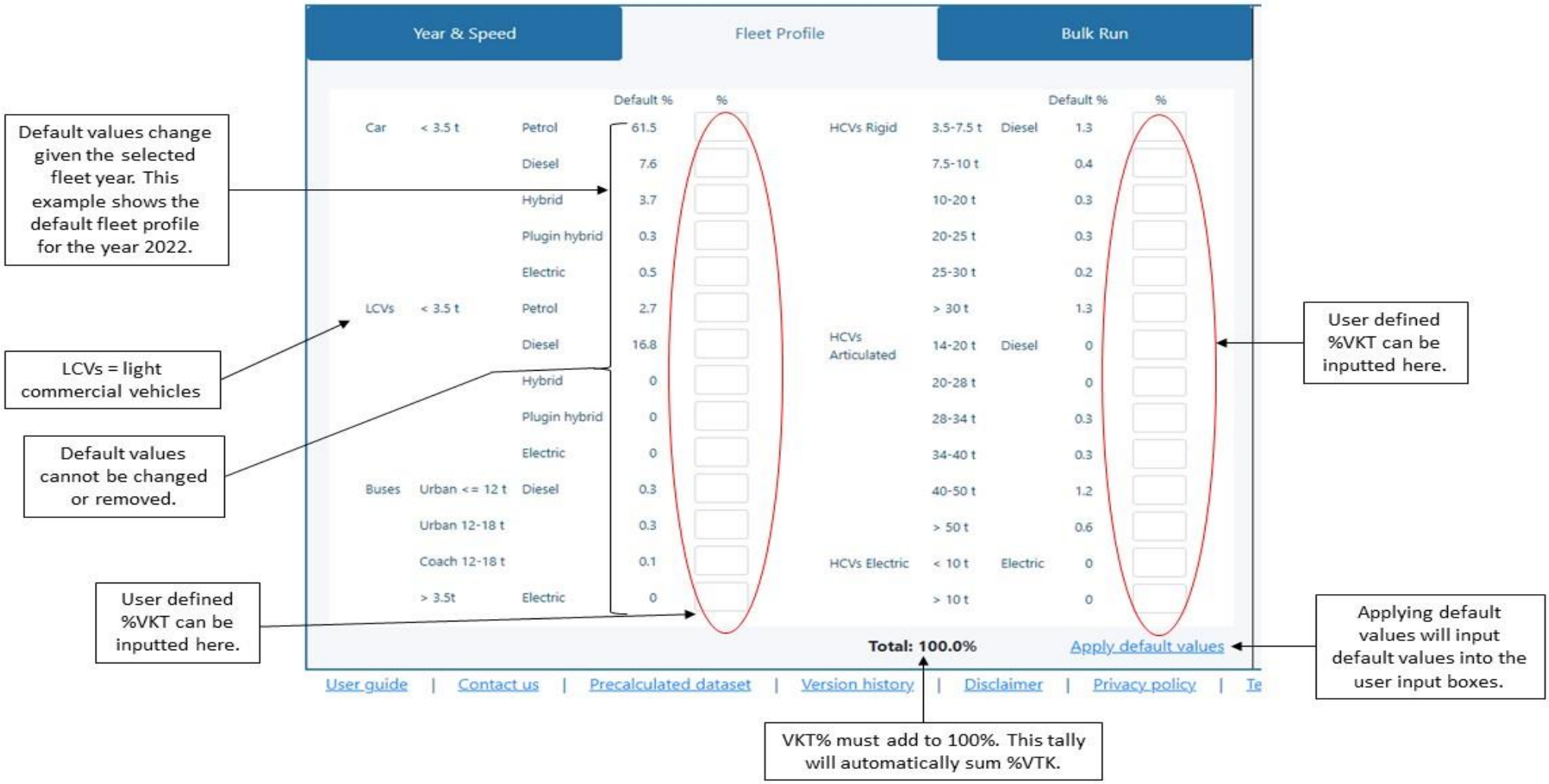
The “Fleet Profile” requires the percentage of vehicle kilometres travelled (%VKT) by each vehicle class to give an overview of the type, number, age and condition of vehicles on the road during the selected fleet year. Percentage of vehicle kilometres travelled (%VKT) by each vehicle class can be based 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 model (VFM). The VFM output includes actual fleet and travel data up to 2022, with projections out to 2050. For the selected year, the VEPM will use the Ministry of Transport fleet profile for that particular year as the default values.[2]

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

[2] Vehicle Emissions Prediction Model: VEPM 7.1 Technical Report, January 2025. Available at: nzta.govt.nz

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



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 Users cannot allocate %VKT to vehicle categories that are not included in the default fleet for the analysis year. For example, in 2001 there were no plug-in hybrid vehicles in the fleet so the user cannot include these in the fleet.

