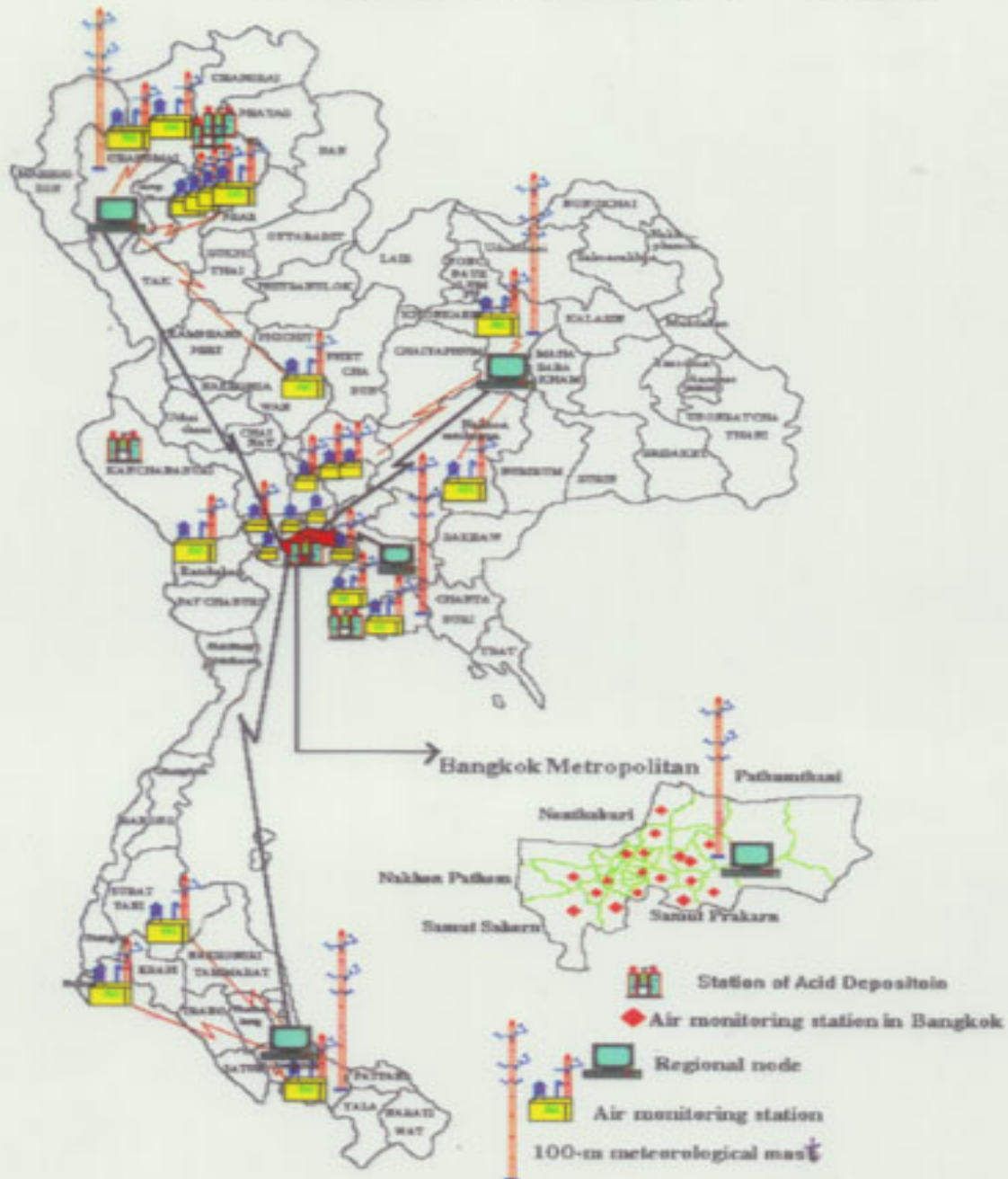


Automotive Emission in Thailand

**Present at Regional Workshop
“Reduction of Emission from 2-3 Wheelers”
September 5-7, 2001
Hanoi, Viet Nam**

**Mr. Janejob
Suksod
Chief, Automotive Air Pollution Sub-division
Air Quality and Noise Management Division
Pollution Control Department**

Ambient air monitoring network of Thailand



Roadside Air Quality in Bangkok 1999

Pollutants	Air Pollutant Concentration			
	Range	P ₉₅	Average	Std.
TSP (24-hr) mg/m ³	0.05 - 0.74	0.36	0.20	0.33
PM-10 (24-hr) ug/m ³	13.3 - 349.8	136.3	80.1	120
CO (1-hr) ppm	0.00 - 21.84	5.90	2.29	30
CO (8-hr) ppm	0.00 - 13.45	5.26	2.29	9
Pb (24-hr) ug/m ³	0.00 - 0.49	0.20	0.08	-
Pb (monthly) ug/m ³	0.03 - 0.25	0.18	0.09	1.5
O ₃ (1-hr) ppb	0.00 - 79.0	26.0	6.9	100
SO ₂ (1-hr) ppb	0.00 - 108.0	22.9	8.3	300
SO ₂ (24-hr) ppb	0.00 - 48.6	18.6	8.20	120
NO ₂ (1-hr) ppb	0.00 - 182.0	67.0	33.2	170

Roadside Air Quality in Bangkok 2000

Pollutants	Air Pollutant Concentration			
	Range	P ₉₅	Average	Std.
TSP (24-hr) mg/m ³	0.05 - 0.48	0.35	0.19	0.33
PM-10 (24-hr) ug/m ³	27.0 - 244.4	146.6	82.6	120
CO (1-hr) ppm	0.00 - 18.50	5.60	2.20	30
CO (8-hr) ppm	0.00 - 13.13	5.17	2.19	9
Pb (24-hr) ug/m ³	0.01 - 0.57	0.21	0.10	--
Pb (monthly) ug/m ³	0.03 - 0.24	0.16	0.09	1.5
O ₃ (1-hr) ppb	0.00 - 136.0	31.0	7.6	100
SO ₂ (1-hr) ppb	0.00 - 232.0	24.0	9.3	300
SO ₂ (24-hr) ppb	0.00 - 38.0	19.2	9.2	120
NO ₂ (1-hr) ppb	0.00 - 169.0	81.0	35.4	170

