

# Development of bottom-up emission inventory for vehicle fleet in Ho Chi Minh City to assess potential co-benefits to air quality and climate

Huynh Hai Van and Nguyen Thi Kim Oanh

Environmental Engineering and Management Program  
School of Environment, Resources and Development, Asian Institute of Technology,  
Paholyothin Highway Km. 42, Klong Luang, Pathumthani 12120, Thailand  
Email: jackiehuynh1990@gmail.com & kimoanh@ait.ac.th

## Introduction

Traffic contribute a substantial amount of emissions of air pollutants and climate forcing agents, both long-lived greenhouse gases and short-lived climate pollutants (SLCP). The traffic emissions, however are not adequately quantified for Asian developing cities.

This study conducted a bottom-up emission inventory for urban passenger fleet (buses, trucks, taxi, personal cars and motorcycles) and trucks in Ho Chi Minh City (HCMC), Vietnam, for 2013 and projected the emission under a scenario of faster Euro3 technology intrusion. The data collection and analysis were done using International Vehicle Emission (IVE) model (ISSR, 2008). The emission reduction under this scenario was quantified for toxic pollutants and climate forcers using GWP.

## Key Findings

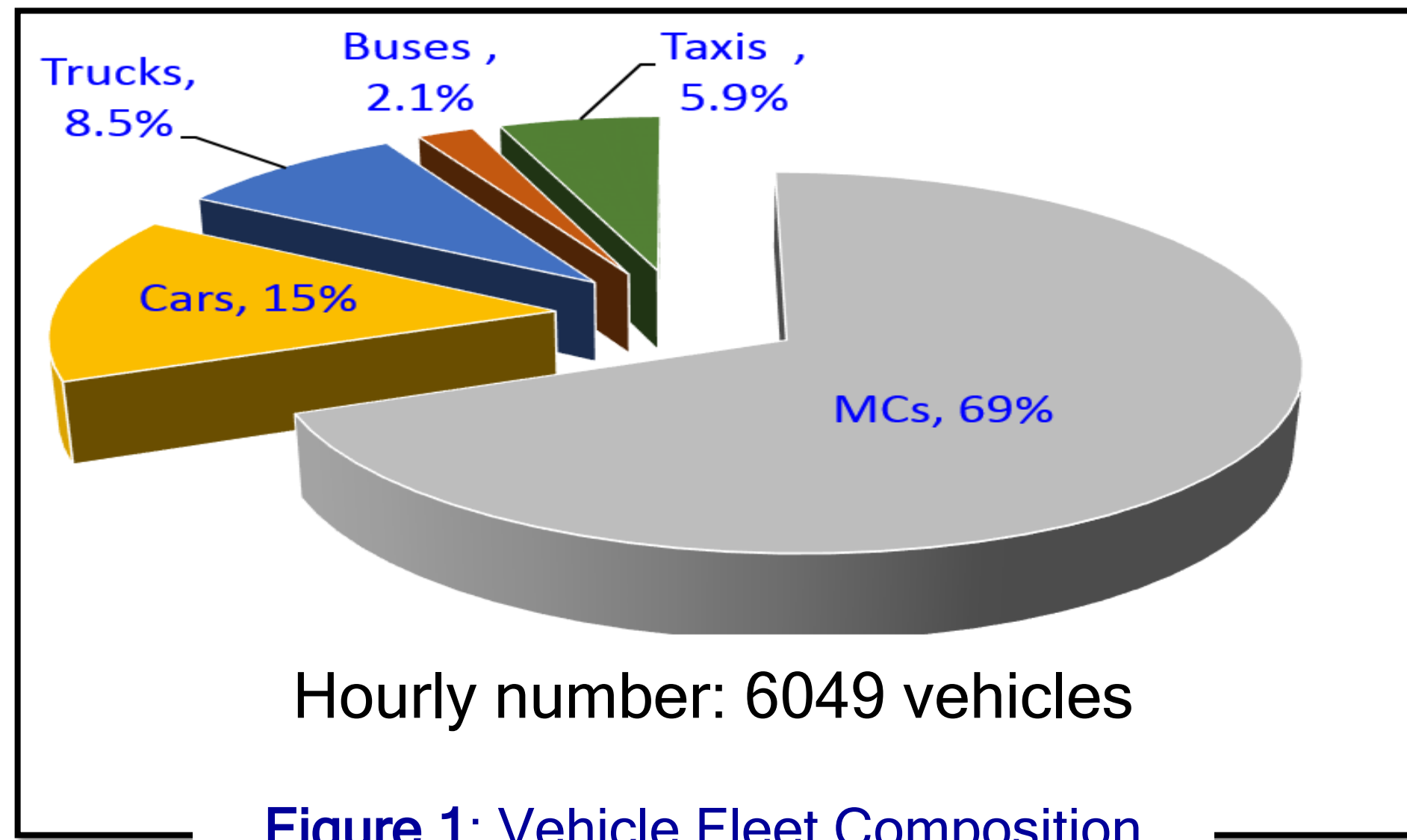


Figure 1: Vehicle Fleet Composition

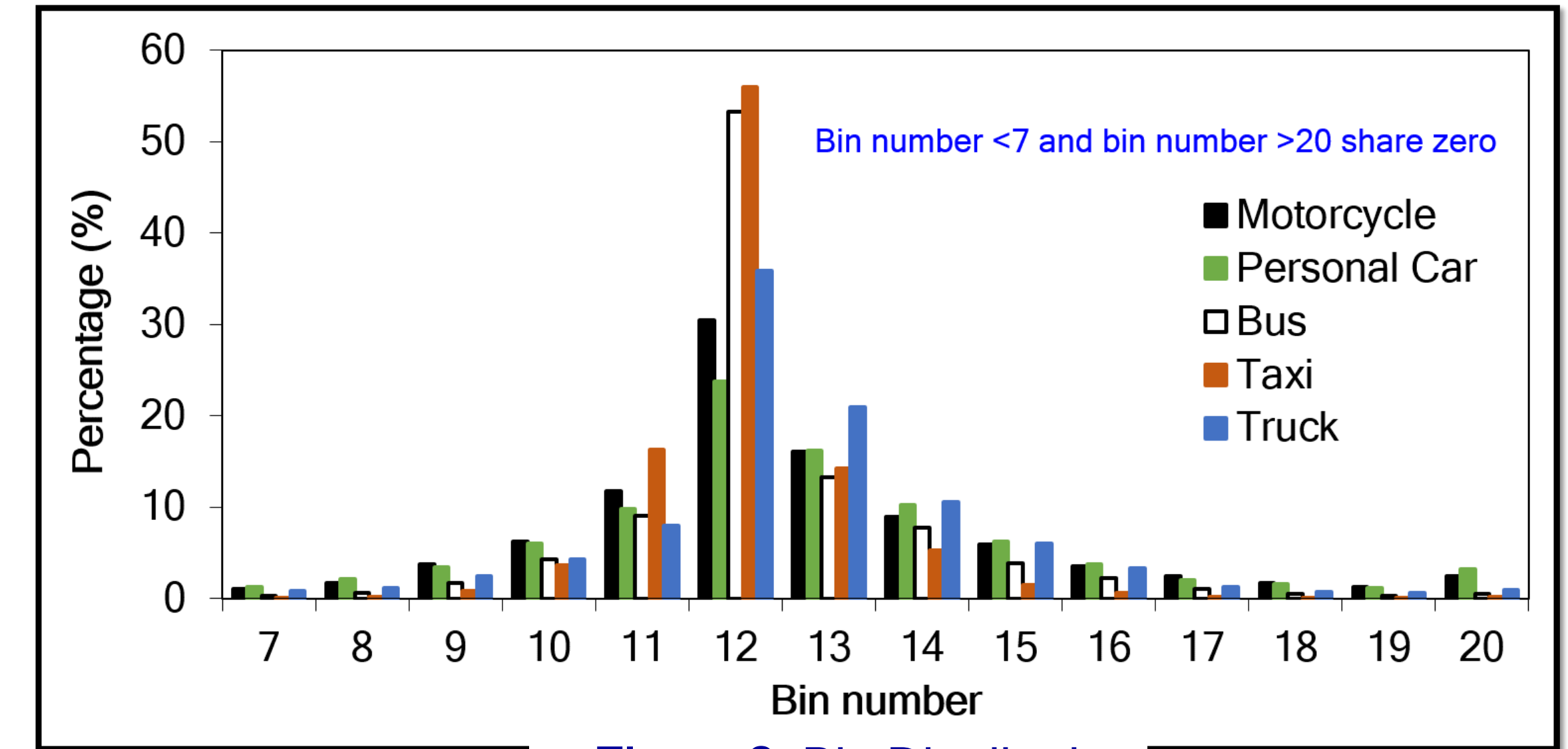


