

A Study on Predicting CO₂ Emissions Based on Calculated ECU Data and Deep Learning Model on Real-Driving Conditions for LDVs

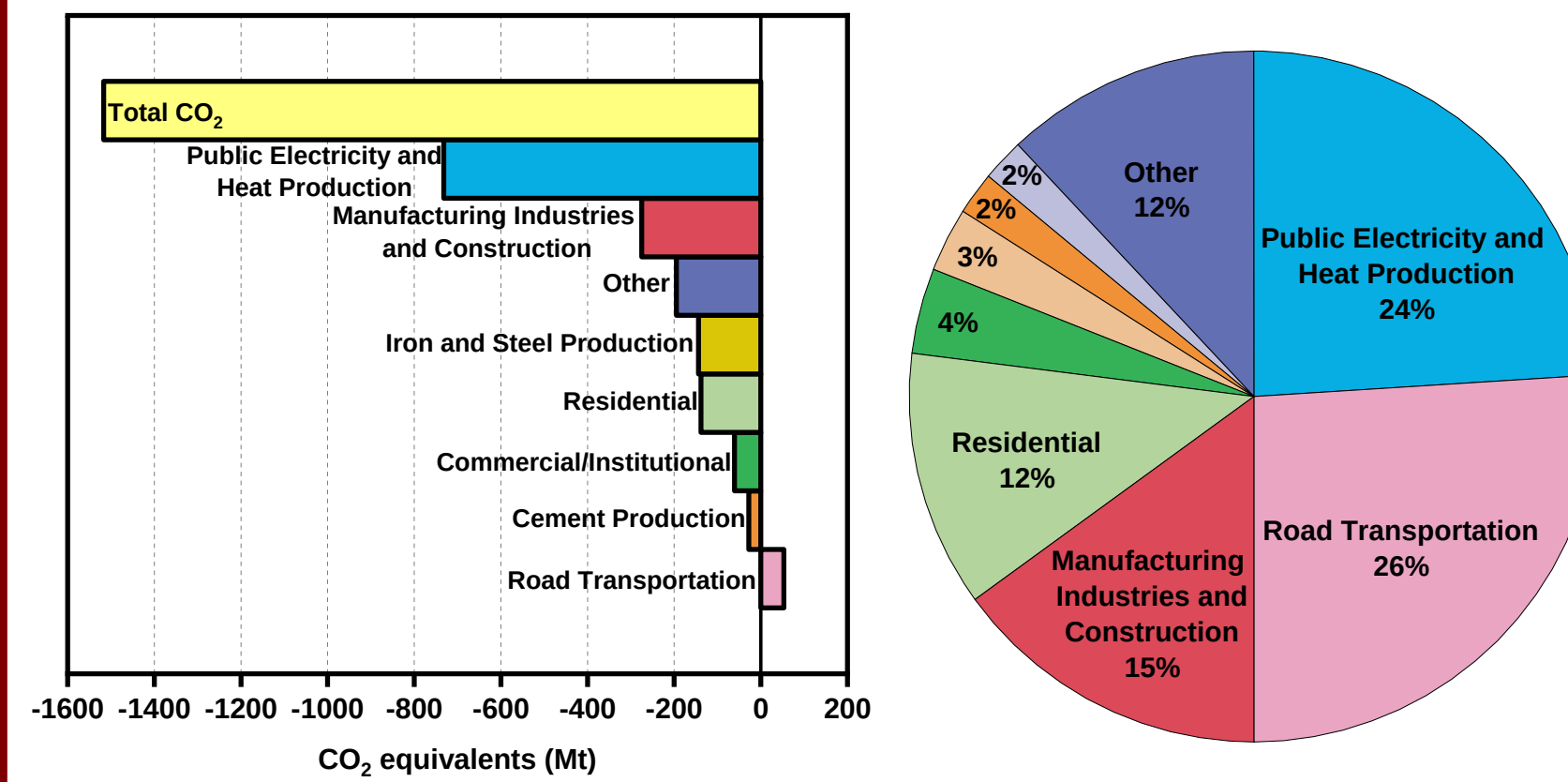
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26th ETH-Conference on Combustion Generated Nanoparticles, June 20th – 22nd, 2023 at ETH Zurich, Switzerland

❖ Introduction

Absolute Change of CO₂ Emissions 1990 to 2020 for EU-KP Share of CO₂ Emissions in 2020 for EU-KP



◆ In EU-KP, CO₂ emissions decreased in the majority of sectors between 1990 and 2020. However, CO₂ emissions increased in road transportation.