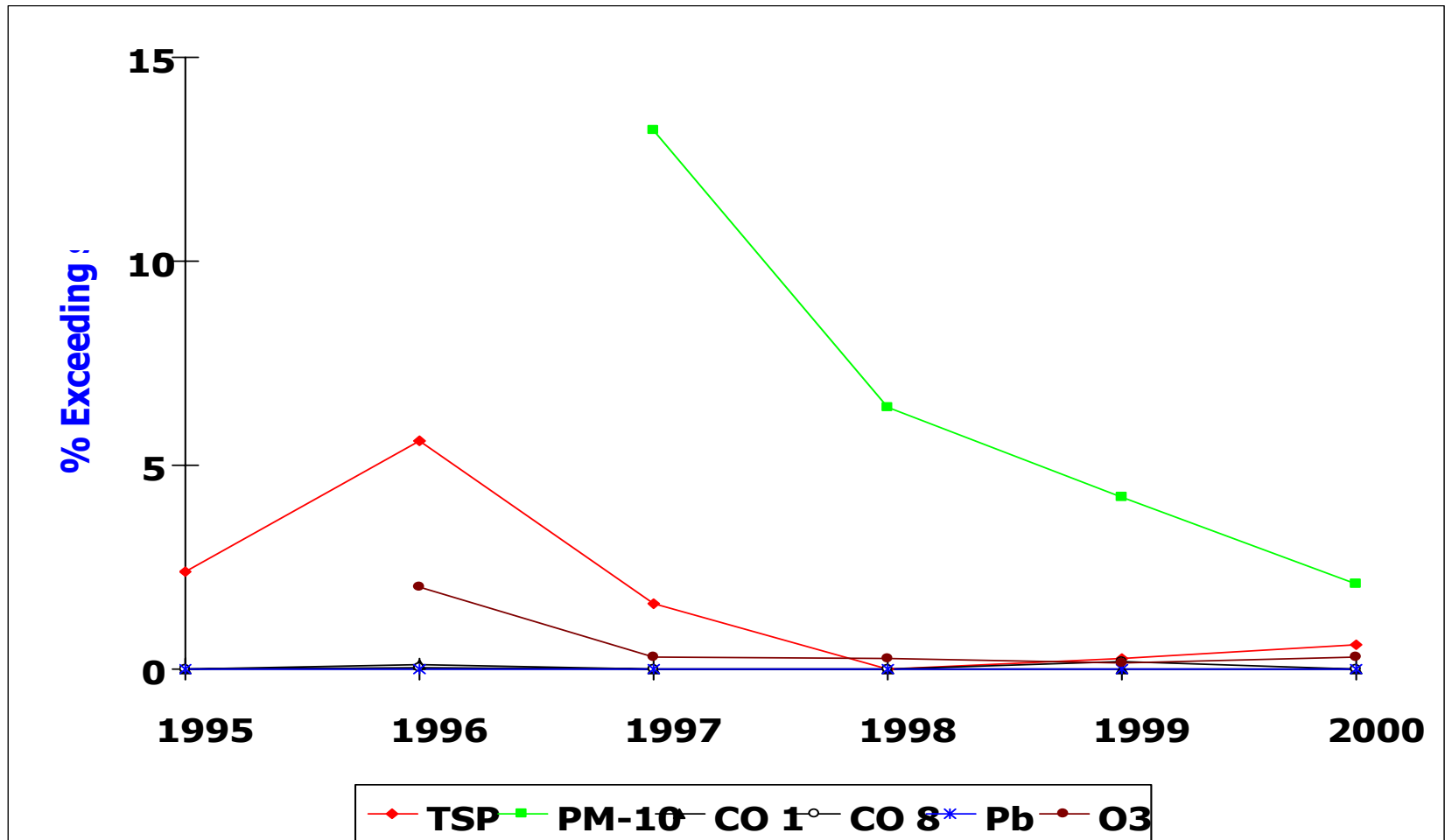
Ambient Air Quality in Bangkok 1999

Pollutants	Air Pollutant Concentration		
	Range	P95	Average
TSP (24-hr) mg/m ³	0.02 - 0.37	0.22	0.10
PM-10 (24-hr) ug/m ³	16.1 - 202.0	116.3	60.6
CO (1-hr) ppm	0.00 - 16.80	3.80	1.23
CO (8-hr) ppm	0.00 - 12.36	3.48	1.25
Pb (24-hr) ug/m ³	0.00 - 0.60	0.23	0.09
Pb (monthly) ug/m ³	0.02 - 0.37	0.24	0.10
O ₃ (1-hr) ppb	0.00 - 157.0	49.0	13.9
SO ₂ (1-hr) ppb	0.00 - 135.0	15.0	4.8
SO ₂ (24-hr) ppb	0.00 - 59.0	12.1	4.9
NO ₂ (1 hr) ppb	0.00 - 158.0	53.0	22.8

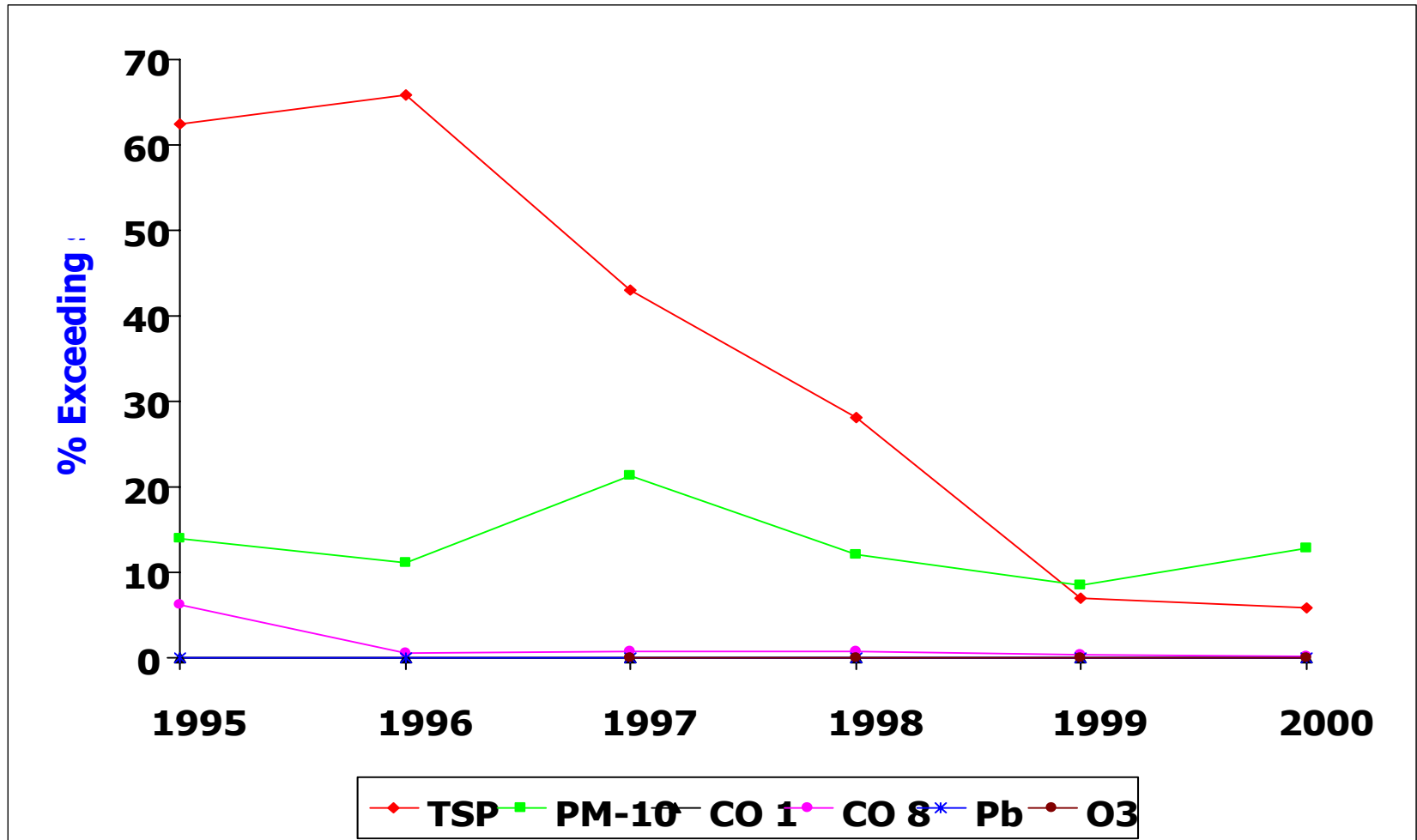
Ambient Air Quality in Bangkok 2000

Pollutants	Air Pollutant Concentration			
	Range	P ₉₅	Average	Std.
TSP (24-hr) mg/m ³	0.02 - 0.33	0.19	0.09	0.33
PM-10 (24-hr) ug/m ³	18.6 - 169.4	102.7	56.1	120
CO (1-hr) ppm	0.00 - 12.50	2.60	0.96	30
CO (8-hr) ppm	0.00 - 8.20	2.31	0.97	9
Pb (24-hr) ug/m ³	0.01 - 0.44	0.24	0.09	--
Pb (monthly) ug/m ³	0.02 - 0.33	0.21	0.09	1.5
O ₃ (1-hr) ppb	0.00 - 203.0	54.0	15.6	100
SO ₂ (1-hr) ppb	0.00 - 161.0	20.0	6.7	300
SO ₂ (24-hr) ppb	0.00 - 76.4	15.7	6.7	120
NO ₂ (1 hr) ppb	0.00 - 136.0	53.0	22.8	170

