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# Urban AQM in Asia: Status and Trends

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**Regional Coordination Meeting**  
**Bangkok**

**30-13 January, 2008**



## Outline Presentation

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- Organizational update CAI-Asia
- AQ and GHG emissions in Asia
- AQM and Climate Change Management in Asia
- The way forward

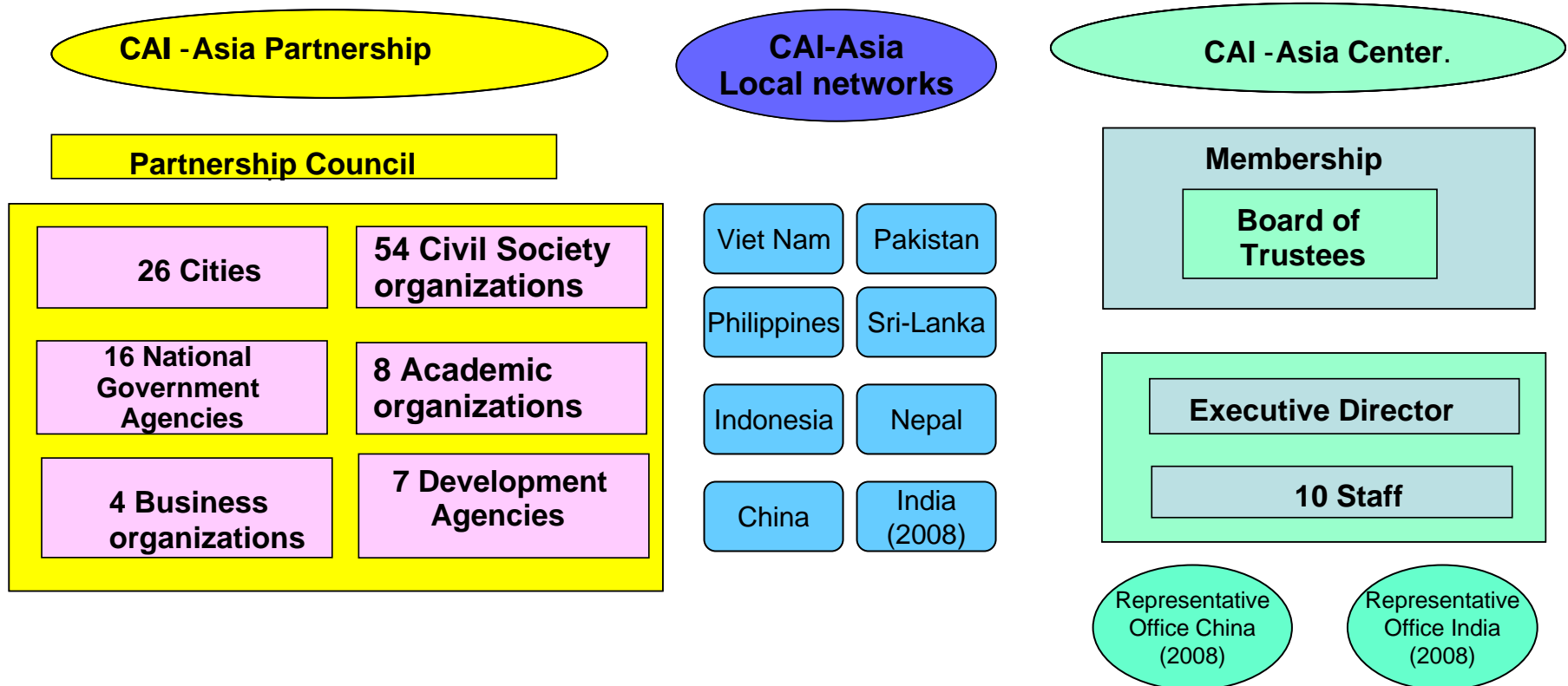


# Part 1: Update on CAI-Asia



# CAI-Asia Mission and Structure

CAI-Asia promotes and demonstrates innovative ways to improve the air quality of Asian Cities by sharing experiences and building partnership

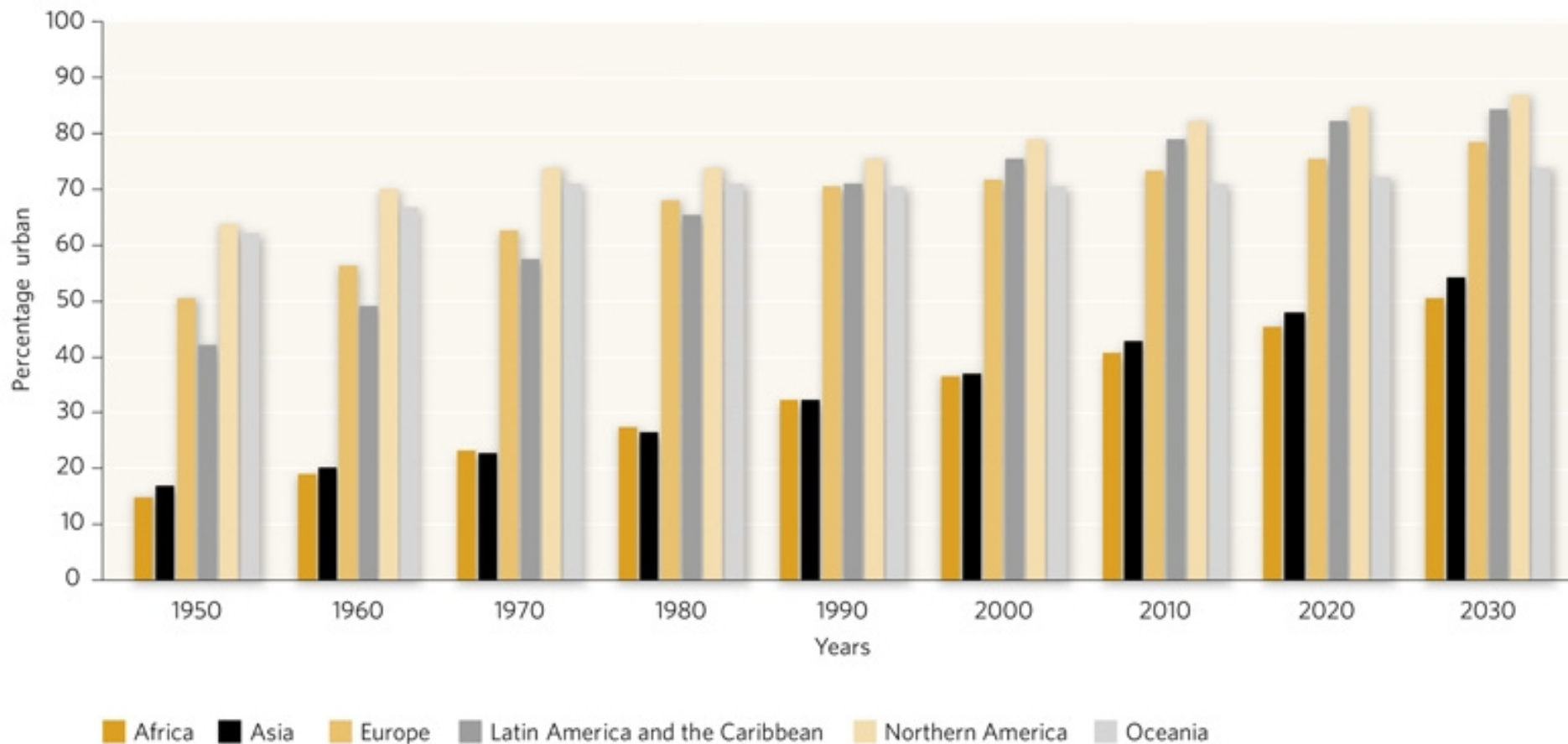




## Part 2: AQ and GHG emissions in Asia



# Percentage of population residing in urban areas (by region), 1950-2030

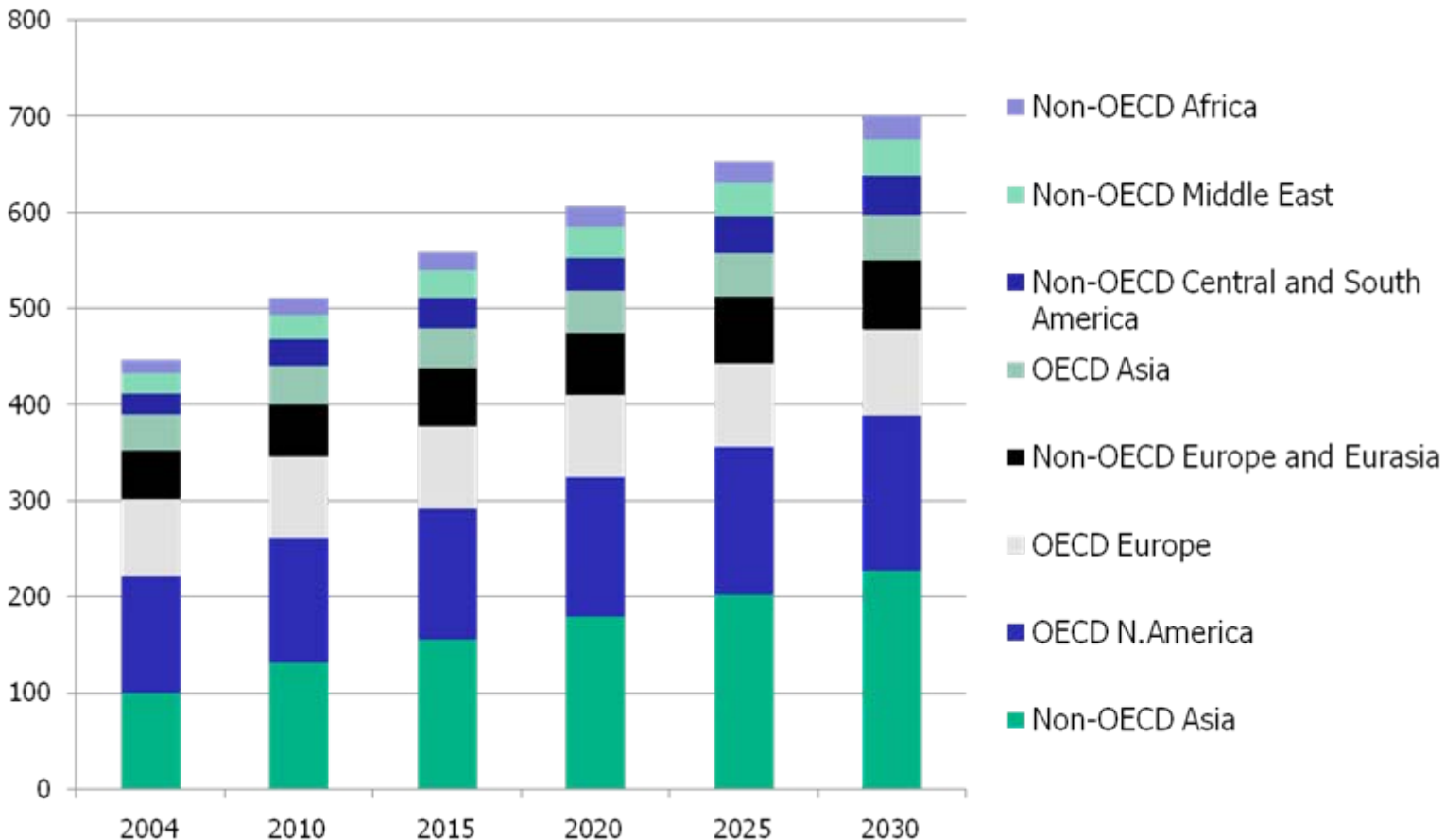


Source: United Nations, 2006. World Urbanization Prospects: The 2005 Revision. Table A.2. New York: Population Division, Department of Economic and Social Affairs, United Nations



# Worldwide Energy Consumption 2004 - 2030

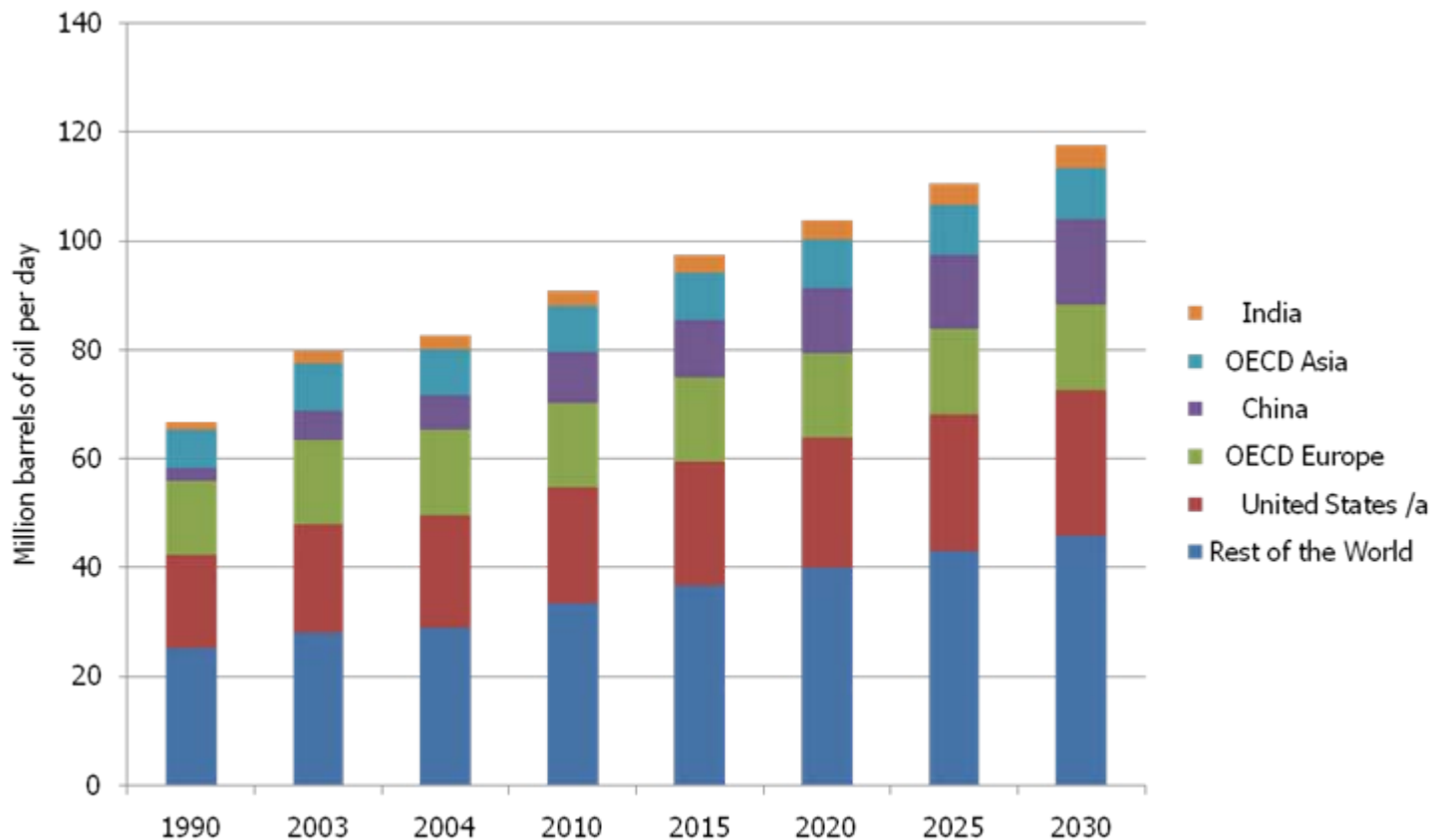
World Marketed Energy Consumption by Country Grouping, 2004-2030(Quadrillion Btu)



Sources: 2004 Energy Information Administration (EIA), International Energy Annual 2004 (May-July 2006), web site [www.eia.doe.gov/iea](http://www.eia.doe.gov/iea). Projections: EIA, System for the Analysis of Global Energy Markets (2007).