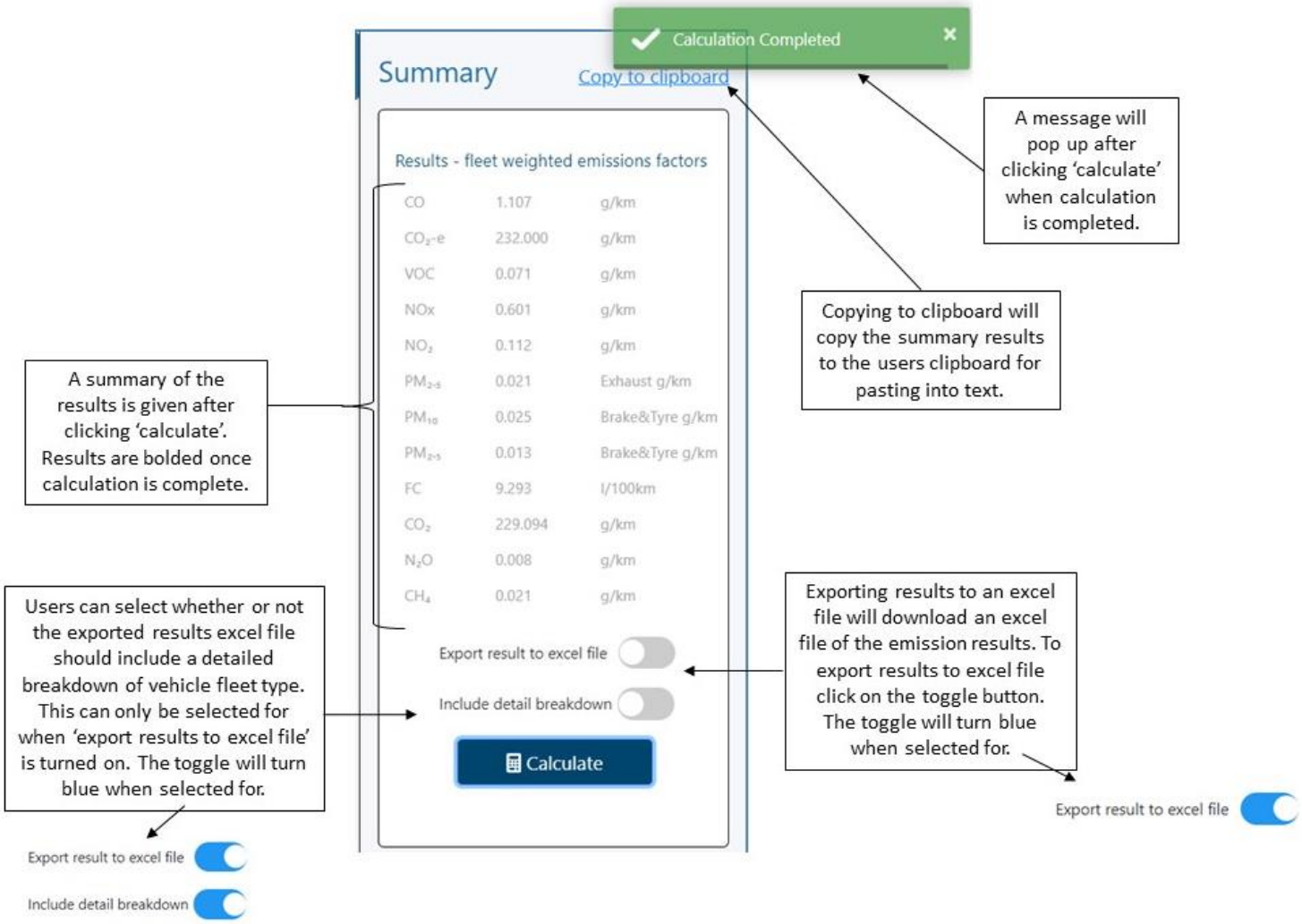
5 Where a user defined value is not specified (but the %VKT adds to 100%) the VEPM will assume the value to be 0%.