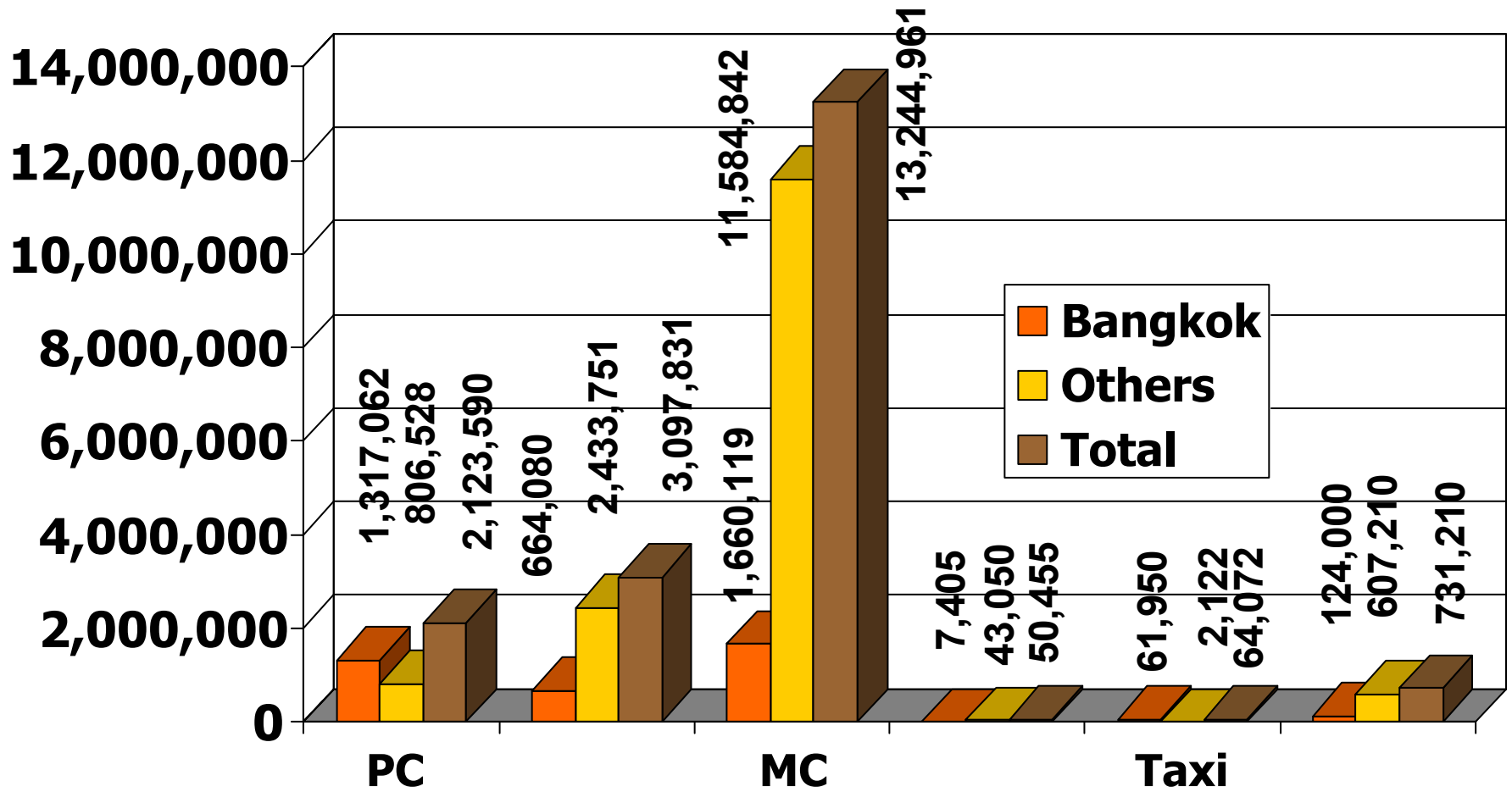
Trend of Ambient Air Quality in Bangkok (1995-2000)



Trend of Roadside Air Quality in Bangkok (1995-2000)



Vehicles Register in Thailand (1999)



Sources: Land Transport Department

Traffic Portion in Bangkok Metropolitan Areas (1997)

Areas	Traffic Portion (%)				
	Gasoline	L-Diesel	H-Diesel	Tuk-Tuk	Motorcycle
Bangkok	41	38	10	1	11
Surround Area	24	45	14	1	16
Average	33	42	12	1	13

Automotive Emission Factor (1997)

Vehicle Type	Emission Factor (g/km.)				
	NO _x	SO ₂	CO	PM	HC
Gasoline	1.460	0.182	5.745	0.005	1.535
Light Duty Diesel	4.116	0.117	2.177	0.398	0.984
Heavy Duty Diesel	28.478	0.534	11.887	1.855	3.074
Motorcycle	0.051	0.041	5.868	0.150	8.552

Emission Load from Mobile Source (1997)

Vehicles Type	Emission Load (tons/year)				
	NO _x	SO ₂	CO	PM	HC
Gasoline	34,133	4,250	134,311	701	35,886
Light Duty Diesel	65,836	1,679	34,821	6,366	15,739
Heavy Duty Diesel	163,703	3,068	68,331	10,663	17,671
Motorcycle	976	786	112,308	2,871	163,677
Total	264,648	9,784	349,771	20,602	232,973

Emission Load Portion from Mobile Source (1997)

Vehicles Type	Emission Load (%)				
	NO _x	SO ₂	CO	PM	HC
Gasoline	12.9	43.4	38.5	3.4	15.4
Light Duty Diesel	24.9	17.2	9.9	30.9	6.8
Heavy Duty Diesel	61.8	31.4	19.5	51.7	7.6
Motorcycle	0.4	8.0	32.1	4.0	70.2
Total	100	100	100	100	100

Emission Control Strategies for Motor Vehicles in Thailand

1. Emission Standards.

- Standards for New Vehicles.**
- Standards for In-Use Vehicles**

2. In-Use Vehicles Control.

- Inspection and Maintenance Program.**
- Road Side Inspection.**

Emission Control Strategies for Motor Vehicles in Thailand

3. Fuel Reformulation Programs.

- Gasoline**
- Diesel**
- Oil Lubrication**

4. Other Measures.

- Alternative Fuel; CNG, Ethanol**
- Bus Improvement Program.**
- Introduction of Green Fleet Program.**

New Motorcycle Emission Standards

Level	Reference Standards	Announcement	Enforces
1	ECE 40-00	Aug-92	Aug-93
2	ECE 40-01	Sep-93	Mar-95
3	CO \leq 13 (g/km.) HC \leq 5(g/km.)	Mar-96	Jul-97

New Motorcycle Emission Standards (Cont.)

Level	Reference Standards	Annoucement	Enforces
4	<p>CO\leq4.5, HC+NOx\leq 3 g/km</p> <p>White Smoke \leq 15%</p> <p>Evaporative \leq 2 g/test</p> <p>Evap. for 150cc. up</p>	Jul-99	Jul-01
5	<p>CO\leq3.5,HC+Nox\leq 2 g/km</p> <p>White Smoke \leq 15%</p> <p>Evaporative \leq 2 g/test</p>	-	<p>\leq110 cc.:Jul-03</p> <p>All MC :Jul-04</p>

In-Use Emission Standards

Vehicles Type	Pollutant	Standard	Instrument	Measuring Method
Motorcycle	CO	4.5 %	NDIR	Idle Test
	HC	10,000 ppm		
	White Smoke	30 %	Opacity	Measuring at 3/4 of Maximum Horse Power RPM.
	Noise	100 dBA	Sound Level Meter	Measuring at 1/2 or 3/4 Of Maximum Horse Power RPM.

35 %

el

Annual Inspection Program

- Motorcycle
- - Older than 5 years inspection every year.
- Tuk-Tuk
- - Inspection every year.

Fuel Quality in Thailand

- Diesel

- - Sulfur Content ≤ 0.05 % (by Weight)

