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# from all on-road vehicles.
- Emission factors in EMFAC-HK are multiplied by territory-wide vehicle activity data to estimate territory-wide emission inventories.
- 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/emfac-hk.html

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

Outline

- Application of EMFAC-HK
- Timeline of EMFAC-HK updates
- Changes made in EMFAC-HK update (V4.2)
- 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#.

- Some default data may become outdated over time. Thus, we will issue a 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.

#See Appendix II in https://www.epd.gov.hk/epd/english/environmentinhk/air/guide_ref/emfac-hk.html

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Timeline of EMFAC-HK updates

Planned changes:
- Incorporate appropriate changes from CARB's EMFAC
- Further updates due to Policy changes or other changes
- …

EMFAC-HK V4.1 Released: Jan 2019

EMFAC-HK V4.2 To be Released: Jan 2020

EMFAC-HK V? Released: Early 2021

Changes will be discussed later

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Comparison of Current EMFAC-HK V4.1 & EMFAC-HK update (V4.2)

Modelling Methodology Related

Current	Update
To align with CARB's EMFAC2014, added start emissions for SCR diesel vehicles.	To align with CARB's EMFAC2017, revised methodology of start emissions for SCR diesel vehicles.
Assumed Euro 3 motorcycle (MC) has catalytic converter	Assumed Euro 3 MC has no catalytic converter
Hydrocarbons speciation methodology to align with CARB's EMFAC2011	To align with CARB's EMFAC2017, revised hydrocarbons speciation methodology.

Changes highlighted in red.

Comparison of Current EMFAC-HK V4.1 & EMFAC-HK update(V4.2)

Activity Related

Current	Update
Default speed profile employed 2016 Vehicle Emission Inventory	Due to update of 2016 Vehicle Emission Inventory, revised default speed profile.

Changes highlighted in red.

Split of Exhaust Tech Groups

Split Exhaust Tech Groups:

EICODE	FUEL	Old TG Desc	New TG Desc	TGI
PLB	LPG	Euro IV & V	Euro IV	50
PLB	LPG	---	Euro V	51
PLB	LPG	Euro IV & V CAT Replaced	Euro IV CAT Replaced	58
PLB	LPG	---	Euro V CAT Replaced	48

New Tech Group indexes

Changes highlighted in red.

Comparison of Current EMFAC-HK V4.1 & EMFAC-HK update (V4.2)

Policy Related

Current	Update
Plan to progressively phase out all Euro IV DCV by end 2023	Plan to progressively phase out all Euro IV DCV by end 2027 (tentative)

Changes highlighted in red.

Changes in Implementation Dates of Vehicle Emission Standards

Current EMFAC-HK (V4.1)

Vehicle Class\ Fuel Type	Euro 4	
	Petrol	Diesel
Motorcycle	1.7.2020 (tentative)	

EMFAC-HK update (V4.2)

Vehicle Class\ Fuel Type	Euro 4	
	Petrol	Diesel
Motorcycle	1.10.2020 (tentative)	

Changes highlighted in red.

Emfac-HK homepage, Appendix III

Changes in Implementation Dates of Vehicle Emission Standards

Current EMFAC-HK (V4.1)

Vehicle Class\ Fuel Type		Euro VI		
		LPG	Petrol	Diesel
Bus	<= 9 t	NA	1.1.2021 (tentative)	
Light Bus	>3.5 t	1.1.2021 (tentative)		

EMFAC-HK update (V4.2)

Vehicle Class\ Fuel Type		Euro VI		
		LPG	Petrol	Diesel
Bus	<= 9 t	NA	1.3.2021 (tentative)	
Light Bus	>3.5 t	1.3.2021 (tentative)		

Changes highlighted in red.

Emfac-HK homepage, Appendix III

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

Comparison of Current EMFAC-HK V4.1 & EMFAC-HK update (V4.2)

Emission Output

Current	Update
No NO_2 will be output (external spreadsheet has been used to estimate NO_2 level)	NO_2 will be output with other pollutants. All output files formats are modified!
Only one of PM_{30}, PM_{10} and $PM_{2.5}$ can be output in a single run	All PM_{30}, PM_{10} and $PM_{2.5}$ will be output in a single run. All output files formats are modified! (PM options in INP will be ignored)

Changes highlighted in red.

Output Files Revision

<u>No more “bcd.csv” output</u>

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	CALYR	START MY	END MYR	REGION	SAR	STARTS	POPULATI	VKT	VEH TYPE	VEH TECH	POLLUTAN	PROCESS	EMISSION	BASIS
2	2030	1986	2030	SAR Avera	Hong Kon	10	7	121	PC	NCAT	CO	Run Exh	0.003855	Day
3	2030	1986	2030	SAR Avera	Hong Kon	10	7	121	PC	NCAT	NOx	Run Exh	0.000432	Day
4	2030	1986	2030	SAR Avera	Hong Kon	10	7	121	PC	NCAT	PM	Run Exh	0.000004	Day
5	2030	1986	2030	SAR Avera	Hong Kon	10	7	121	PC	NCAT	VOC	Run Exh	0.000185	Day
6	2030	1986	2030	SAR Avera	Hong Kon	10	7	121	PC	NCAT	CO2	Run Exh	0.026478	Day
7	2030	1986	2030	SAR Avera	Hong Kon	10	7	121	PC	NCAT	CO	Start Ex	0.000424	Day
8	2030	1986	2030	SAR Avera	Hong Kon	10	7	121	PC	NCAT	NOx	Start Ex	0.000029	Day
9	2030	1986	2030	SAR Avera	Hong Kon	10	7	121	PC	NCAT	PM	Start Ex	0.000001	Day
10	2030	1986	2030	SAR Avera	Hong Kon	10	7	121	PC	NCAT	VOC	Start Ex	0.000042	Day
11	2030	1986	2030	SAR Avera	Hong Kon	10	7	121	PC	NCAT	CO2	Start Ex	0.002032	Day
12	2030	1986	2030	SAR Avera	Hong Kon	10	7	121	PC	NCAT	CO	Hot Soak	0	Day
13	2030	1986	2030	SAR Avera	Hong Kon	10	7	121	PC	NCAT	NOx	Hot Soak	0	Day
14	2030	1986	2030	SAR Avera	Hong Kon	10	7	121	PC	NCAT	PM	Hot Soak	0	Day
15	2030	1986	2030	SAR Avera	Hong Kon	10	7	121	PC	NCAT	VOC	Hot Soak	0.000045	Day

Output Files Revision (cont')

".csv" output file

Added NO_2 result

All PM species are output at the same time

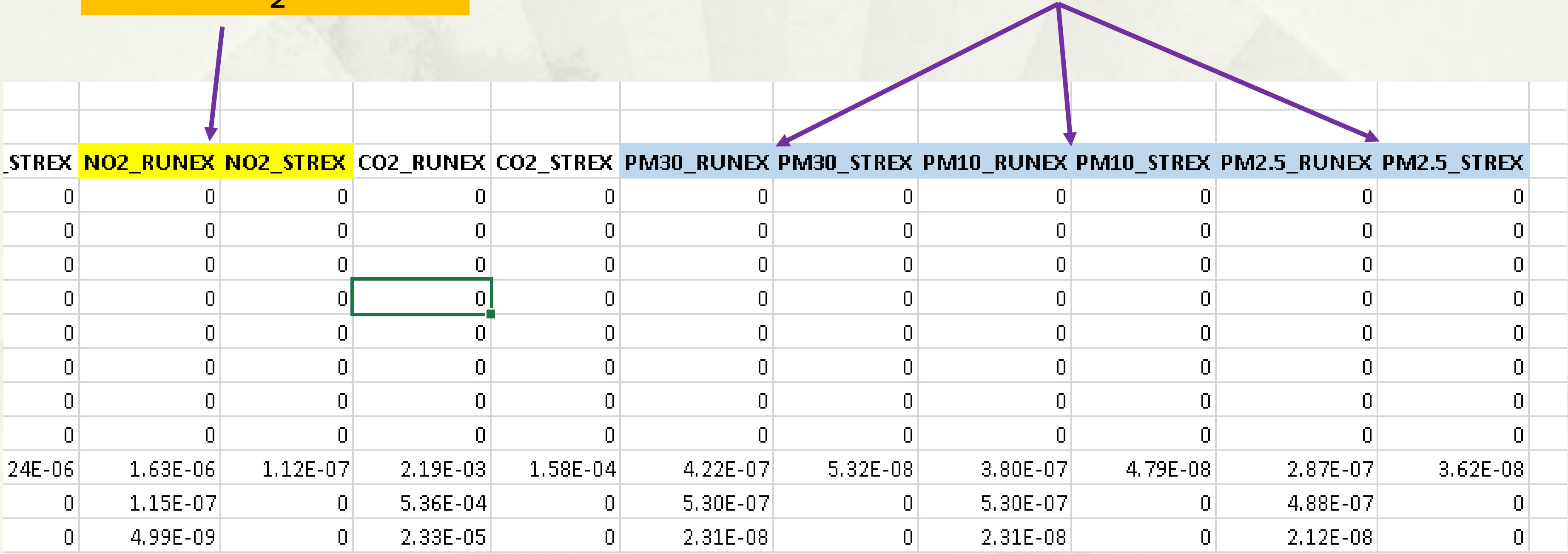
27	-------	-------	-------	-------	-------	-------	-------	-------	-------	-----
28	Oxides of Nitrogen Emissions									
29	Run Exh	0.00043	0.18204	0.00729	0	0.18975	0	0.00009	0	2.!
30	Start Ex	0.00003	0.07195	0	0	0.07198	0	0.00001	0	0.(
31	-------	-------	-------	-------	-------	-------	-------	-------	-------	-----
32	Nitrogen Dioxide Emissions									
33	Run Exh	0.00002	0.0091	0.00094	0	0.01007	0	0	0	0
34	Start Ex	0	0.0036	0	0	0.0036	0	0	0	0.(
35	-------	-------	-------	-------	-------	-------	-------	-------	-------	-----
36	Carbon Dioxide Emissions (000)									
37	Run Exh	0.00003	4.94639	0.04525	0	4.99167	0	0.00082	0	1.!
38	Start Ex	0	0.08006	0	0	0.08006	0	0	0	0.(
39	-------	-------	-------	-------	-------	-------	-------	-------	-------	-----
40	Total Particulate Emissions									
41	Run Exh	0.00001	0.06257	0.0005	0	0.06308	0	0.00001	0	
42	Start Ex	0	0.0056	0	0	0.00561	0	0	0	
43	-------	-------	-------	-------	-------	-------	-------	-------	-------	-----
44	PM10 Emissions									
45	Run Exh	0	0.0607	0.0005	0	0.0612	0	0.00001	0	
46	Start Ex	0	0.00544	0	0	0.00544	0	0	0	
47	-------	-------	-------	-------	-------	-------	-------	-------	-------	-----
48	PM2.5 Emissions									
49	Run Exh	0	0.05632	0.00046	0	0.05678	0	0.00001	0	
50	Start Ex	0	0.00504	0	0	0.00504	0	0	0	
51	-------	-------	-------	-------	-------	-------	-------	-------	-------	-----

