

# Vehicle Emissions Standards in Asia Issues and Challenges

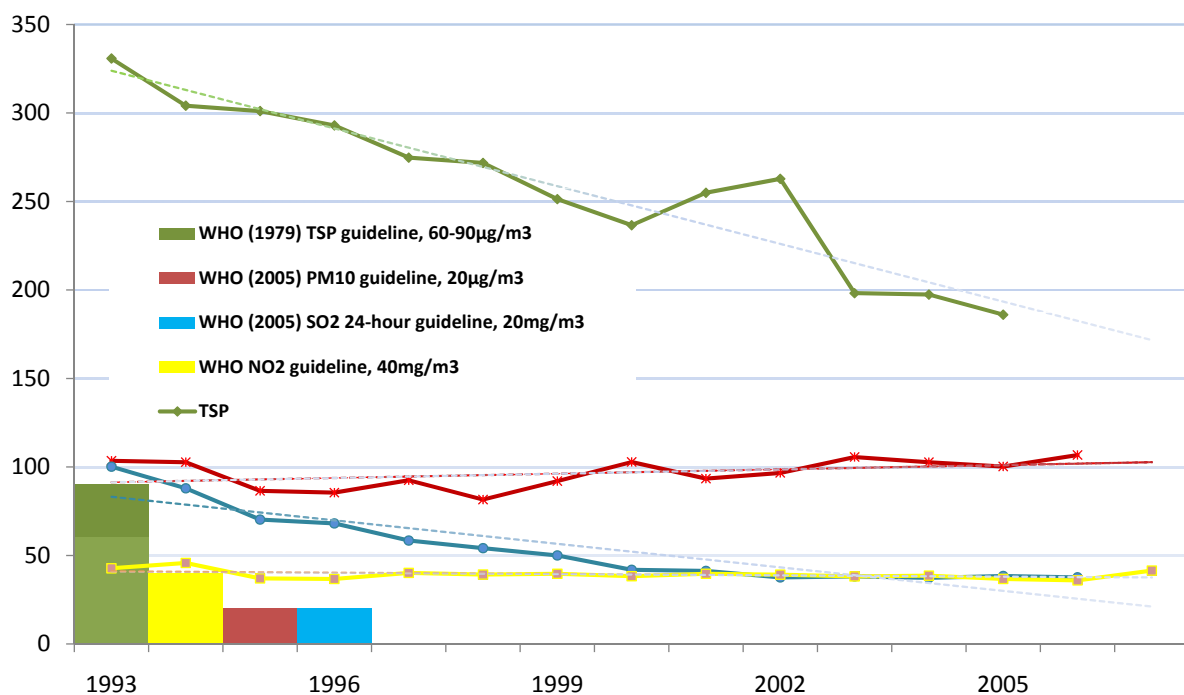
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CAI-Asia Center

Transport, Air Quality, and Climate Change  
Global Transport Knowledge Partnership (gTKP)  
Thailand  
10 November 2008