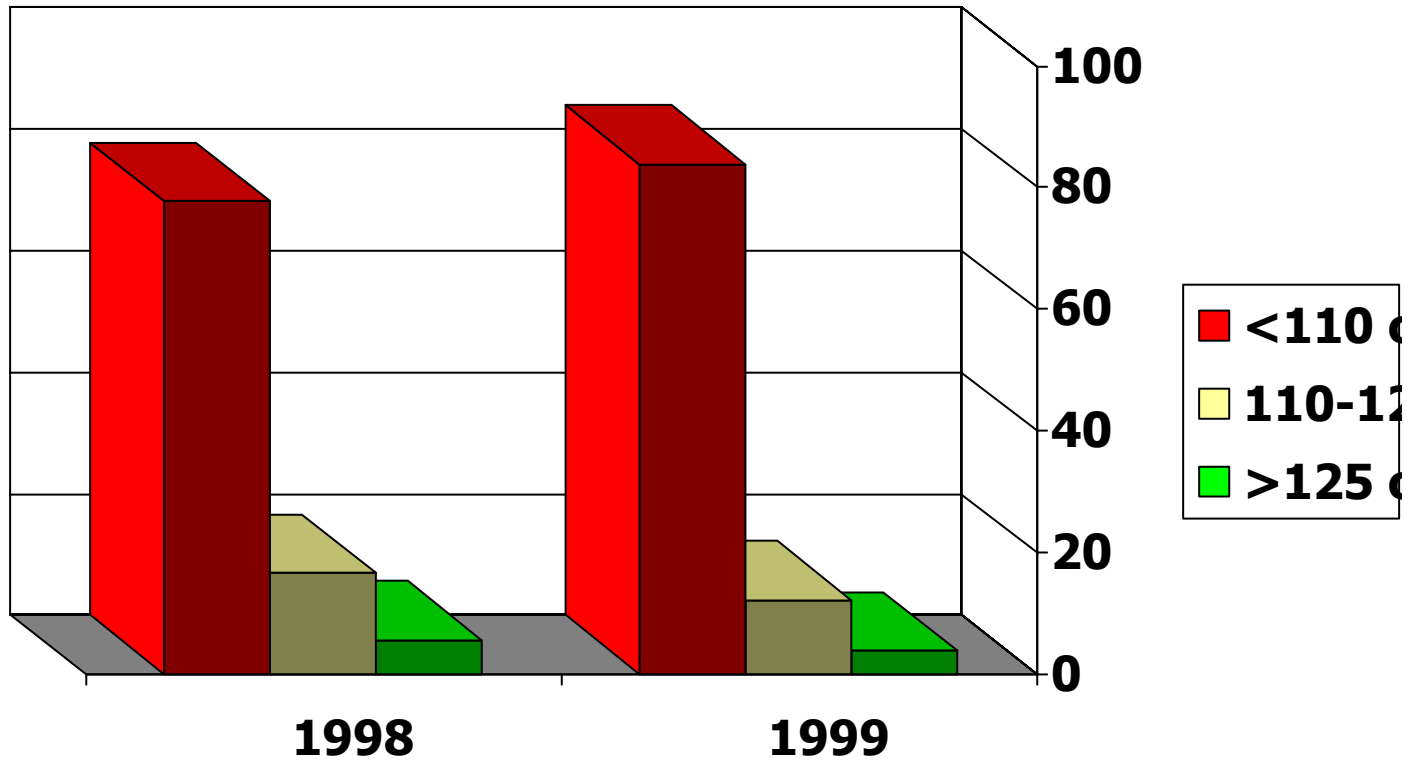
- Gasoline

- - Unleaded Gasoline

- - Benzene ≤ 3.5 % (by Volume)

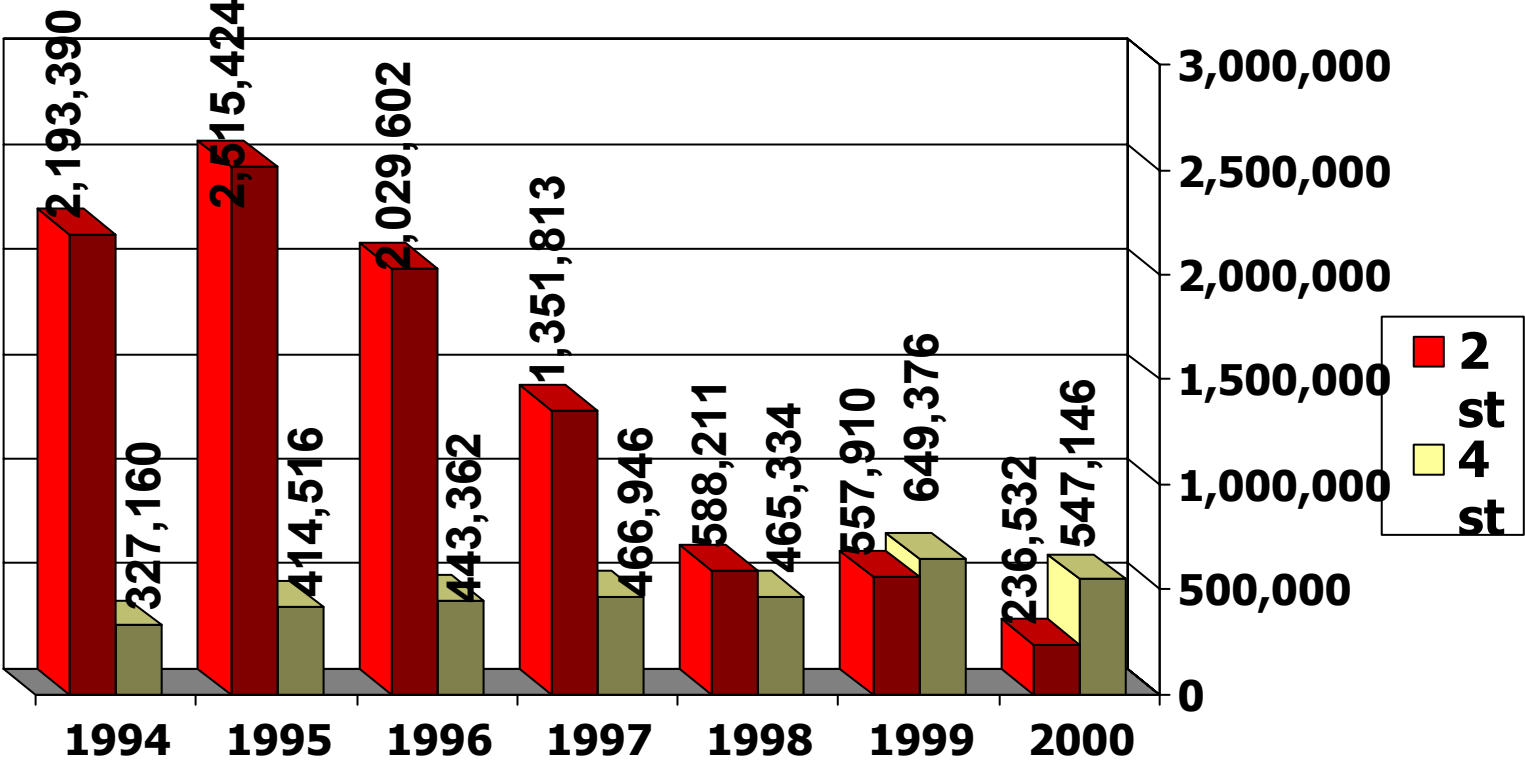
- - Aromatic ≤ 35 % (by Volume)

Engine size Portion of Motorcycle Sale in Thailand



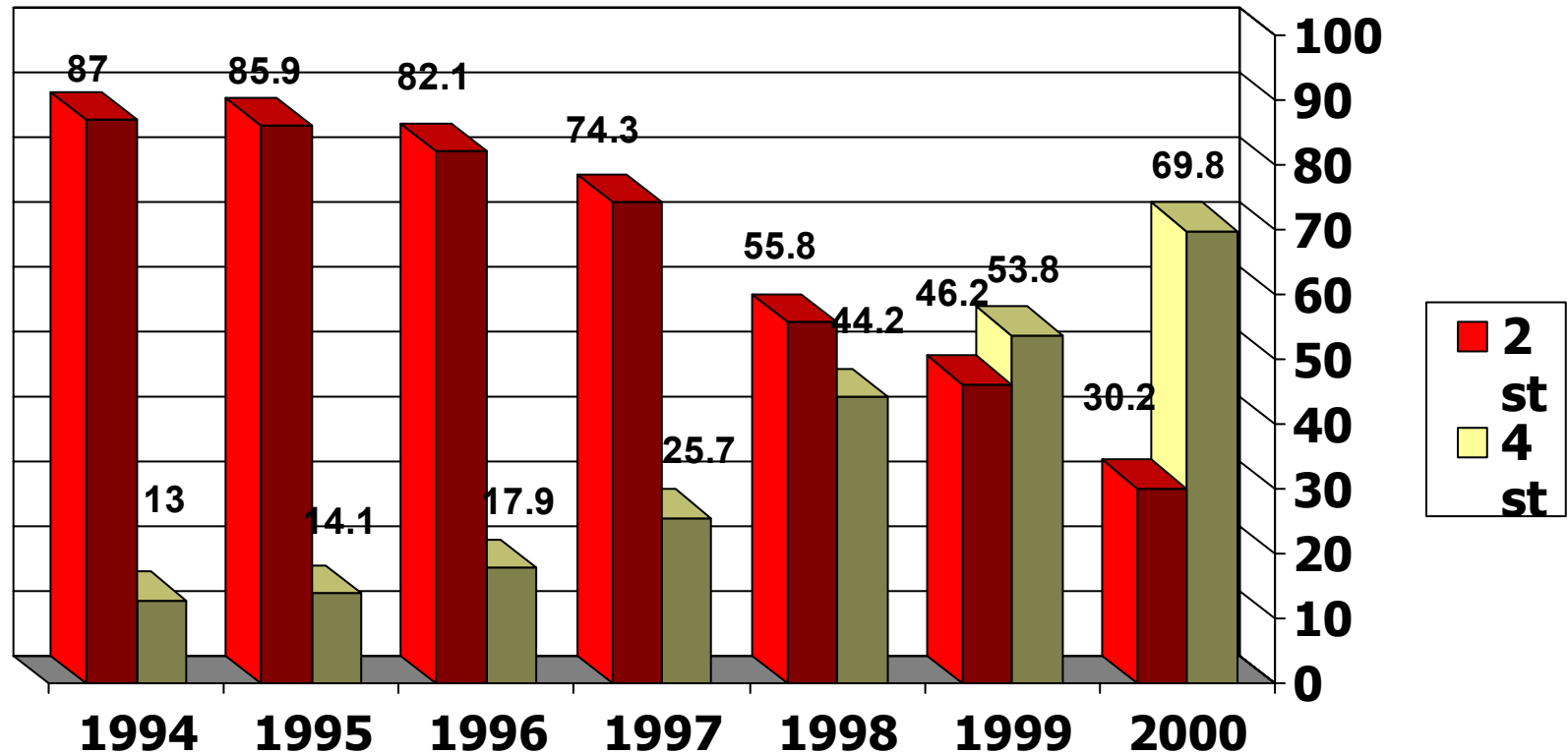
Sources : Thai Automotive Industrial Association