◆ Similar to EU-KP, CO₂ emissions accounted for a high proportion in Korea in 2020.

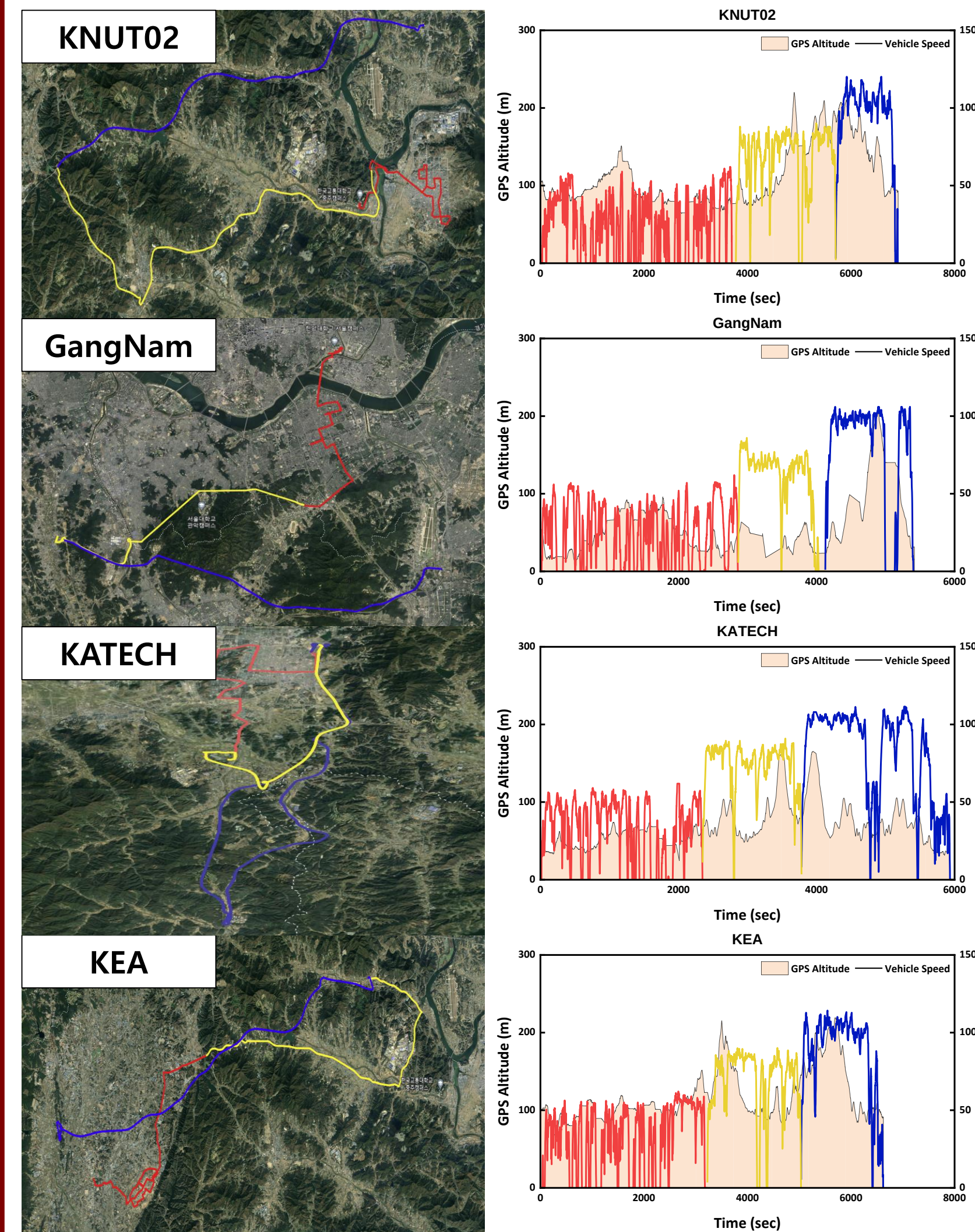
◆ Globally, to reduce CO₂ emissions of light-duty vehicles has been strengthened emissions regulation. (e.g. EU - Fit for 55, Korea - FRAMEWORK ACT ON CARBON NEUTRALITY AND GREEN GROWTH FOR COPING WITH CLIMATE CRISIS)

◆ To monitoring CO₂ emissions from road transportation, various emission calculation systems suitable for each country have been developed and used. (e.g. EU - COPERT, HBEFA, USA - MOVES, Korea - CAPSS)

◆ Therefore, researchers aimed to predict CO₂ emissions during real-driving through deep learning model.