## Air Pollution in Asian Cities

Aggregate Annual AQ Trends in Asian Cities

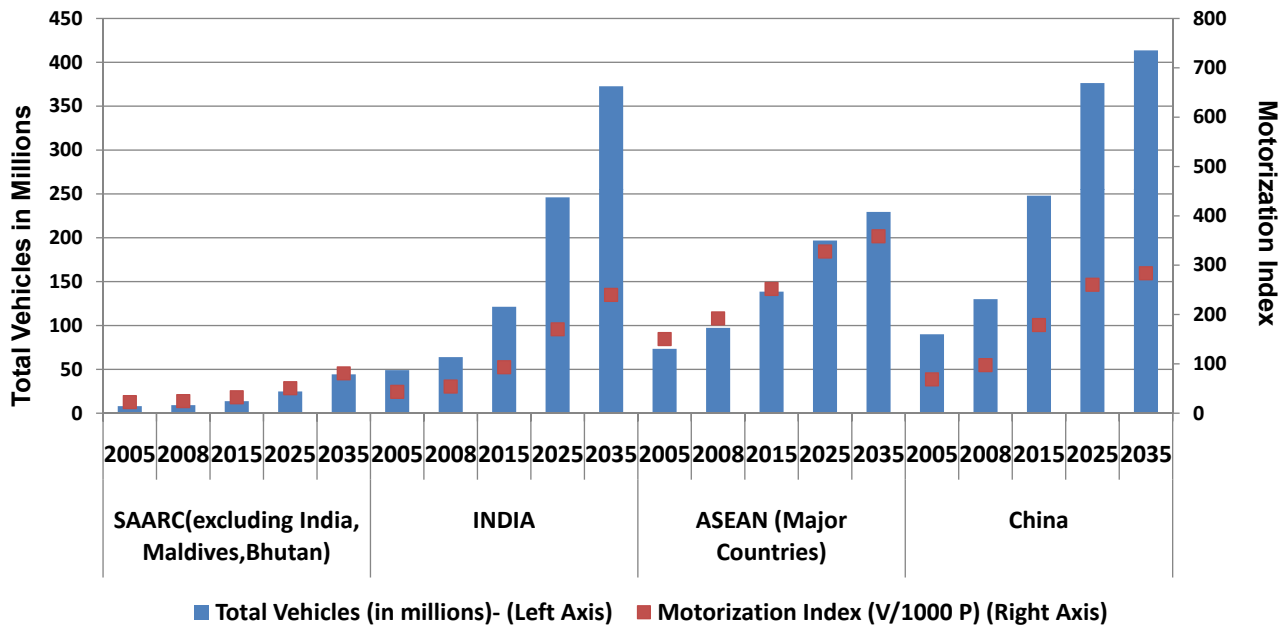


Source: 2008. CAI-Asia



# Increasing motorization

### Total Vehicles and Motorization Index



Source: 2008. ADB, CAI-Asia, Segment Y Ltd.

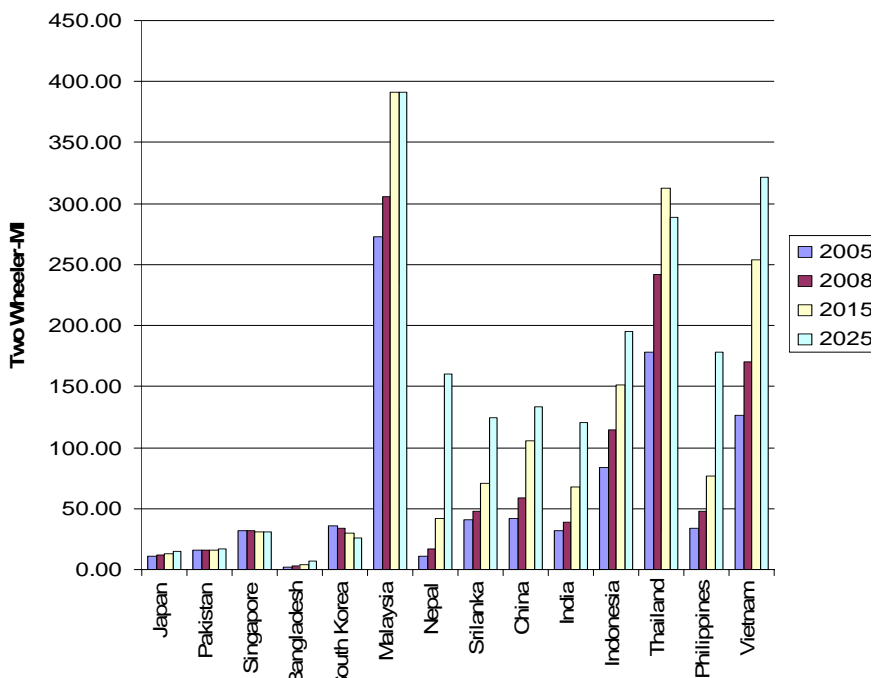
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# 2-3 Wheelers in Asia

### Motorisation-Index ( Two wheelers/1000Population)



- 2-3 wheeler ownership is increasing for almost all Asian countries
- As countries achieve higher GDP, growth of 2-3 wheelers slows down
- Southeast Asian countries have the highest growth rates