Sale Number of 2St. and 4St. Motorcycle in Thailand



Sources : Thai Automotive Industrial Association

Sale Portion of 2St. and 4St. Motorcycle in Thailand

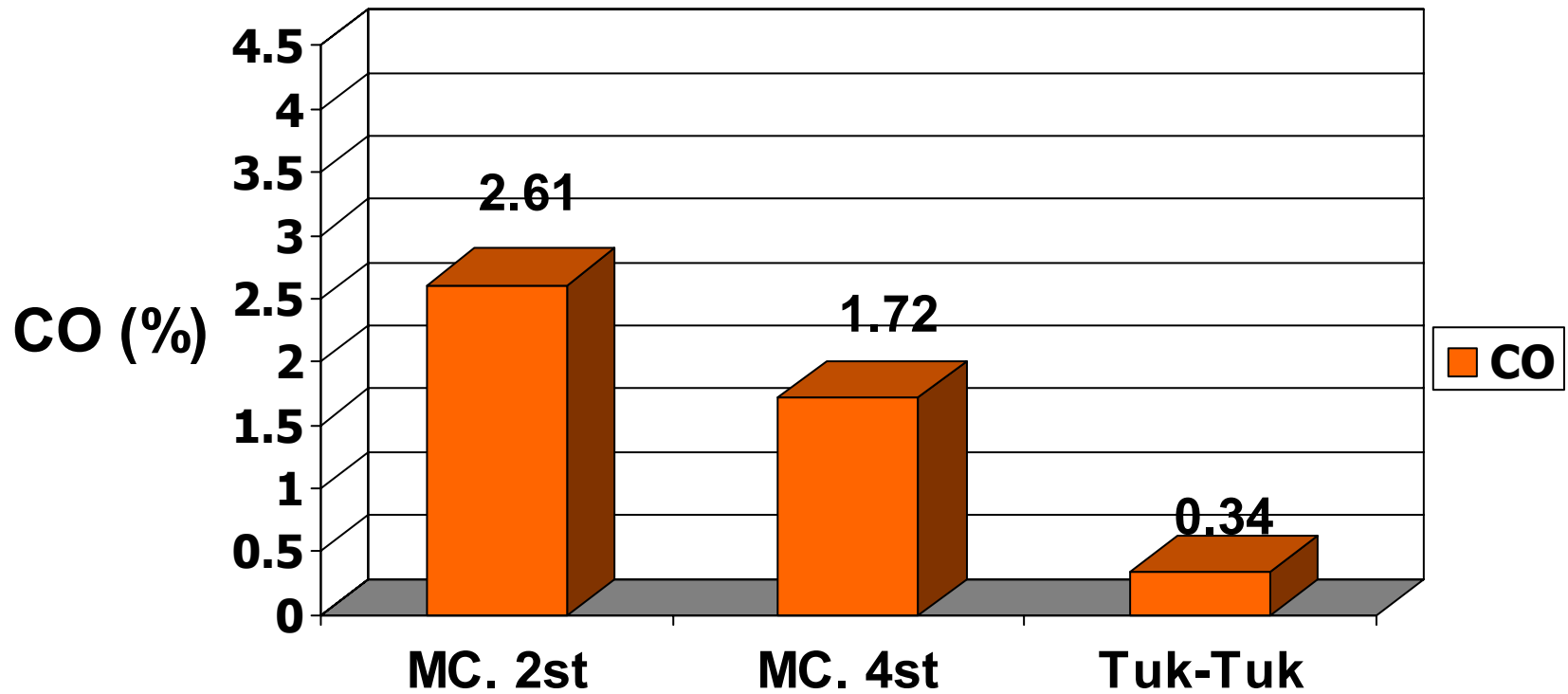


Sources : Thai Automotive Industrial Association

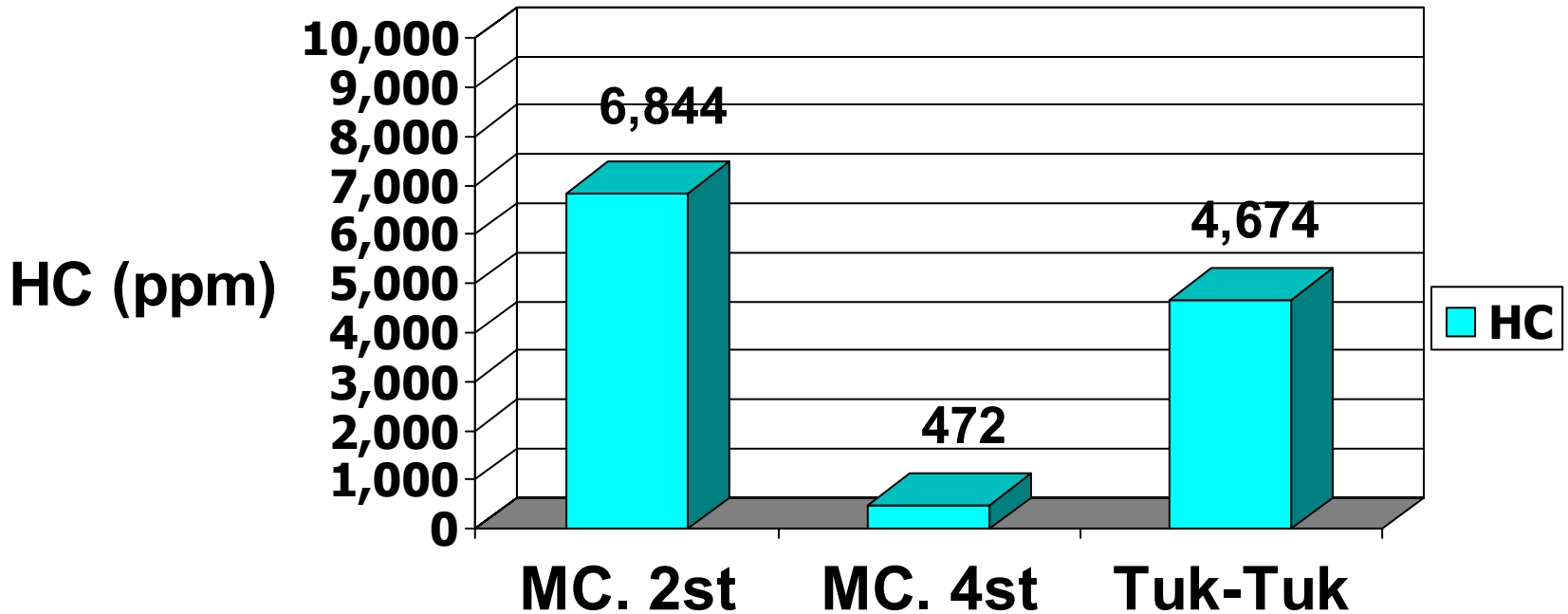
Tuk-Tuk Emission Reduction

- LPG (Liquid Petroleum Gas)
- **Low Smoke Oil.**
- **Demonstration Program on
Retrofitting Hot Tube.**