Figure 2: Bin Distribution

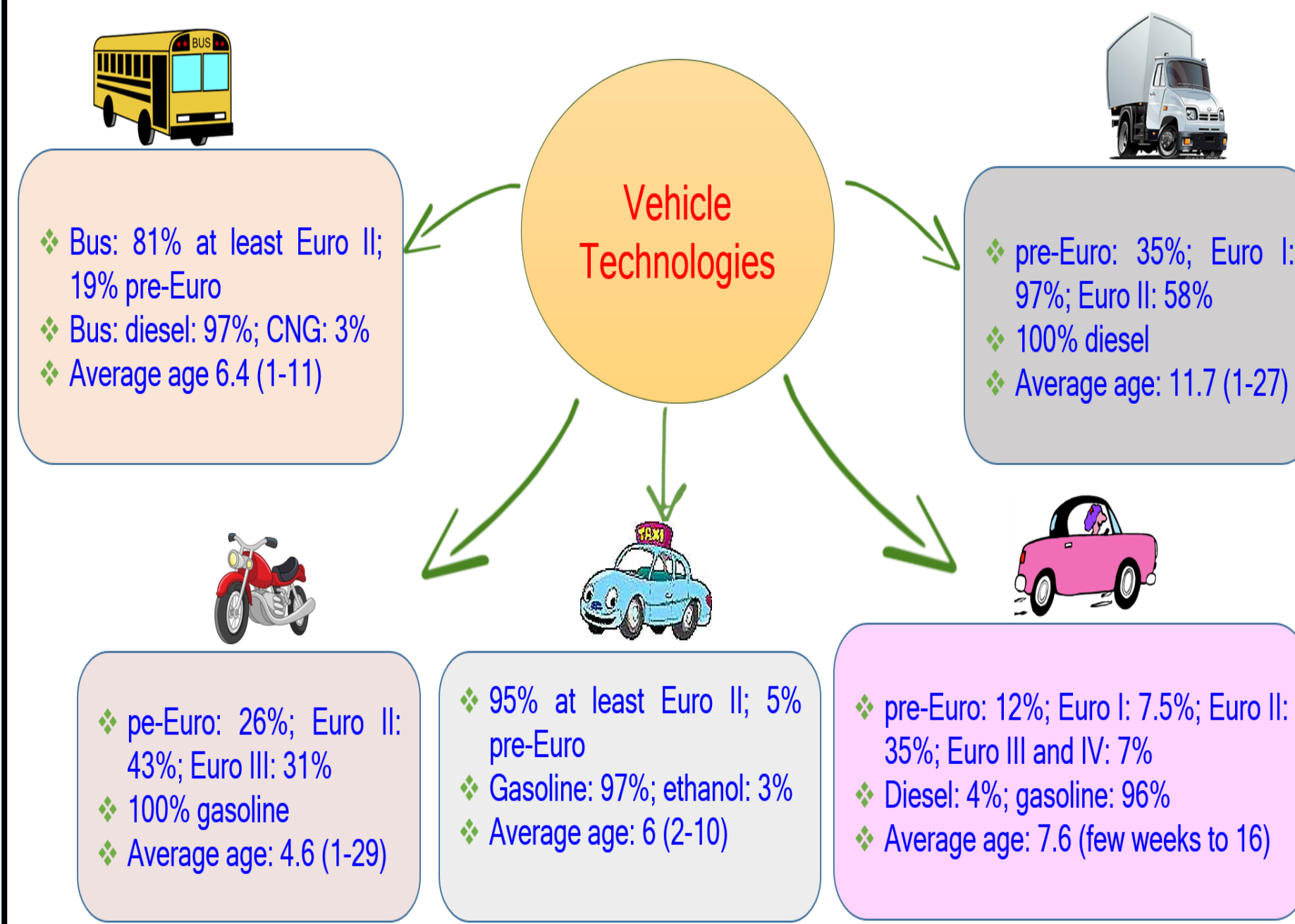


Figure 3: Vehicle Technology Distribution

Table 1: Daily vehicle activities in HCMC, 2013

Vehicle type	Number of active vehicle	Average Speed (km/h)	Daily VKT		Daily number of startups	
			Per vehicle (km veh <sup>-1</sup> )	Per fleet (1000 km fleet <sup>-1</sup> )	Per vehicle (No. veh <sup>-1</sup> )	Per fleet (1000 times fleet <sup>-1</sup> )
Motorcycle	5,004,831	14.9 ± 8.8	15.1	75,573	10.6	53,051
Bus	3,358	16.1 ± 3.3	195.6	657	14	47
Taxi	17,802	14.7 ± 9.2	118	2,101	26.6	474
Personal car	315,943	23.9 ± 13.4	70.3	22,211	4.6	1,453
Truck	185,501	15.0 ± 9.0	31.4	5,825	6.9	1,280

