

Appendix 3.6 Calculation of Vehicular Emission Source

Estimation of Vehicular Emission for the Study Area with EMFAC-HK model

The major air quality impact arisen by the Project is the stack emission during the operation phase. Open road emission also contribute to the cumulative air quality in the Study Area. As NO₂ and the particulate matters are the key pollutant for the stack emission, the estimation shall also focus on vehicular emission in NO₂ and particulates namely RSP and FSP. EMFAC-HK v3.4 model is adopted to estimate the vehicular emission rates of NO_x and particulate matters, RSP and FSP. The input parameters and model assumptions made in EMFAC-HK model are summarised as follows.

Model Year

EMFAC-HK consider 45 years of model years for the estimation of vehicular emission. The model years start from 45 years preceding the year of interest to the year of interest as the final model year. The following table summarizes the starting and final model years of the assessment years implemented in EMFAC-HK.

Table 1 Starting and Final model yeas in EMFAC-HK

Scenario Year	Starting Model Year	Final Model Year
Year 2020 – 2026 (Phase 1 Construction)		
2021	1976	2021
Year 2026 – 2030 (Phase 1 Operation + Phase 2 Construction)		
2026	1981	2026
2028	1983	2028
2030	1985	2030
Ultimate (Phase 2 Operation)^[1]		
2030	1985	2030

Road Grouping

Roads within 500 meters of study area were classified into road category of similar nature and driving pattern. Roads are classified by their speed limits. The detail of the road category adopted in the EMFAC-HK is summarized as below:

Table 2 Road Category adopted in EMFAC-HK

Group	Roads	Justification
Group 1	Local road at speed 50 km/hr	Speed limit at 50 km/hr with cold start trips

Vehicle Technology fraction

Exhaust technology fraction and evaporative technology fraction in the model are based on the default value.

The “2015 Licensed Vehicle by Age and Technology Group Fractions” provided in EPD’s website, is adopted in this assessment. Since the provided exhaust technology fractions are only up to Year 2015 at the time of the assessment, those after Year 2015 are projected in accordance with EPD’s Guideline on Modelling Vehicle Emissions – Appendix 3 “Implementation Schedule of Vehicle Emission Standards in Hong Kong (updated as at October 2017)” and Appendix 4 “EMFAC-HK Technology Group Indexes (Released in February 2018)”.

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Vehicle Population

As recommended in the EPD’s Guideline on Modelling Vehicle Emissions, default vehicle populations forecast in EMFAC-HK was used.

Vehicle Accrual

The default accrual rates in EMFAC-HK are estimated from the local mileage data adjusted to reflect the total VKT for each vehicle class. The default value was used.

Vehicle Kilometre Travel (VKT)

The “vehicle fleet” refers to all motor vehicles operating on roads within this assessment area. The modelled fleet was broken down into 16 vehicle classes based on the information in the Transport Monthly Digest and vehicle population provided by EPD.

Vehicle-kilometer-travelled (VKT) represents the total distance travelled on a weekday. The VKT is calculated by multiplying the number of vehicles, which based on the highest predicted hourly traffic flow, and the length of road travelled in the assessment area. The diurnal variation of VKT in the assessment area was provided by the traffic consultant, and the input in the model is by vehicle/fuel/hour.

Trips

For those roads with cold starts as advised by the traffic consultant, the diurnal variation of daily trips in the assessment area of the Project applied in the EMFAC-HK model were provided by the traffic consultant.

Speed Fraction

Speed fraction represents the percentage in different speed ranges of each vehicle type weighted by VKT. The speed limits of existing road were made reference to the Traffic AIDs (plan marked the road marking, traffic sign and speed limits) from TD.

In accordance with the Road Traffic Ordinance, for any road with design speed limit of 70 kph or above, the speed limit for medium goods vehicles, heavy goods vehicles, buses and buses would be limited to not more than 70 kph. Thus, the speeds of medium goods vehicles, heavy goods vehicles and buses from the flow speed or 70 kph, whichever is lower, were adopted. For the public light buses, the speed limit should be limited to speed limit of the carriageway or 80 kph, whichever is lower, were adopted.

Temperature and Humidity Profile

Given that Hong Kong is a small city, temperature and humidity are generally similar in various regions of Hong Kong. Therefore default profiles of temperature and humidity in EMFAC-HK were used.

Estimation of Composite Vehicular Emission Factor

Referring to the EPD’s Guideline on Modelling Vehicle Emissions, “Burden mode” was used for calculating area-specific emission inventories. It was applied for this Project, since it can provide hourly vehicular emissions, taking into account of ambient conditions and speeds combined with vehicle activity, i.e. the number of vehicles, the kilometres driven per day and the number of daily trips.