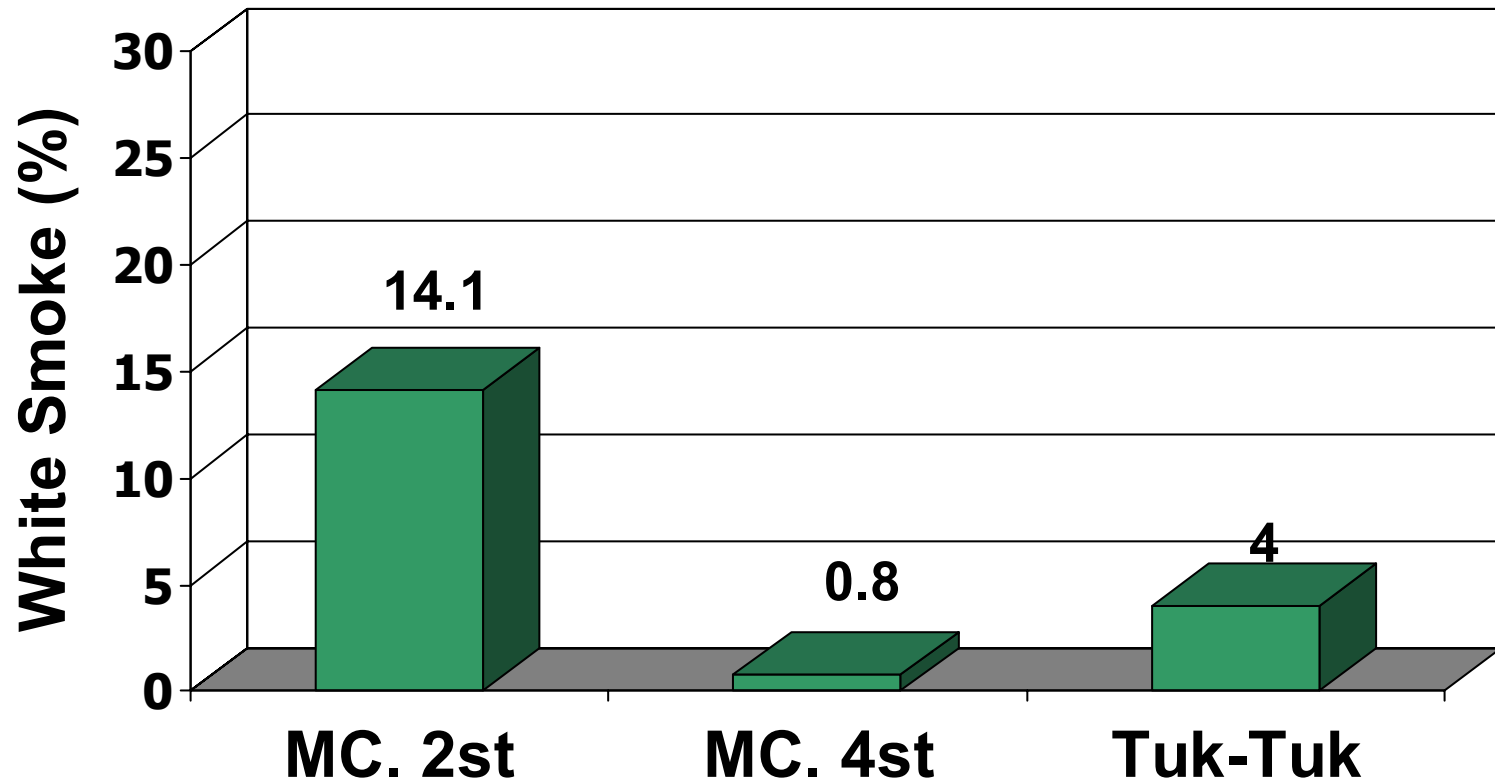
Average CO Concentration in Exhaust Gas (2000)



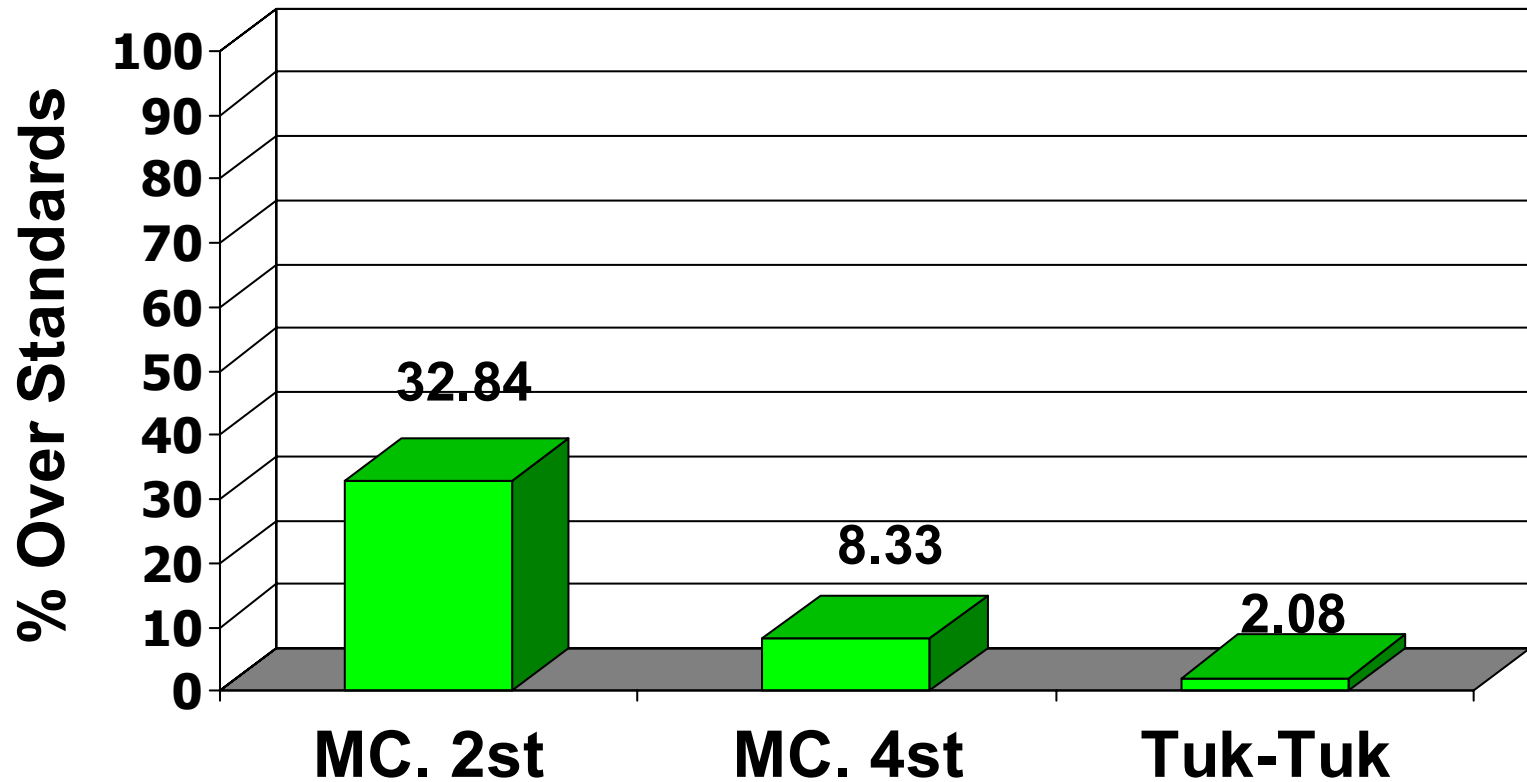
Average HC Concentration in Exhaust Gas (2000)



Average White Smoke in Exhaust Gas (2000)