## Research Design

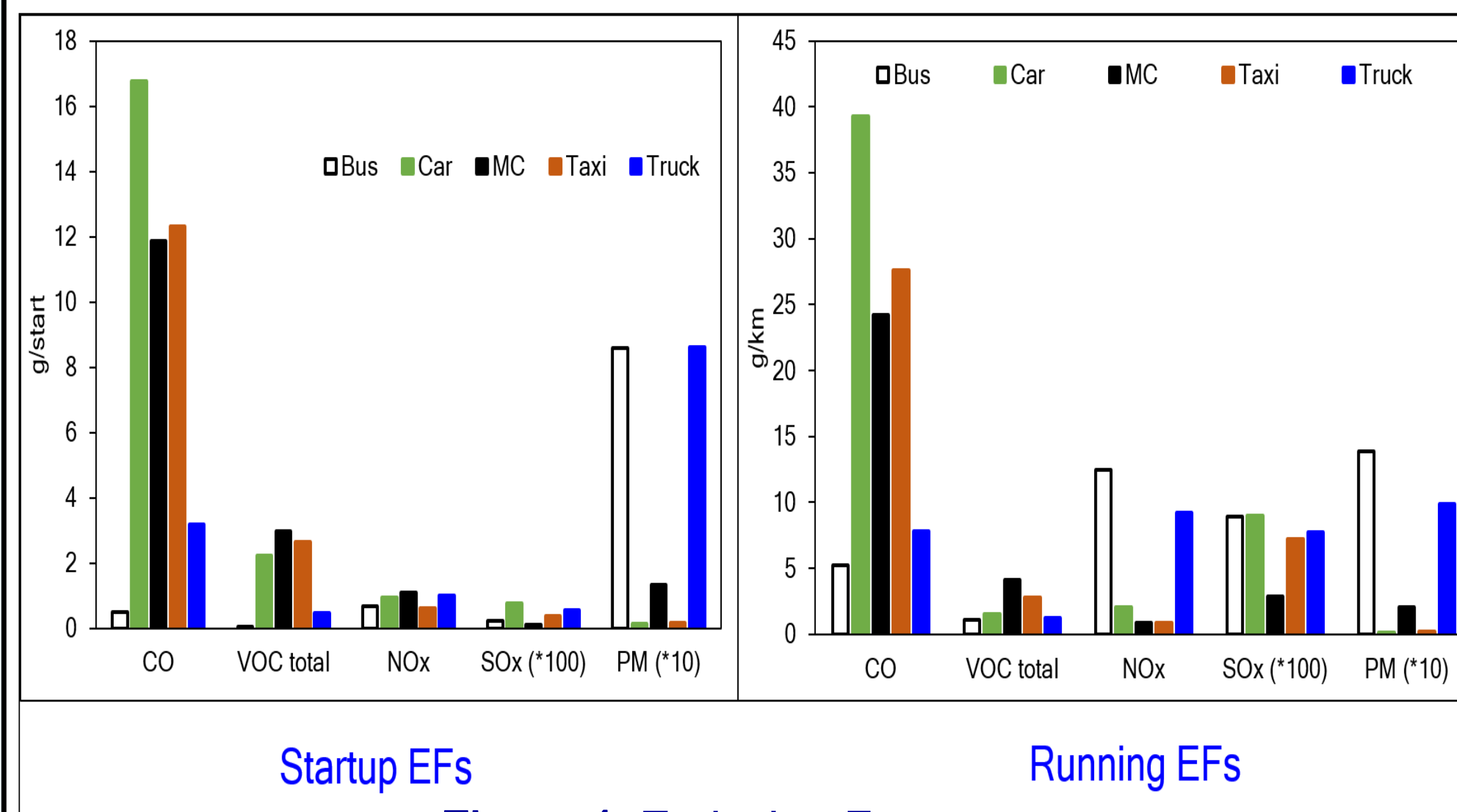