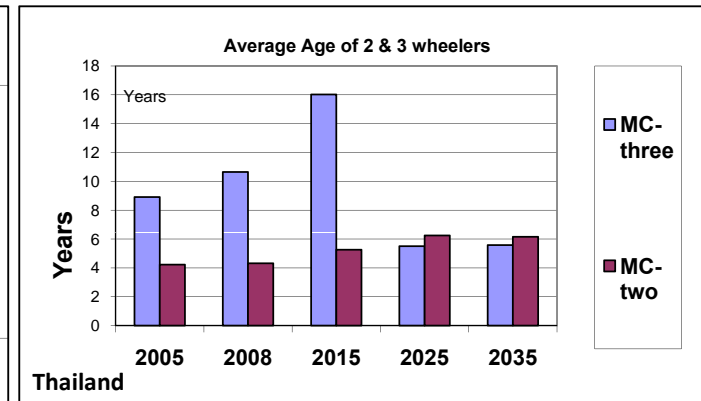
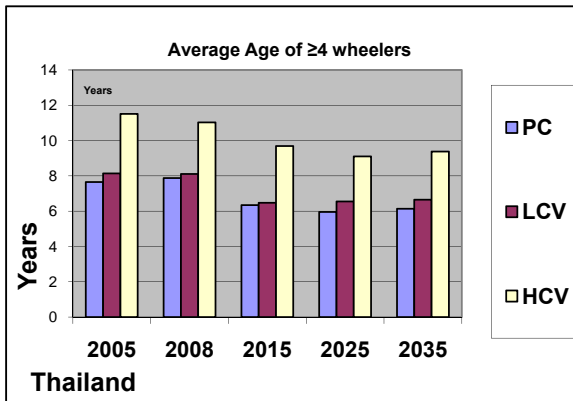
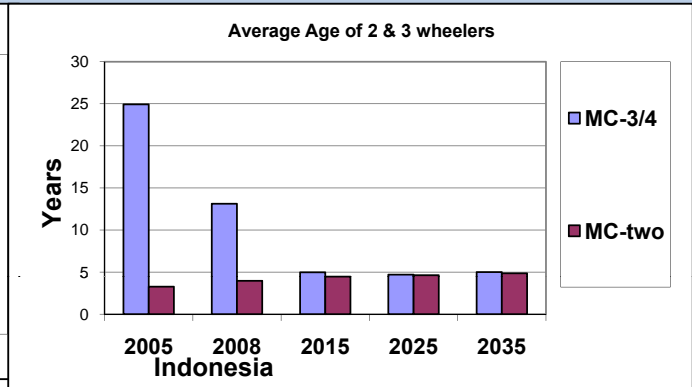
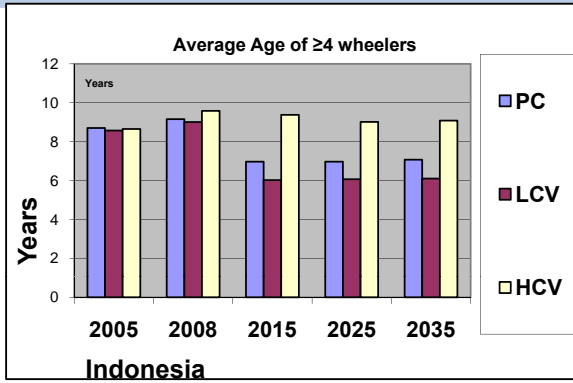
Source: 2008. ADB, CAI-Asia, and Segment Y Ltd.

