### **Briefing on EMFAC-HK Update**

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### Background

- EPD has adapted the vehicle emission model, EMFAC, developed by California Air Resources Board (CARB) for use in Hong Kong since 2005.
- EMFAC-HK calculates emission rates<sup>#</sup> from all on-road vehicles.
- \* For territory-wide emission inventories, emission factors in EMFAC-HK are multiplied by territory-wide vehicle activity data.
- For other vehicle emission assessment like EIA, EMFAC-HK provides fleet average emission factors and the consultants will provide case specific activity data
- We have promulgated updates every January, if needed, since 2013
- EMFAC-HK Webpage: https://www.epd.gov.hk/epd/english/environmentinhk/air/guide\_ref/emfa c-hk.html

#Emission rate = Emission Factor (g/km) x Vehicle activity (km/day)

## Outline

- Application of EMFAC-HK
- Timeline of updates of Vehicle Emission
   Model
- Changes made in EMFAC-HK update (V4.1)
- Comparison of emissions and fleet average emission factors (FAEF)
- Transitional Arrangement
- Meeting Air Quality Objectives

### **Application of EMFAC-HK**

- EMFAC-HK is a tool for estimating vehicle emissions with default vehicle emission factors and assumptions<sup>#</sup>. As the emission factors and assumptions may change over time due to new data collected, some default data may become outdated. Besides, there may be changes in policies which have impact on vehicle emissions. Thus, we will issue new version of EMFAC-HK in early part of the year when necessary.
- When using EMFAC-HK, users can apply other appropriate assumptions in estimating vehicle emissions to suit their projects/purpose.
- The users should judge whether the default values of EMFAC-HK are applicable to their case and how robust their assessments are.

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### **Timeline of updates of Vehicle Emission Model**



- Changed compiler from Compaq FORTRAN to Intel FORTRAN
  - Changed some parts of GUI<sup>%</sup>
- Updated default base year to 2016
- Updated zero mile emission factors, deterioration rates, regime growth rates, speed correction factors
- Added start emissions for diesel SCR<sup>##</sup> vehicles
- Policy Implementation:
  - Euro 4 motorcycles and Euro VI light buses/buses
  - Phasing out Euro IV DCV\*

 <sup>%</sup> GUI – graphical user interface
 ##SCR - Selective Catalytic Reduction device
 \* DCV - diesel commercial vehicles except franchised buses

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### Changes in EMFAC-HK V4.1

#### **Technical Items**

- A. Changed program compiler from obsolete Compaq FORTRAN to Intel FORTRAN. (No emission impact)
- B. Updated the base year from 2015 to 2016 including traffic data and vehicle population distribution (usually 2-3 years)
- C. Updated model parameters based on
  - Much more real-world vehicle emission data by using PEMS\* (PEMS data) for Euro IV to VI vehicles
    - used 242 vehicle data since V3.1 (1/2016) (120 Euro IV-VI)
    - use 330 vehicle data now (200 Euro IV-VI)
  - 2016/17 remote sensing data (used 2015 since V3.3 (1/2017))

 D. Added Start Emissions for SCR diesel vehicles to align with update of CARB's EMFAC2014 (USEPA approved its release in Dec. 2015). (Only occurs when engine is started after turning off for many hours)

\* PEMS - Portable Emission Measurement System

### Changes in EMFAC-HK V4.1

#### Policy Changes

- E. Tightening emission standards of newly registered motorcycles to Euro
   4 in 2020 except motor tricycles
- F. i. tightening emission standards of newly registered light buses of design weight more than 3.5t and buses of design weight 3.5 to 9t to Euro VI in 2021

ii. no newly registered LPG light buses from 2021 (business decision)

- G. Progressively phasing out Euro IV DCV by end 2023
  - depending on different deadlines for retirement, the emission projection will be different

#### **Activity Related**

V3.4	V4.1
2015 vehicle population distribution from TD (updated in 1/2017)	2016 vehicle population distribution from TD
2015 VKT from TD	2016 VKT from TD
2015 survey on vehicle classification on 100 road segments from TD and EPD in- house surveys	2016 survey on vehicle classification on 100 road segments from TD and EPD in-house surveys
EPD conducted surveys in 2012-15 on vehicle classifications to supplement TD's data (from 11 p.m. to 7 a.m.) and 64 additional road segments	EPD conducted surveys in 2012-16 on vehicle classifications to supplement TD's data (from 11 p.m. to 7 a.m.) and 64 additional road segments
2015 speed limits from TD & HyD	2016 speed limits from TD & HyD
2015 speed surveys from TD	2016 speed surveys from TD
2015 ambient temperature & relative humidity from HKO	2016 ambient temperature & relative humidity from HKO