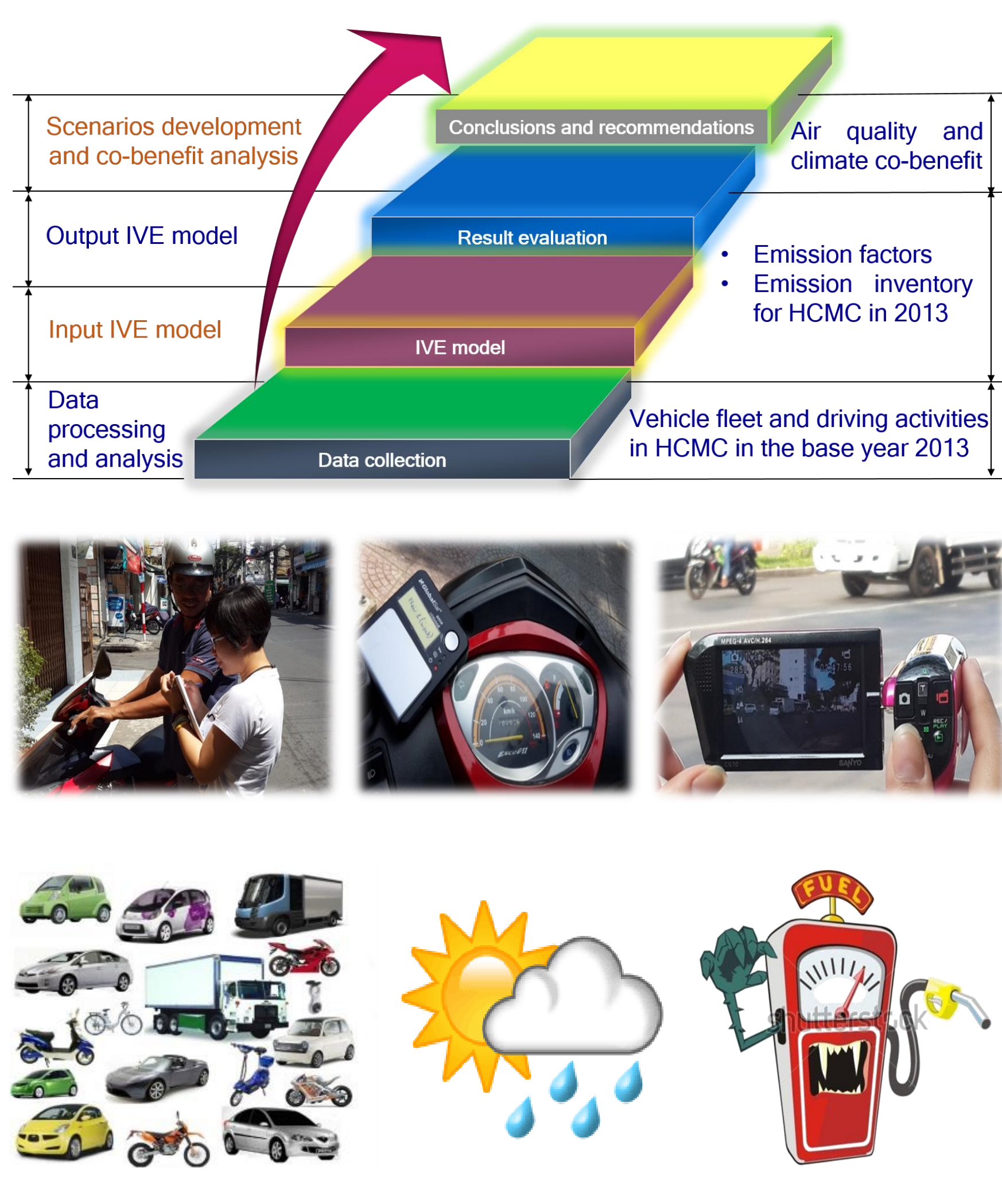