Output Files Revision (cont’)

“bdn.csv” output file

Added NO_2 columns

All PM species are output at the same time

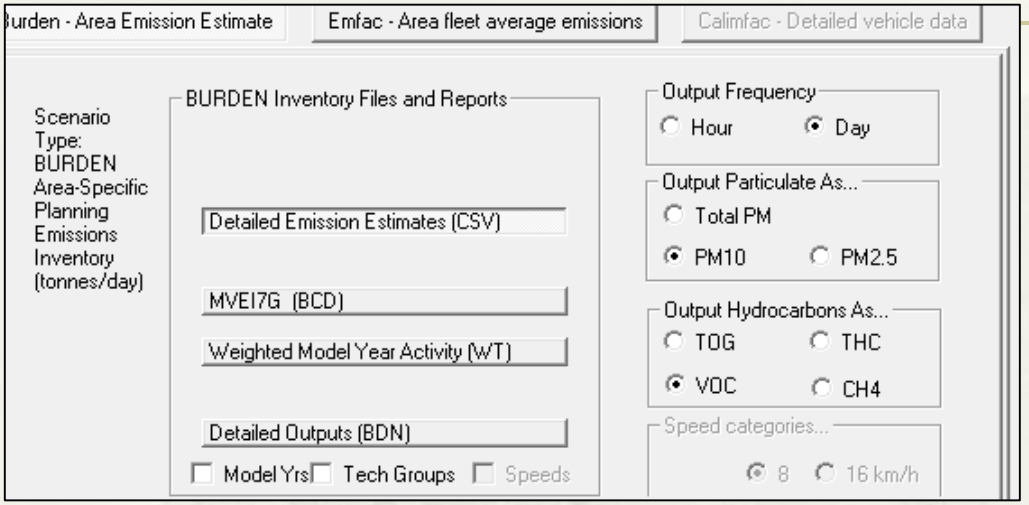


_STREX	NO2_RUNEX	NO2_STREX	CO2_RUNEX	CO2_STREX	PM30_RUNEX	PM30_STREX	PM10_RUNEX	PM10_STREX	PM2.5_RUNEX	PM2.5_STREX
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
24E-06	1.63E-06	1.12E-07	2.19E-03	1.58E-04	4.22E-07	5.32E-08	3.80E-07	4.79E-08	2.87E-07	3.62E-08
0	1.15E-07	0	5.36E-04	0	5.30E-07	0	5.30E-07	0	4.88E-07	0
0	4.99E-09	0	2.33E-05	0	2.31E-08	0	2.31E-08	0	2.12E-08	0

- ❖ EMFAC mode output “.rtl.csv” also includes NO_2 and all PMs

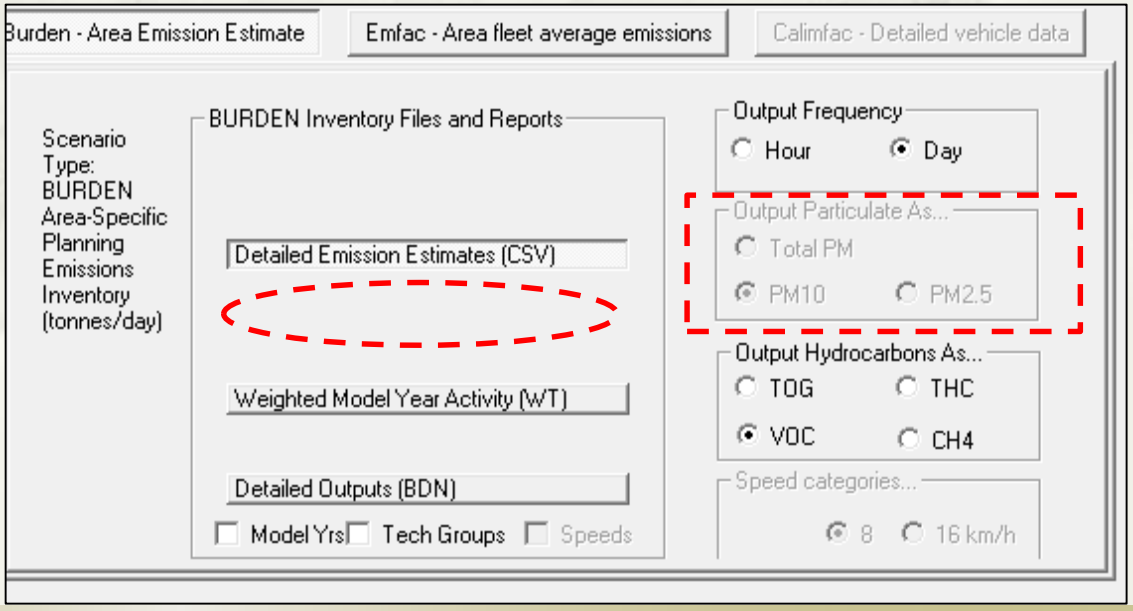
Output Selection Screen Revised

Current



Update

BCD output and PM options are disabled



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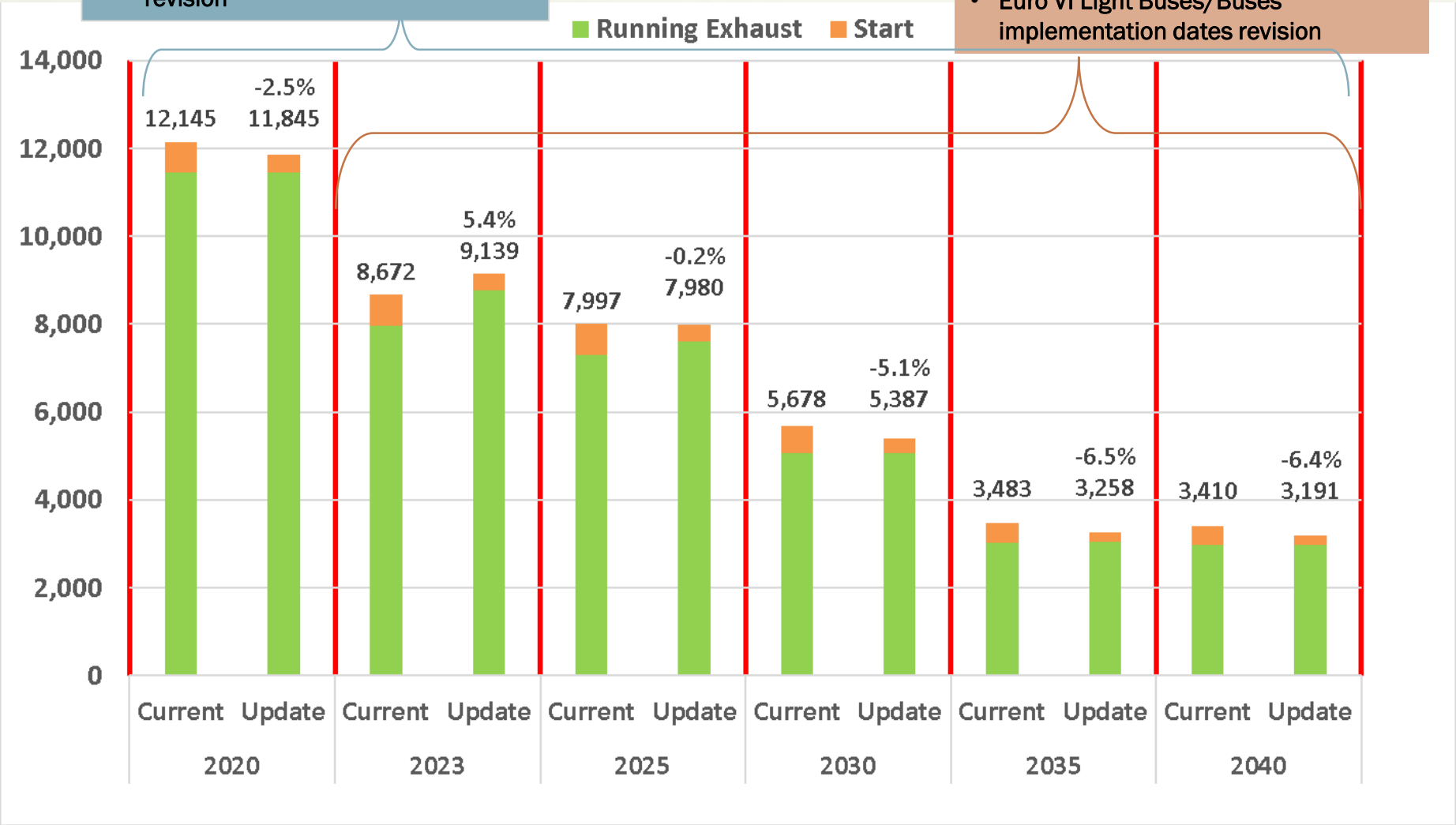
Comparison of Territory-wide NOx Emissions in Current (V4.1) and EMFAC-HK update (V4.2)