6 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.

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



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

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, CO_2-e, VOC, NOx, NO_2, $PM_{2.5}$, PM_{10}, $PM_{2.5}$, FC, CO_2, N_2O and CH_4

3 (Exporting results to an excel file) will download an export file (see Figure 5.2). This file 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

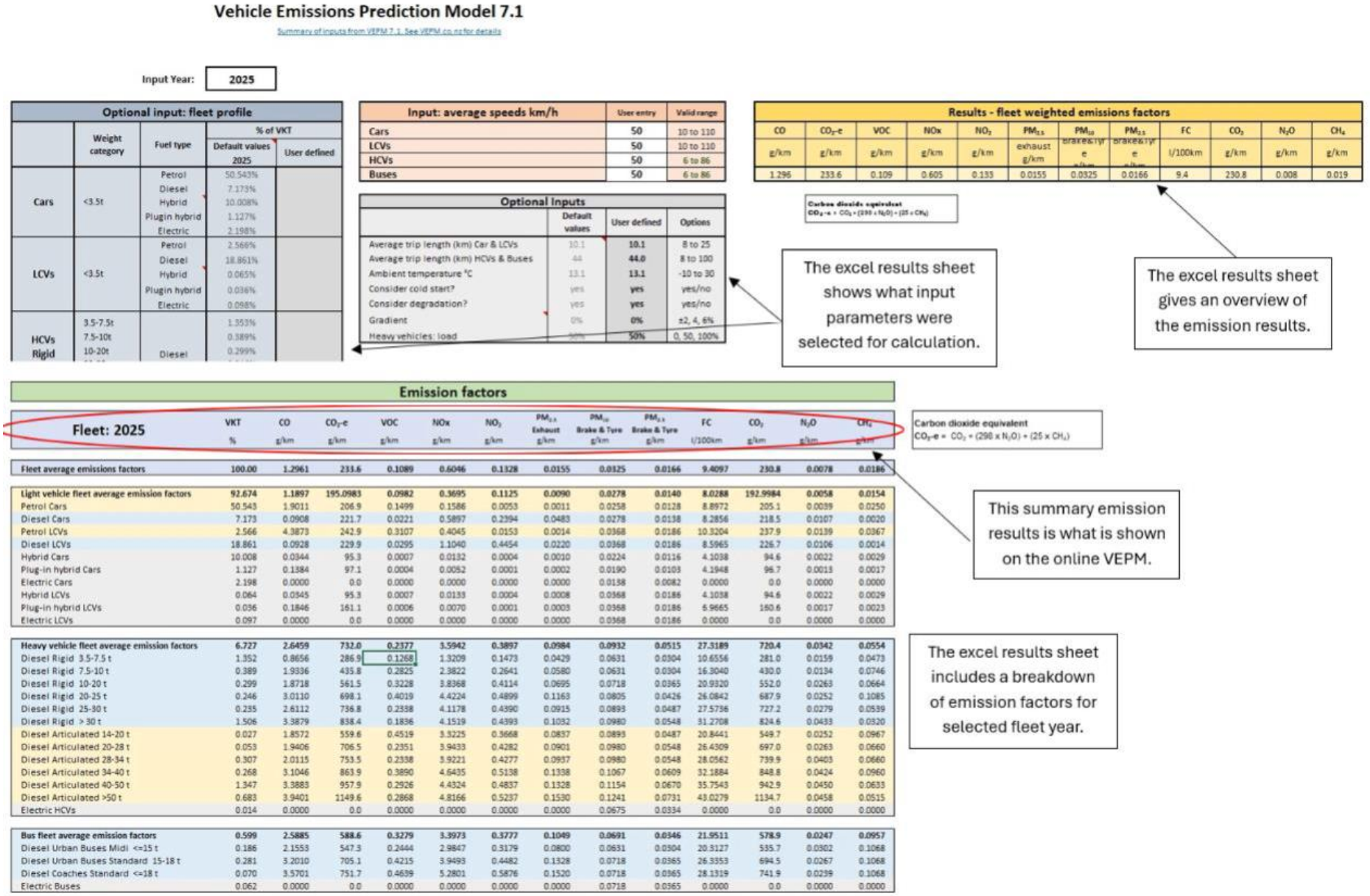
4 Users can select whether the exported results excel file includes a detailed breakdown of vehicle fleet type (Figure 5.3). Including a detailed breakdown allows the user to view the following vehicle fleet parameters:

Year, Fleet, EfMethod, Category, Fuel Type, Segment, Standard, StandardOrigin, Technology, Mode, Pollutant, Speed, SlopePercent, LoadPercent, ColdStart, Degradation, Temperature, AveTripLength, RatioFleet, AgeYears, VktCummulative, Fuelld, 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 7.1

Summary of inputs from VEPM 7.1. See VEPM co.ns for details

Input Year: 2025

Optional input: fleet profile

	Weight category	Fuel type	% of VKT: Default values 2025	% of VKT: User defined
Cars	<3.5t	Petrol	50.543%	
		Diesel	7.173%	
		Hybrid	10.008%	
		Plugin hybrid	1.127%	
		Electric	2.198%	
LCVs	<3.5t	Petrol	2.566%	
		Diesel	18.861%	
		Hybrid	0.065%	
		Plugin hybrid	0.036%	
		Electric	0.098%	
HCVs Rigid	3.5-7.5t		1.353%	
	7.5-10t		0.389%	
	10-20t	Diesel	0.299%	

Input: average speeds km/h	User entry	Valid range
Cars	50	10 to 110
LCVs	50	10 to 110
HCVs	50	6 to 86
Buses	50	6 to 86

Optional Inputs

	Default values	User defined	Options
Average trip length (km) Car & LCVs	10.1	10.1	8 to 25
Average trip length (km) HCVs & Buses	44	44.0	8 to 100
Ambient temperature °C	13.1	13.1	-10 to 30
Consider cold start?	yes	yes	yes/no
Consider degradation?	yes	yes	yes/no
Gradient	0%	0%	±2, 4, 6%
Heavy vehicles: load	50%	50%	0, 50, 100%

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

Results - fleet weighted emissions factors

CO	CO_2-e	VOC	NOx	NO_2	$PM_{2.5}$ exhaust	PM_{10} brake&tyre	$PM_{2.5}$ brake&tyre	FC	CO_2	N_2O	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
1.296	233.6	0.109	0.605	0.133	0.0155	0.0325	0.0166	9.4	230.8	0.008	0.019

Carbon dioxide equivalent
CO_2-e = CO_2 + (298 x N_2O) + (25 x CH_4)