◆ As a basic study, a study on predicting CO₂ emissions based on calculated ECU data and deep learning model on real-driving conditions for LDVs.

❖ Test Route



		Urban	Rural	Motorway	Total
Trip Distance (km)	KNUT02	30.11	34.33	28.99	93.43
	GangNam	22.93	20.74	23.95	67.62
	KATECH	29.81	33.27	35.53	98.60
	KEA	35.92	35.38	31.30	102.60
Trip Duration (min.)	KNUT02	62.9	32.1	20.1	115.1
	GangNam	47.7	21	21.5	90.2
	KATECH	39.1	23.8	35.9	98.8
	KEA	53.7	30.1	26.5	110.3

❖ Test Vehicle



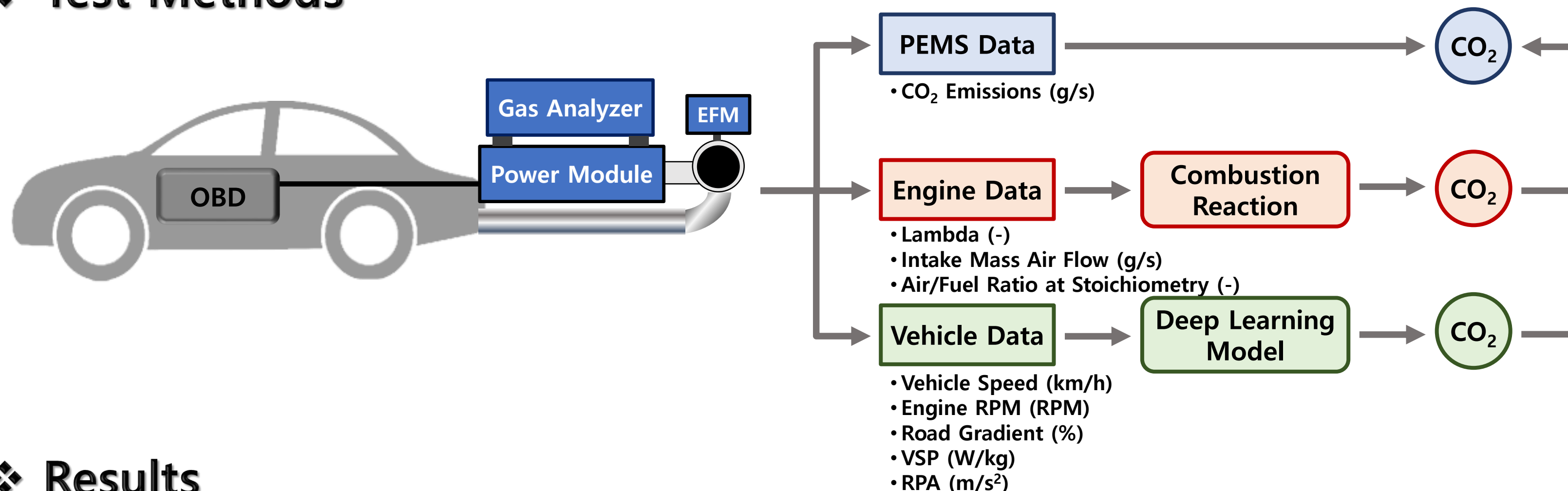
Vehicle	Fuel Type	Model Year	Vehicle Type	Disp.	Tolerance Weight	Max. Torque	Emission Regulation
Veh. 1	Diesel	2018	Sedan	1,685cc	1,520kg	34.7kg·m	Euro-6
Veh. 2	Gasoline	2017	Sedan	1,591cc	1,480kg	27kg·m	LEVIII-ULEV70
Veh. 3	Hybrid (Gasoline + Electricity)	2017	Sedan	1,999cc	1,585kg	19.3kg·m	LEVIII-ULEV125