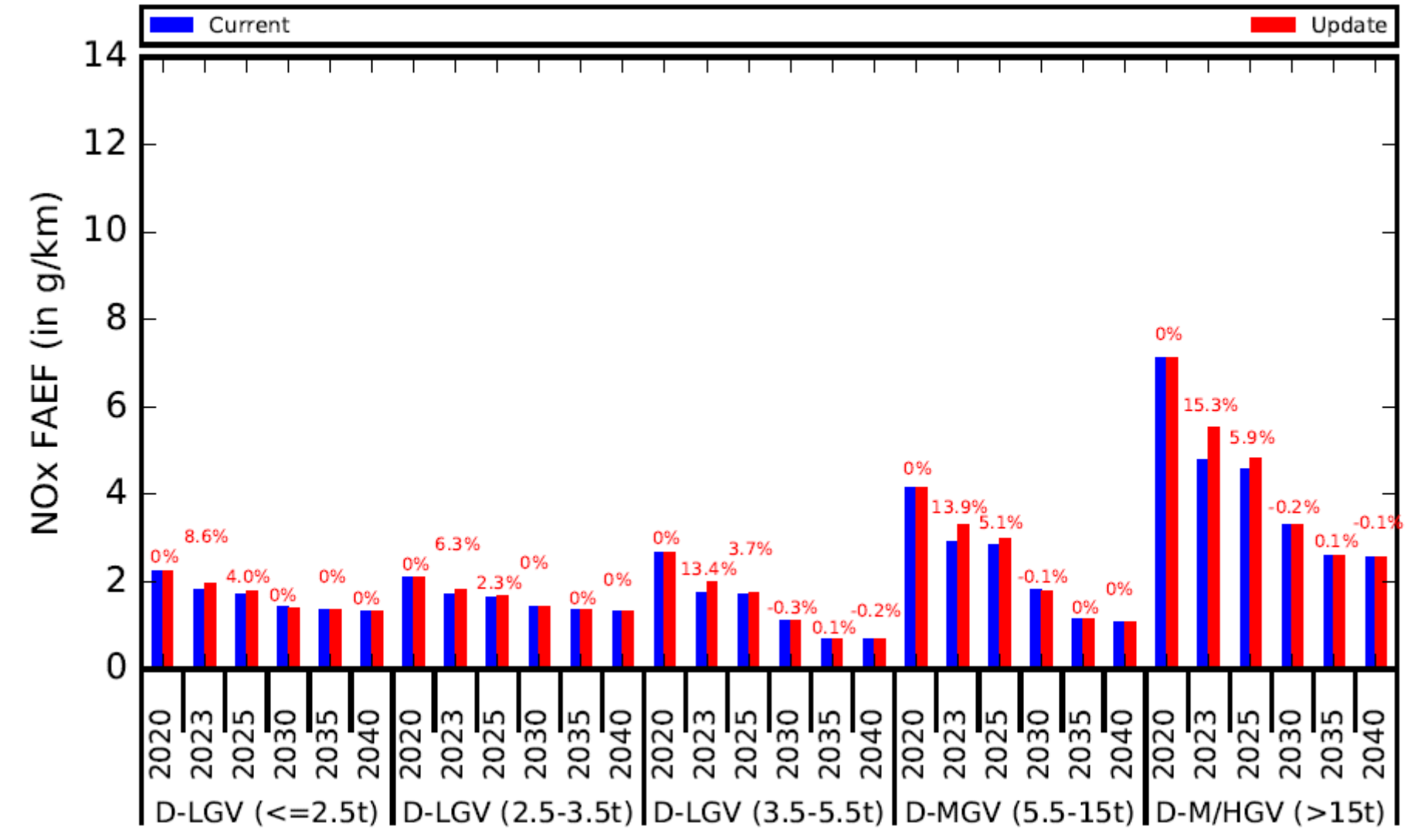
- ❖ Diesel SCR start emission changes
- Euro 3 MC changes
- Euro 4 MC implementation dates revision

- ❖ Revision of Phasing Out Euro IV DCV Programme schedule
- Euro VI Light Buses/Buses implementation dates revision

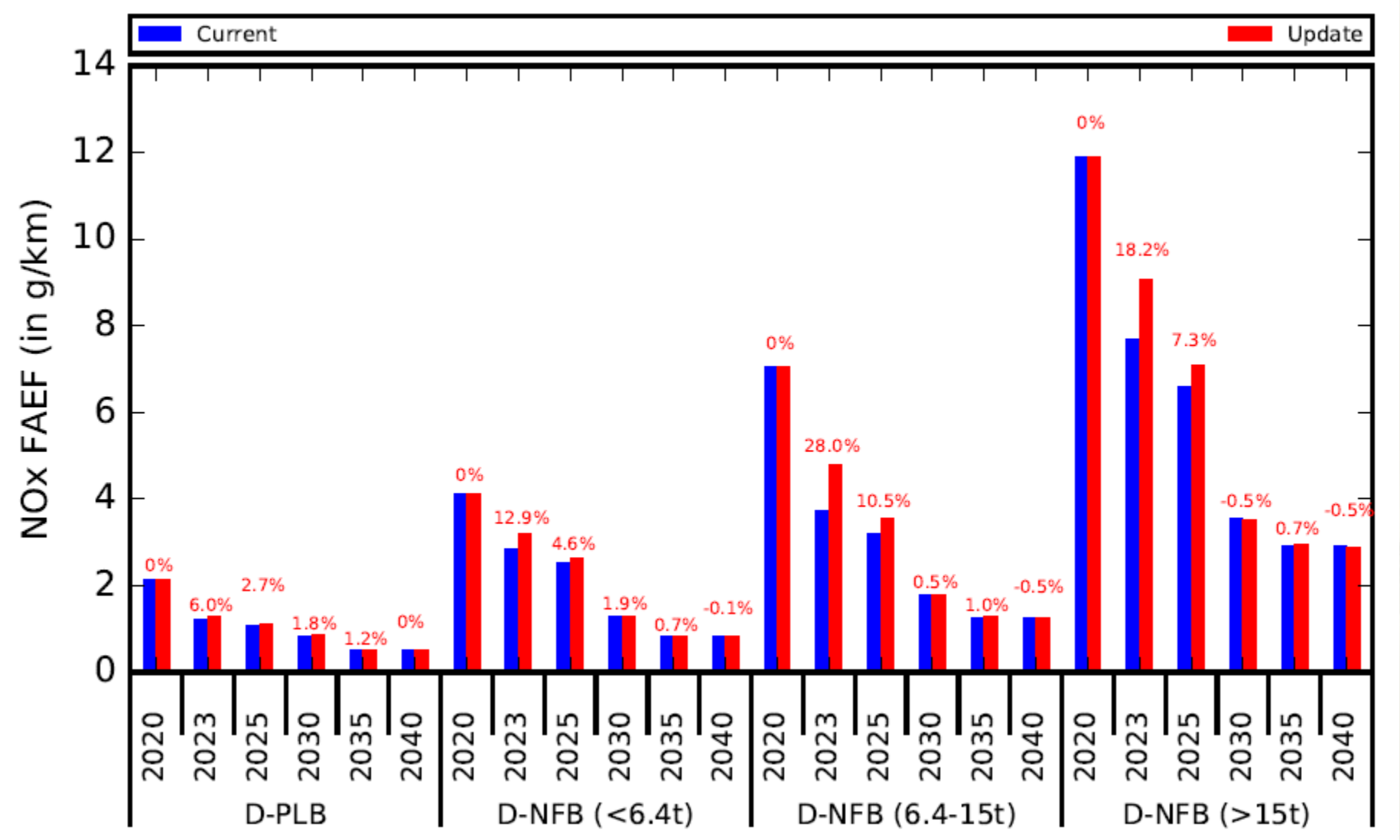


Remark: Hong Kong average speed from 2016 Vehicle Emission Inventory is used in all versions for comparison purpose.

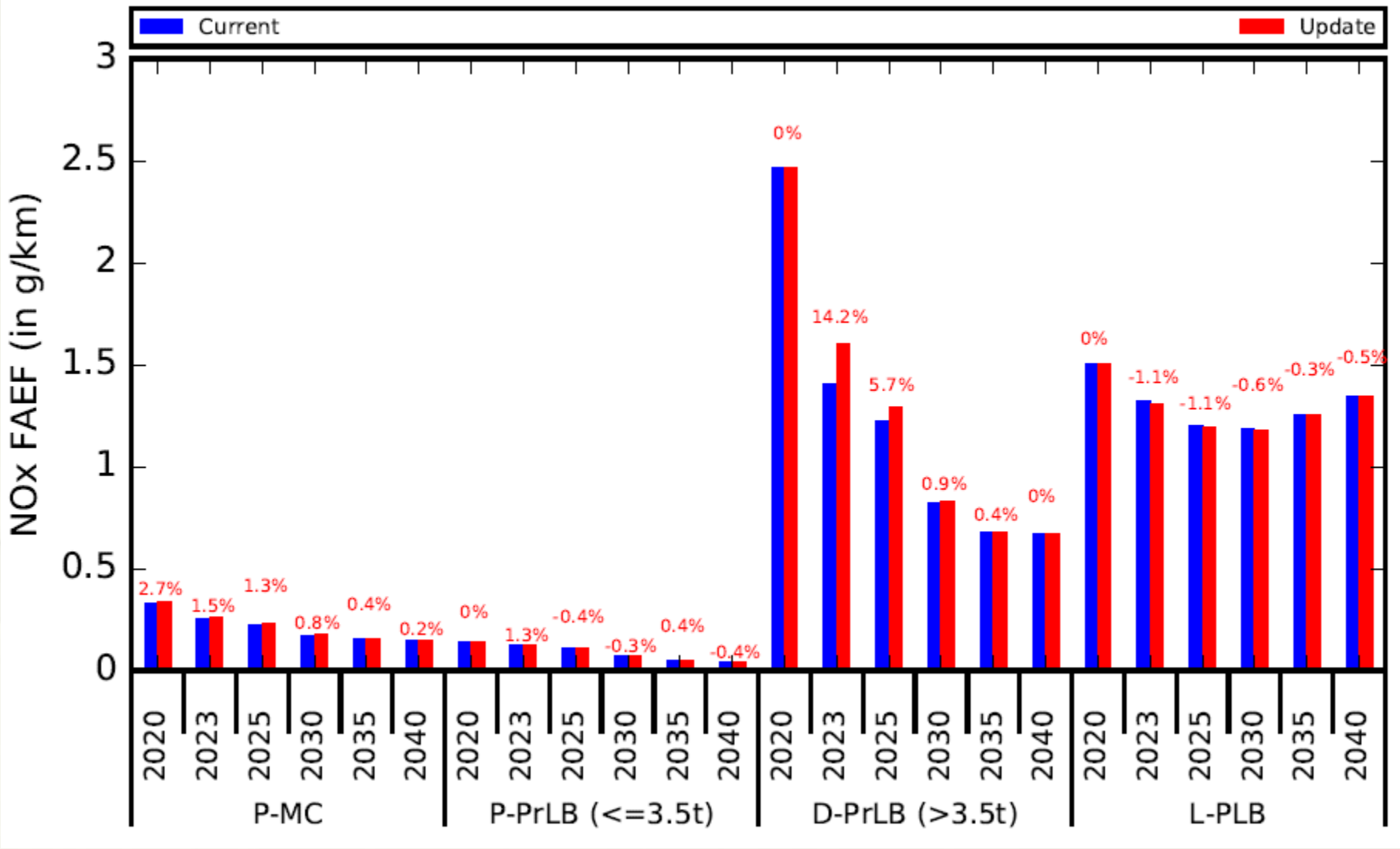
Comparison of NOx (Running Exhaust) FAEF (at 12km/hr) – Diesel Goods Vehicles