#### **Emission Factor Related**

V3.4	V4.1
Updated Speed Correction Factors (SCF), zero mile emission factors (ZMEF) and deterioration rates (DR). Real-world vehicle emission data (242 vehicles with 120 of Euro IV-VI) are used to determine these factors or as references. International emission factors are used using local data as reference if few data are collected in some tech groups.	Same approach but having more real-world vehicle emission data (330 vehicles with 200 of Euro IV-VI).
Estimated occurrence of normal, high and super emitters for petrol cars and LPG taxis based on 2015 remote sensing data.	Estimated occurrence of normal, high and super emitters for petrol cars and LPG taxis based on 2016/17 remote sensing data.
No start emission for diesel vehicles.	Added start emissions for SCR diesel vehicles, aligning with CARB's EMFAC.

#### Modelling Methodology Related

V3.4	V4.1
Population Forecast:	Population Forecast:
• All except franchised buses, taxis &	• Disabled the smoothing function in
public light buses (PLB) used a	mitigating sharp new sales in population
smoothing function to mitigate sharp	forecast.
new sales in population forecast.	and the product of
Exhaust Tech Group description:	Exhaust Tech Group description:
No Euro 4 motorcycle (MC)	Added Euro 4 MC (TG278)
	all the first the state of the

#### **Policy Related**

V3.4	<b>V4.1</b>
Updated Euro VI implementation dates	Plan to implement -
according to legislative amendments	• Euro 4 MC in 2020
and the second	• Euro VI light buses more than 3.5t
	and buses 3.5- 9t in 2021
LPG light buses are available	Based on the information from trade, no
	newly registered LPG light buses from 2021
	(for assessment purpose only).
No program to phase out Euro IV DCV	Plan to progressively phase out Euro IV
	DCV by end 2023

### Changes in Implementation Dates of Vehicle Emission Standards

#### EMFAC-HK V3.4

#### EMFAC-HK V4.1

Vehicle Class\		Euro VI		
Fuel Type		LPG	Petrol	Diesel
Private Car			1.7.17	1.10.17#
Goods	<= 3.5t	NA	1.1.18	
Vehicle	>3.5 t		1.10.18	
Bus	<= 9 t	NA	No schedule	
	>9 t		1.10.18	
Light	<= 3.5t	1.1.18		3
Bus	>3.5 t	No schedule		lule
Taxi	Taxi		1.7.17 NA	

Vehicle Class		Euro VI			
Fuel Type		LPG	Petrol	Diesel	
Private Ca	ar		1.7.17	1.10.17#	
Goods	<= 3.5t	NA	1.1.18		
Vehicle	>3.5 t	Para	1.10.18		
carbo I	<= 9 t		1.1.2021		
Bus		NA	(tentative)		
N. M.	>9 t	/	1.10.18		
Licht	<= 3.5t	1.1.18			
Ligni	> 2 5 +		1.1.2021		
DUS	>3.3 [	(tentative)			
Taxi	axi		1.7.17 NA		

Changes highlighted in red.

Emfac-HK homepage, Appendix III

Notes: # HK adopted California LEV III Standards on 1 October 2017 for diesel PC.

### Changes in Implementation Dates of Vehicle Emission Standards

#### EMFAC-HK V3.4

EMFAC-HK V4.1

Vehicle Class	6.5	Euro IV		
<b>Fuel Type</b>	LPG	Petrol	Diesel	
Motorcycle	NA No Schedule		edule	

Vehicle Class	Euro IV			
Fuel Type	LPG	Petrol	Diesel	
Motorcycle	NA	1.7.2020 (tentative)	NA (from 1.7.2020 tentative)	
Motor tricycle	No Schedule			

Changes highlighted in red.