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	NOx g/km	NO_2 g/km	$PM_{2.5}$ Exhaust g/km	PM_{10} Brake & Tyre g/km	$PM_{2.5}$ Brake & Tyre g/km	FC l/100km	CO_2 g/km	N_2O g/km	CH_4 g/km
Fleet average emissions factors	100.00	1.2961	233.6	0.1089	0.6046	0.1328	0.0155	0.0325	0.0166	9.4097	230.8	0.0078	0.0186
Light vehicle fleet average emission factors	92.674	1.1897	195.0983	0.0982	0.3695	0.1125	0.0090	0.0278	0.0140	8.0288	192.9984	0.0058	0.0154
Petrol Cars	50.543	1.9011	206.9	0.1499	0.1586	0.0053	0.0011	0.0258	0.0128	8.8972	205.1	0.0039	0.0250
Diesel Cars	7.173	0.0908	221.7	0.0221	0.5897	0.2394	0.0483	0.0278	0.0138	8.2856	218.5	0.0107	0.0020
Petrol LCVs	2.566	4.3873	242.9	0.3107	0.4045	0.0153	0.0014	0.0368	0.0186	10.3204	237.9	0.0139	0.0367
Diesel LCVs	18.861	0.0928	229.9	0.0295	1.1040	0.4454	0.0220	0.0368	0.0186	8.5965	226.7	0.0106	0.0014
Hybrid Cars	10.008	0.0344	95.3	0.0007	0.0132	0.0004	0.0010	0.0224	0.0116	4.1038	94.6	0.0022	0.0029
Plug-in hybrid Cars	1.127	0.1384	97.1	0.0004	0.0052	0.0001	0.0002	0.0190	0.0103	4.1948	96.7	0.0013	0.0017
Electric Cars	2.198	0.0000	0.0	0.0000	0.0000	0.0000	0.0000	0.0138	0.0082	0.0000	0.0	0.0000	0.0000
Hybrid LCVs	0.064	0.0345	95.3	0.0007	0.0133	0.0004	0.0008	0.0368	0.0186	4.1038	94.6	0.0022	0.0029
Plug-in hybrid LCVs	0.036	0.1846	161.1	0.0006	0.0070	0.0001	0.0003	0.0368	0.0186	6.9665	160.6	0.0017	0.0023
Electric LCVs	0.097	0.0000	0.0	0.0000	0.0000	0.0000	0.0000	0.0368	0.0186	0.0000	0.0	0.0000	0.0000
Heavy vehicle fleet average emission factors	6.727	2.6459	732.0	0.2377	3.5942	0.3897	0.0984	0.0932	0.0515	27.3189	720.4	0.0342	0.0554
Diesel Rigid 3.5-7.5 t	1.352	0.8656	286.9	0.1268	1.3209	0.1473	0.0429	0.0631	0.0304	10.6556	281.0	0.0159	0.0473
Diesel Rigid 7.5-10 t	0.389	1.9336	435.8	0.2825	2.3822	0.2641	0.0580	0.0631	0.0304	16.3040	430.0	0.0134	0.0746
Diesel Rigid 10-20 t	0.299	1.8718	561.5	0.3228	3.8368	0.4114	0.0695	0.0718	0.0365	20.9320	552.0	0.0263	0.0664
Diesel Rigid 20-25 t	0.246	3.0110	698.1	0.4019	4.4224	0.4899	0.1163	0.0805	0.0426	26.0842	687.9	0.0252	0.1085
Diesel Rigid 25-30 t	0.235	2.6112	736.8	0.2338	4.1178	0.4390	0.0915	0.0893	0.0487	27.5736	727.2	0.0279	0.0539
Diesel Rigid > 30 t	1.506	3.3879	838.4	0.1836	4.1519	0.4393	0.1032	0.0980	0.0548	31.2708	824.6	0.0433	0.0320
Diesel Articulated 14-20 t	0.027	1.8572	559.6	0.4519	3.3225	0.3668	0.0837	0.0893	0.0487	20.8441	549.7	0.0252	0.0967
Diesel Articulated 20-28 t	0.053	1.9406	706.5	0.2351	3.9433	0.4282	0.0901	0.0980	0.0548	26.4309	697.0	0.0263	0.0660
Diesel Articulated 28-34 t	0.307	2.0115	753.5	0.2338	3.9221	0.4277	0.0937	0.0980	0.0548	28.0562	739.9	0.0403	0.0660
Diesel Articulated 34-40 t	0.268	3.1046	863.9	0.3890	4.6435	0.5138	0.1338	0.1067	0.0609	32.1884	848.8	0.0424	0.0960
Diesel Articulated 40-50 t	1.347	3.3883	957.9	0.2926	4.4324	0.4837	0.1328	0.1154	0.0670	35.7543	942.9	0.0450	0.0633
Diesel Articulated >50 t	0.683	3.9401	1149.6	0.2868	4.8166	0.5237	0.1530	0.1241	0.0731	43.0279	1134.7	0.0458	0.0515
Electric HCVs	0.014	0.0000	0.0	0.0000	0.0000	0.0000	0.0000	0.0675	0.0334	0.0000	0.0	0.0000	0.0000
Bus fleet average emission factors	0.599	2.5885	588.6	0.3279	3.3973	0.3777	0.1049	0.0691	0.0346	21.9511	578.9	0.0247	0.0957
Diesel Urban Buses Midi <=15 t	0.186	2.1553	547.3	0.2444	2.9847	0.3179	0.0800	0.0631	0.0304	20.3127	535.7	0.0302	0.1068
Diesel Urban Buses Standard 15-18 t	0.281	3.2010	705.1	0.4215	3.9493	0.4482	0.1328	0.0718	0.0365	26.3353	694.5	0.0267	0.1068
Diesel Coaches Standard <=18 t	0.070	3.5701	751.7	0.4639	5.2801	0.5876	0.1520	0.0718	0.0365	28.1319	741.9	0.0239	0.1068
Electric Buses	0.062	0.0000	0.0	0.0000	0.0000	0.0000	0.0000	0.0718	0.0365	0.0000	0.0	0.0000	0.0000

Carbon dioxide equivalent
CO_2-e = CO_2 + (298 x N_2O) + (25 x CH_4)

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

	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	0.0001448029840290895	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	0.0001031966110633384	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	0.0001064782836554384	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	0.0003284814938804207	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	0.000579212048129665	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	0.0001448029840290895	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	0.0001448029840290895	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	0.0001031966110633384	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	0.0001064782836554384	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**

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 highlighted in Figure 6.1 below.