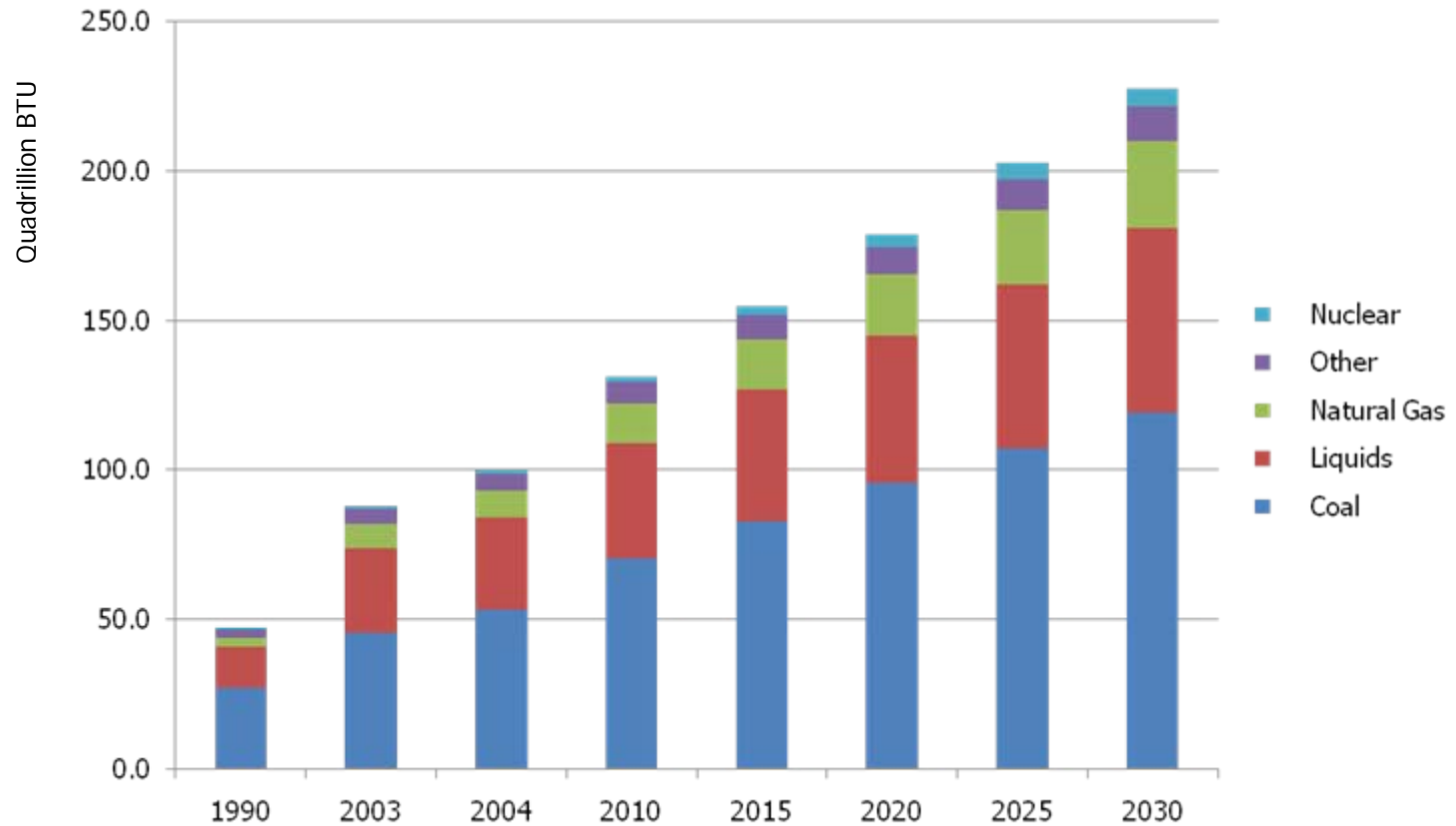
# World Liquid Fuels Consumption Projections







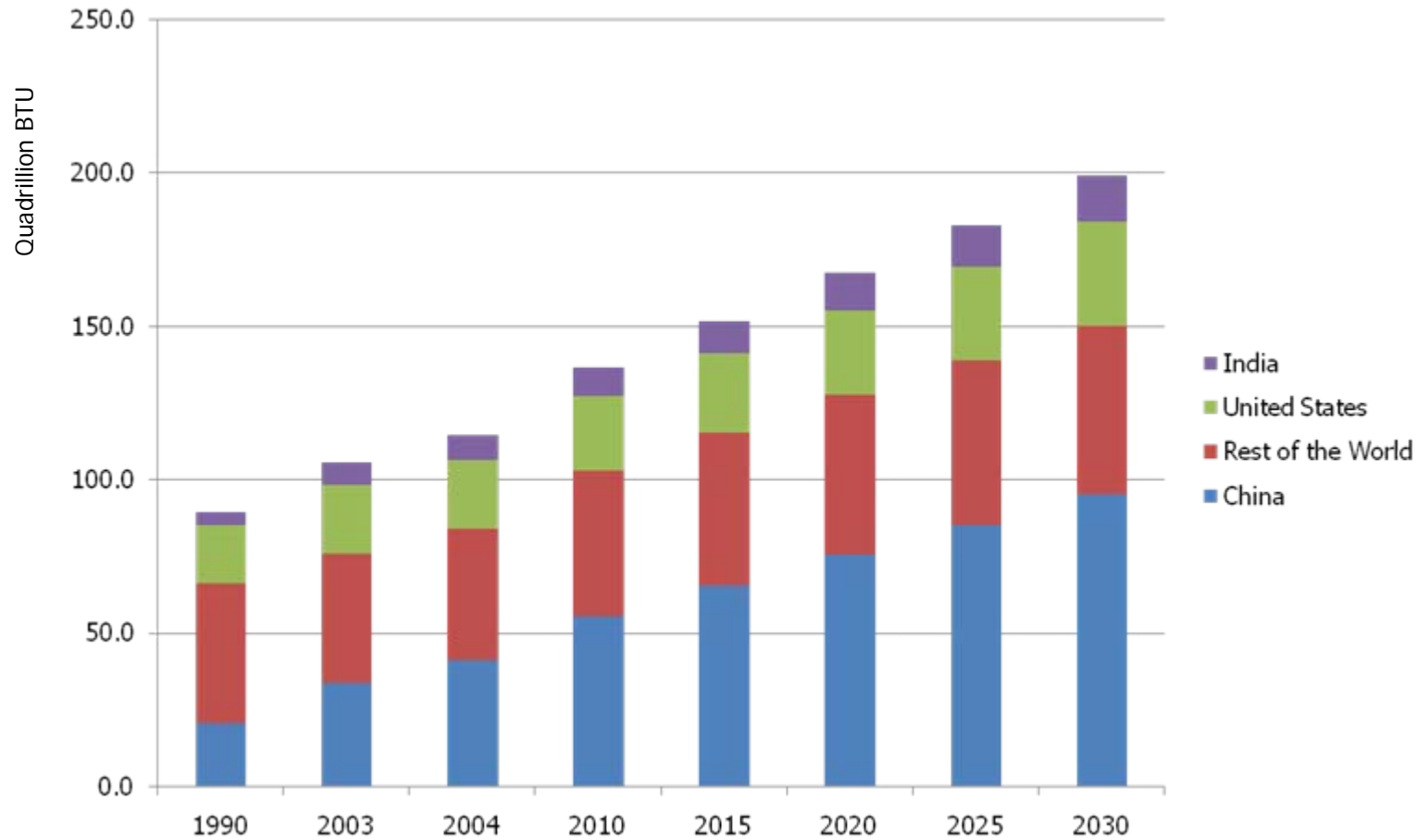
# Fuel Consumption: Non-OECD Asia



Source: Energy Information Administration. International Energy Outlook 2007



# Coal Consumption Projections

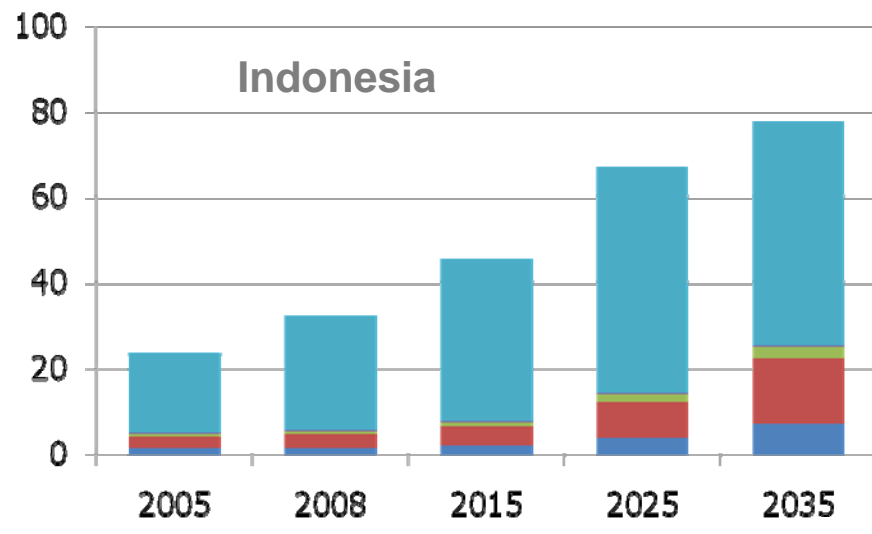
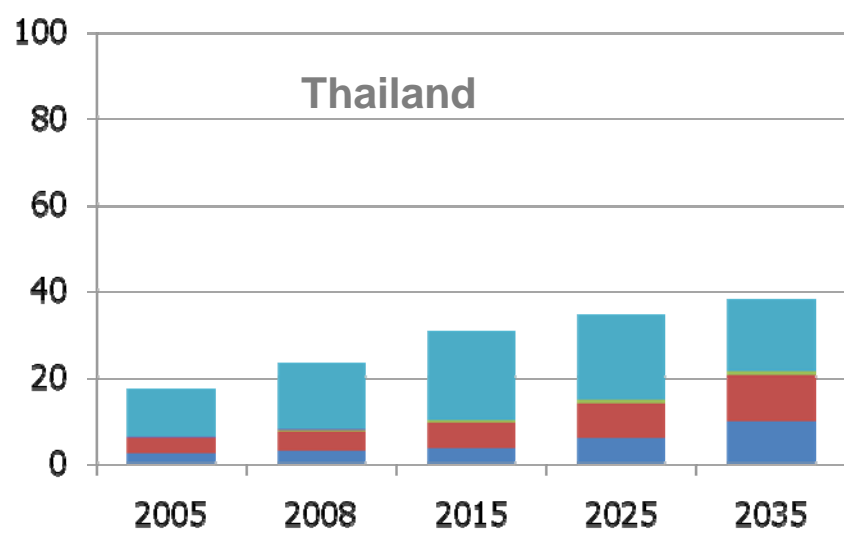
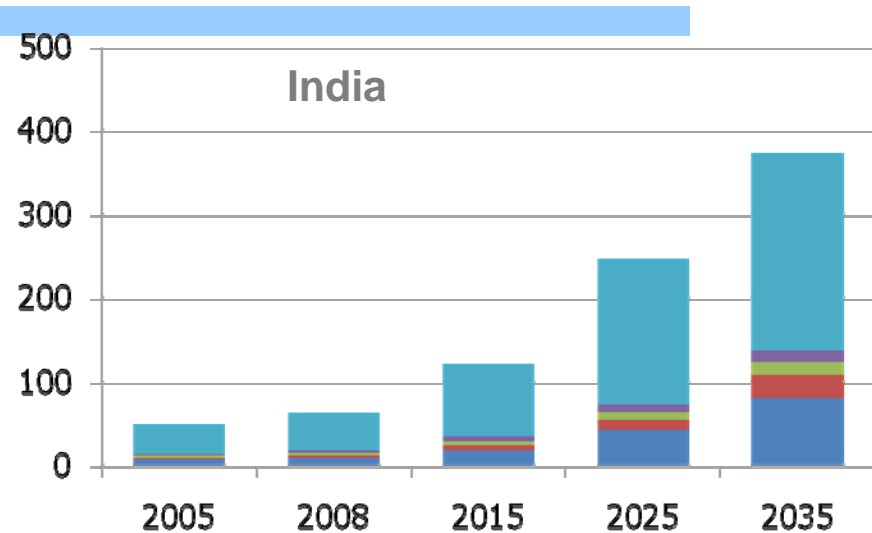
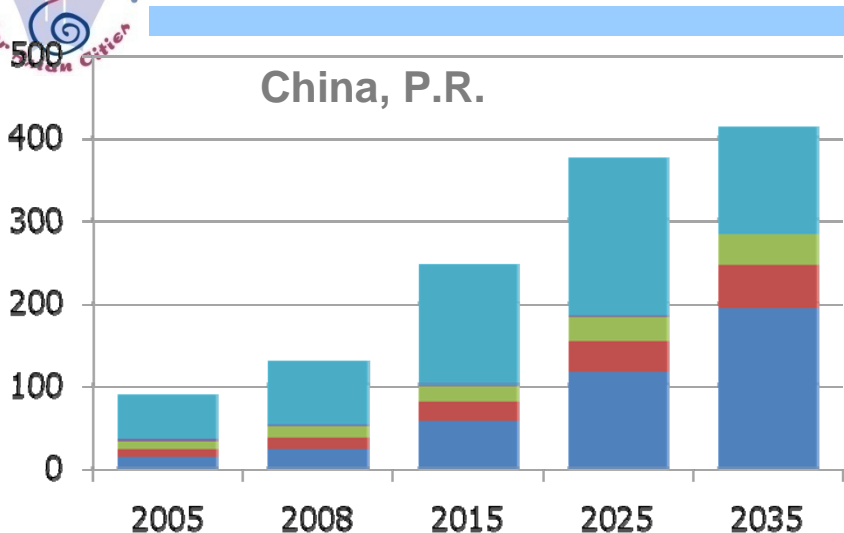


Source: Energy Information Administration. International Energy Outlook 2007



# Vehicle Growth Forecast in Asia

(in millions of vehicles)

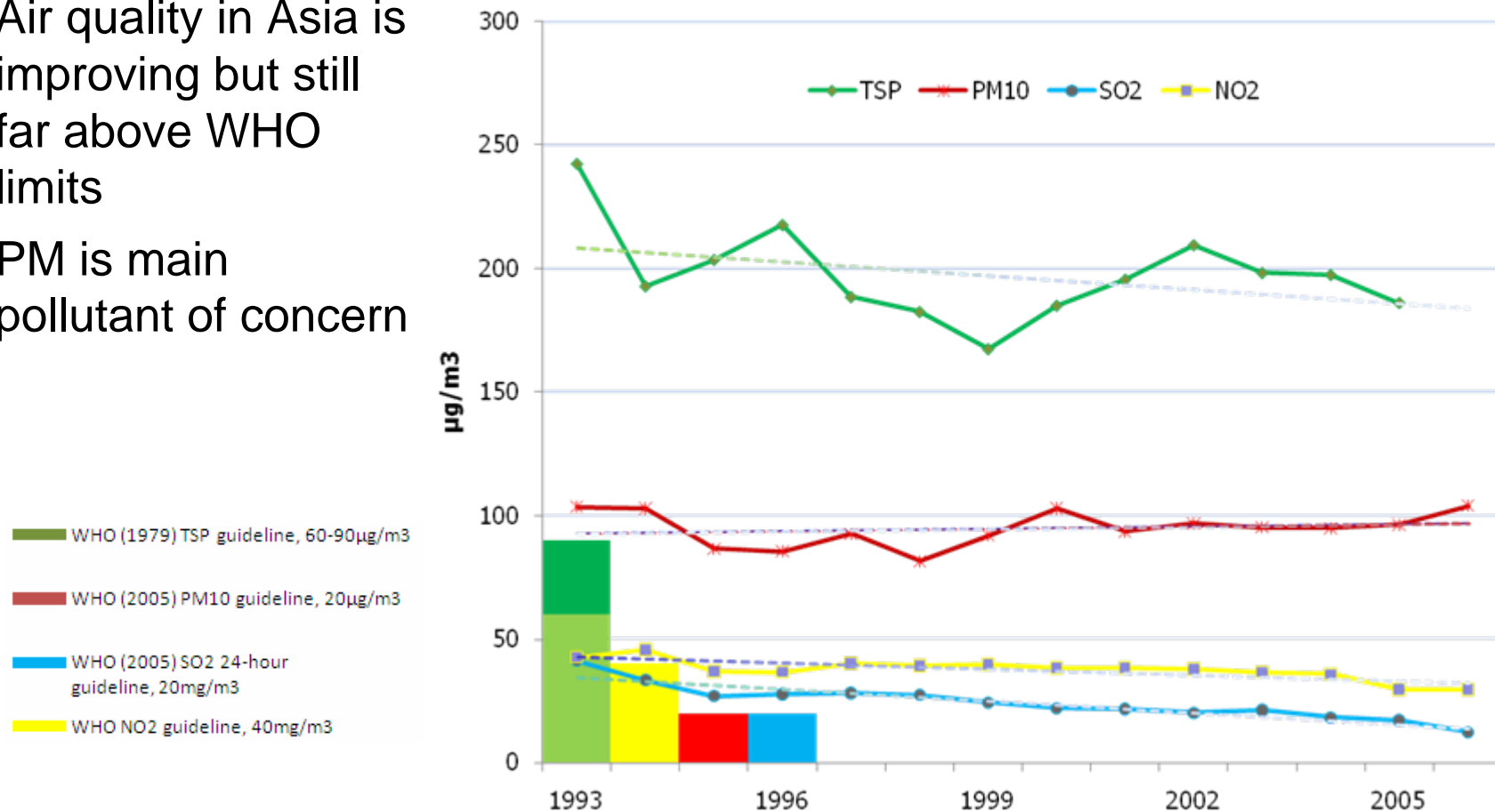


■ PC ■ LCV ■ HCV ■ MC-three ■ MC-two

# Trends Air Pollution 2003-2006

- Air quality in Asia is improving but still far above WHO limits
- PM is main pollutant of concern