Figure 4: Emission Factors

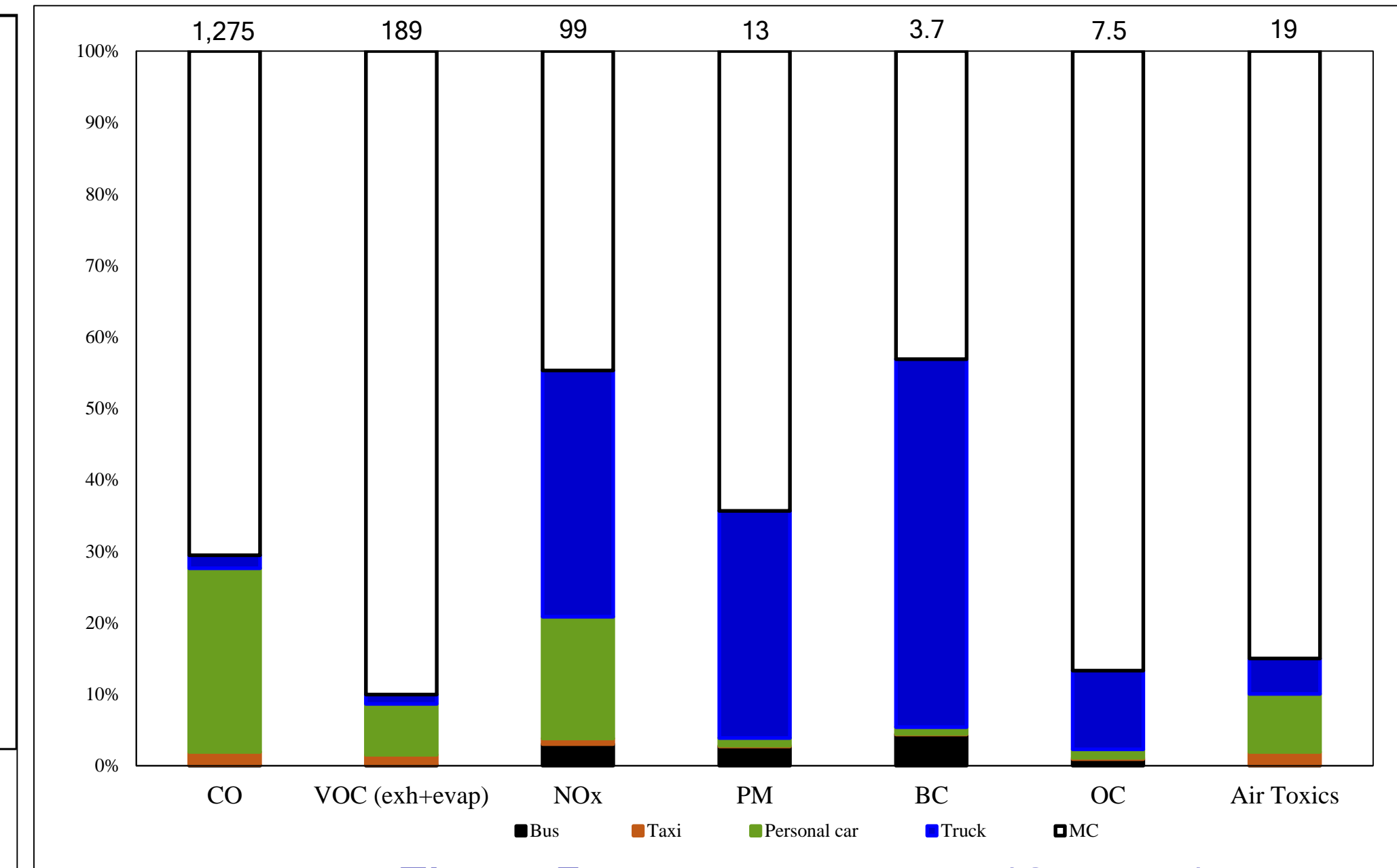


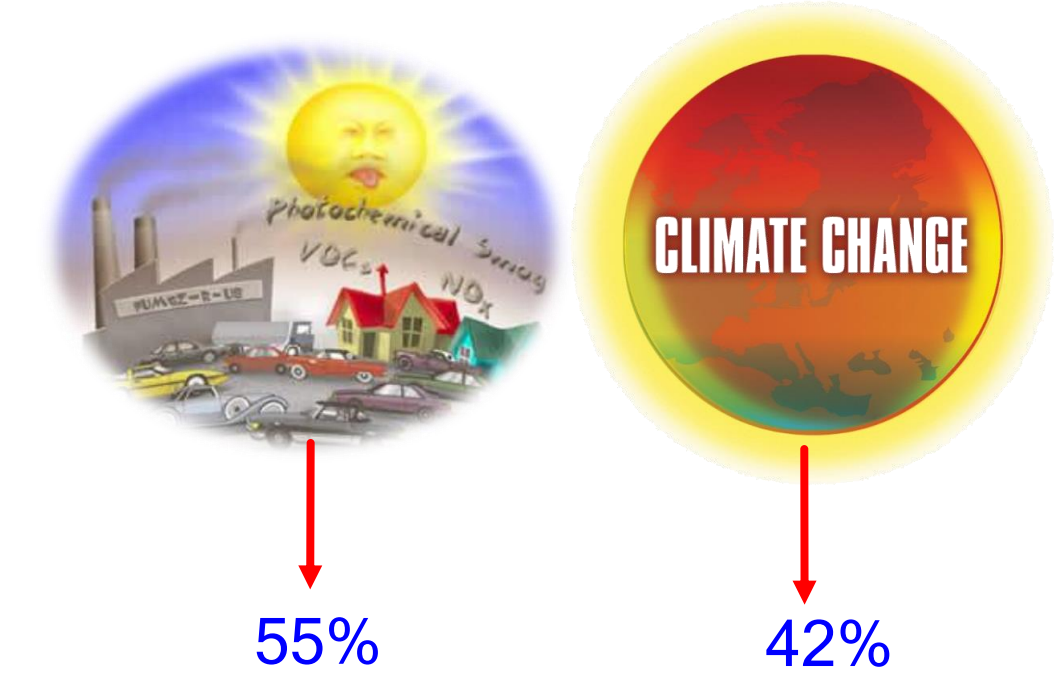
Figure 5: Annual Emission (Gg/year)

Low speed and high mileage of trucks and bus resulted in high running EFs of PM (2.2 g/km and 1.9 g/km, respectively) and NOx (13.1 and 10.2, respectively). Gasoline powered fleets of personal car, motorcycle and taxi had high EFs of CO (39.3 g/km, 24.2 g/km, and 27.6 g/km, respectively) and VOC (1.5 g/km, 4.1 g/km and 2.8 g/km, respectively).

Table 2: Annual emission of air pollutants and GWP (CO<sub>2</sub> eq. 20 year horizon)

Species (Gg)	Base case		Scenario (Euro3)		
	Pollutants	CO <sub>2</sub> eq	Pollutants	CO <sub>2</sub> eq	Reduction %
CO	1,274.8	7,649.0	545.26	3,271	57.2
VOC (exh+evap)	189.0	2,646.2	108.68	1,521	42.5
NOx	99.0	1,295	42.56	556.99	57.0
Sulfate	1.8	-258.4	1.01	-141.07	45.4
PM	12.9	-	5.19	-	59.77
BC	3.7	11,716	1.13	3,620	69.10
OC	7.5	-1,793	3.74	-897.27	49.97
CO <sub>2</sub>	10,722	10,723	10,445	10,445	2.6
N <sub>2</sub> O	0.5	132.3	0.43	125.03	5.5
CH <sub>4</sub>	33.0	2,374.5	20.10	1,447	39.1
Air toxics *	27.4	-	15.52	-	43.3
Total AP (excluding BC, OC, and CO <sub>2</sub> , N <sub>2</sub> O)	1,644.9	-	742.6	-	54.9
Total GWP	-	34,485	-	19,950	42.1

Scenario at least Euro3 standard



\*(Air toxics include 1,3-Butadiene, acetaldehyde, formaldehyde and benzene)

## Conclusions

- Within each fleet, the vehicles with high mileage and without emission controls had higher EF.
- MC large fleet had the largest emissions of CO VOC
- High EF for PM and NOx from the diesel powered truck and bus
- make the fleets the largest contributors to emission of these pollutants.
- Faster Euro3 intrusion would bring in substantial reduction of toxic air pollutant emission (55%) and climate forcing (42%)

## References Used

Van, H. H. (2014). *Development of Emission Inventory for Vehicle Fleet in Ho Chi Minh City to Estimate Environment and Climate Co-benefit of Faster Technology Intrusion* (Master research study No. EV-11-15, Asian Institute of Technology, 2011). Bangkok: Asian Institute of Technology

ISSRC. (2008). *IVE Model Users Manual Version 2.0*. Retrieved August 2, 2013, from <http://www.issrc.org/ive/downloads/manuals/UsersManual.pdf>.