Comparison of NOx (Running Exhaust) FAEF (at 12km/hr) – Diesel Public Light Buses and Non-Franchised Buses

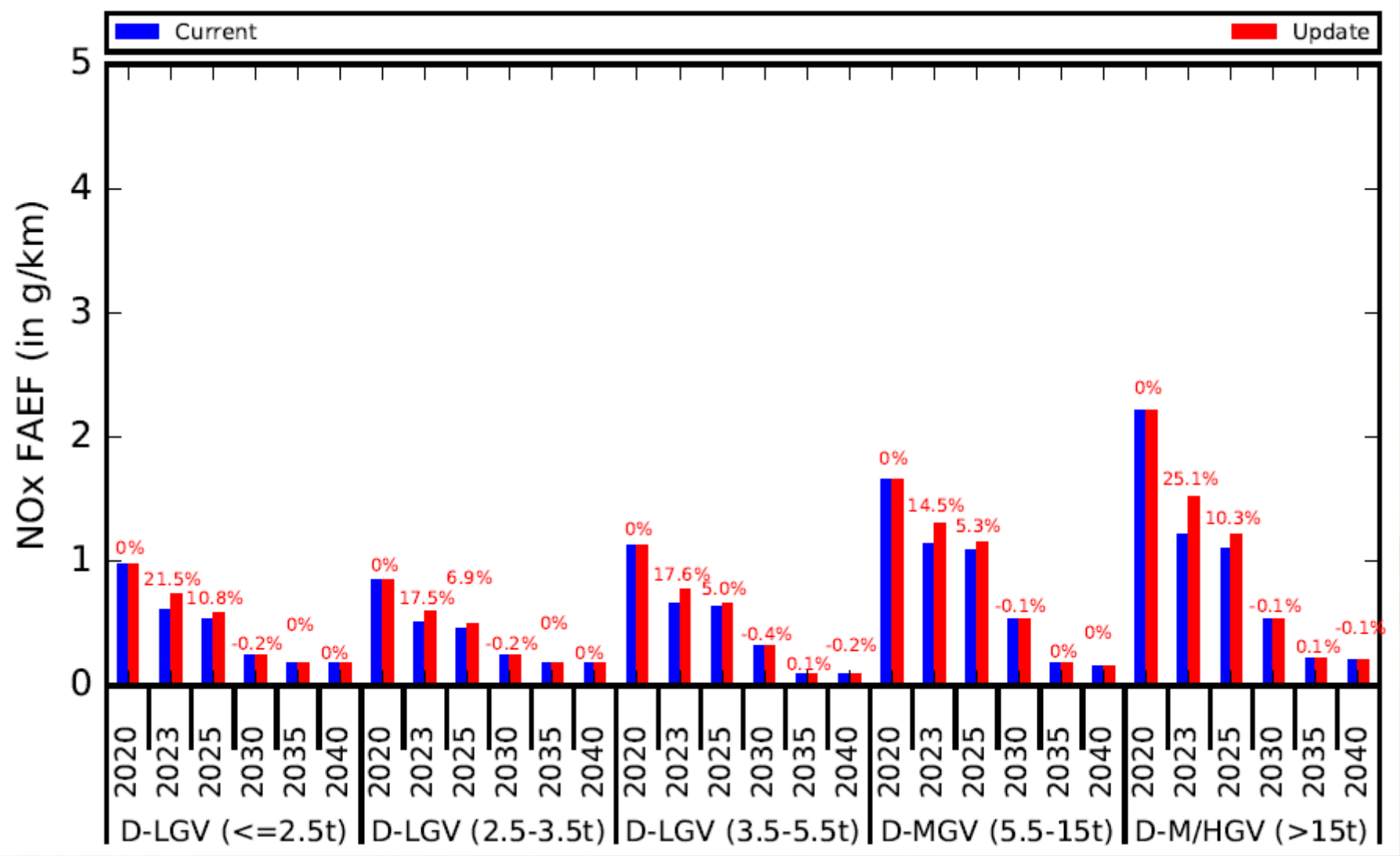


Comparison of NOx (Running Exhaust) FAEF (at 12km/hr)– Others

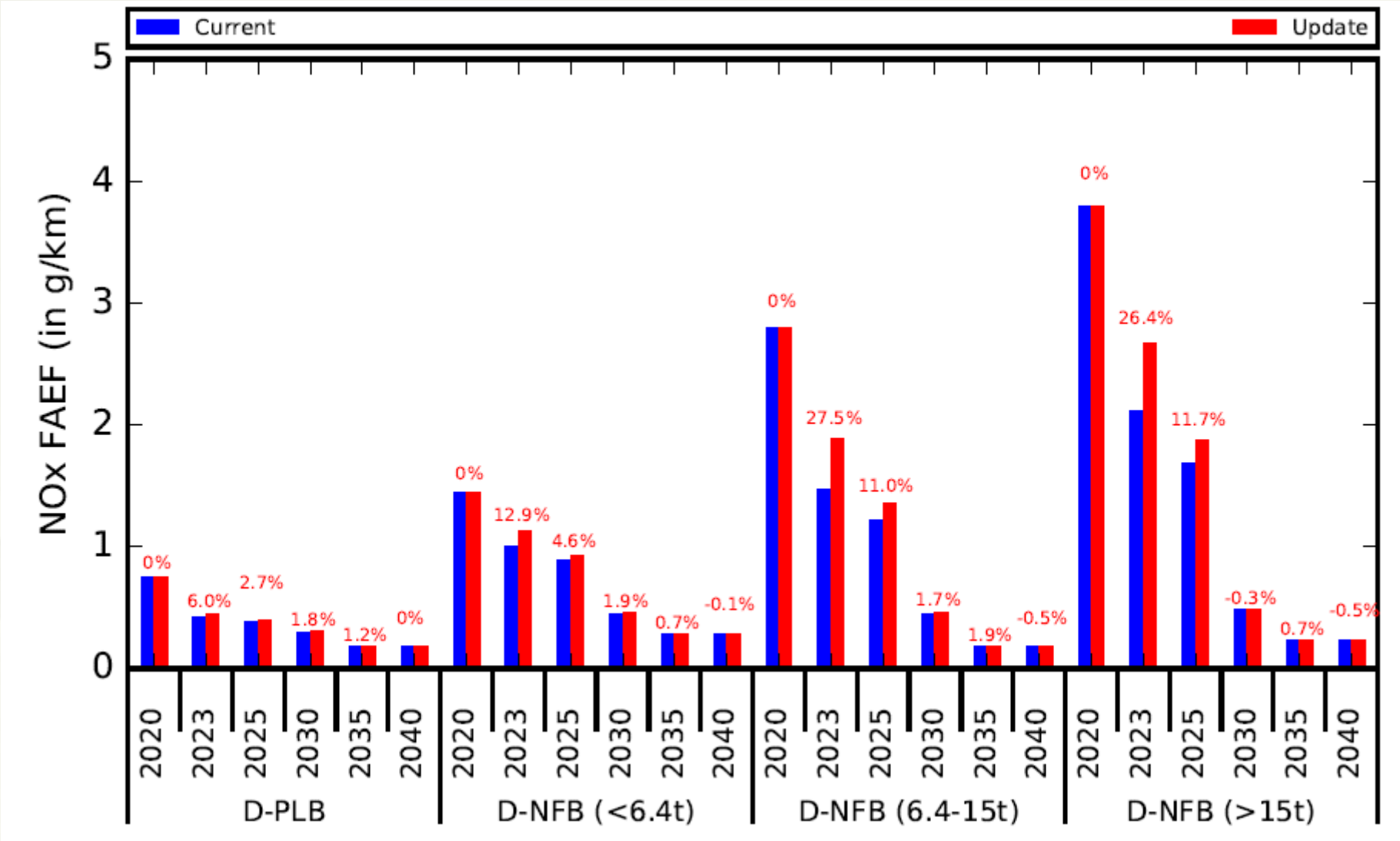


Changes of NOx fleet average emission factors for running exhaust of all remaining classes are negligible