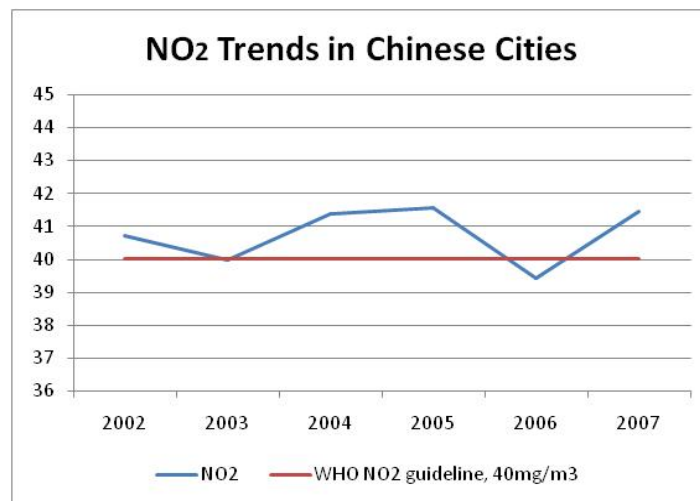
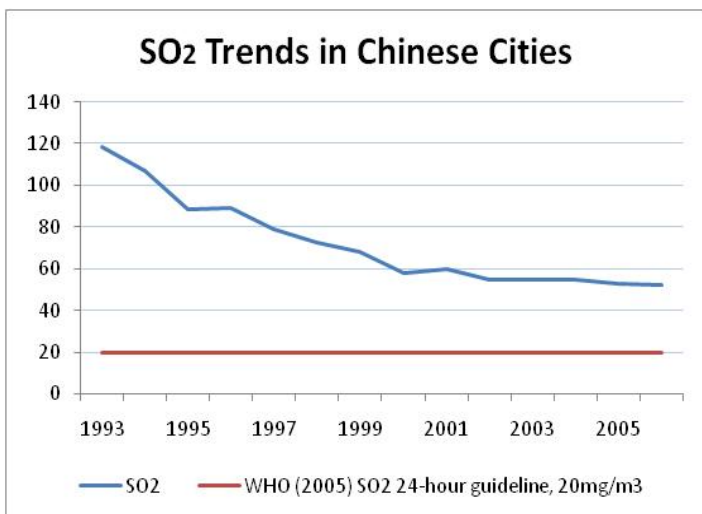
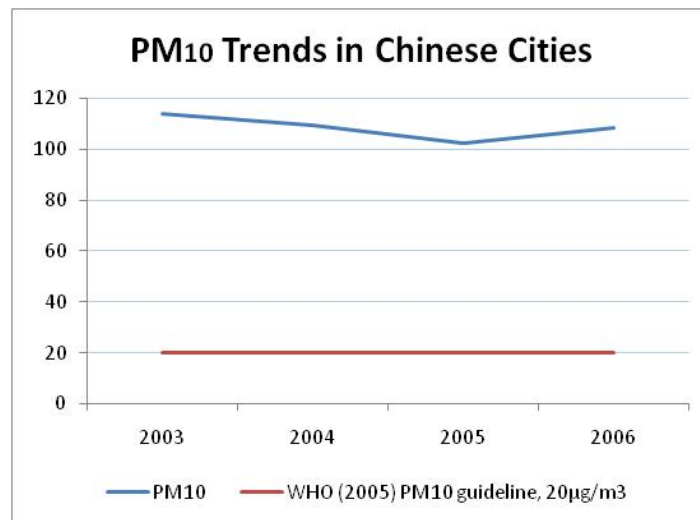
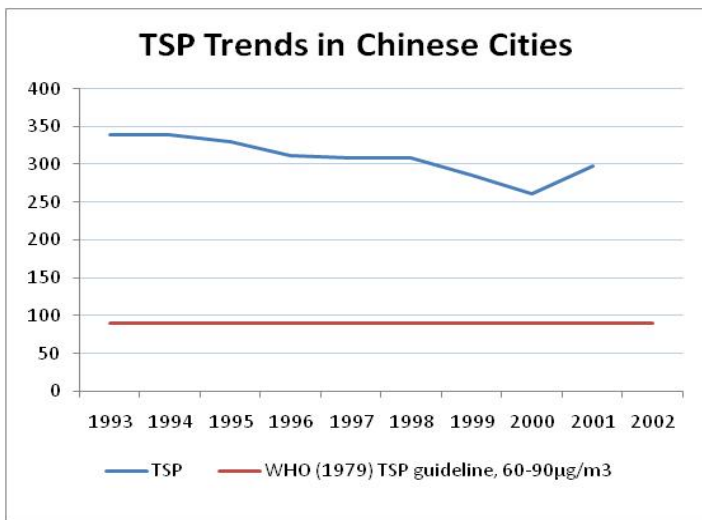
## Aggregated Annual AQ Trends 1993-2006



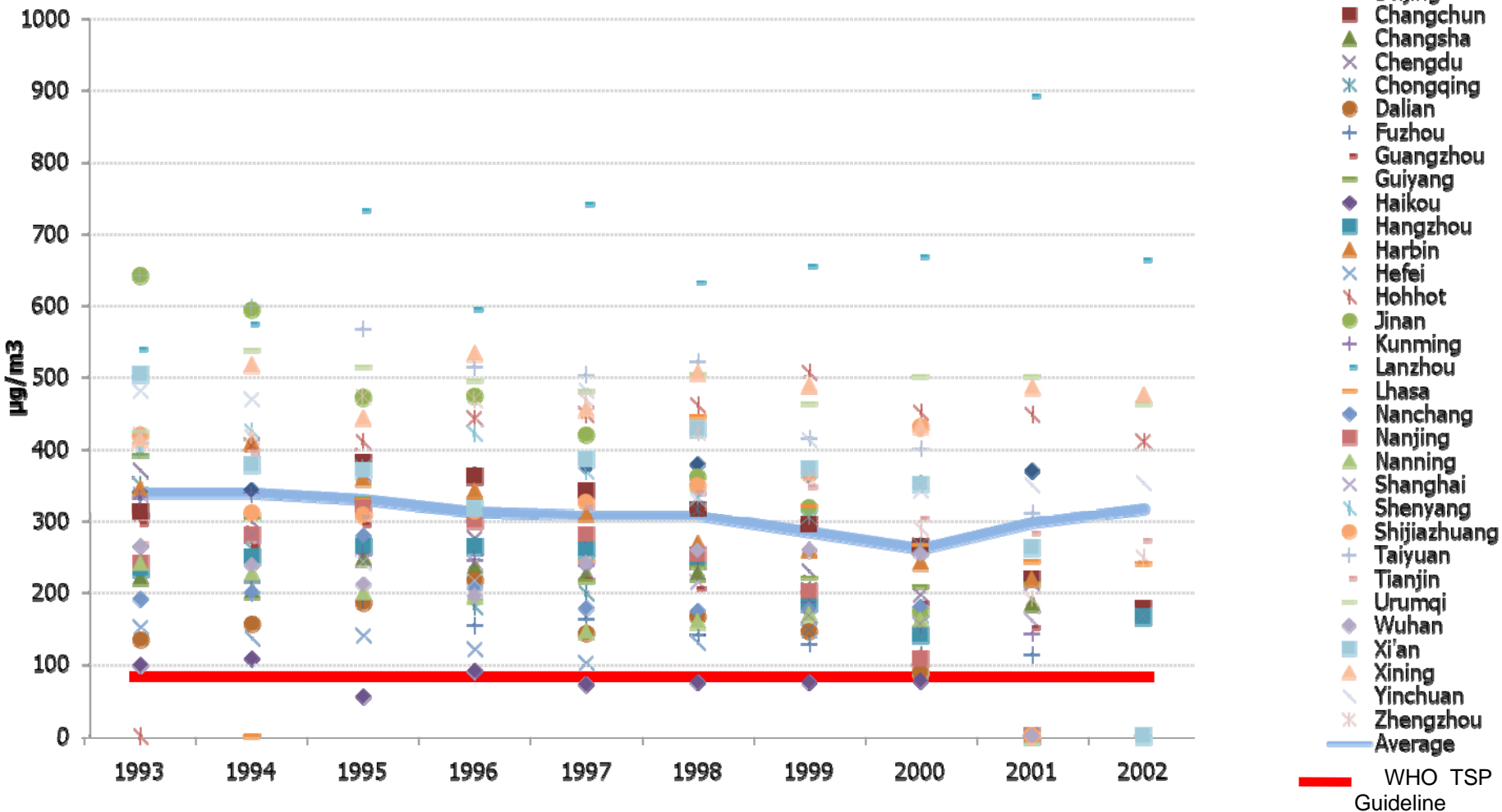
Note: TSP data aggregated from 17 cities; PM10 data from 32 cities; SO<sub>2</sub> data from 31 cities; NO<sub>2</sub> data from 29 cities



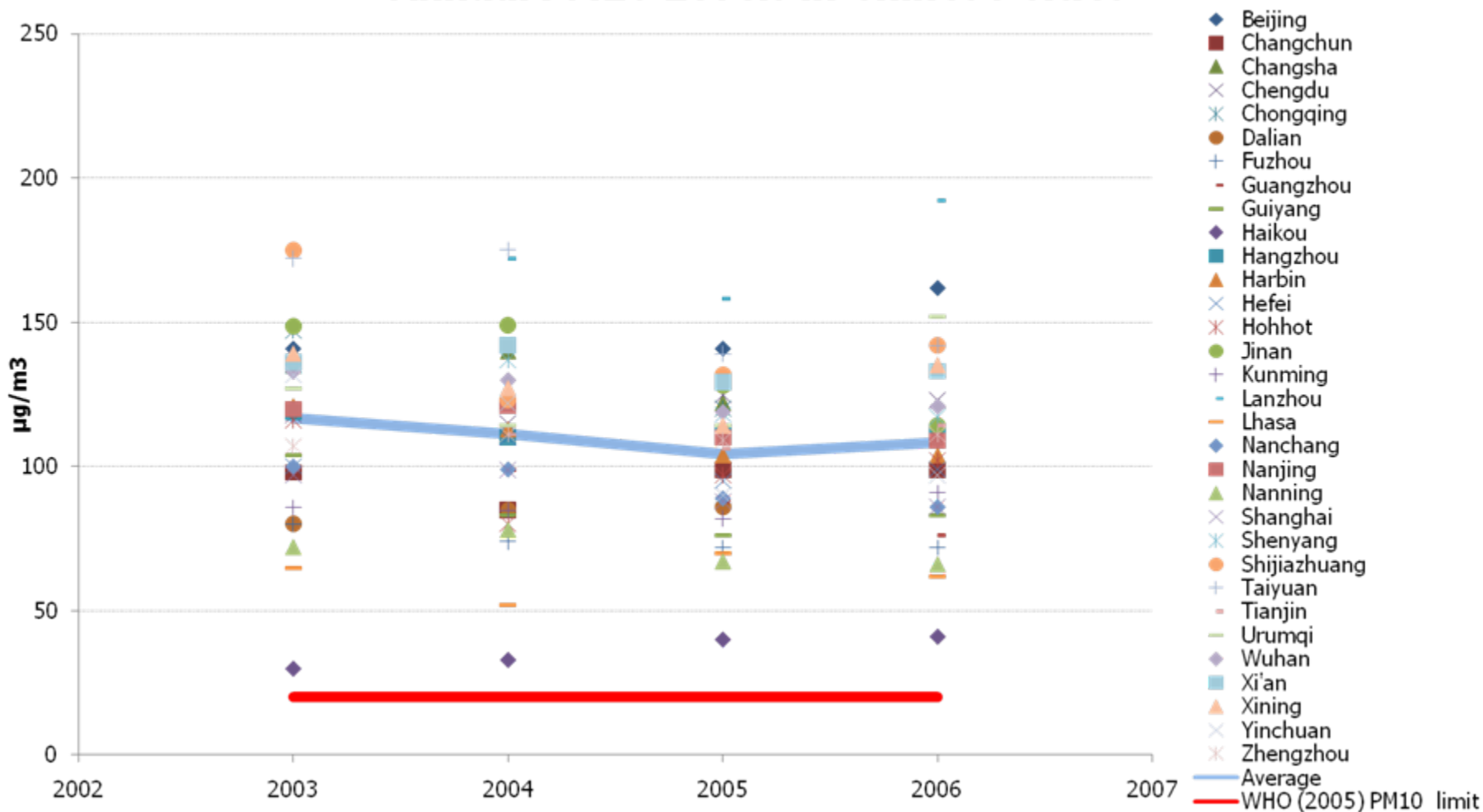
# Aggregate AQ Levels in Chinese Cities ( $\mu\text{g}/\text{m}^3$ )