Figure 6.1 shows a screenshot of the left-hand side "inputs" of the bulk run tab when opening. Figure 6.2 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

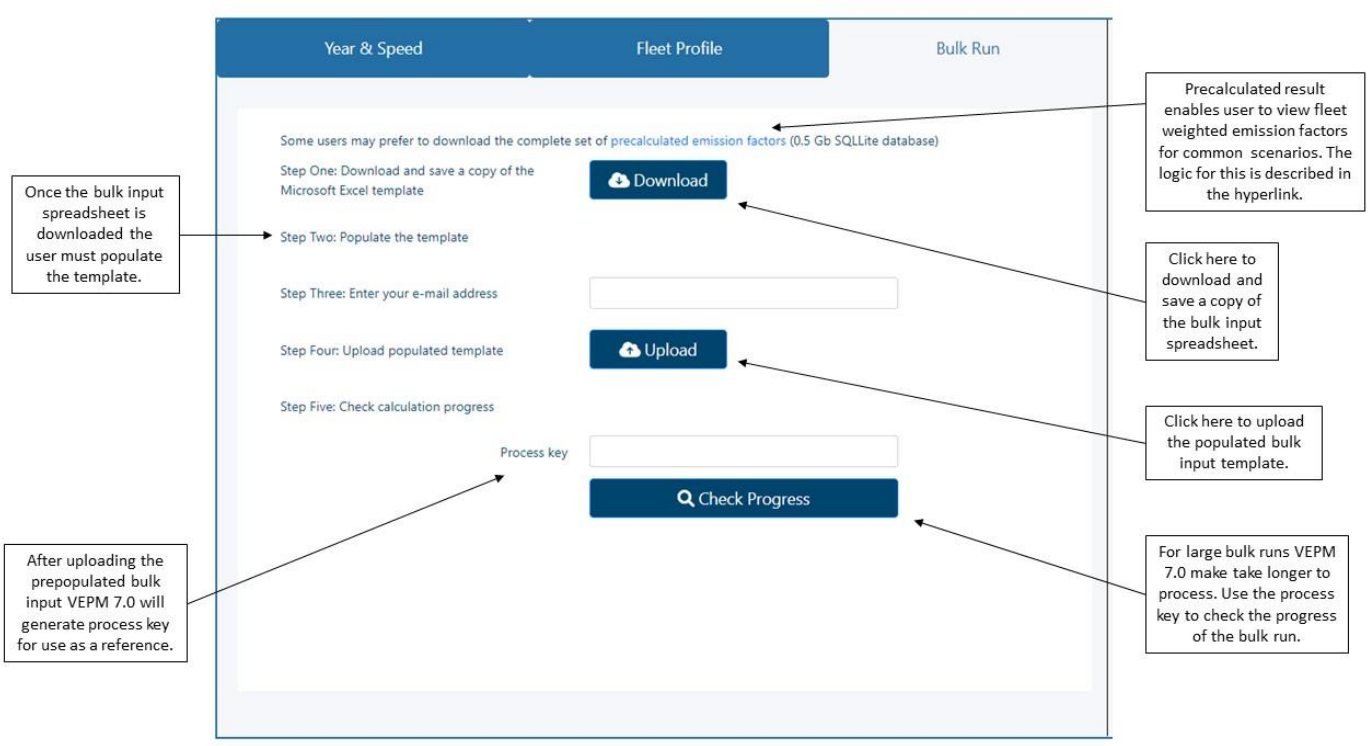
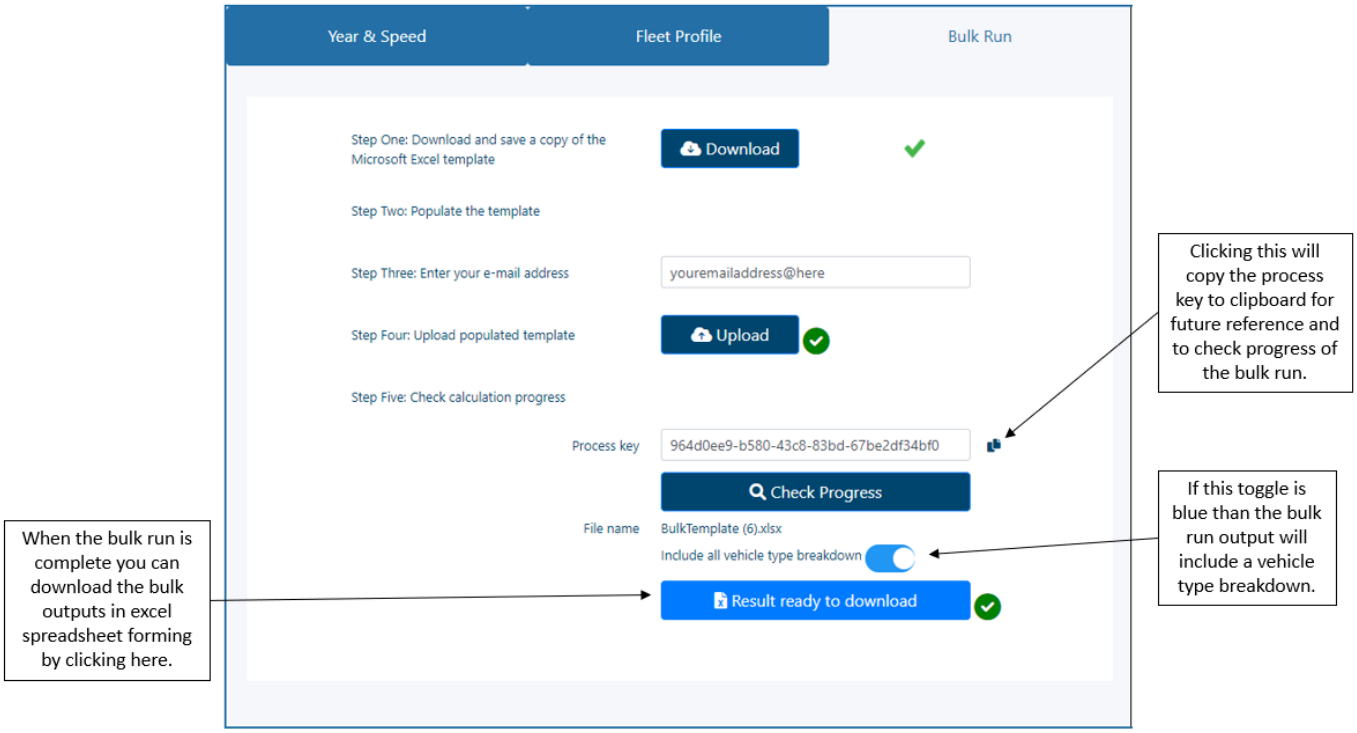