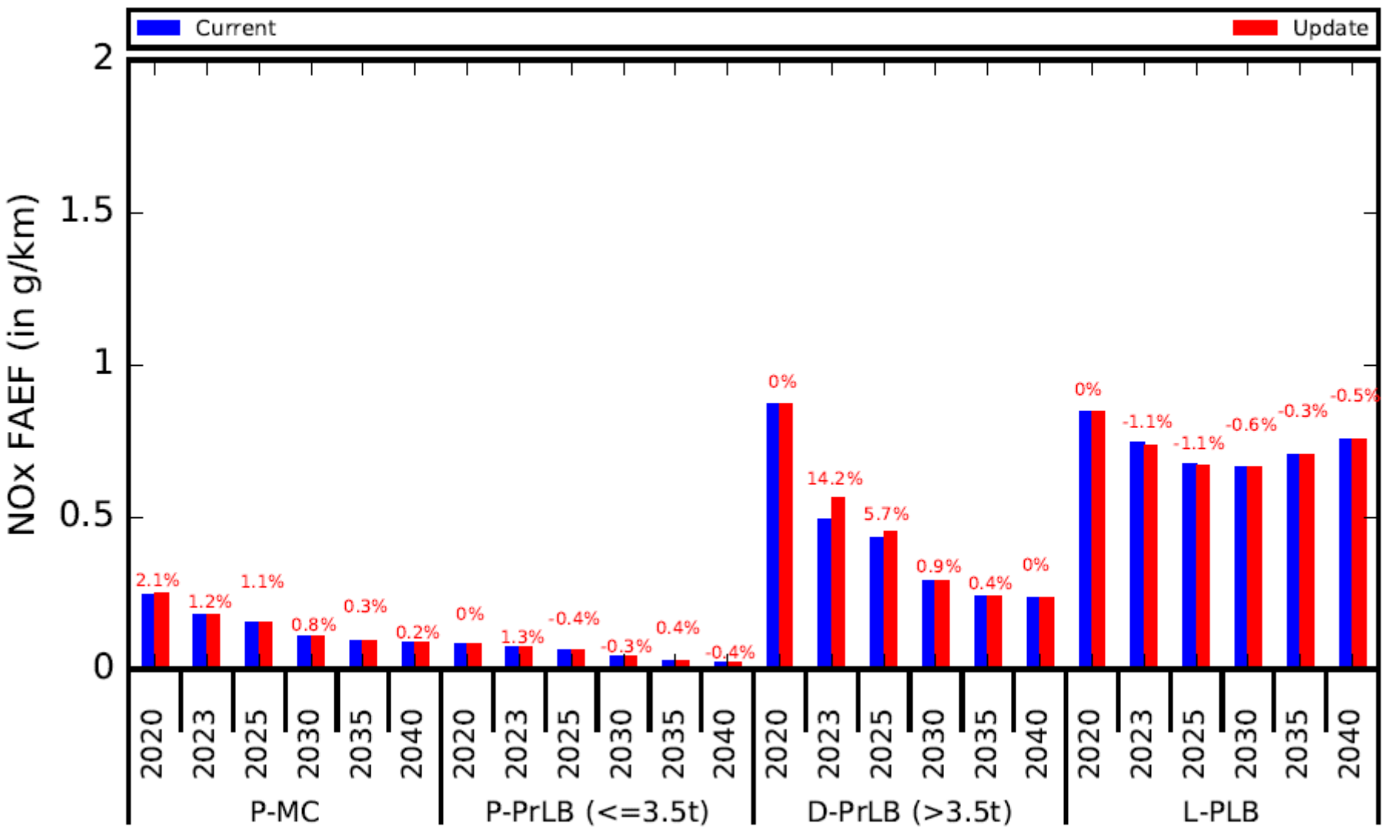
Comparison of NOx (Running Exhaust) FAEF (at 68km/hr) – Diesel Goods Vehicles



Comparison of NOx (Running Exhaust) FAEF (at 68km/hr) – Diesel Public Light Buses and Non-Franchised Buses



Comparison of NOx (Running Exhaust) FAEF (at 68km/hr)– Others

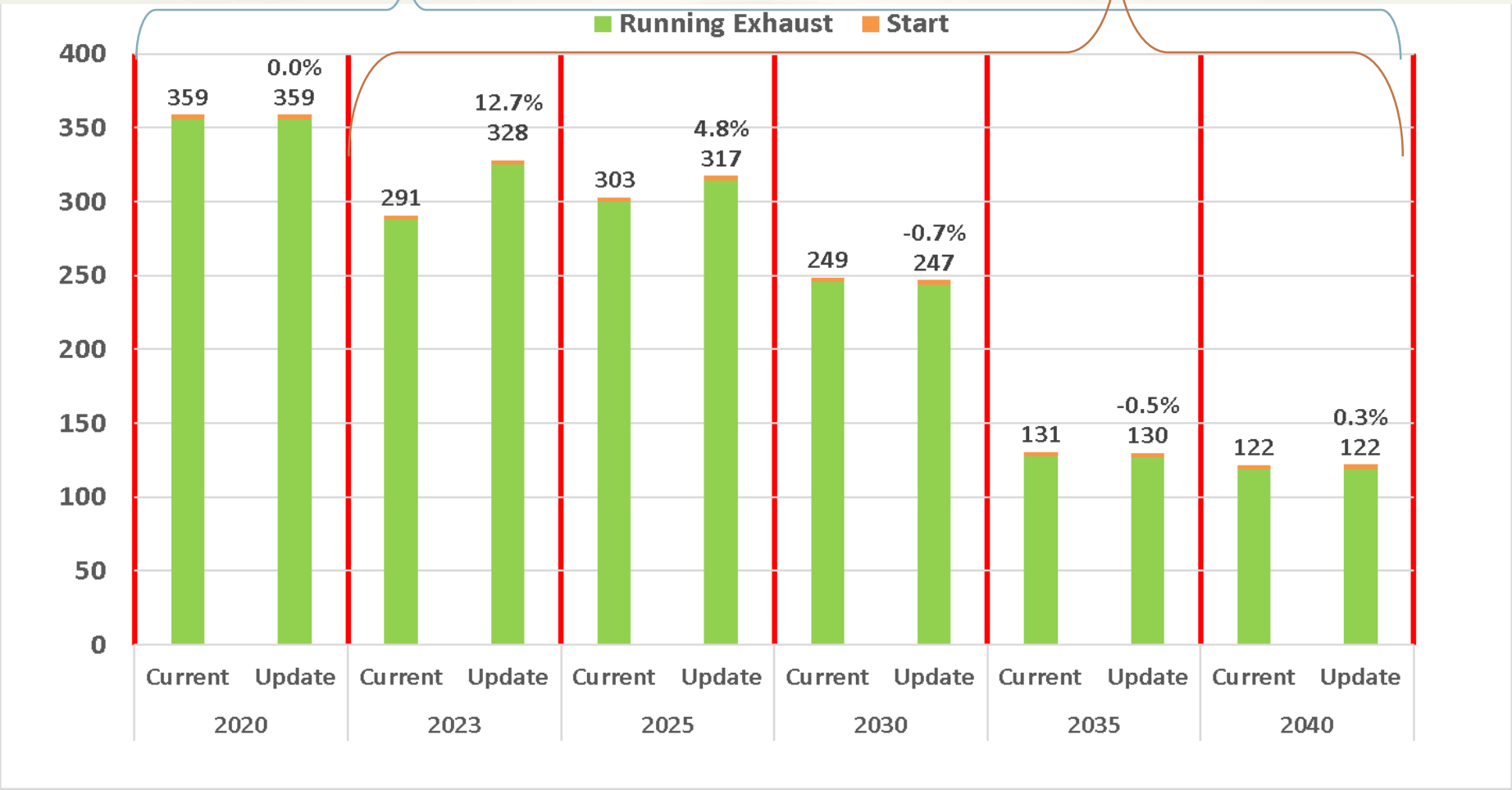


Changes of NOx fleet average emission factors for running exhaust of all remaining classes are negligible

Comparison of Territory-wide PM_{10} Emissions in Current (V4.1) and EMFAC-HK update (V4.2)

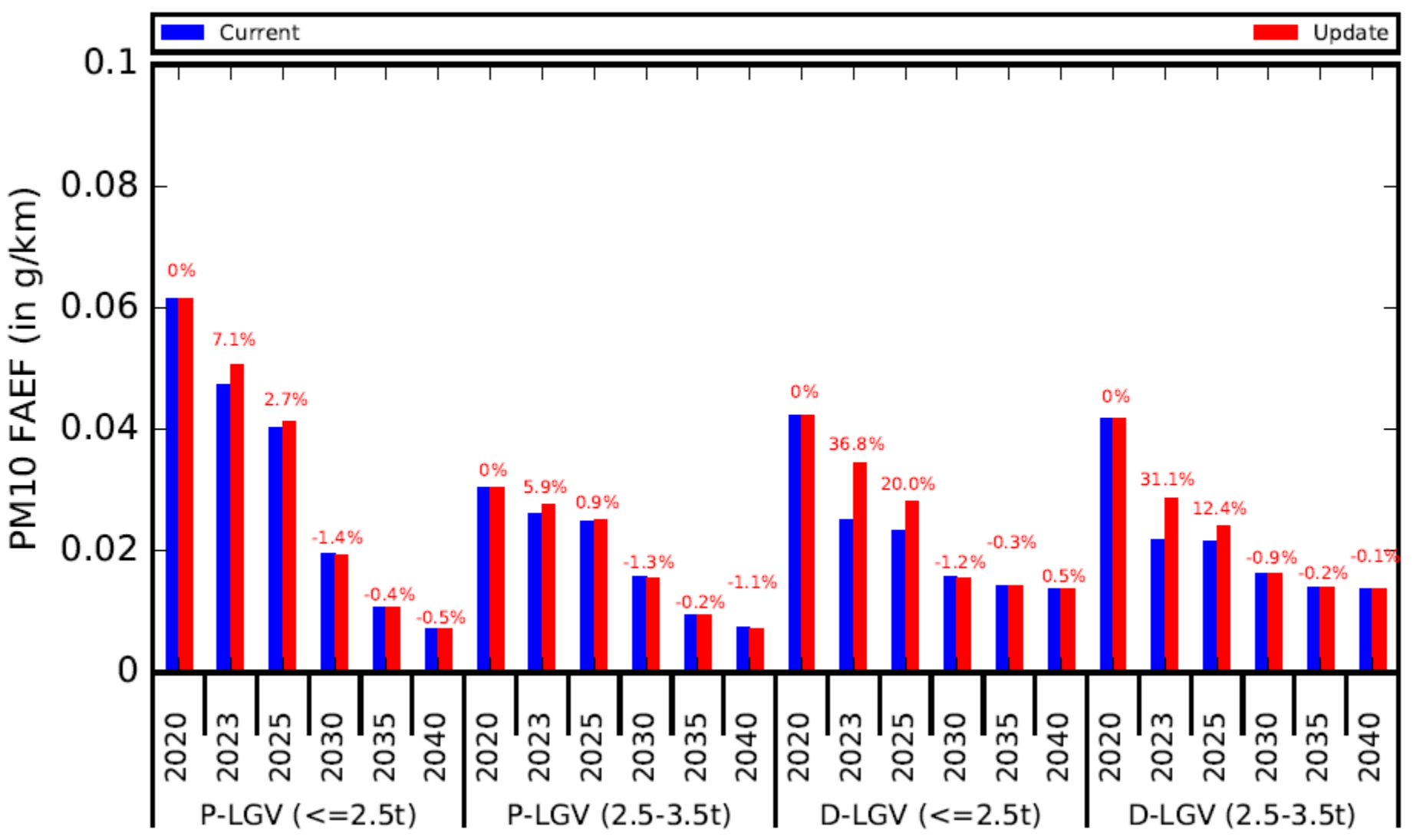
- Euro 3 MC changes
- Euro 4 MC implementation dates revision