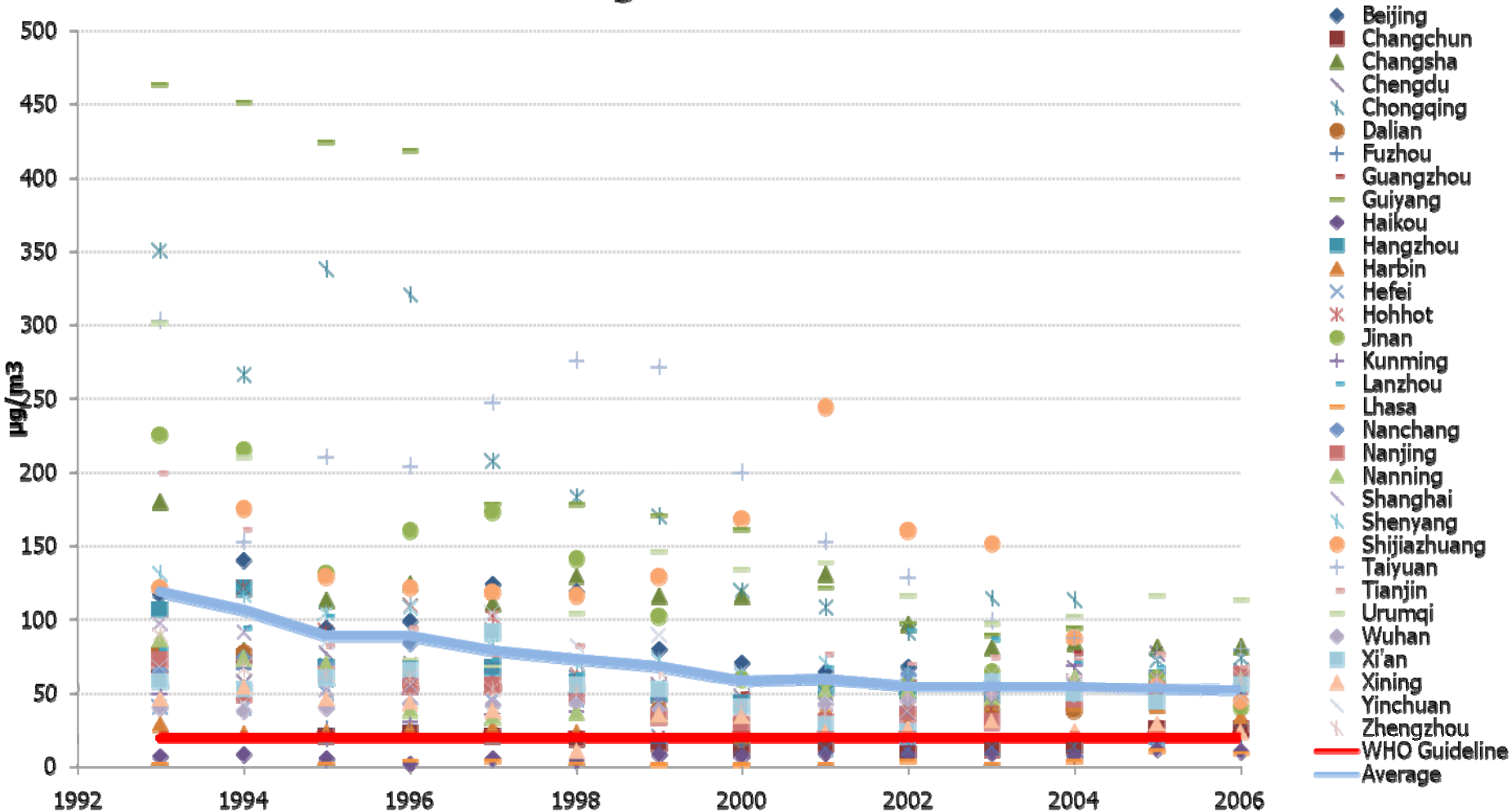
## Annual TSP Levels in Chinese Cities



## Annual PM10 Levels in Chinese Cities

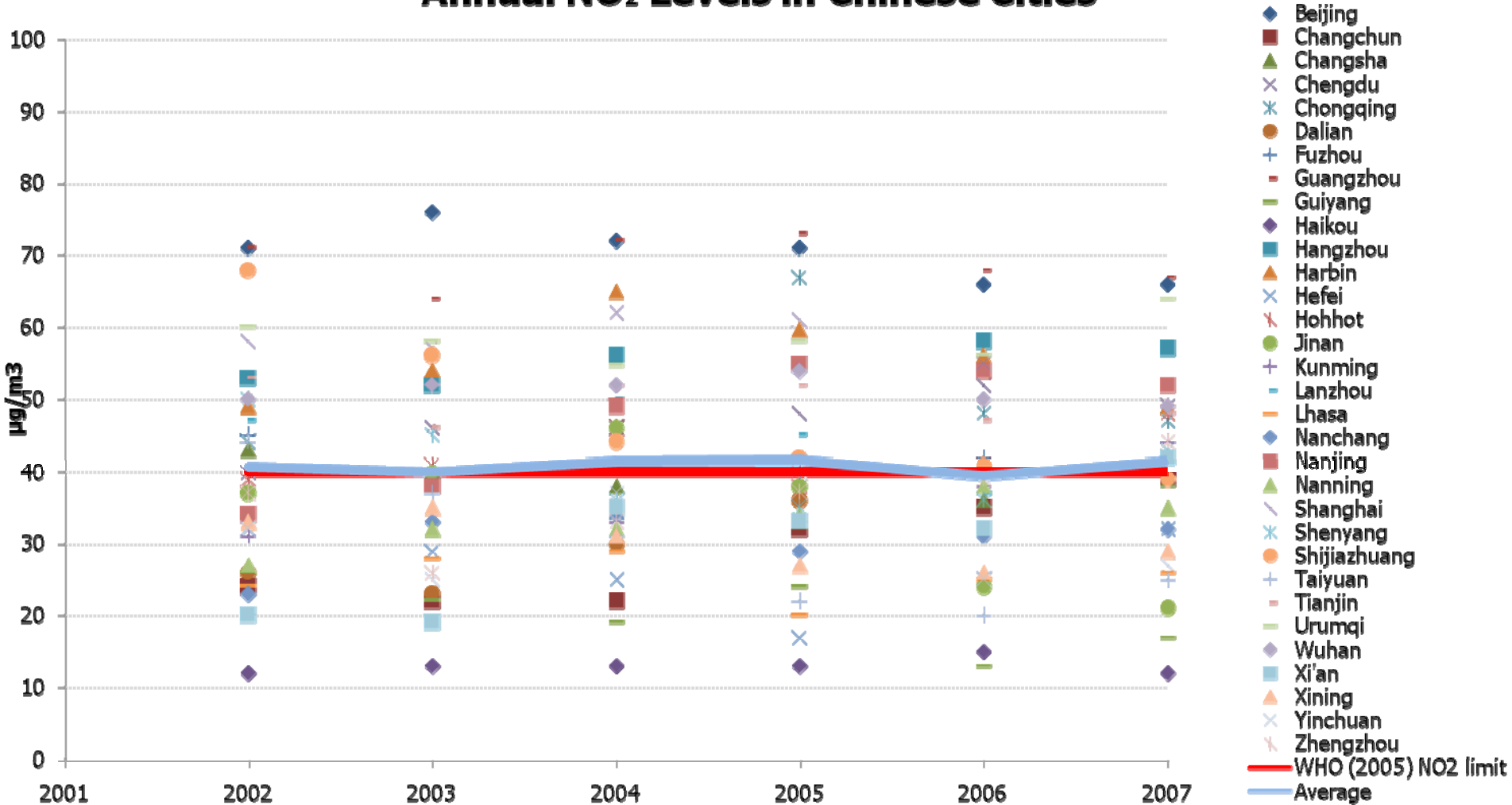


## Annual Average SO<sub>2</sub> Levels in Chinese Cities



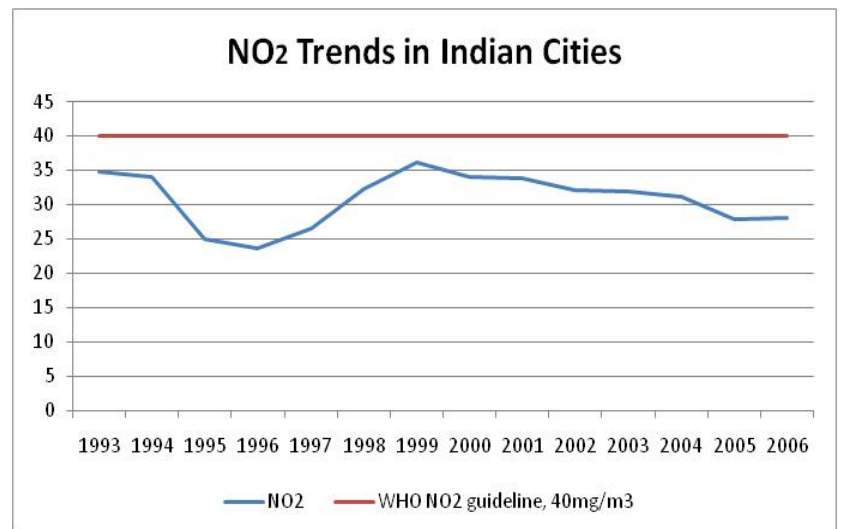
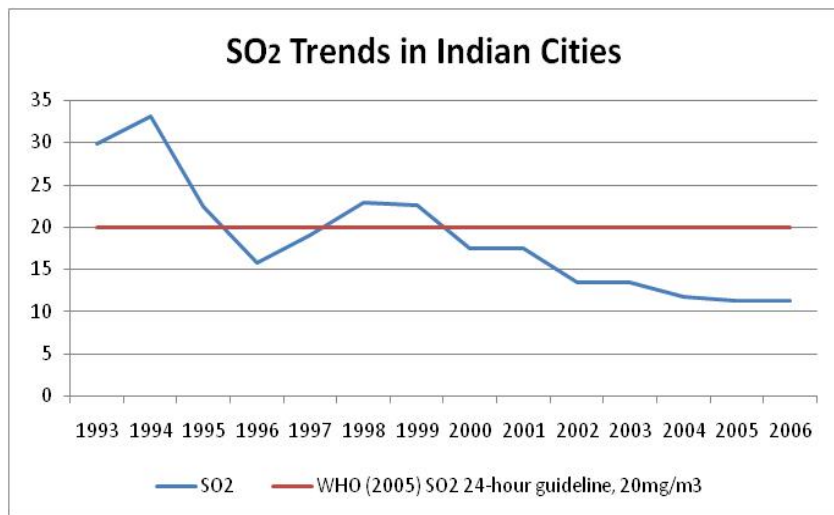
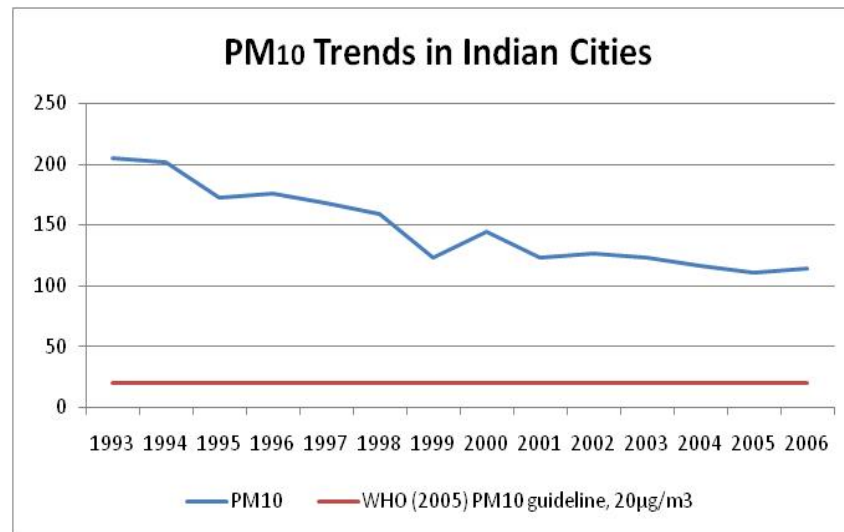
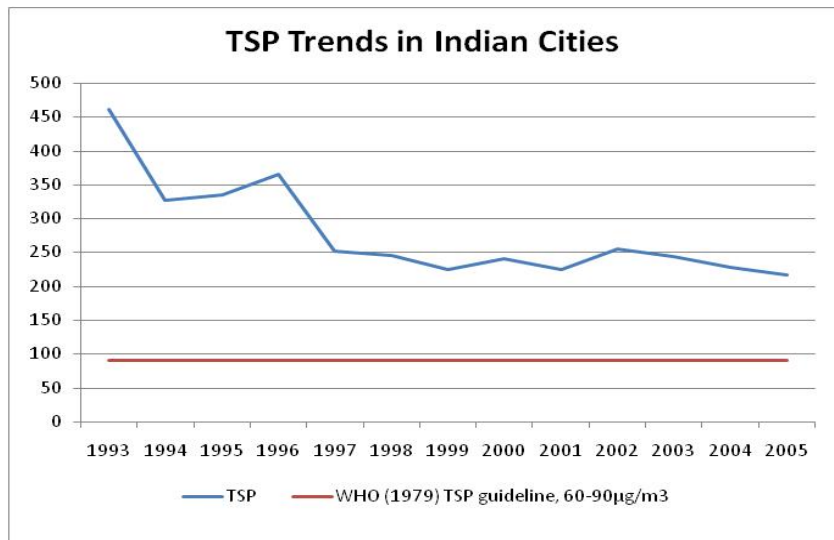


## Annual NO<sub>2</sub> Levels in Chinese Cities

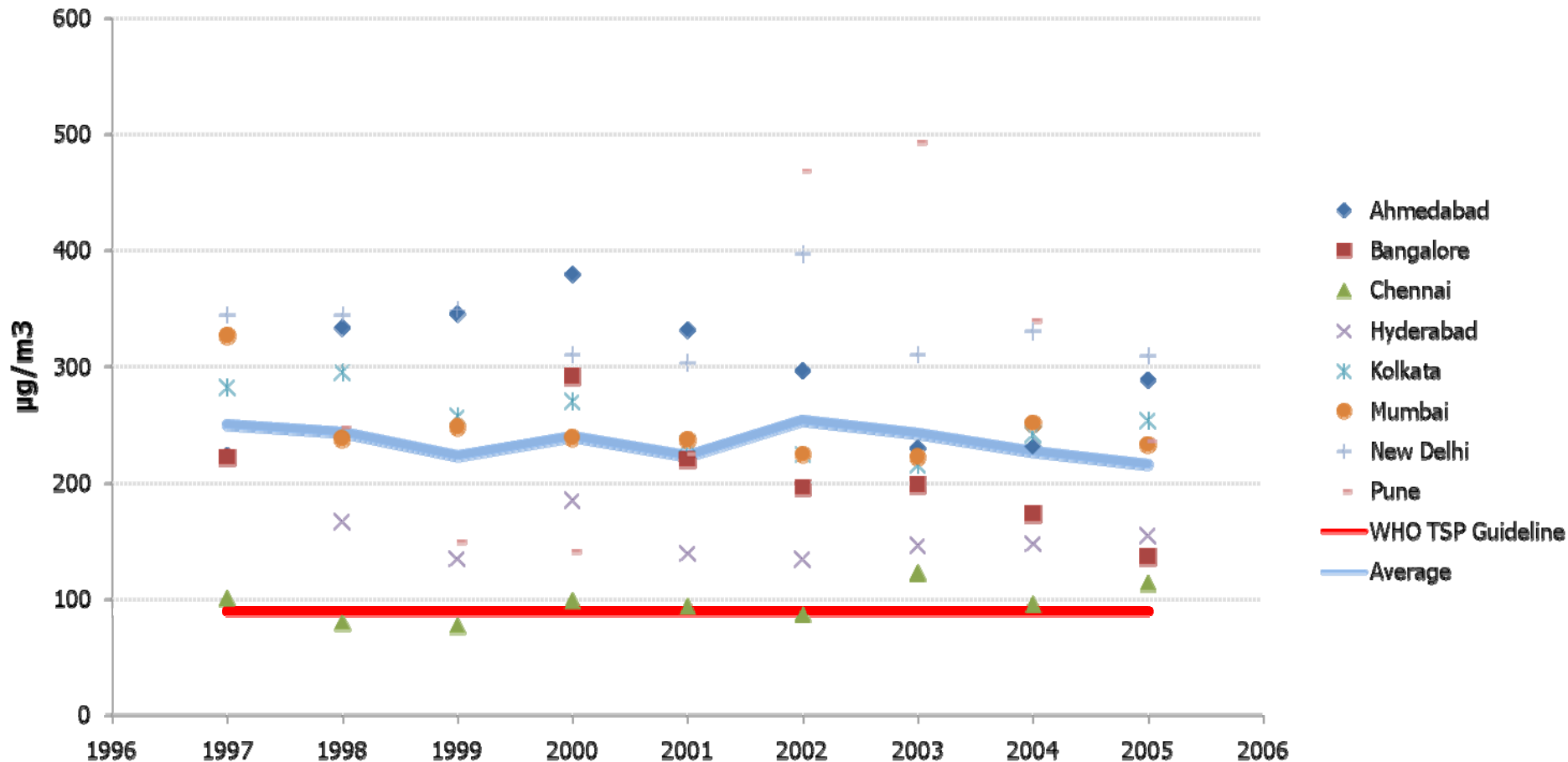




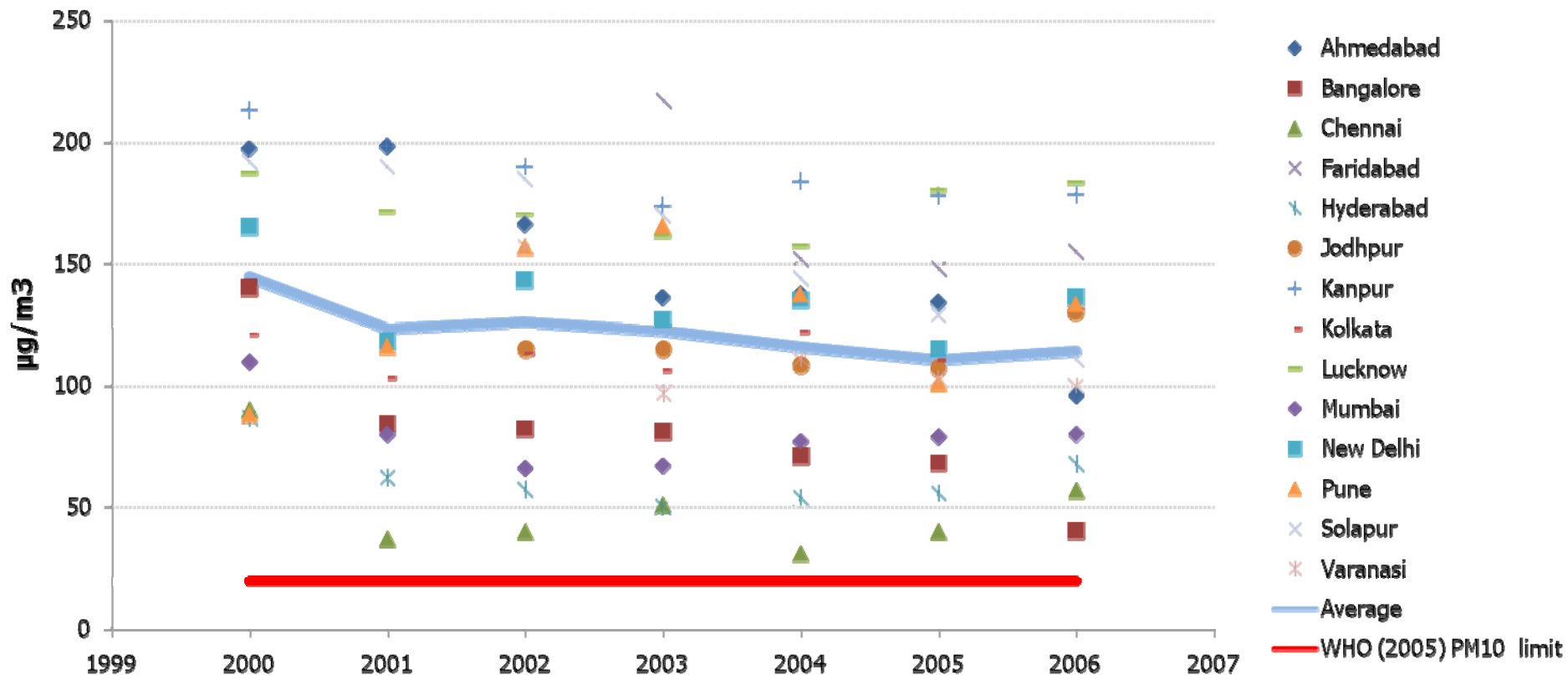
# Aggregate AQ Levels in Indian Cities ( $\mu\text{g}/\text{m}^3$ )