Emfac-HK homepage, Appendix III

### **Addition of Exhaust Tech Group**

#### Exhaust Tech Group Added:

Vehicle Class	Vehicle Emission Standards	Technology Group Index
Motorcycle	Euro 4	278

#### **Graphical User Interface (GUI) Related**

V3.4	V4.1
Main screen size is pretty long	Resized main screen for easier operation
<ul> <li>For Population, Accrual, Trip &amp; VKT editing:</li> <li>Direct cell-by-cell editing in 2D grid</li> <li>Multiple cells editing by copying, editing and pasting to and from external spreadsheets</li> </ul>	<ul> <li>For Population, Accrual, Trip &amp; VKT editing:</li> <li>Disabled direct cell-by-cell editing in 2D grid</li> <li>Multiple cells editing by copying, editing and pasting to and from external spreadsheets</li> </ul>
	Note: Nothing is changed from input file point of view.

### **Main Screen Size Changed**



### **2D Grid Editor Changed**

#### V3.4

otal	Cal Pop	for area			Copy with Headi	ings Paste Data
		Hong Kong SAR	]			
litin	g Mode			Editing Cal Pop	(registered vehicle	es with adjustments)
Tot	al Cal Po	p By Vehicle Clas	s By Vehicle and Fue	By Vehicle/F	uel/Age	
$\overline{)}$			Vehicle Class			^
)		1	2	3	4	
	1	27942.0	0.0	0.0	48.0	_
	2	33898.0	0.0	0.0	59.0	
	3	32415.0	0.0	0.0	186.0	Гастурс
	4	26875.0	0.0	1.0	195.0	Petrol
	5	26068.0	0.0	2.0	69.0	Discol
	6	26192.0	0.0	0.0	77.0	Diesei
	7	21526.0	0.0	5.0	55.0	LPG
	8	28004.0	0.0	15.0	67.0	
	9	30617.0	0.0	8.0	175.0	
е 60	10	28774.0	0.0	8.0	271.0	
¥	11	23332.0	0.0	3.0	75.0	
	12	24053.0	0.0	0.0	35.0	
	13	26712.0	0.0	2.0	6.0	
	14	11063.0	0.0	8.0	3.0	
	15	8084.0	0.0	41.0	4.0	
	16	8137.0	0.0	12.0	8.0	
	17	4481.0	0.0	23.0	5.0	
	18	2508.0	0.0	8.0	2.0	
	19	1144.0	0.0	11.0	2.0	
	20	661.0	0.0	11.0	2.0	
	21	466.0	0.0	14.0	0.0	×
c						>



V4.1

- Cell-by-cell online editing disabled
- Multiple cells editing remains similarly (i.e. copy out, edit and paste it back).

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#### Comparison of Territory-wide NOx Emissions in EMFAC-HK V3.4 and EMFAC-HK V4.1



#### Comparison of NOx (Running Exhaust) FAEF – Goods Vehicles



#### **Comparison of NOx (Running Exhaust) FAEF – Buses**



#### **Comparison of NOx (Running Exhaust) FAEF – Others**



#### Comparison of Territory-wide PM10 Emissions in EMFAC-HK V3.4 and EMFAC-HK V4.1



#### **Comparison of PM10 (Running Exhaust) FAEF – Goods** Vehicles



#### Comparison of PM10 (Running Exhaust) FAEF – Buses



#### Comparison of PM10 (Running Exhaust) FAEF – Others



### **Release of EMFAC-HK**

### \* Will release EMFAC-HK V4.1 in January 2019.

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### Transitional Arrangement for Use of EMFAC-HK in EIA Studies

- Provision of 6-month transition period for EIA studies being conducted for adaption to the new model and reduction of abortive work (same as the current arrangement)
- During the transition period, EIA reports submitted under Section 6 of the EIAO may continue to use the previous old model version for the air quality impact assessment. After the transition period, all EIA report submissions must use the new model version

## **Meeting Air Quality Objectives**

- \* Air Quality Objectives (AQOs) are the principal air quality standards in determining the acceptability of air quality impacts of development projects
- \* Annex 4 of the Technical Memorandum on EIA Process (TM) issued under the EIAO sets out the criteria for evaluating air quality impact in EIA studies. The key criterion is that AQOs and other standards established under the Air Pollution Control Ordinance have to be met. The same criterion applies to non-EIAO case.
- Project proponents need to demonstrate that, by means of various mathematical air quality assessment models, upon inclusion of the impacts caused by the project, the cumulative air pollutant concentration at identified air sensitive receivers would comply with the AQOs during the construction and operation phases of the project.
- Meeting the annual concentration standard of NO2, i.e. 40ug/m3, is challenging in urban districts and at the vicinity of trunk roads
- \* Appropriate **mitigation measures** have to be adopted to **control and prevent noncompliance**, if necessary.

# Thank you.

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