❖ Correlation Test

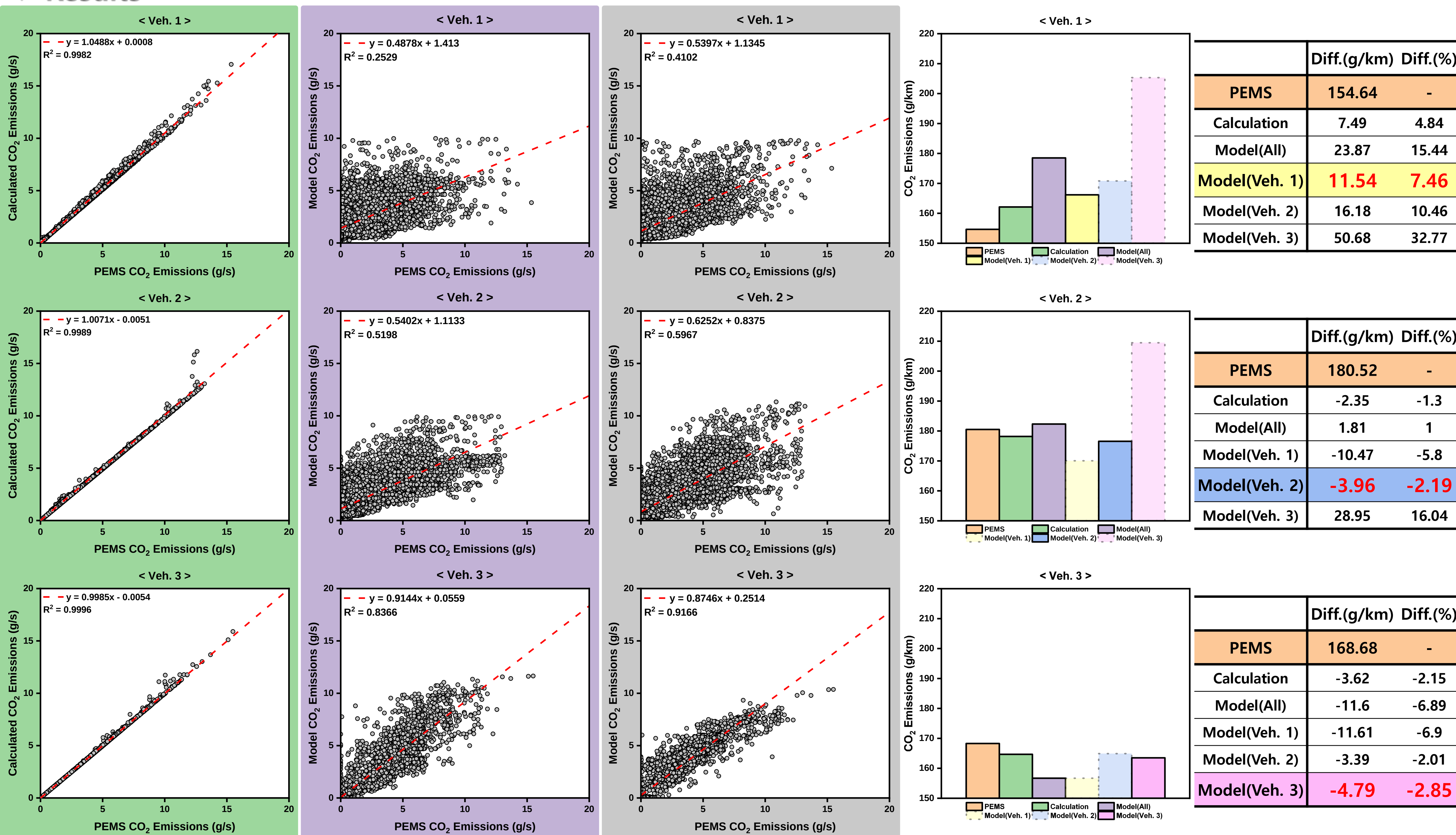


Vehicle	Test Mode	CVS (g/km)	PEMS (g/km)	Diff. (%)	Diff. (abs.)
Veh. 1	WLTC	138.66	152.52	10	13.86
Veh. 2	WLTC	128.841	131.489	2	2.65
Veh. 3	WLTC	110.561	113.841	3	3.28

❖ Test Methods



❖ Results



❖ Conclusions

- ◆ Deep learning model results are similar to Combustion reaction calculation results and characteristics of diesel vehicles (CI engine, EGR) are shown.
- ◆ The deep learning models conducted with each vehicle data have high accuracy than that conducted with diesel, gasoline and hybrid vehicle data at once.
- ◆ Although the deep learning model has lower accuracy than combustion reaction calculation for time-series data, it has a similar level of high accuracy for one RDE.
- ◆ It is possible to predict CO₂ emissions through dynamic factors of vehicles, but there exist limit.
- ◆ For accurate prediction, it requires to add factors related to engine and combustion. Also, it requires to add static factors like displacement, Tolerance weight, year, presence of after-treatments.

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✉ Acknowledgement

This work was supported by the Korea Agency for infrastructure Technology Advancement(KAIA) grant funded by the Ministry of Land, infrastructure and Transport(Grant RS-2023-00243220).