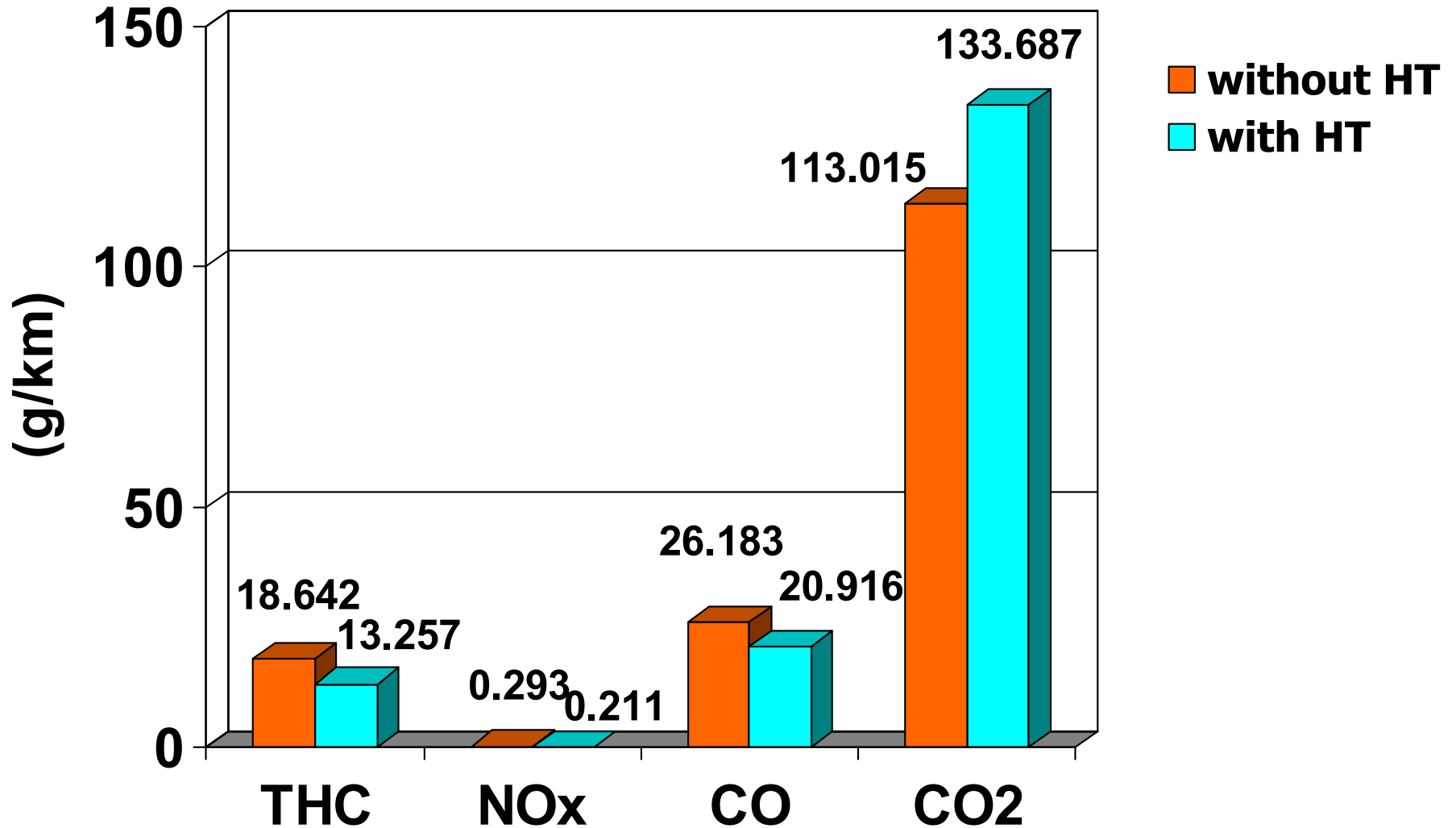
Average White Smoke in Exhaust Gas (2000)



Demonstration Program
on
Retrofitting Hot Tube
in Tuk-Tuk.

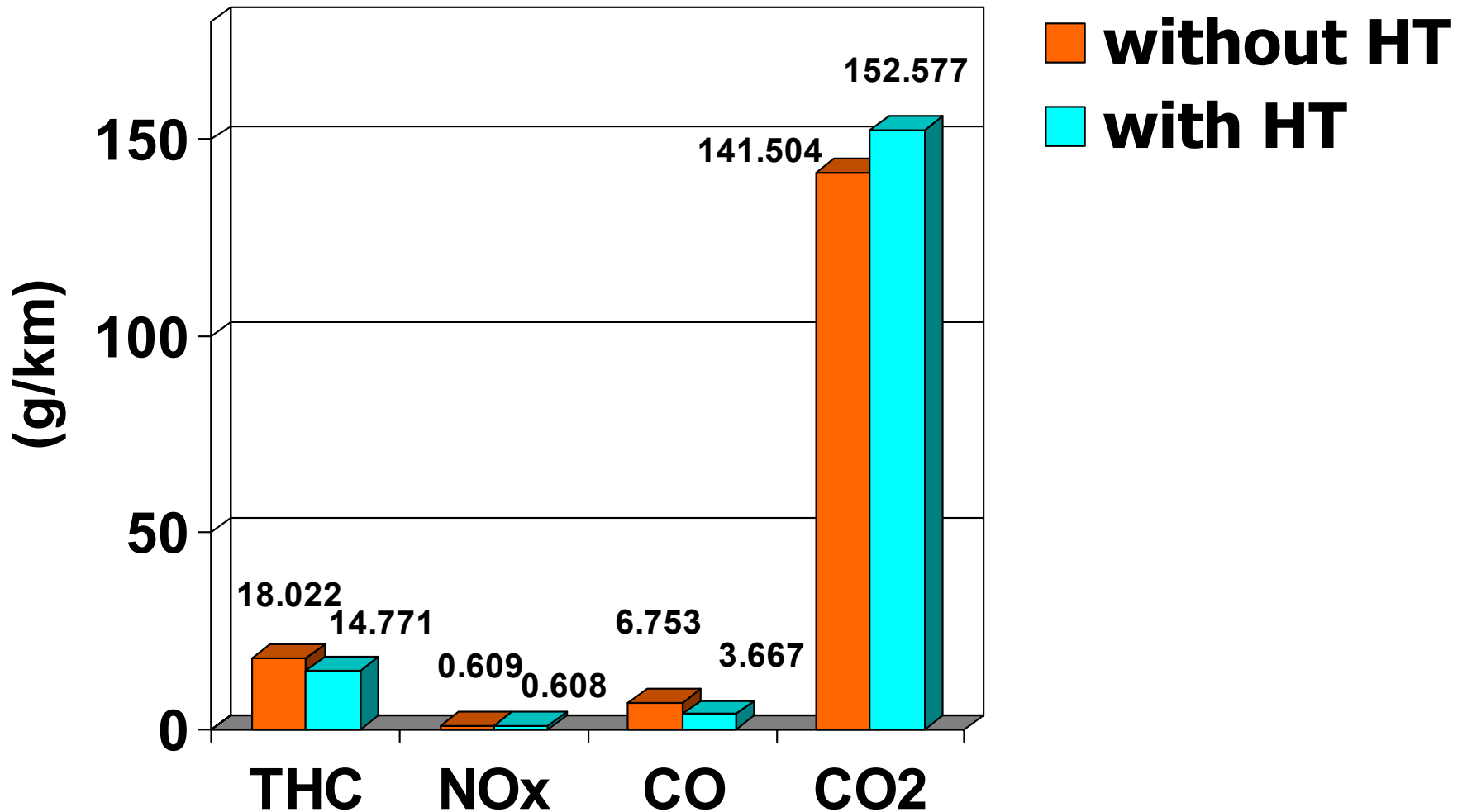
Emission from Tuk-Tuk No.1 (g/km)

Demonstration Program on Retrofitting Hot Tube



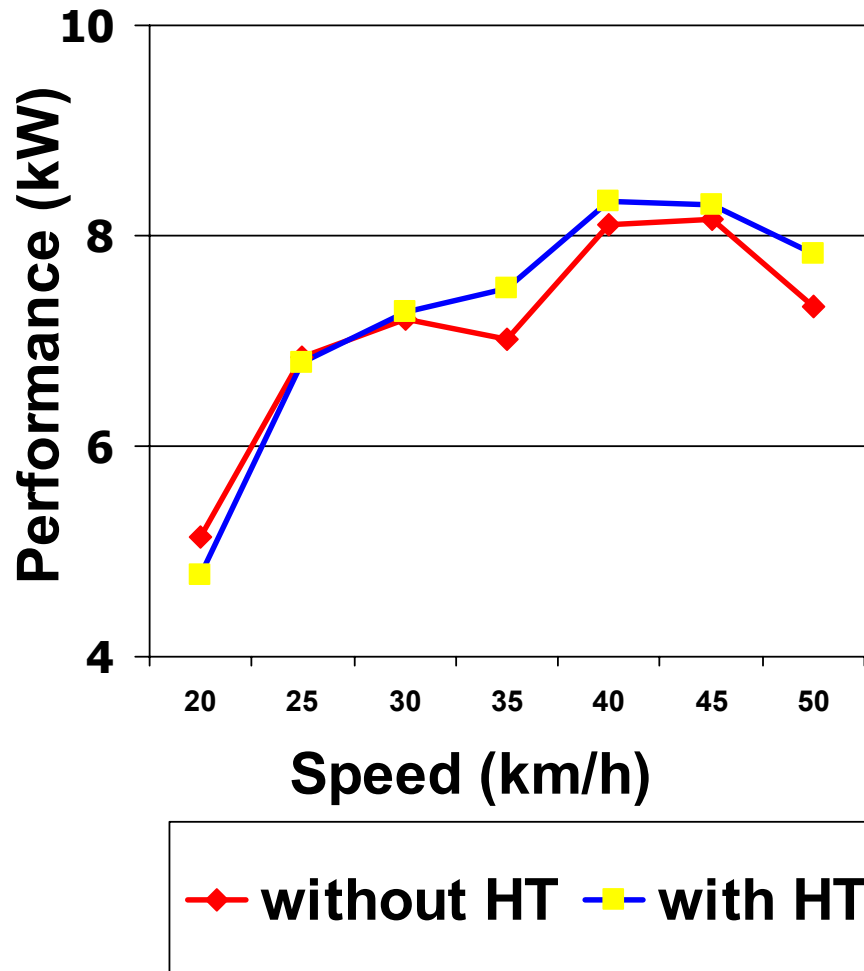
Emission from Tuk-Tuk No.2 (g/km)