❖ Phasing Out Euro IV DCV Programme schedule revision
- Euro VI Light Buses/Buses implementation dates revision

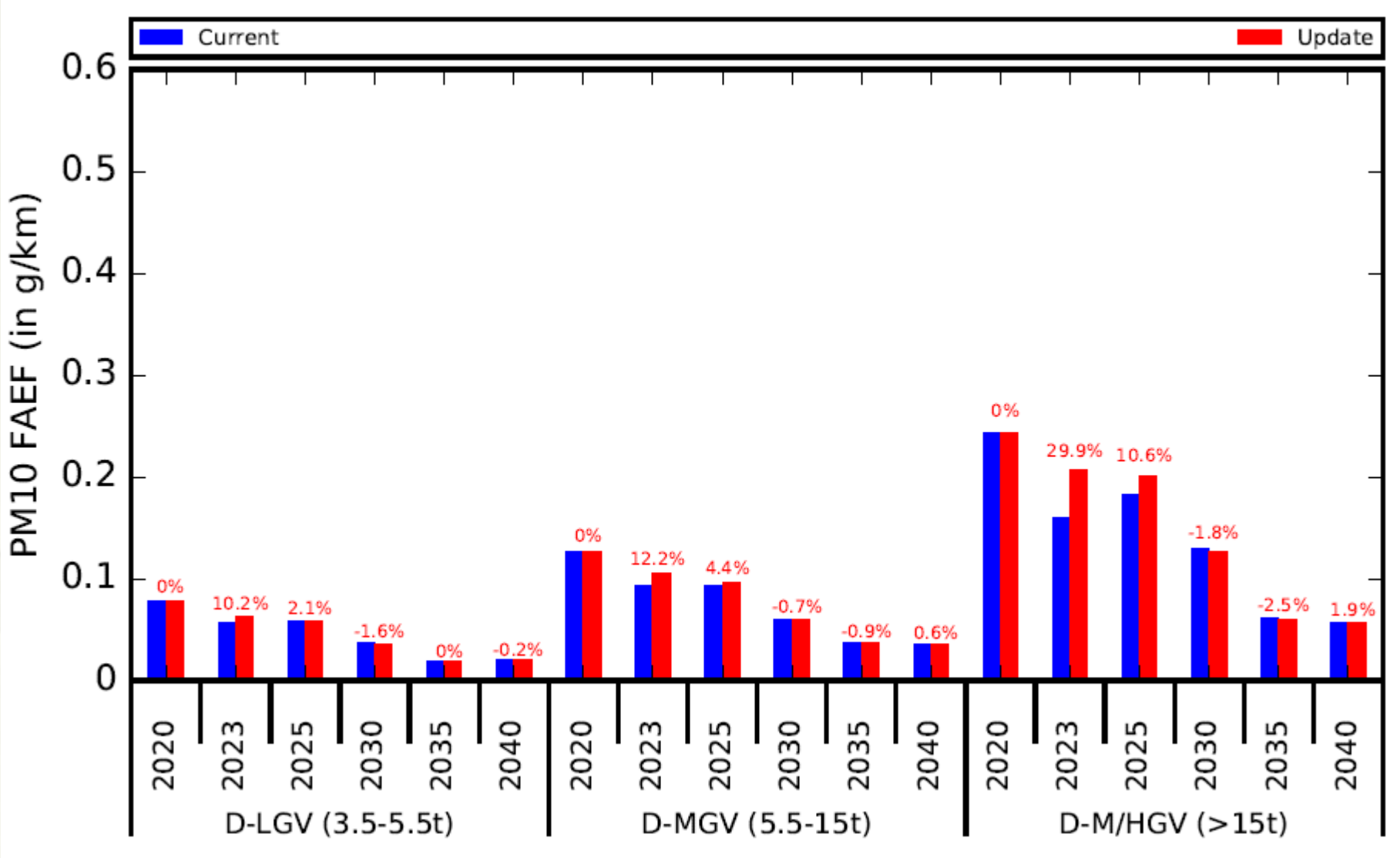


Remark: Hong Kong average speed from 2016 Vehicle Emission Inventory is used in all versions for comparison purpose.

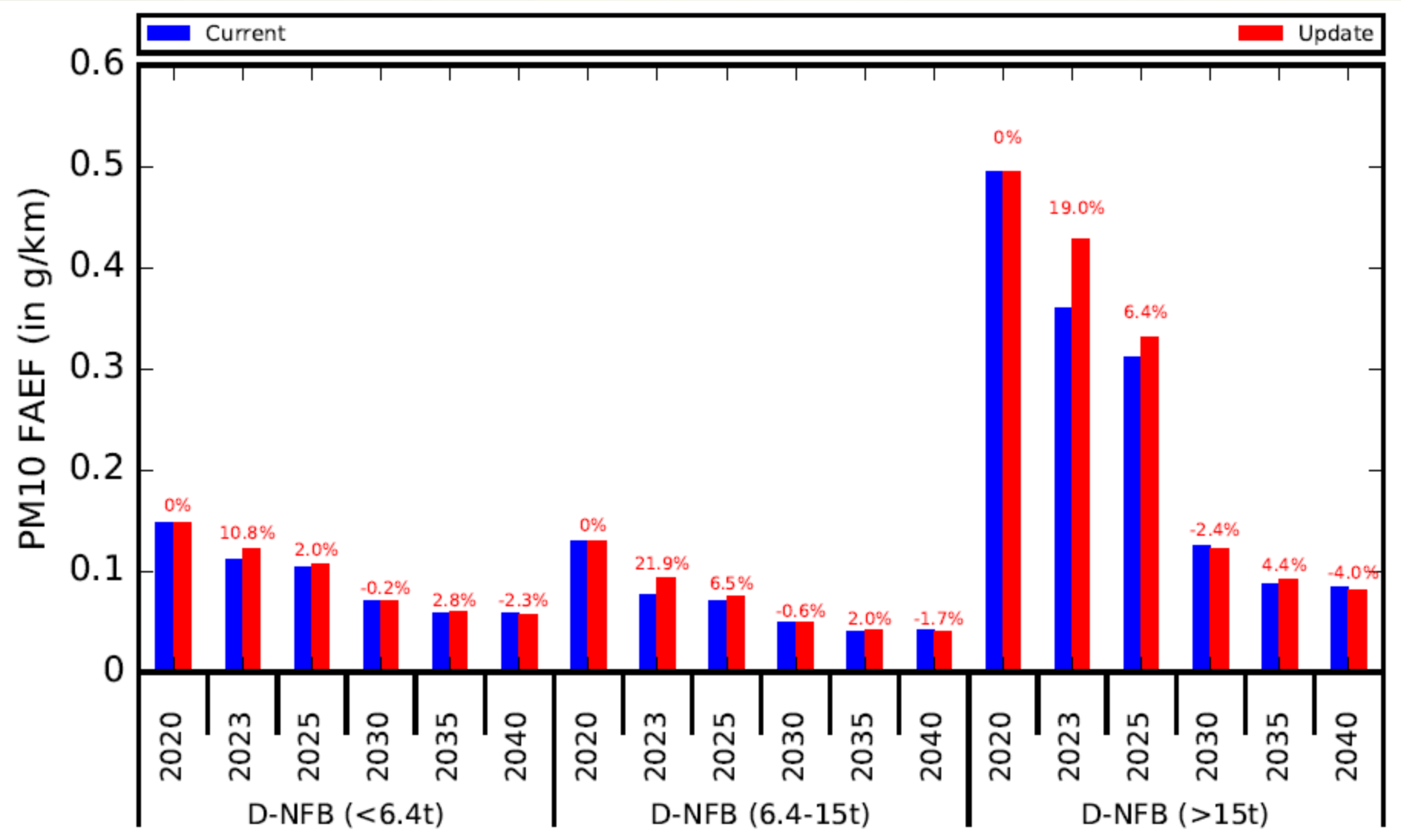
Comparison of PM_{10} (Running Exhaust) FAEF (at 12km/hr) – Light Goods Vehicles ≤ 3.5t