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Assuming that NO_x is comprised of NO and NO₂ only, the hourly emission of NO_x was split into NO and NO₂ based on the resulting ratio of NO₂ and NO_x by EMFAC-HK for each vehicle type. The NO₂-to-NO_x ratio for each vehicle type extracted from EMFAC-HK is presented in table below in the appendix.

The hourly emissions of NO, NO₂, RSP and FSP were divided by the number of vehicles and the distance travelled to obtain the emission factors in gram per miles per vehicle. The calculated 24-hour composite emission factors of 16 vehicle classes for each road type were adopted in the subsequent air dispersion modelling.

Vehicular Emission Burden by EMFAC-HK

For Year 2026 – 2030 Scenario, vehicular emission burden for NOX and RSP were calculated based on the traffic forecast and EMFAC-HK v3.4 model. The results are summarized as below.

Table 3 Vehicular Emission Burden and VKT of Open Road Source

Year	NOx (kg/day)	RSP (kg/day)	VKT
2026	2.70	0.14	3343
2028	2.36	0.13	3373
2030	1.89	0.10	3406

According to the results, Year 2026 is selected as the worst affected year by vehicular emission.

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NO and NO₂ to NO_x Ratios

Year 2021

YLEPP - Speed Limit - 50kph

Vehicle Class	Sum of NO2	Sum of Nox	NO2/NOx Ratio	NO/NOx Ratio
FBDD	0.053	0.531	0.099	0.901
FBSD	0.005	0.059	0.089	0.911
HGV7	0.086	0.282	0.305	0.695
HGV8	0.162	1.451	0.110	0.890
LGV3	0.000	0.001	0.080	0.920
LGV4	0.008	0.101	0.083	0.917
LGV6	0.029	0.105	0.280	0.720
MC	0.001	0.014	0.050	0.950
NFB6	0.011	0.039	0.280	0.720
NFB7	0.011	0.041	0.271	0.729
NFB8	0.006	0.072	0.076	0.924
PC	0.001	0.019	0.052	0.948
PLB	0.008	0.085	0.098	0.902
PV4	0.002	0.015	0.149	0.851
PV5	0.038	0.152	0.248	0.752
TAXI	0.004	0.162	0.023	0.977

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NO and NO₂ to NO_x Ratios

Year 2026

YLEPP - Speed Limit - 50kph

Vehicle Class	Sum of NO2	Sum of Nox	NO2/NOx Ratio	NO/NOX Ratio
FBDD	0.018	0.439	0.041	0.959
FBSD	0.004	0.039	0.111	0.889
HGV7	0.073	0.244	0.300	0.700
HGV8	0.138	1.094	0.110	0.890
LGV3	0.000	0.001	0.080	0.920
LGV4	0.007	0.092	0.079	0.921
LGV6	0.023	0.084	0.280	0.720
MC	0.001	0.013	0.050	0.950
NFB6	0.011	0.040	0.280	0.720
NFB7	0.009	0.032	0.271	0.729
NFB8	0.004	0.036	0.105	0.895
PC	0.001	0.010	0.054	0.946
PLB	0.008	0.063	0.133	0.867
PV4	0.002	0.016	0.148	0.852
PV5	0.036	0.146	0.248	0.752
TAXI	0.005	0.175	0.027	0.973

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Summary of Composite Vehicular Emission Factors for CALINE4
Open Road 24 hour NO2 Emission and Traffic Profile (Year 2026)

Table with 29 columns: District, Source ID, Link No., Road Type, X-Start, Y-Start, X-End, Y-End, Height, Width, Length, and 24 columns for Hourly Emissions (Hour 01 to Hour 24). Each row represents a specific source and its contribution to total emissions over a 24-hour period.

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NO and NO₂ to NO_x Ratios

Year 2045

YLEPP - Speed Limit - 50kph

Vehicle Class	Sum of NO2	Sum of Nox	NO2/NOx Ratio	NO/NOX Ratio
FBDD	0.020	0.070	0.290	0.710
FBSD	0.001	0.005	0.290	0.710
HGV7	0.014	0.041	0.328	0.672
HGV8	0.058	0.184	0.110	0.890
LGV3	0.000	0.001	0.054	0.946
LGV4	0.004	0.067	0.054	0.946
LGV6	0.004	0.014	0.280	0.720
MC	0.001	0.012	0.050	0.950
NFB6	0.011	0.041	0.280	0.720
NFB7	0.006	0.023	0.278	0.722
NFB8	0.003	0.009	0.326	0.674
PC	0.000	0.007	0.054	0.946
PLB	0.008	0.058	0.142	0.858
PV4	0.002	0.016	0.151	0.849
PV5	0.035	0.142	0.250	0.750
TAXI	0.005	0.167	0.027	0.973

Appendix 3.6 Locations of Vehicular Emission Sources