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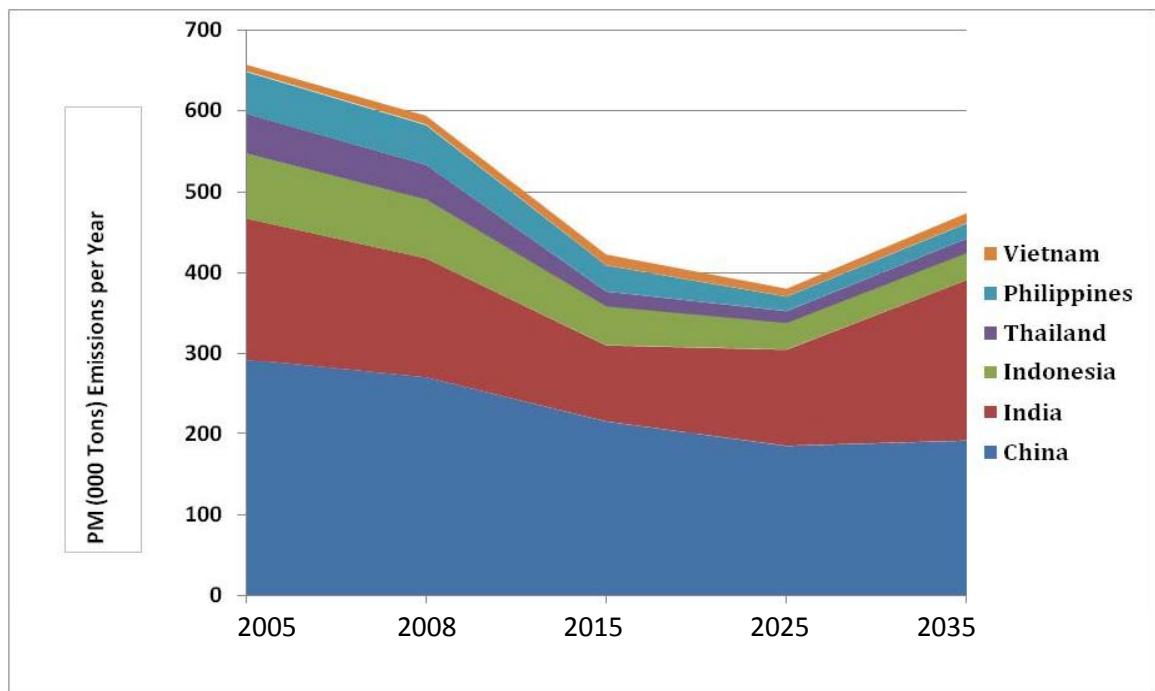
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# Ageing vehicle fleet



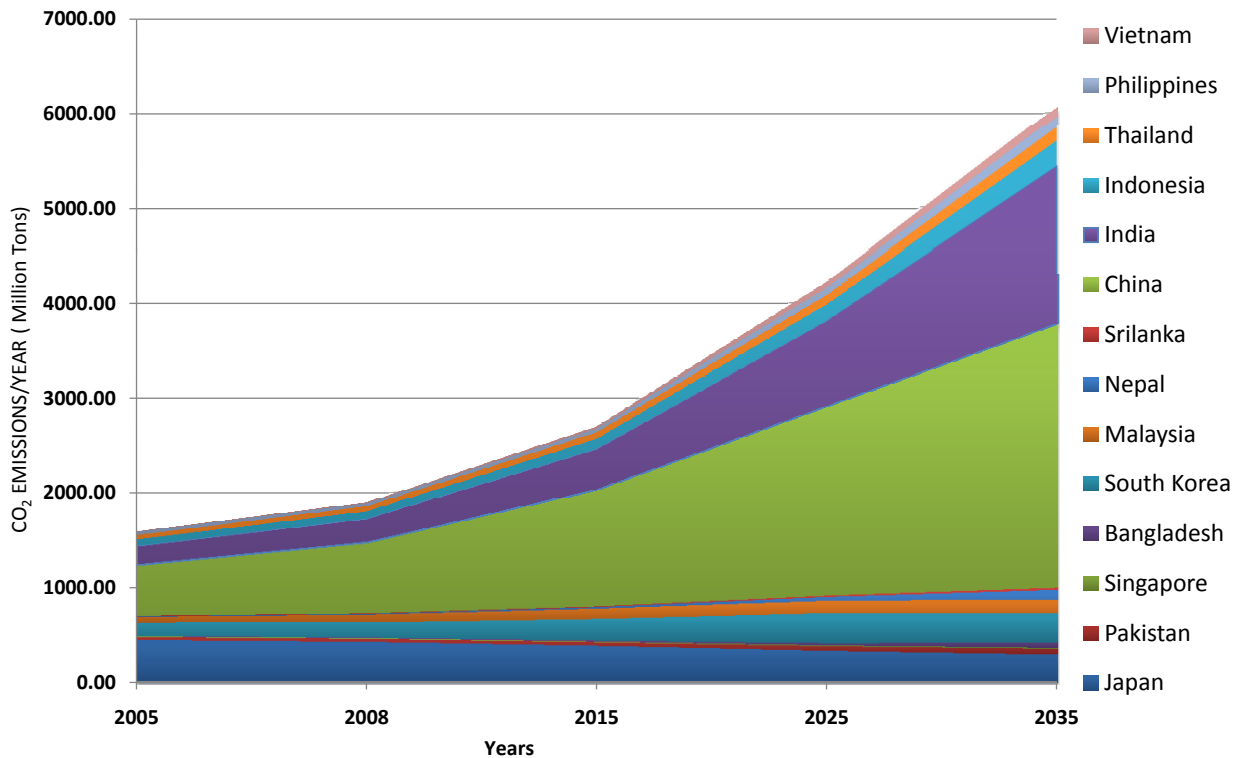
# Transport PM Emissions in some Asian Countries