Figure 6.2: Example of a populated bulk run input on VEPM



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

Step 1 – Bulk input	In the "Bulk Run" tab, click to download and save a copy of the bulk input spreadsheet (see Figure 6.2). Figure 6.3 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 6.3). Optional parameters, highlighted in blue in Figure 6.3, 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.
Step 3 – Bulk runs Once the bulk input spreadsheet has been populated the populated excel spreadsheet can be uploaded to VEPM. Instructions on how to upload the populated excel spreadsheet are described below:	
Step 3.1 – Enter email address	
Step 3.2 – Upload populated bulk run	Click the upload button in the bulk run tab (see Figure 6.1) and select the populated excel bulk run spreadsheet.
Step 3.3 – Model processing bulk run	The bulk run will be added to the process queue. A background process will pick this job and process it. Please note that the process may take longer for large bulk input runs.
Step 3.4 – Including a vehicle type breakdown	If the user requires a breakdown of emission factors by vehicle type, rather than total fleet weighted emissions factors, select the (Include all vehicle type breakdown) (see Figure 6.2). The toggle will turn blue when this feature is selected for.
Step 3.5 – Process key	After uploading the populated bulk input to the online VEPM, the model will generate a process key to use for future reference, you can copy this to clipboard by clicking the copy icon next to the process key (see Figure 6.2). 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, CO_2-e, VOC, NOx, NO_2, NO2, N20, PM exhaust, PM_{10}, FC, $PM_{2.5}$, $PM_{2.5}$, FC, CO_2, CH_4, 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 6.5 presents the Bulk Outputs for the example input data shown in Figure 6.4.