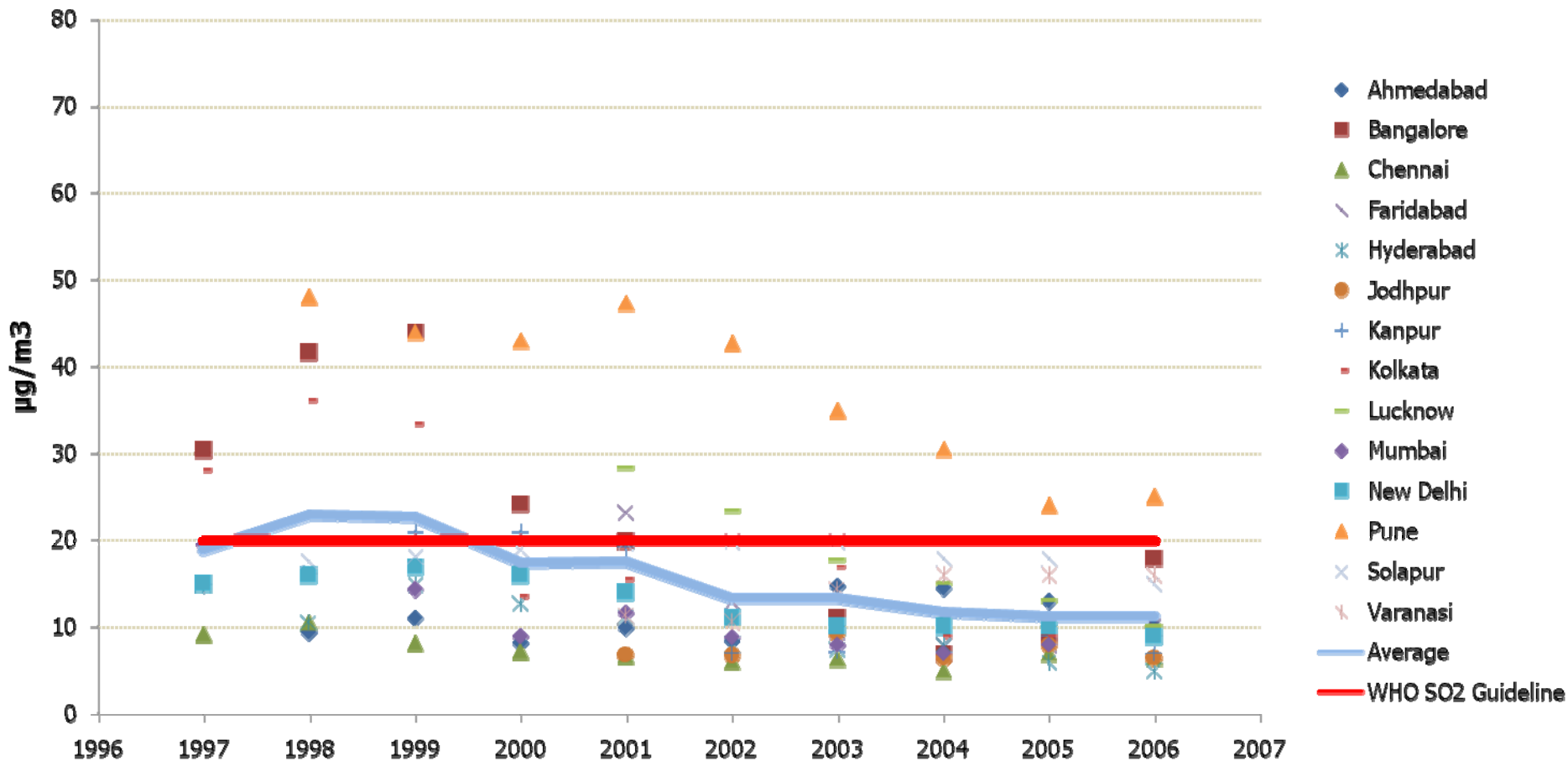
## Annual TSP Levels in Indian Cities



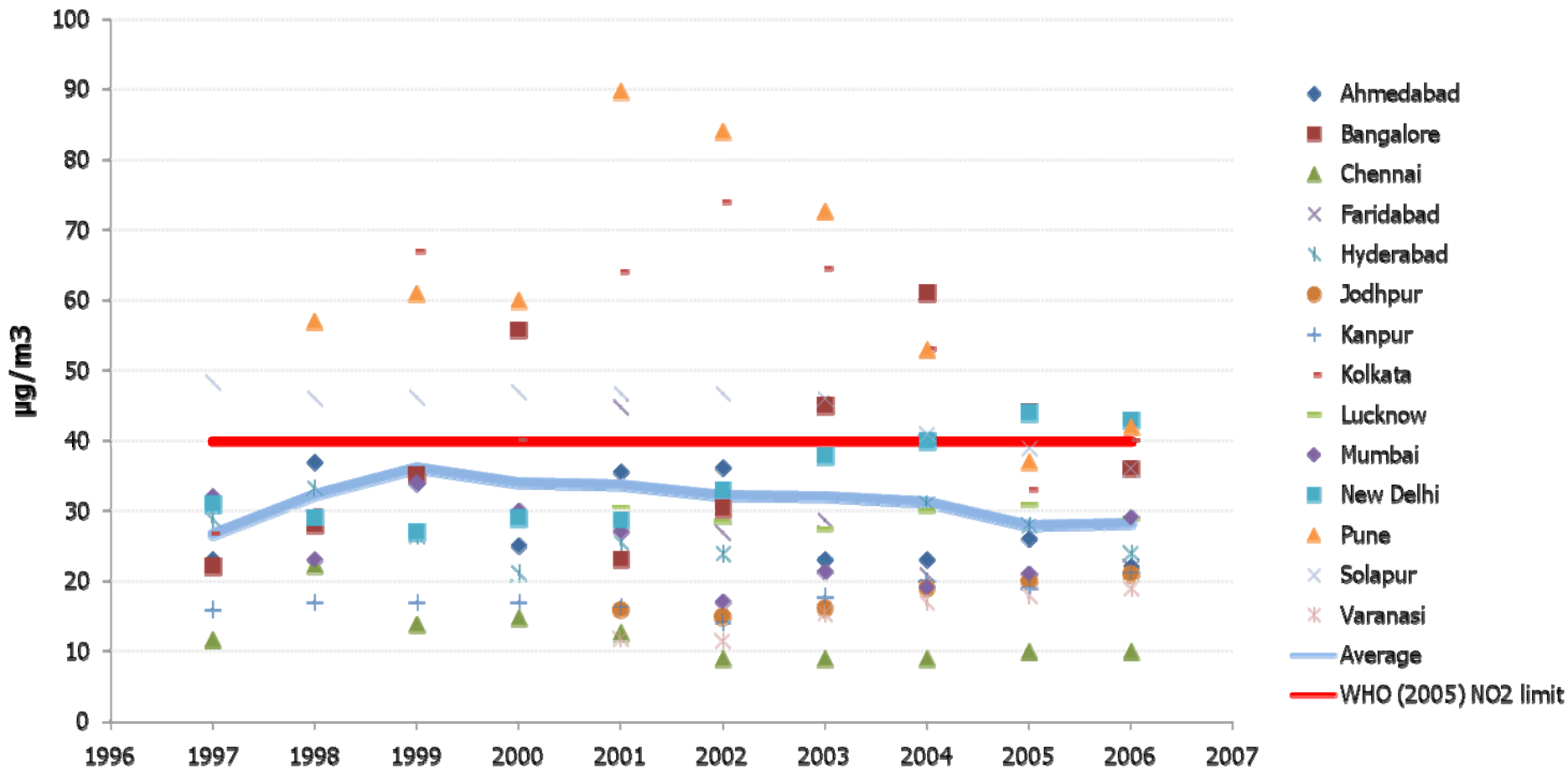
## Annual PM<sub>10</sub> Levels in Indian Cities



## Annual SO<sub>2</sub> Levels in Indian Cities

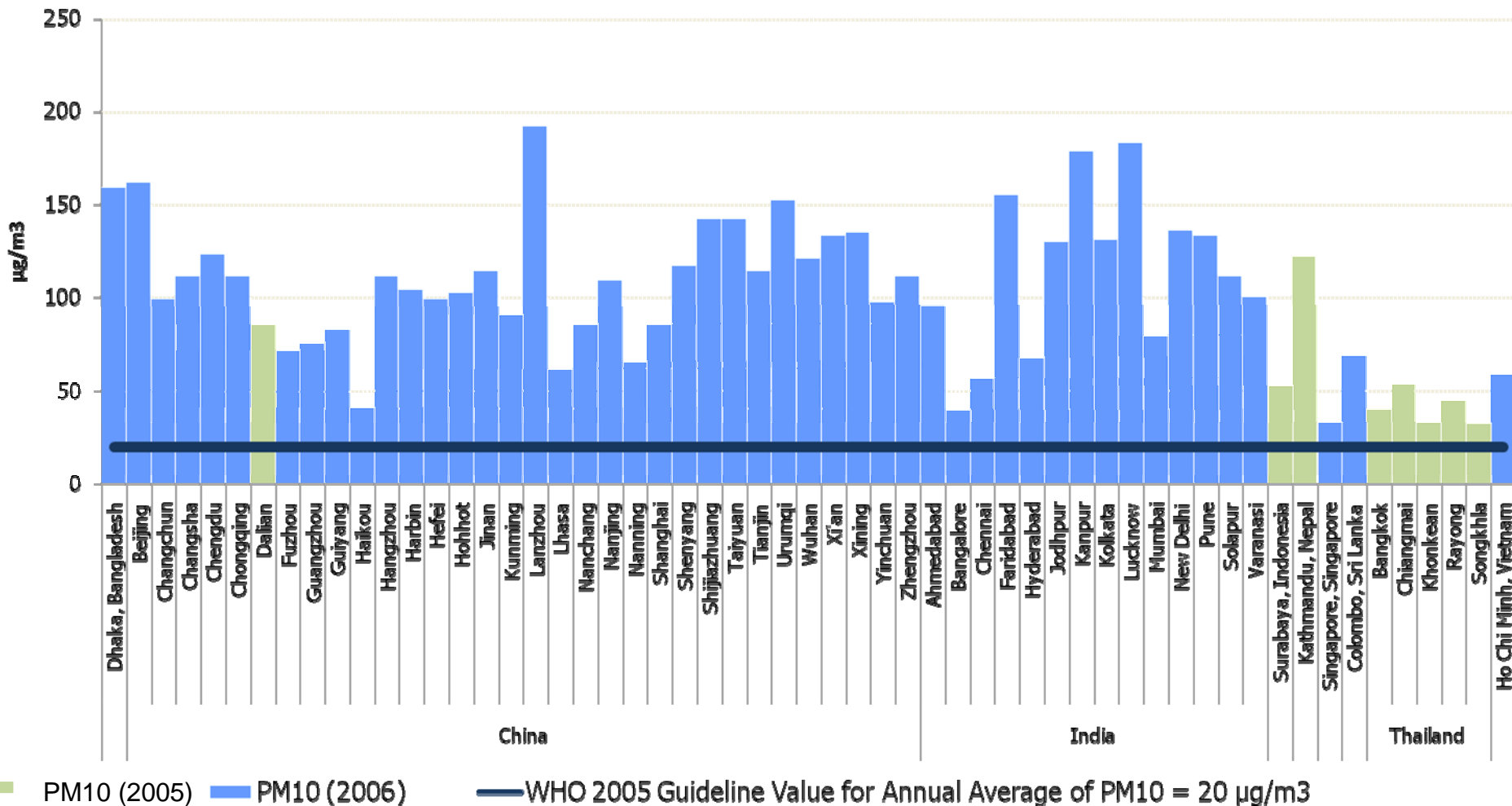


## Annual NO<sub>2</sub> Levels in Indian Cities



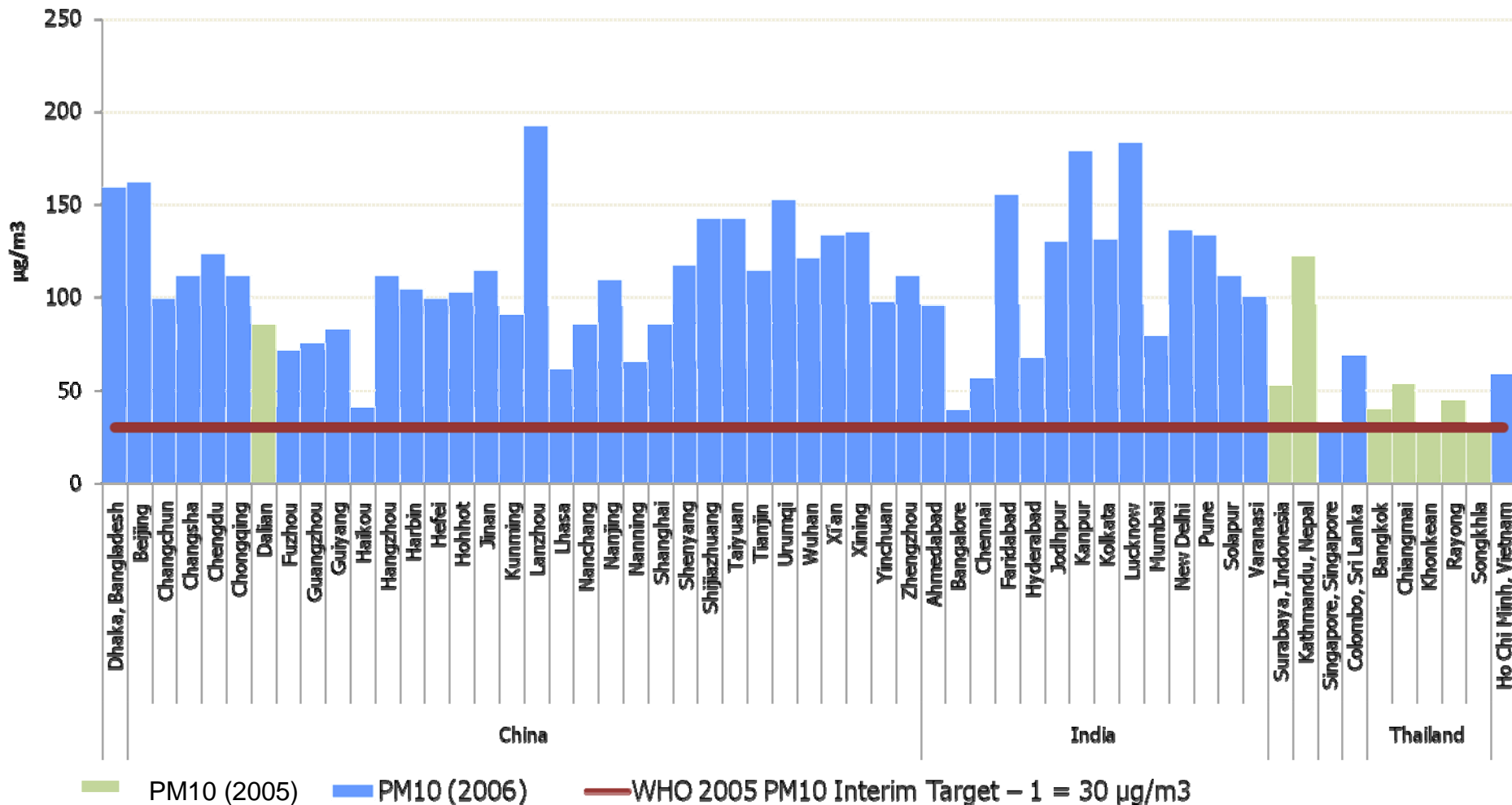
# PM levels in Asia – versus WHO guideline values