Source: 2008. ADB, CAI-Asia, and Segment Y Ltd



# Transport CO<sub>2</sub> Emissions in Asia



Source: 2008. ADB, CAI-Asia, and Segment Y Ltd

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# Transport options to reduce air pollution and CO<sub>2</sub>

	AP ↓	CO <sub>2</sub> ↓	\$ Costs
<b>Reduce emissions per kilometer</b>			
Technology/ vehicle change	+++	+	low
Behavioral change (e.g. Fleet mgm't, driver's training)	++	+	low
Fuel-switch (e.g. gas to CNG/LPG, to biofuels)	++	?	?
<b>Reduce emissions per unit transported</b>			
Passenger transport:			
Mode switch	+++	++	low-med
Usage of larger units	+	+	low
Improved occupation rates	++	++	low
Freight transport	++	++	low-med
<b>Reduce number of trips</b>			
Land-use – Behavioral change	+++	+++	? - high
TDM	++	+++	? - med

Source: Authors, adapted from GTZ, 2007

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# Some Solutions



Source: China- Dr. YANG Xinmiao, treehugger, CAI-Asia



Source: India- CAI-Asia, CEPT,



Source: Greenpeace, CAI-Asia

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# Emission Standards for New Light-Duty Vehicles

Country	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14
European Union	E1	Euro 2				Euro 3			Euro 4			Euro 5				Euro 6				
Bangladesh <sup>a</sup>											Euro 2									
Bangladesh <sup>b</sup>											Euro 1									
Hong Kong, China	Euro 1	Euro 2				Euro 3			Euro 4			Euro 5								
India <sup>c</sup>						Euro 1			Euro 2			Euro 3								
India <sup>d</sup>					E1	Euro 2			Euro 3			Euro 4								
Indonesia											Euro 2									
Malaysia				Euro 1									Euro 2			Euro 4				
Nepal						Euro 1														
Pakistan	No conclusive information available																			
Philippines									Euro 1			Euro 2								
PRC <sup>a</sup>							Euro 1		Euro 2		Euro 3		Euro 4							
PRC <sup>e</sup>							Euro 1		Euro 2		Euro 3		Euro 4 Beijing only							
Singapore <sup>a</sup>	Euro 1					Euro 2														
Singapore <sup>b</sup>	Euro 1					Euro 2					Euro 4									
Sri Lanka									Euro 1			Euro 2								
South Korea											Euro 4			Euro 5						
Taipei,					US Tier 1												US Tier 2 Bin 7 <sup>f</sup>			
Thailand	Euro 1					Euro 2			Euro 3			Euro 4								
Vietnam													Euro 2							