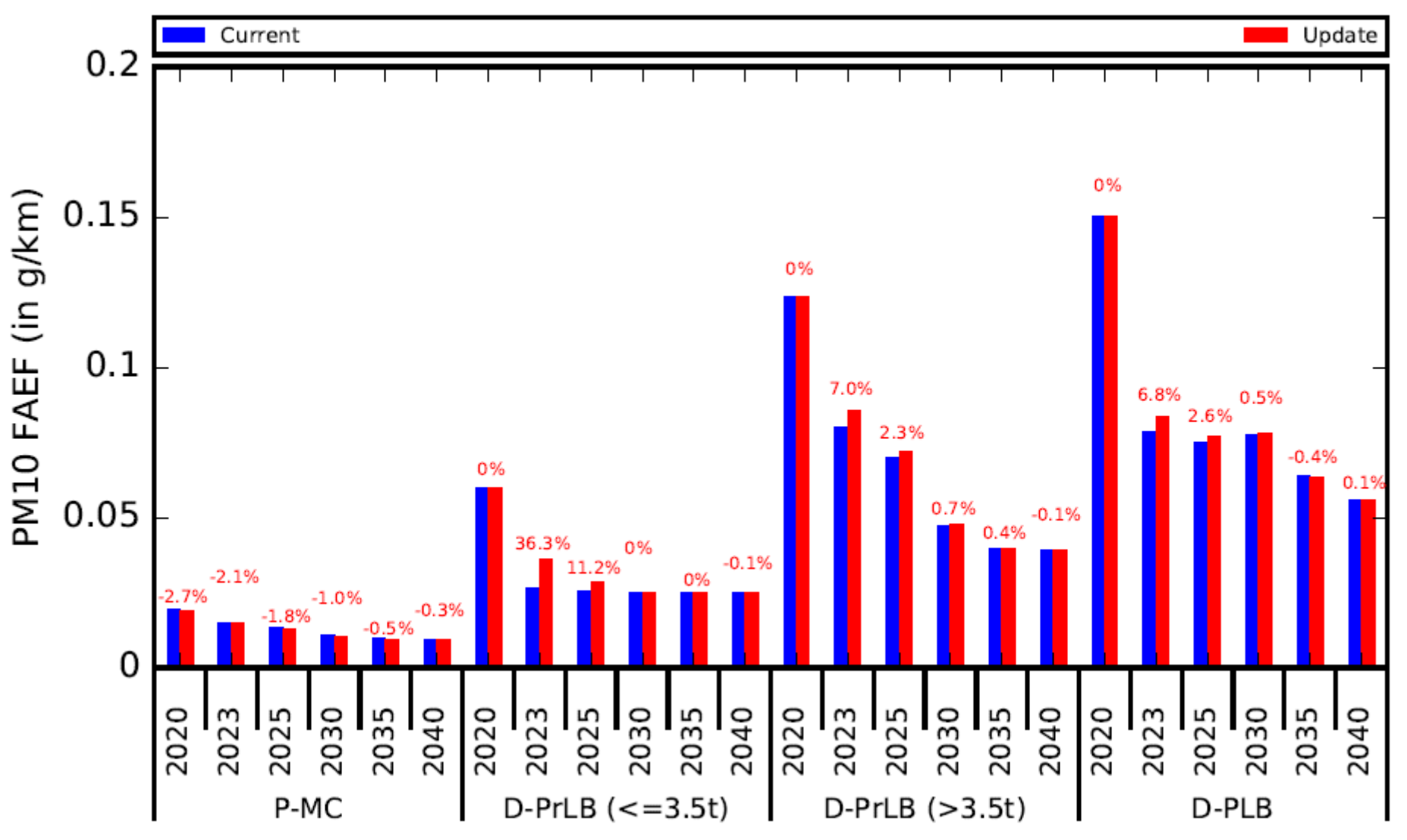
Comparison of PM_{10} (Running Exhaust) FAEF (at 12km/hr) – Goods Vehicles > 3.5 tonnes