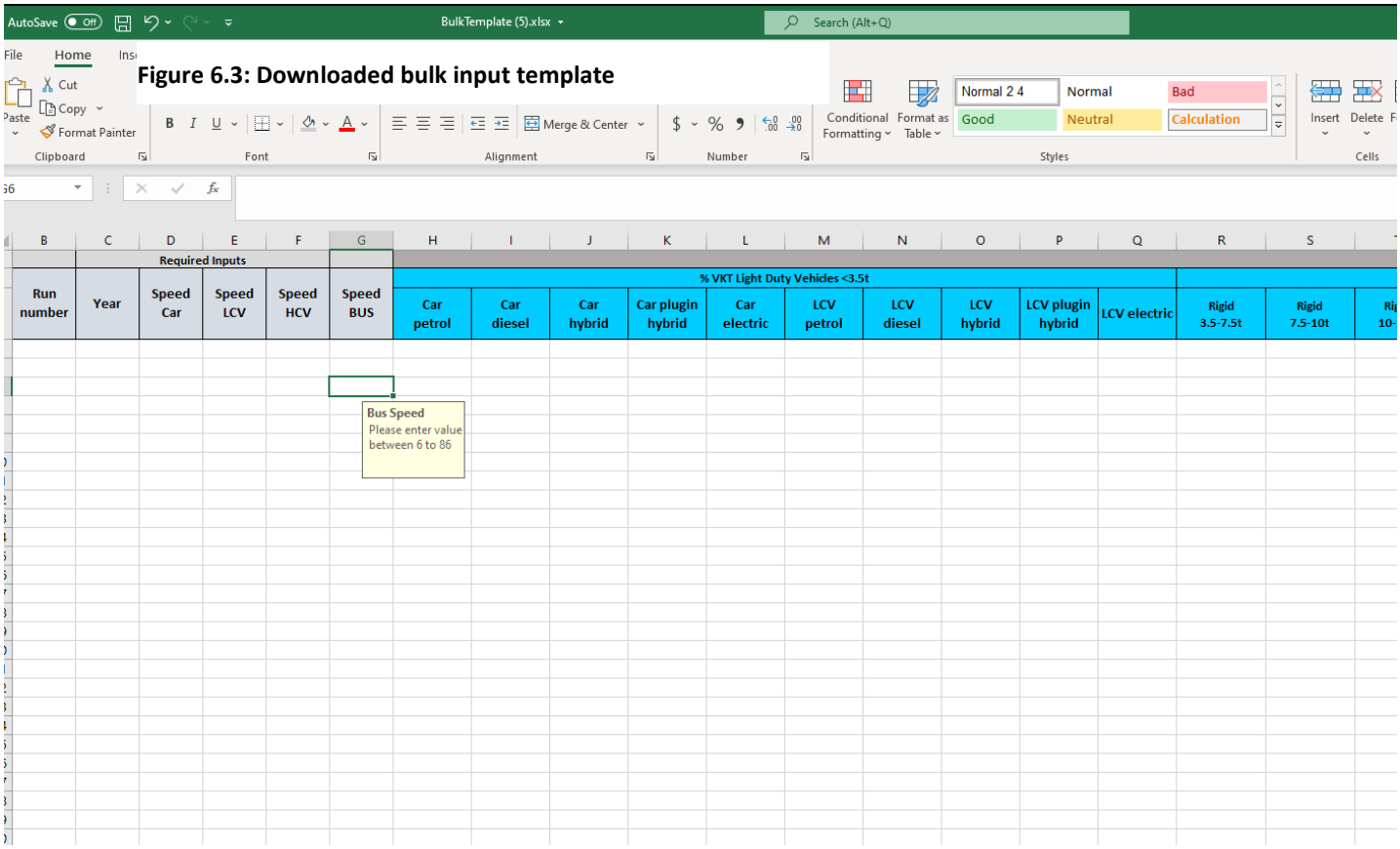


Figure 6.3: Downloaded bulk input template

Figure 6.4: Example bulk input spreadsheet.

	Required Inputs											
												% VKT Light Duty Vehicles <
Run number	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 6.5: 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	0.01126	4.532966	0.014197