Source: CAI-Asia. 2008, Emission standards for new vehicles (light duty). Available: [http://www.cleanairnet.org/caiasia/1412/articles-58969\\_resource\\_1.pdf](http://www.cleanairnet.org/caiasia/1412/articles-58969_resource_1.pdf)

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# Sulfur Levels in Diesel

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Bangladesh							5000										
Cambodia					2000				1500								
Hong Kong,		500					50					10 <sup>a</sup>					
India (nationwide)	5000				2500					500					350		
India (metros)	5000				2500	500				350 <sup>a</sup>					50 <sup>a</sup>		
Indonesia	5000										3500				350		
Japan <sup>b</sup>	500									50		10					
Malaysia	5000		3000				500 <sup>c</sup>			500 <sup>d</sup>							50 <sup>a</sup>
Pakistan	10000						7000 <sup>c</sup>										
Philippines	5000					2000			500								
PRC (nationwide) <sup>e,f</sup>	5000						2000			500							
PRC -	5000						2000		500	350			50				
Singapore	3000		500								50						
South Korea	500							430	100		30		15(10) <sup>f</sup>				
Sri Lanka	10000							5000 <sup>d</sup>			500						
Taipei,	3000			500			350		100				50				
Thailand	2500			500					350		150				50		
Viet Nam	10000											500					
European Union					500					50(10) <sup>f</sup>			10				
United States	500										15						

Source: CAI-Asia. 2008. Current and Proposed Sulfur levels in Diesel in Asia, EU and USA. Available: <http://www.cleanairnet.org/caiasia/1412/article-40711.html>



# Emissions Standards for Motorcycles

Country	Standards			Remarks
	CO	HC	HC+NOx	
Bangladesh	3.5 g/km		2 g/km	Under discussion test = ECE R40
Cambodia	4.5%	10,000ppm		Idle test
Hong Kong, China	13 g/km	3 g/km	0.3 g/km (NOx)	4-stroke
	8 g/km	4 g/km	0.1 g/km (NOx)	2-stroke
India 2000	2 g/km		2 g/km	As per IDC
India 2005 proposed	1.5 g/km		1.5 g/km	As per IDC; Deterioration factor = 1.2
India 2005 3-wheel gas	2.25 g/km		2.0 g/km	
India 2005 3-wheel diesel	1.00 g/km		0.85 g/km	
Indonesia 2001	12 g/km		10 g/km	ECE R40
Indonesia 2004	8 g/km		5 g/km	ECE R40
Indonesia 2007 proposed	5 g/km		3 g/km	ECE R40
Japan				2-stroke
				4-stroke
Malaysia (2003 prop)	2-stroke	8 g/km	4 g/km	0.1 g/km NOx
	4-stroke	13 g/km	3 g/km	0.3 g/km NOx
Nepal				
Pakistan				
Philippines 1999	6%			Idle test
Philippines 2003	4.5%			Idle test
PRC nationwide Moped '01/02 - '04/05	6 g/km		3 g/km	ECE R47

Country	Standards			Remarks
	CO	HC	HC+NOx	
PRC nationwide Moped '05/06 onwards	1 g/km		1.2 g/km	ECE R47
PRC nationwide (2S) '01/02 onwards	8 g/km	4 g/km	0.1 g/km (NOx)	ECE R40
PRC nationwide (4S) '01/02 onwards	13 g/km	3 g/km	0.3 g/km (NOx)	ECE R40
- Beijing 2S + 4S '01 - '03	4.5 g/km		3 g/km	ECE R40
- Beijing 2S + 4S '04 onwards	3.5 g/km		2.0 g/km	ECE R40
Singapore	12 g/km		5 g/km	FTP
Sri Lanka	6.0 g/km			Low-idling;
Taipei, China (current 2-4 stroke)	4%	6,000 ppm		Idle warm test
Taipei, China Jan '04 2 & 4 Stroke	3%	2,000 ppm		Idle Cold test
Thailand	4.5 g/km	3 g/km		Free acceleration 30% white smoke
Thailand July 2003	3.5 g/km		2 g/km	Evaporative emission 2g test 15% white smoke
Thailand July 2004	3.5 g/km		1.8 g/km	Without evaporative emission std. 15% white smoke
Viet Nam MC Proposed 2004	4.5 g/km		3 g/km	
Viet Nam MC Proposed 2007	3.5 g/km		2 g/km	
Viet Nam Moped Proposed 2004	6 g/km		3 g/km	For 3 and 4 wheelers multiply by 2
Viet Nam Moped Proposed 2007- 2 wheel	1.0 g/km		1.2 g/km	
Viet Nam Proposed 2007 - 1/4 wheel	3.5 g/km		2.4 g/km	