Demonstration Program on Retrofitting Hot Tube

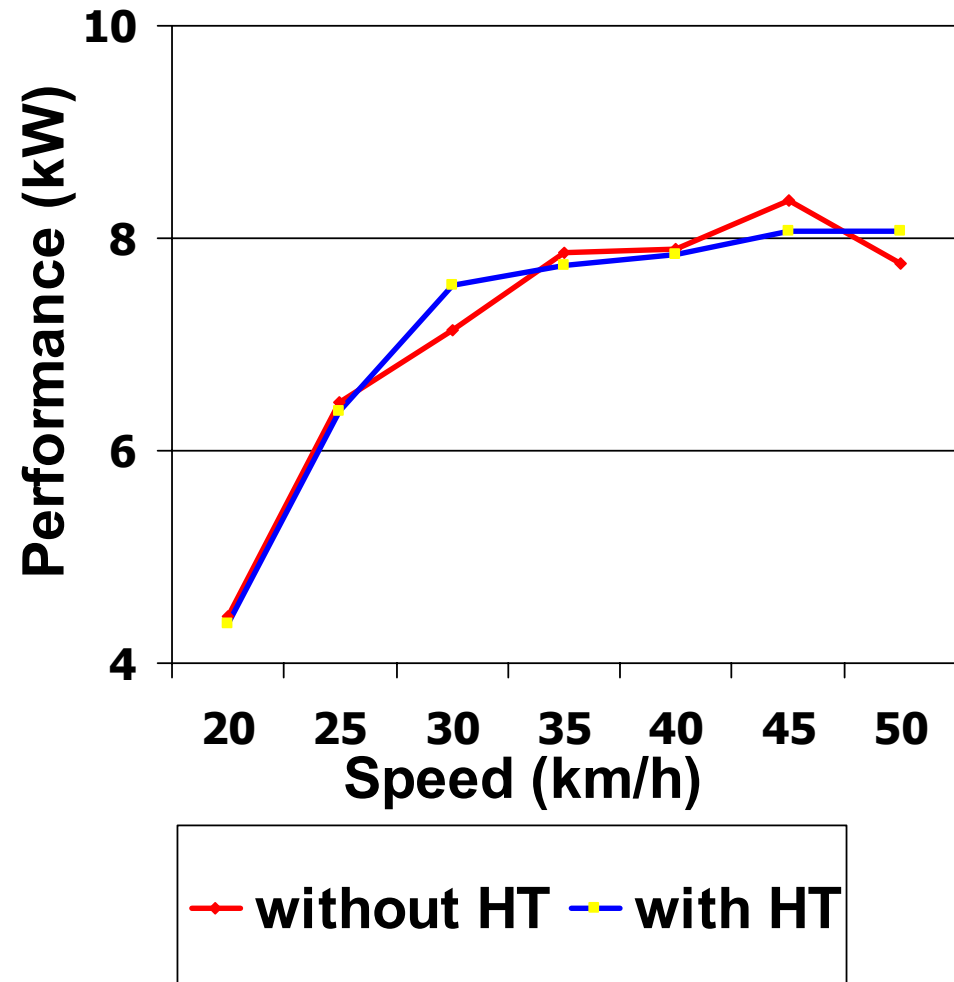


Performance: Demonstration Program on Retrofitting Hot Tube

Tuk-Tuk No.1

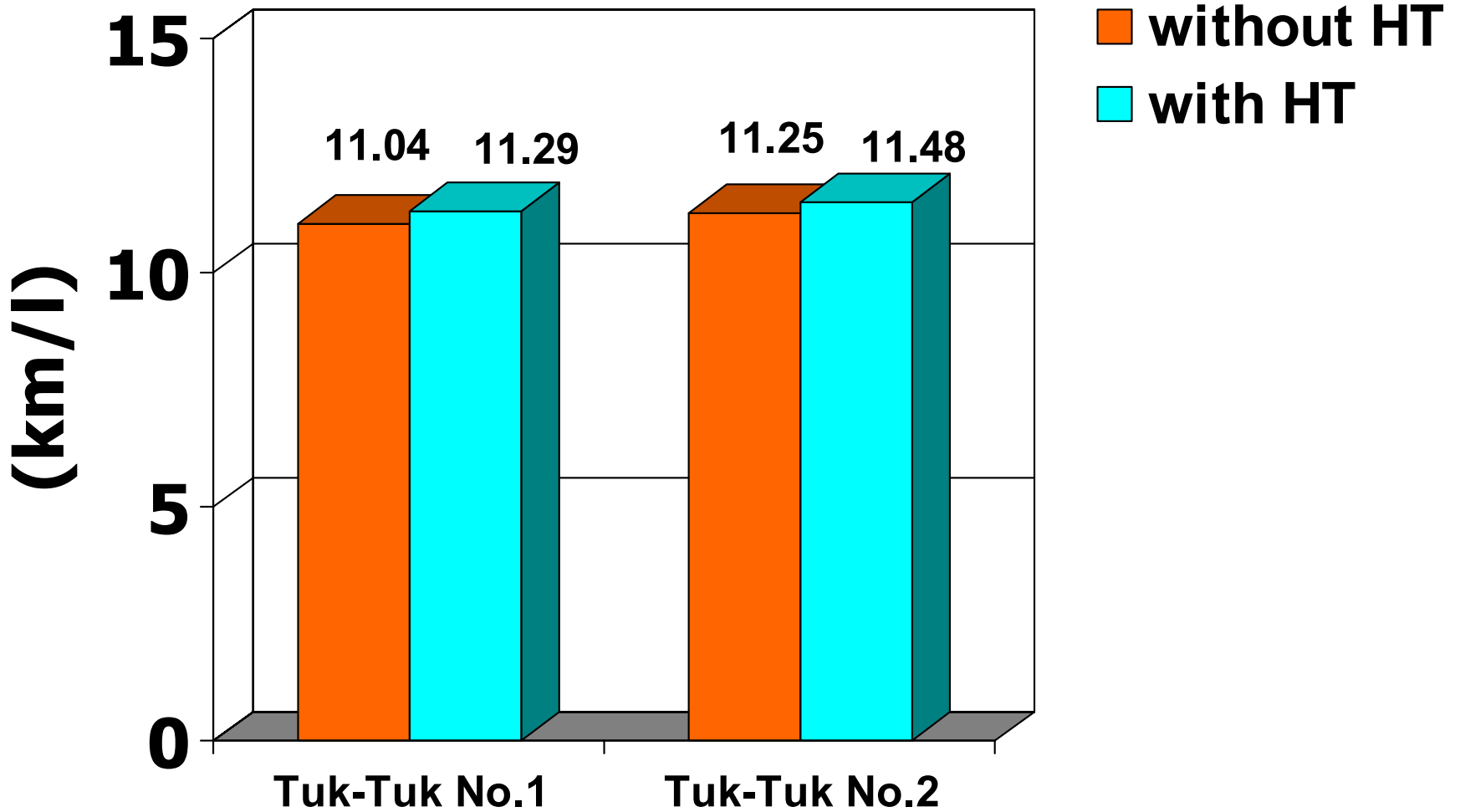


Tuk-Tuk No.2



Fuel Consumption (km/l)

Demonstration Program on Retrofitting Hot Tube



End of Presentation

National Ambient Air Quality Standards (1995)

Pollutants	Conc (mg/m ³)					Method
	1hr avg.	8hr avg.	24hr avg.	1m avg.	ann avg.	
CO	34.20	10.26	-	-	-	Non-dispersive IR
NO ₂	0.32	-	-	-	-	Chemiluminescence
SO ₂	0.78	-	0.30	-	0.10 *	Pararosaniline UV Fluorescence
SPM	-	-	0.33	-	0.10 *	Gravimetric-High Volume Sampling
PM-10	-	-	0.12	-	0.05 *	Gravimetric-High Volume Sampling
O ₃	0.20	-	-	-	-	Chemiluminescence
Lead	-	-	-	1.5 **	-	Atomic Absorptin Spectrophotometer

* geometric mean

** : ug / m³

Air Quality and Noise Information System

(AQNIS)



<http://www.pcd.go.th>



<http://www.aqnis.pcd.go.th>

- general information
- news and events
- forecasts and reports
- noise and vibration

Air quality monitoring network

Region	AQ station	Met station
North	7	1
Northeast	2	1
Central (BKK)	33	1
East	7	1
South	3	1
Total	52	5