## PM10 Annual Ambient Concentrations in Asian Cities vs WHO



# PM levels in Asia – versus WHO guideline values

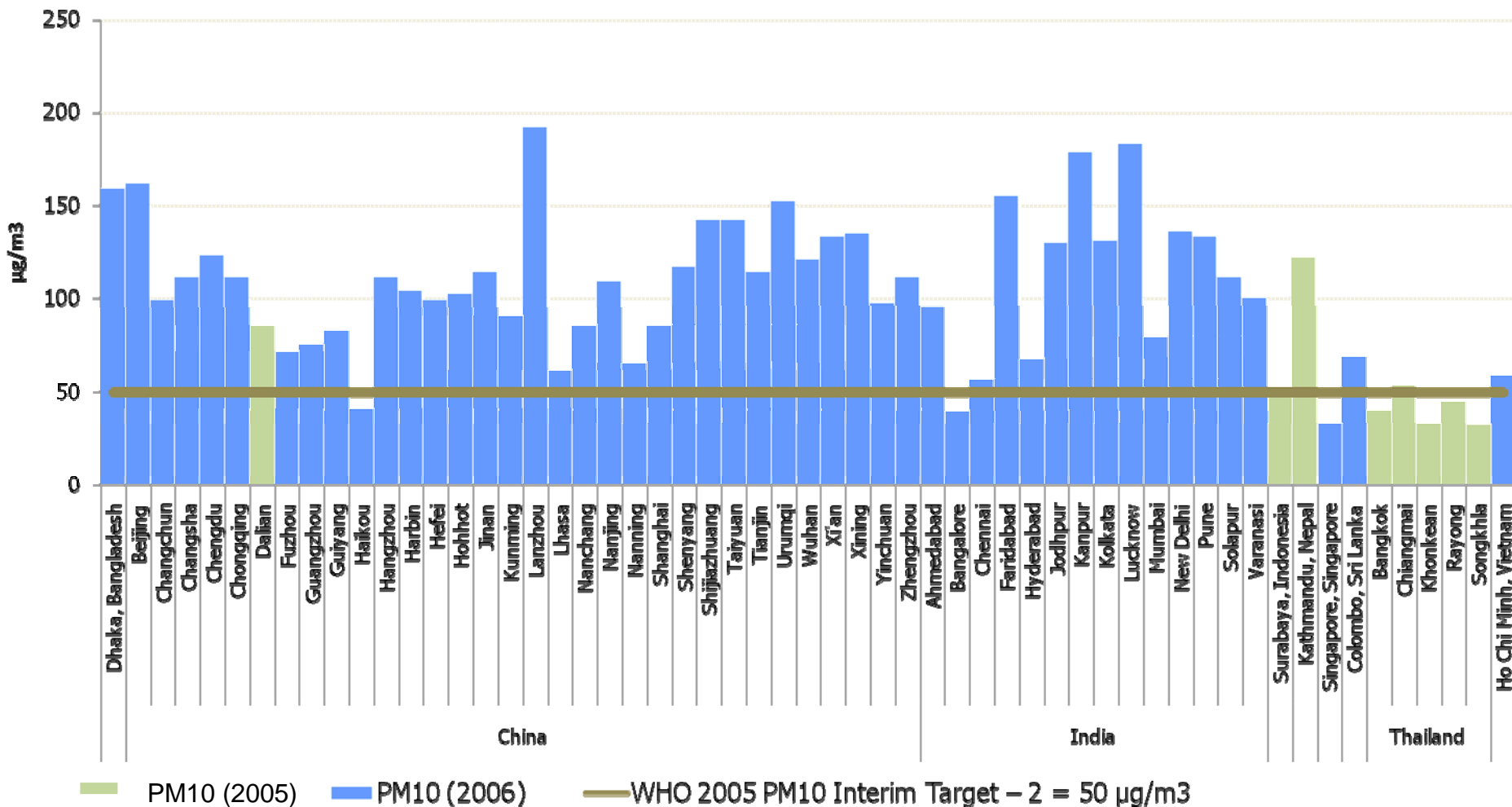
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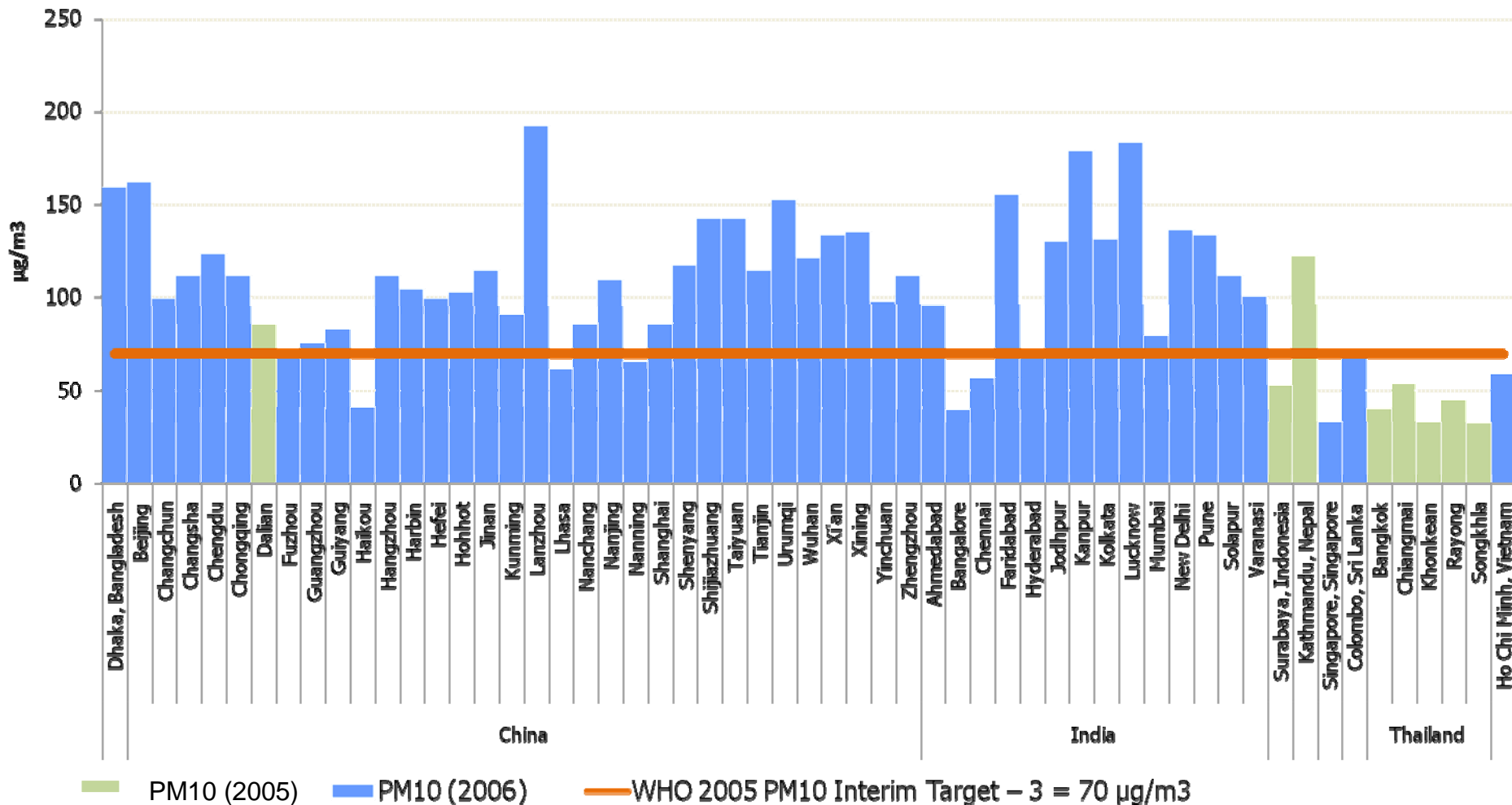
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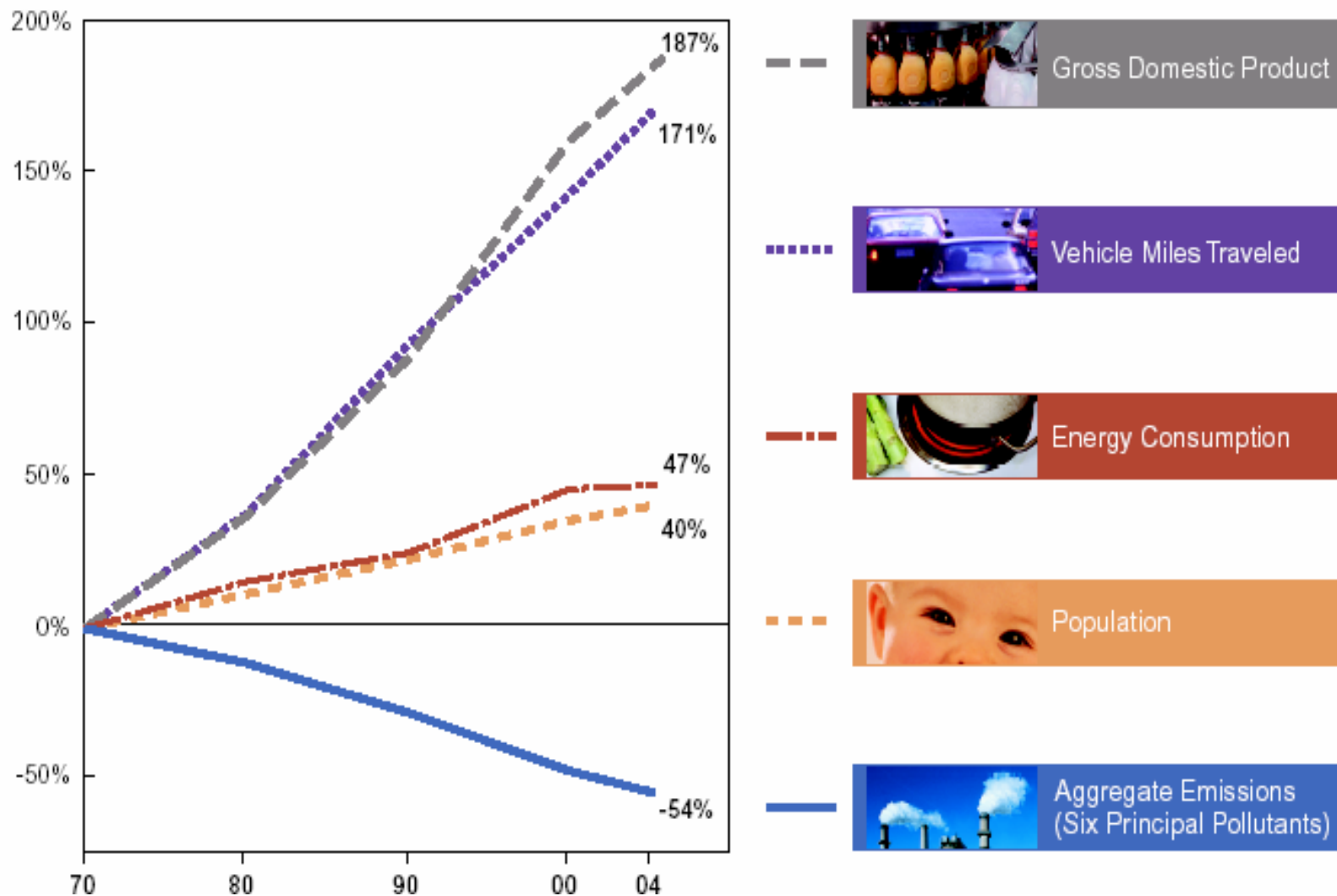
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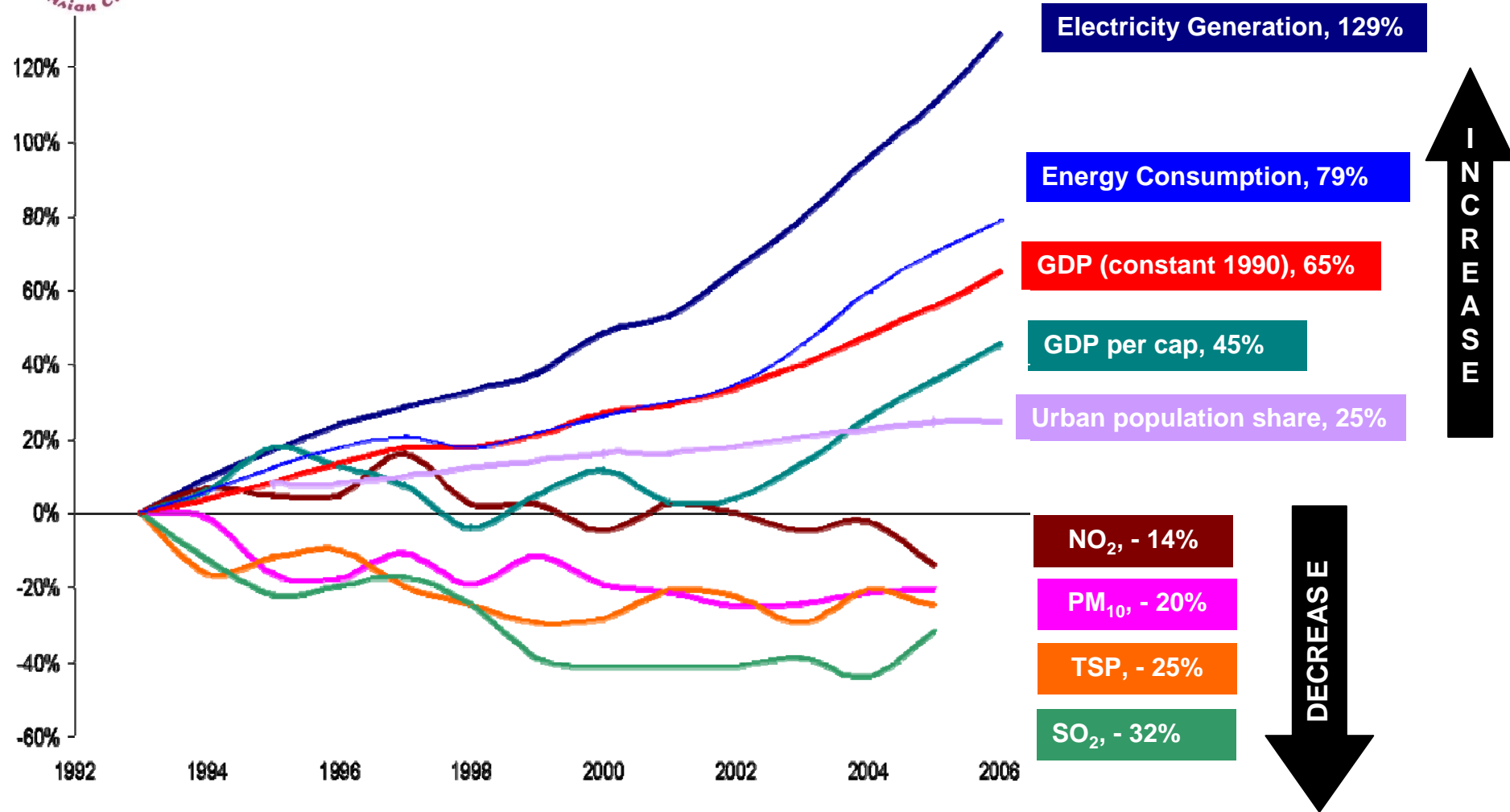
# Economic Growth and Emissions Decline: US experience 1970 - 2004

Comparison of Growth Areas and Emissions





# Economic Growth and Air Pollution Trend: Asia 1992-2006



Sources:  
BP Statistical Review of World Energy June 2007 - <http://www.bp.com/statisticalreview>  
UN DESA - <http://esa.un.org/unpp>