Source: 2003. CAI-Asia

	Gasoline			
	Effectivity date	CO %	HC ppm	Test
Bangladesh	-	24.0 g/km	2.0 g/km	Dynamic
Cambodia	Current	4.5	10,000	Idle
Hong Kong	Current	0.5	-	Low Idle or in accordance with manufacturers' specifications
		0.3		High Idle, $\lambda = 1 \pm 0.03$ or in accordance with manufacturers' specifications
India	Current	3.0		Idle
Indonesia	Current	4.5	1200	Idle
Malaysia	Current	3.5-4.5	600-800	Idle
Nepal	Current	3.0	1000	-
Pakistan	Current	6.0		Idle
Philippines	Before 1997 January	4.5	800	Idle
Philippines	1997	3.5	600	Idle
Philippines	2003	4.5	800	Idle

	Gasoline			
	Effectivity date	CO %	HC ppm	Test
PRC <sup>a</sup>	Current	4.5	900	Idle
PRC <sup>b</sup>	Current	4.5	1200	Idle
Singapore	Current	3.6-6		Idle
Sri Lanka	Before 1998	4.5	1200	Low Idling
Sri Lanka	After 1998	3.0	1200	Low Idling
Thailand	Before 1993 November	4.5	600	Idle
Thailand	After 1993 November	1.5	200	Idle
Viet Nam <sup>c</sup>	Proposed 2002 December	6.0 <sup>d</sup>	1500	Idle
Viet Nam <sup>e</sup>	Proposed 2005	4.5 <sup>e</sup>	1200	Idle
Viet Nam <sup>f</sup>	Proposed 2008	3.0 <sup>f</sup>	600	Idle

Source: 2003. CAI-Asia

	Diesel		
	Effectivity date	Smoke HSU	Test
Bangladesh	-	65	-
Cambodia	Current	50	-
Hong Kong, China	Current	60	Free acceleration
		50	Loaded lug down test on a chassis dynamometer <sup>a</sup>
India	Current	65	Free acceleration
Indonesia	Current	50	Free acceleration
Malaysia	Current	50	-
Nepal <sup>b</sup>	Current	65	-
Pakistan	Current	40	Free acceleration
Philippines	Current	2.5 m <sup>3</sup>	Free acceleration <sup>c</sup>
Philippines	2003	2.5 m <sup>3</sup>	Free acceleration <sup>d</sup>
PRC	Current	4.5 Rb	Free acceleration
Singapore	Current	50	-

	Diesel		
	Effectivity date	Smoke HSU	Test
Singapore	Current	50	-
Sri Lanka	Current	65	Idle
Sri Lanka	Current	75	Free acceleration
Thailand	Current	45	Free acceleration
Thailand	Current	35%	Loaded
Thailand	Current	50	Filter test - free acceleration
Thailand	Current	40%	Filter test - loaded
Viet Nam <sup>e</sup>	Current	72	Idle
Viet Nam <sup>f</sup>	Current	85	Idle
Viet Nam <sup>g</sup>	2005	72	Idle

Source: 2003. CAI-Asia



# Summary and Recommendations

- Motorization in Asian countries will continue to substantially increase in the next years
- In-use vehicles will remain as key source of emissions unless stronger enforcement is put in place
- Need to better understand the current vehicle fleet and establish a comprehensive database
- A systems approach is essential, fuel quality and vehicle emission standards should be regulated together and roadmaps for stricter standards should be put in place
- Reducing sulfur is essential and the benefits of reducing sulfur are clear
- Review and strengthen enforcement in-use emissions standards

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