Comparison of PM_{10} (Running Exhaust) FAEF (at 12km/hr) – Non-Franchised Buses

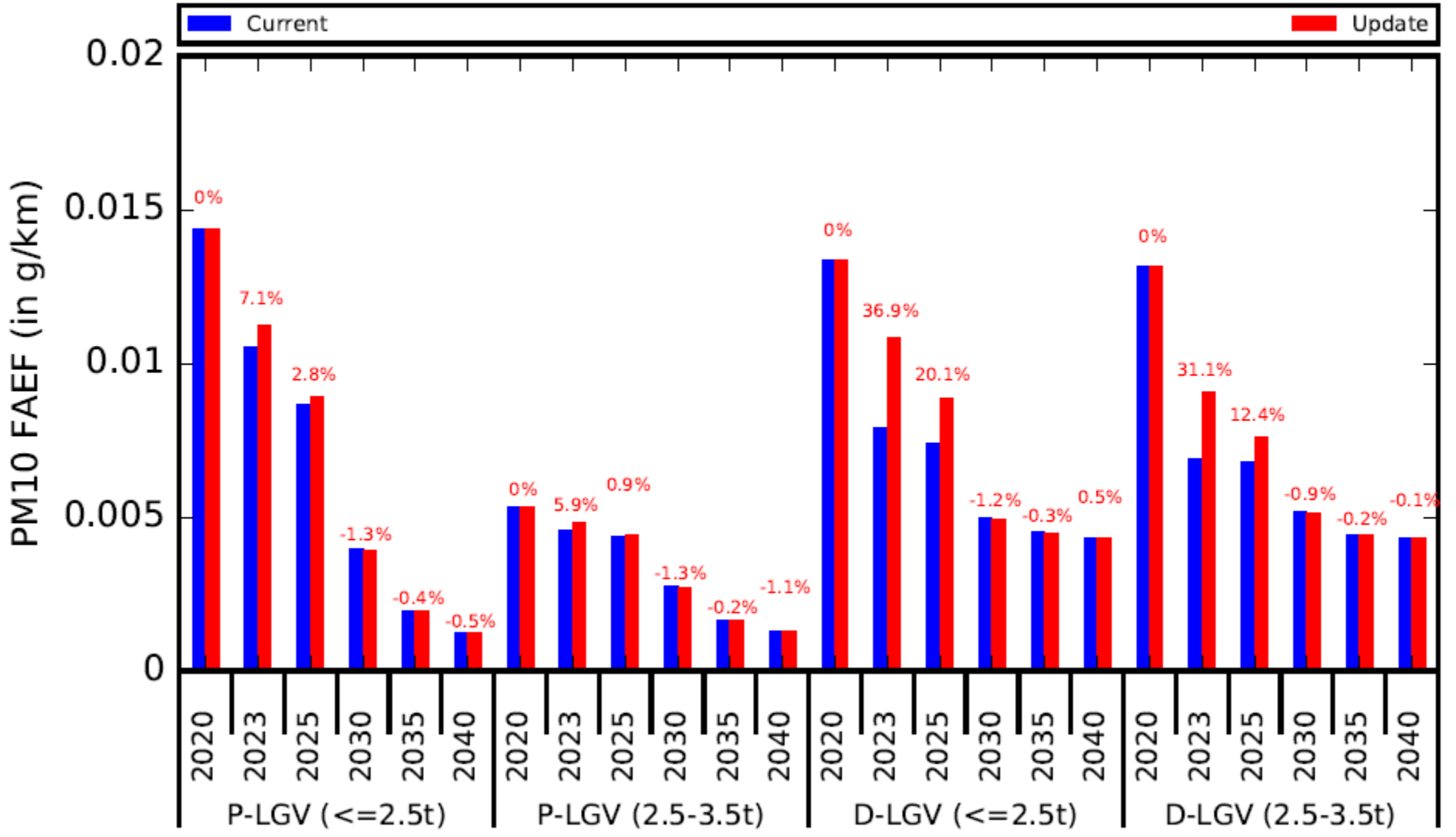


Comparison of PM_{10} (Running Exhaust) FAEF (at 12km/hr) – Others

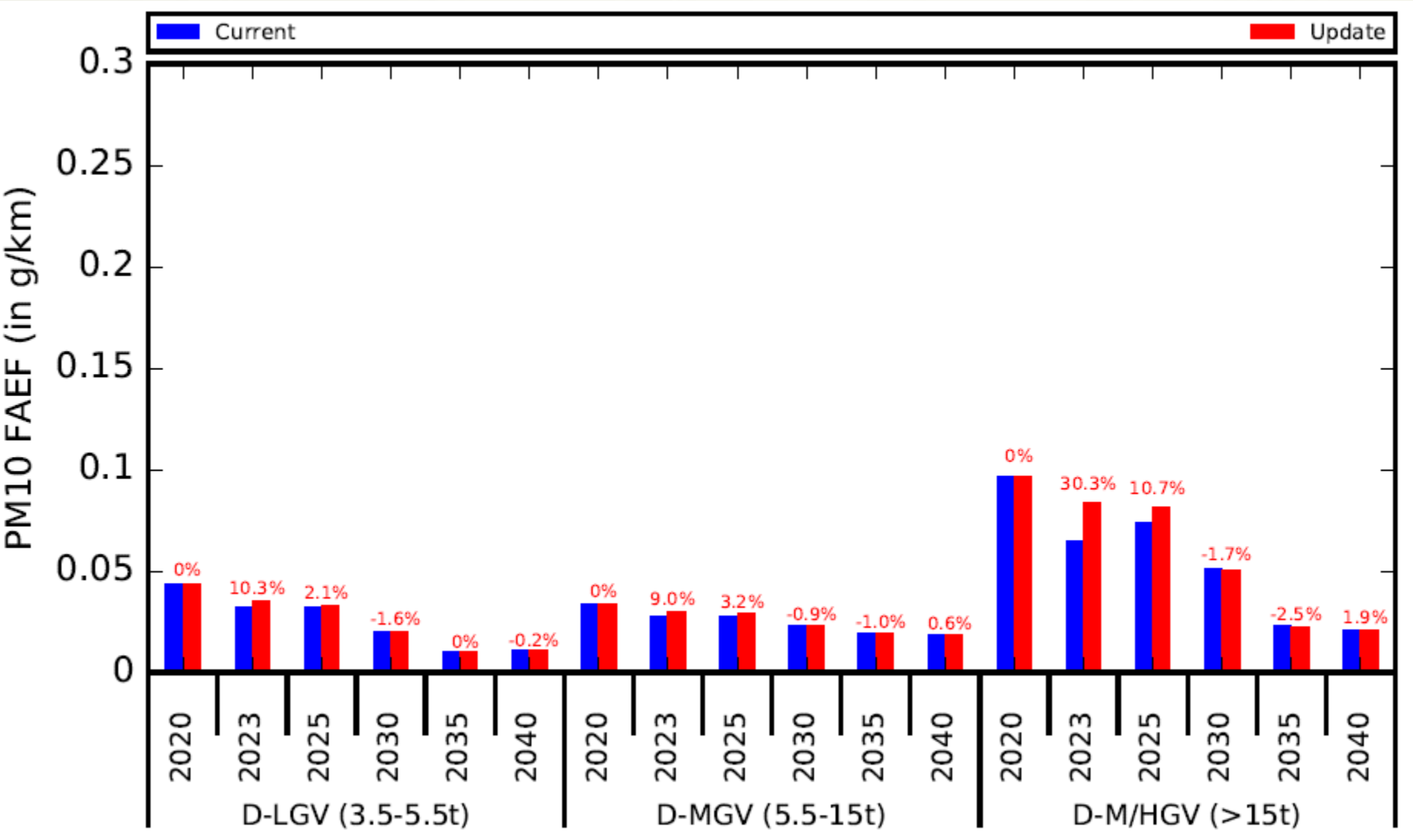


Changes of PM_{10} fleet average emission factors for running exhaust of all remaining classes are negligible.

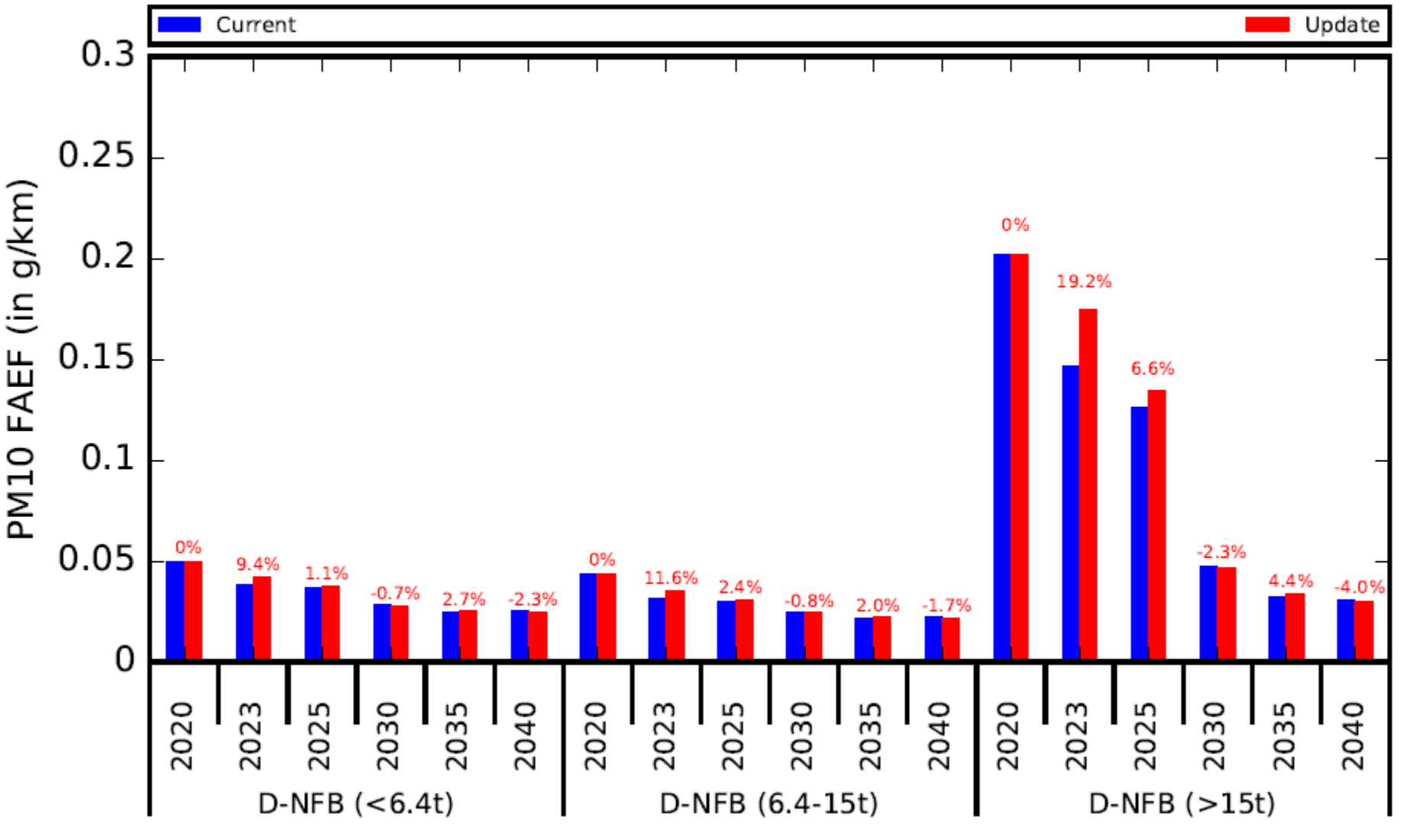
Comparison of PM_{10} (Running Exhaust) FAEF (at 68km/hr) – Light Goods Vehicles ≤ 3.5t



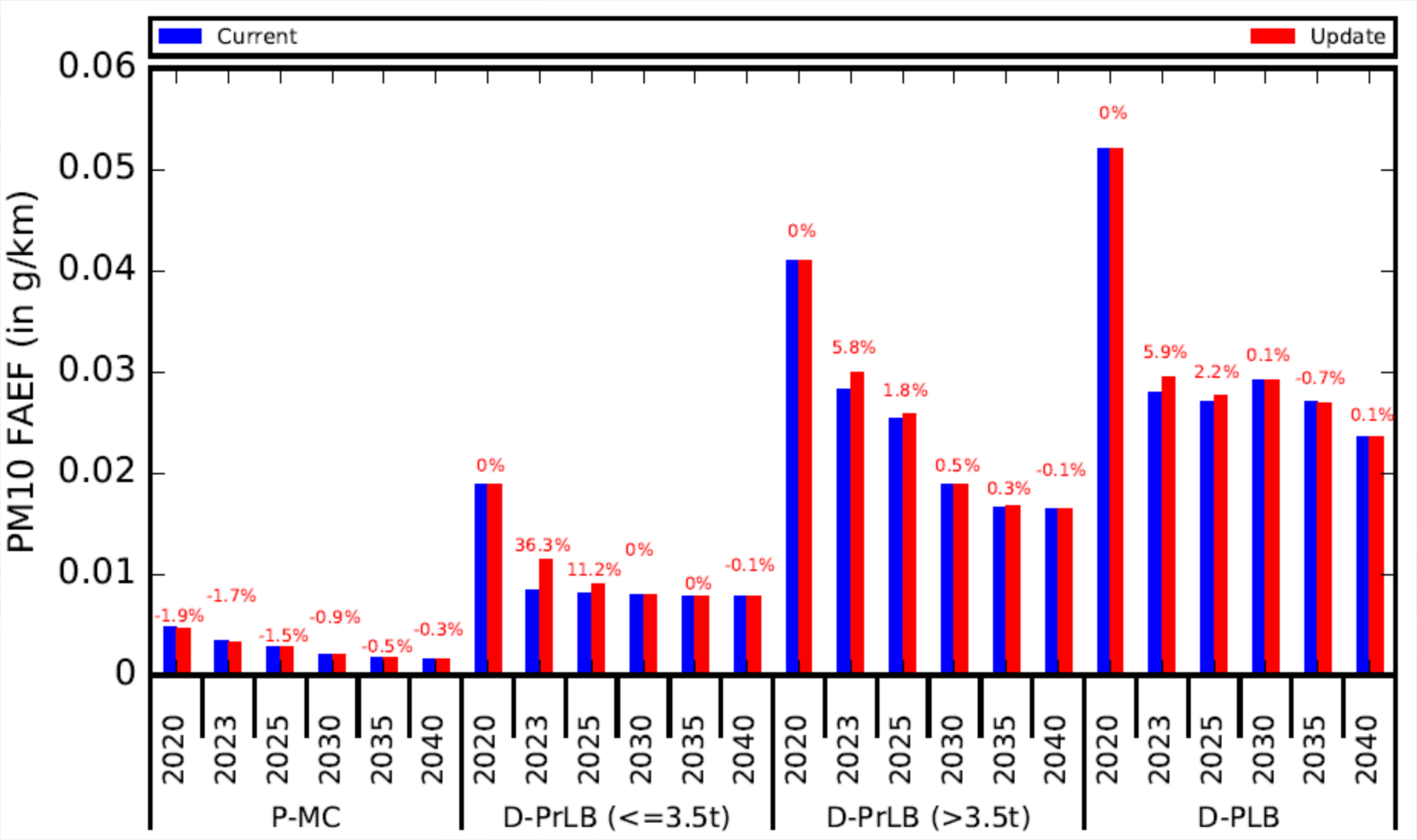
Comparison of PM_{10} (Running Exhaust) FAEF (at 68km/hr) – Goods Vehicles > 3.5 tonnes



Comparison of PM_{10} (Running Exhaust) FAEF (at 68km/hr) – Non-Franchised Buses



Comparison of PM_{10} (Running Exhaust) FAEF (at 68km/hr) – Others



Changes of PM_{10} fleet average emission factors for running exhaust of all remaining classes are negligible.

Release of EMFAC-HK

- Will release EMFAC-HK V4.2 in January 2020.

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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 non-compliance**, if necessary.


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