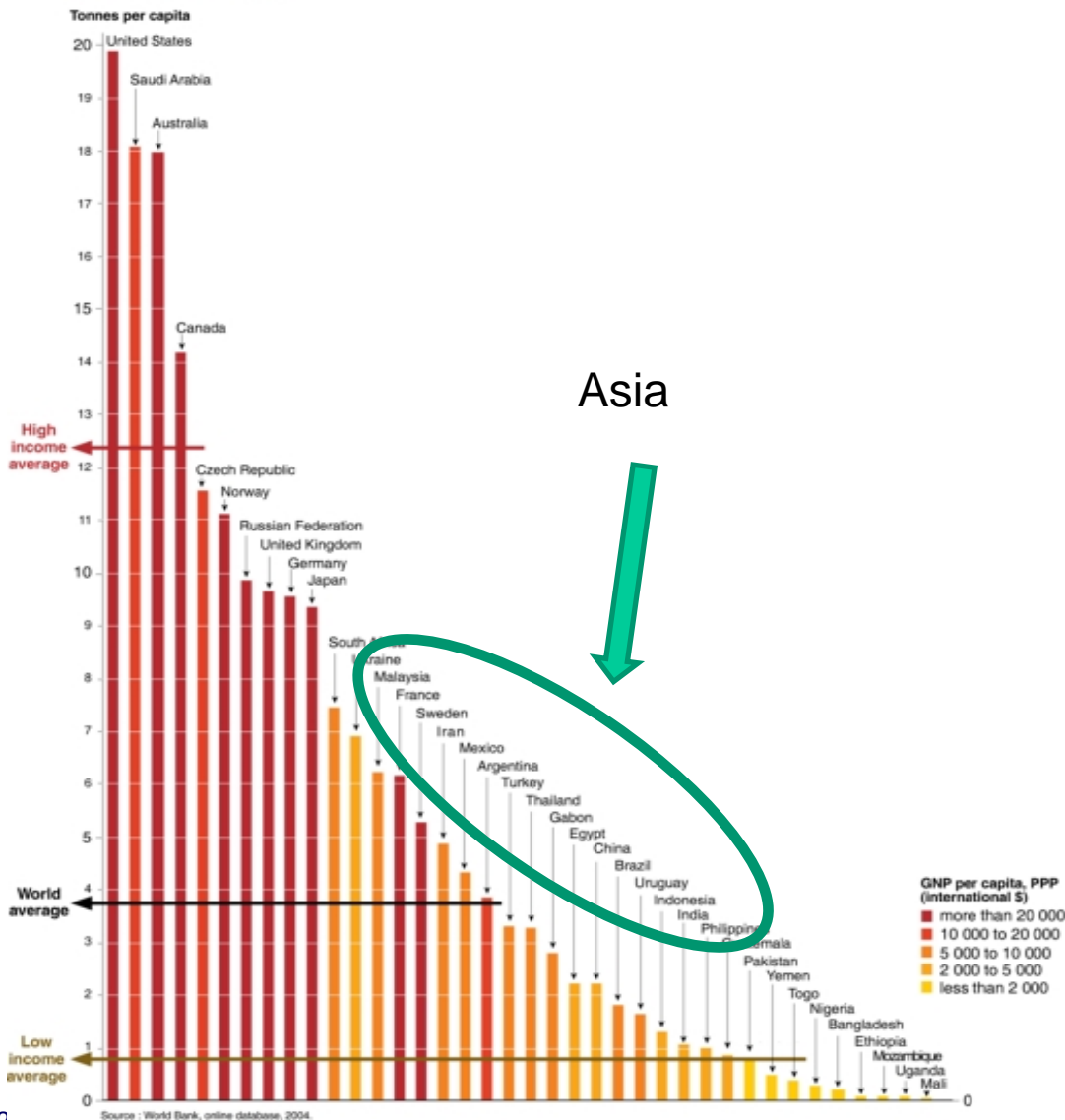
## Impacts Air Pollution

- 2008 will see the publication by HEI of comprehensive assessment of the impact of public health impacts of urban air pollution in Asia based on the PAPA program;
- Policy makers keep emphasizing the importance of economic impacts of urban air pollution.
- However, relatively little progress has been made in 2006 and 2007 in the assessment of: environmental and economic impacts of urban air pollution.
- Global Atmospheric Pollution Forum (GAPF) undertaking work on environmental impacts – crops and corrosion
- A regional approach to assessment of economic impacts of urban air pollution, based on the PAPA approach, could be of help --- who would champion and lead this?

**BAQ 2008 Session?**

# Trends – CO<sub>2</sub> emissions

CO<sub>2</sub> Emissions in 2002

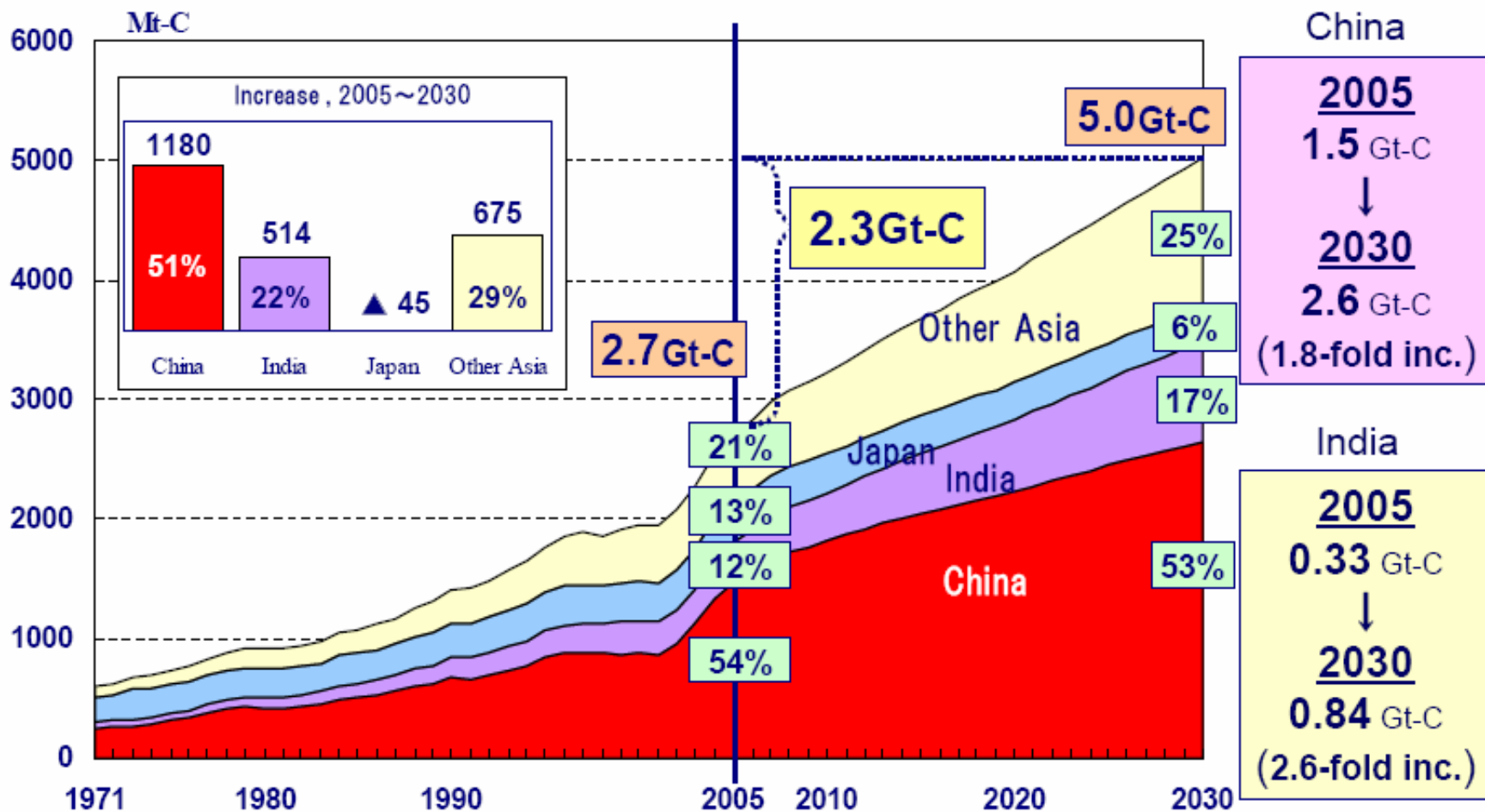


Carbon emissions per capita (2002)

	Tons per capita	
	2004	2030
China	3.6	7.8
India	1.0	1.5
Other non-OECD	1.7	2.4
OECD-Europe	8.2	8.3
US	20.1	21.8

<http://www.eia.doe.gov/oiaf/ieo/emissions.html>

# CO<sub>2</sub> Projections in Asia

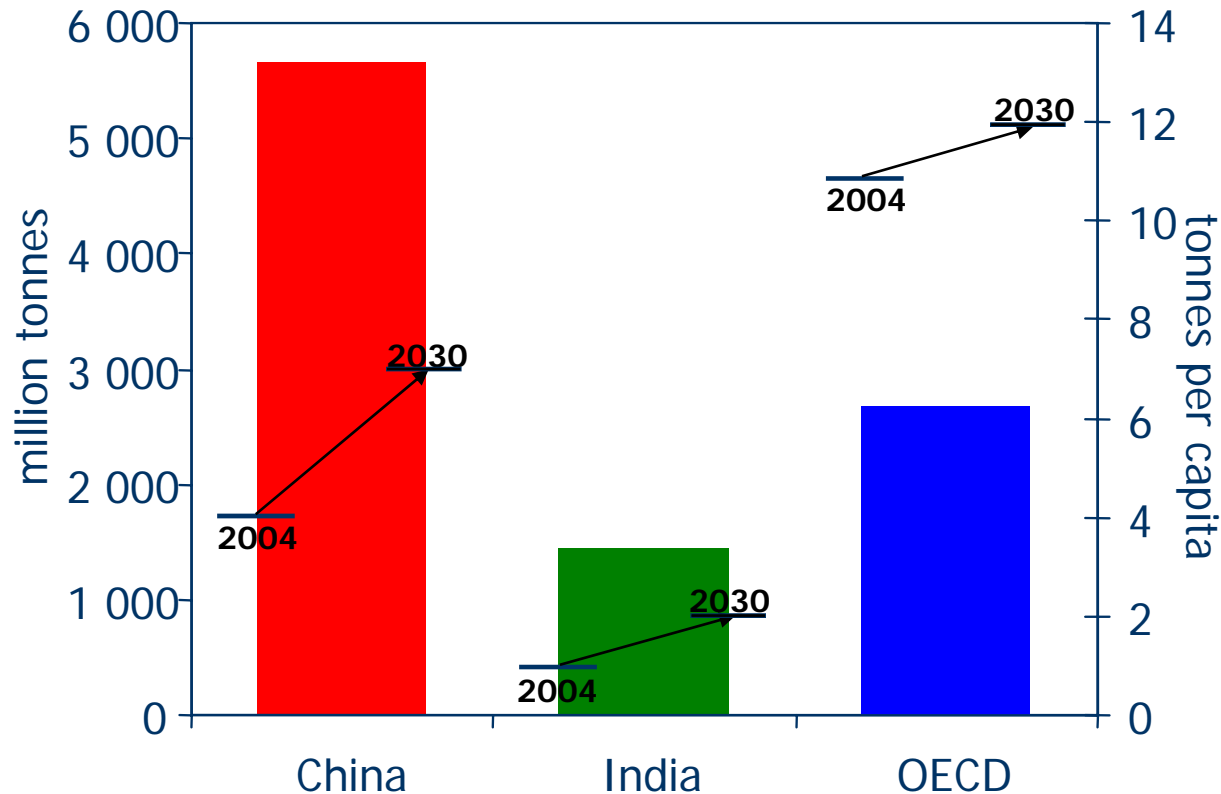


Source: Institute of Energy Economics, Japan. 2007. Asia/World Energy Outlook 2007.



# GHG Emissions India - China

## CO<sub>2</sub> Emissions Growth 2004–2030



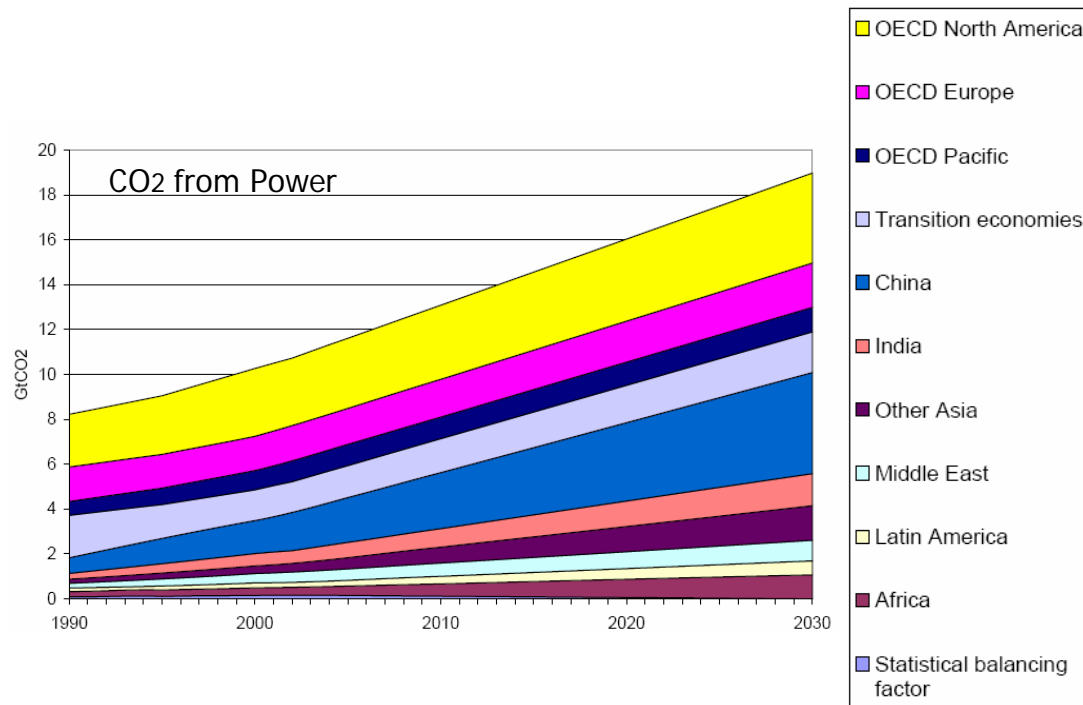
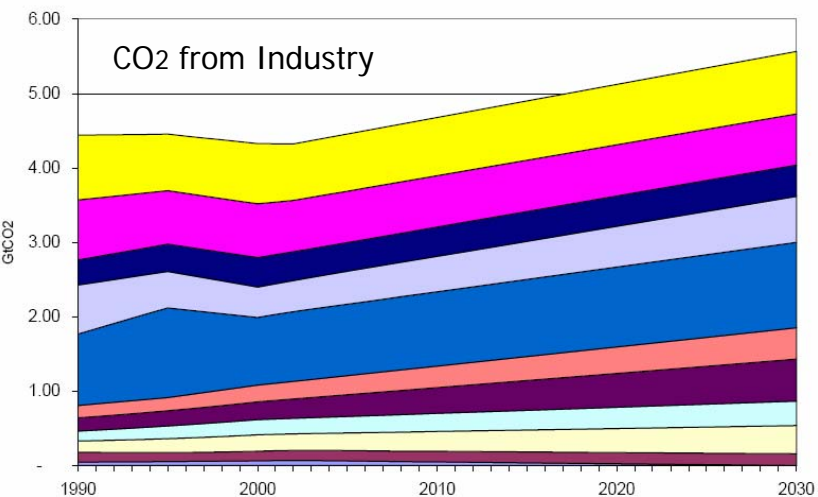
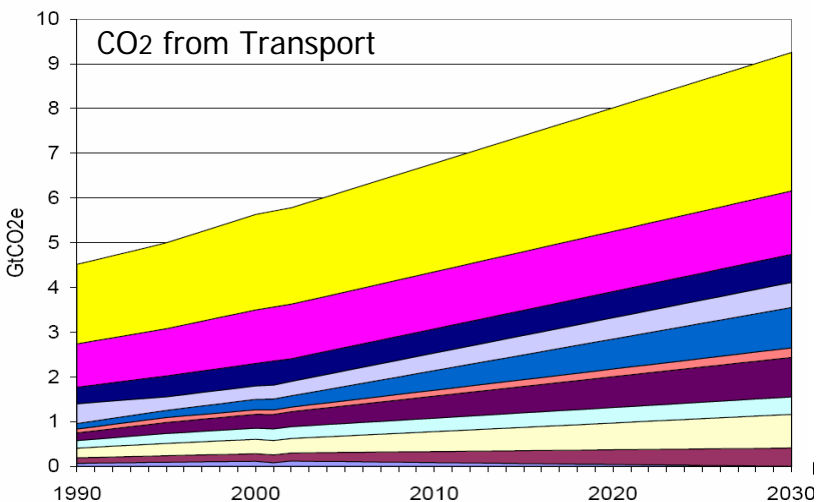
Source: IEA, 2007 - World Energy Outlook 2006

*Emissions growth in China is twice as large as in the OECD, but in 2030 per capita emissions will still be lower than current OECD ones*





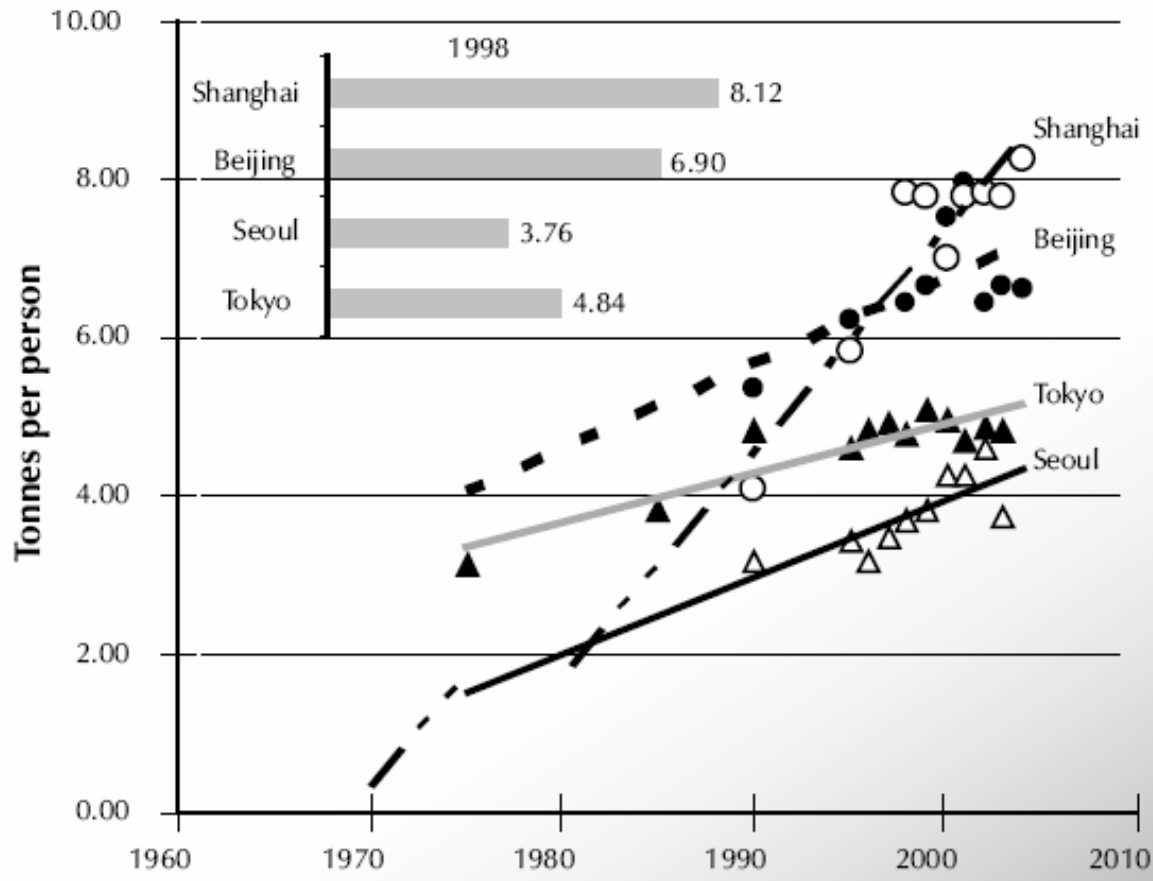
# CO<sub>2</sub> Emissions: Sectors



Source: HM Treasury. Stern Review on the Economics of Climate Change



# Population Density and CO2 Emissions : Selected Asian Cities



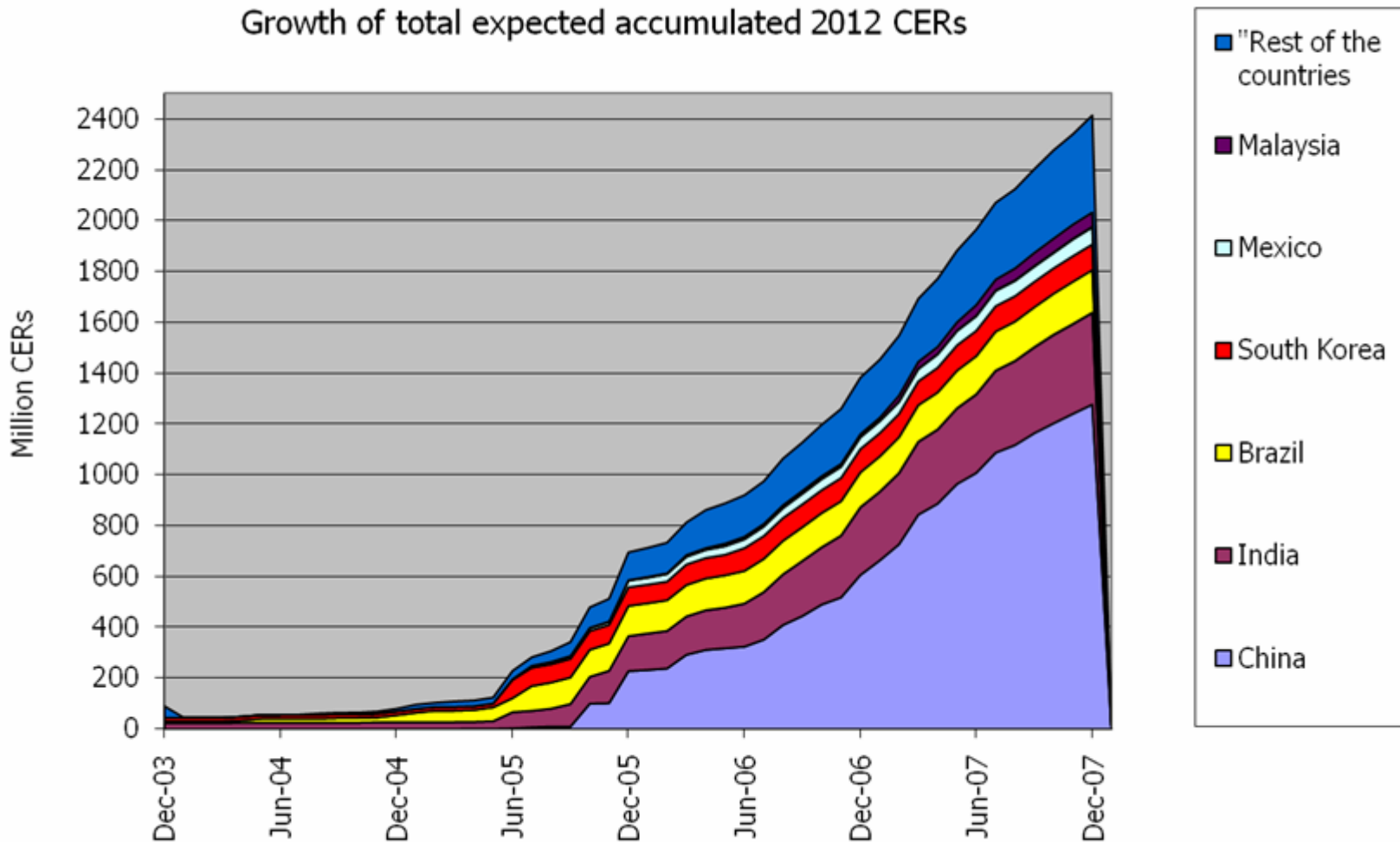
	Tons per capita	
	2004	2030
China	3.6	7.8

Shobhakar Dhakal. 2004. Urban Energy Use and Greenhouse Gas Emissions in Asian Mega-Cities



# CDM – CER generation

Growth of total expected accumulated 2012 CERs

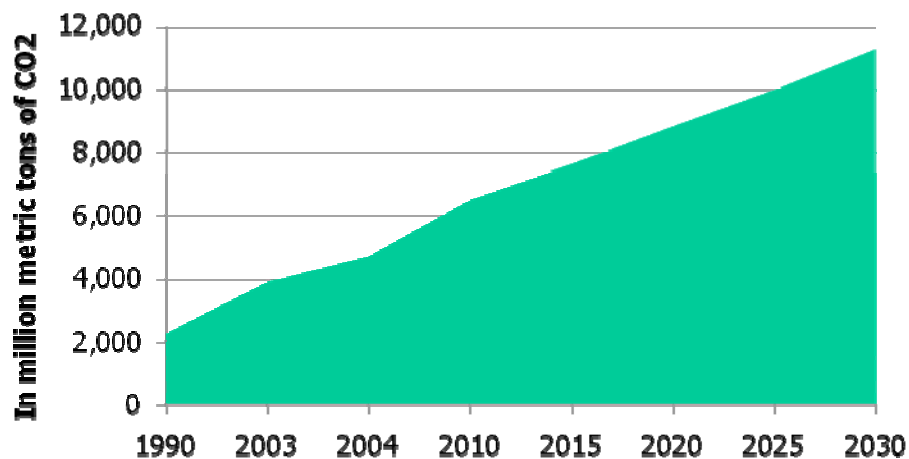


Source: UNEP Risoe. 2008. CDM Pipeline.

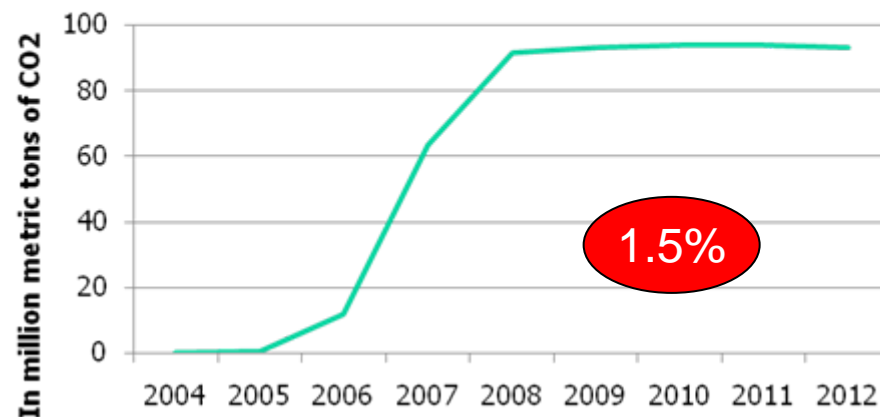


# CO2 Emissions vs CERs

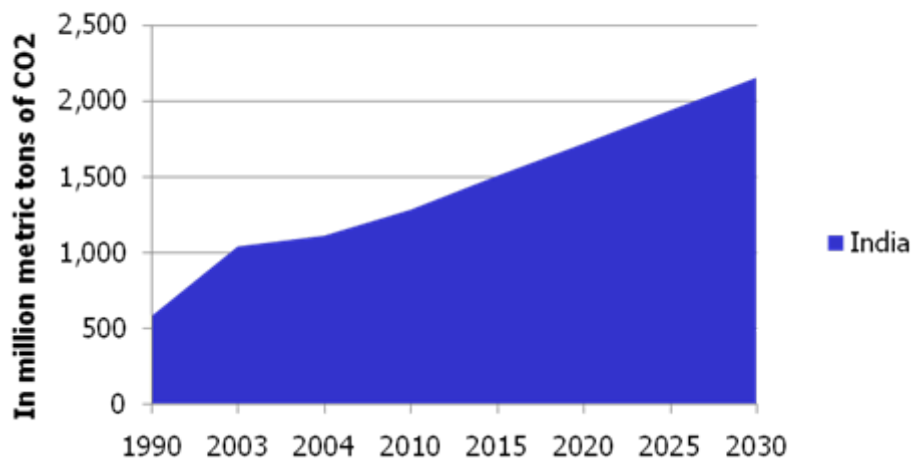
## China CO2 Emissions



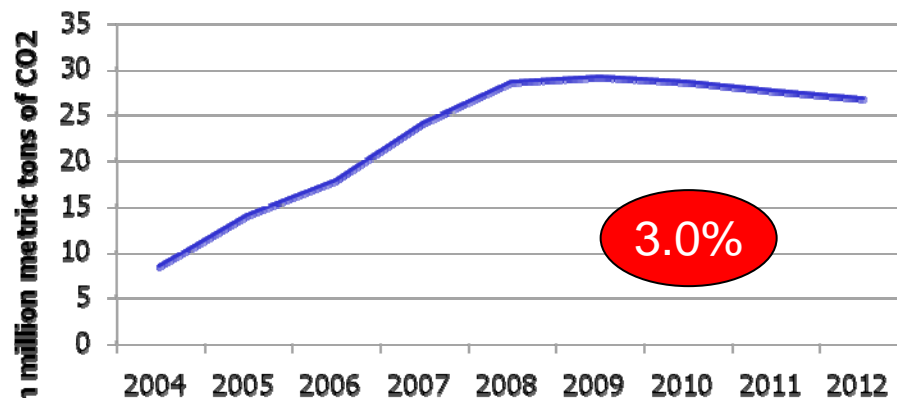
## CERs from Registered CDM Projects in China



## India CO2 Emissions



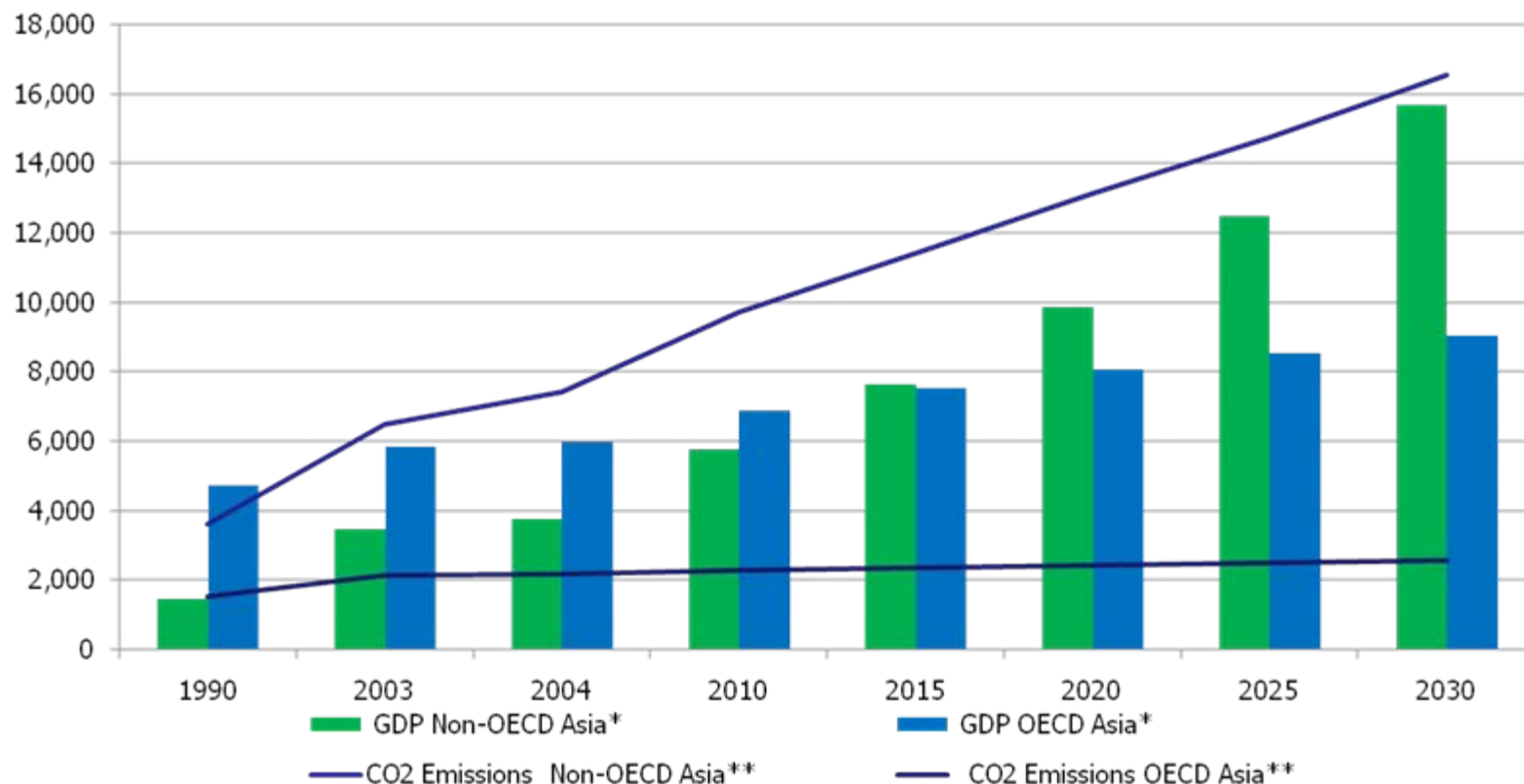
## CERs from Registered CDM Projects in India



Source: Energy Information Administration. International Energy Outlook 2007; IGES 2008 CDM Database



# Economic Growth and CO<sub>2</sub> Emissions



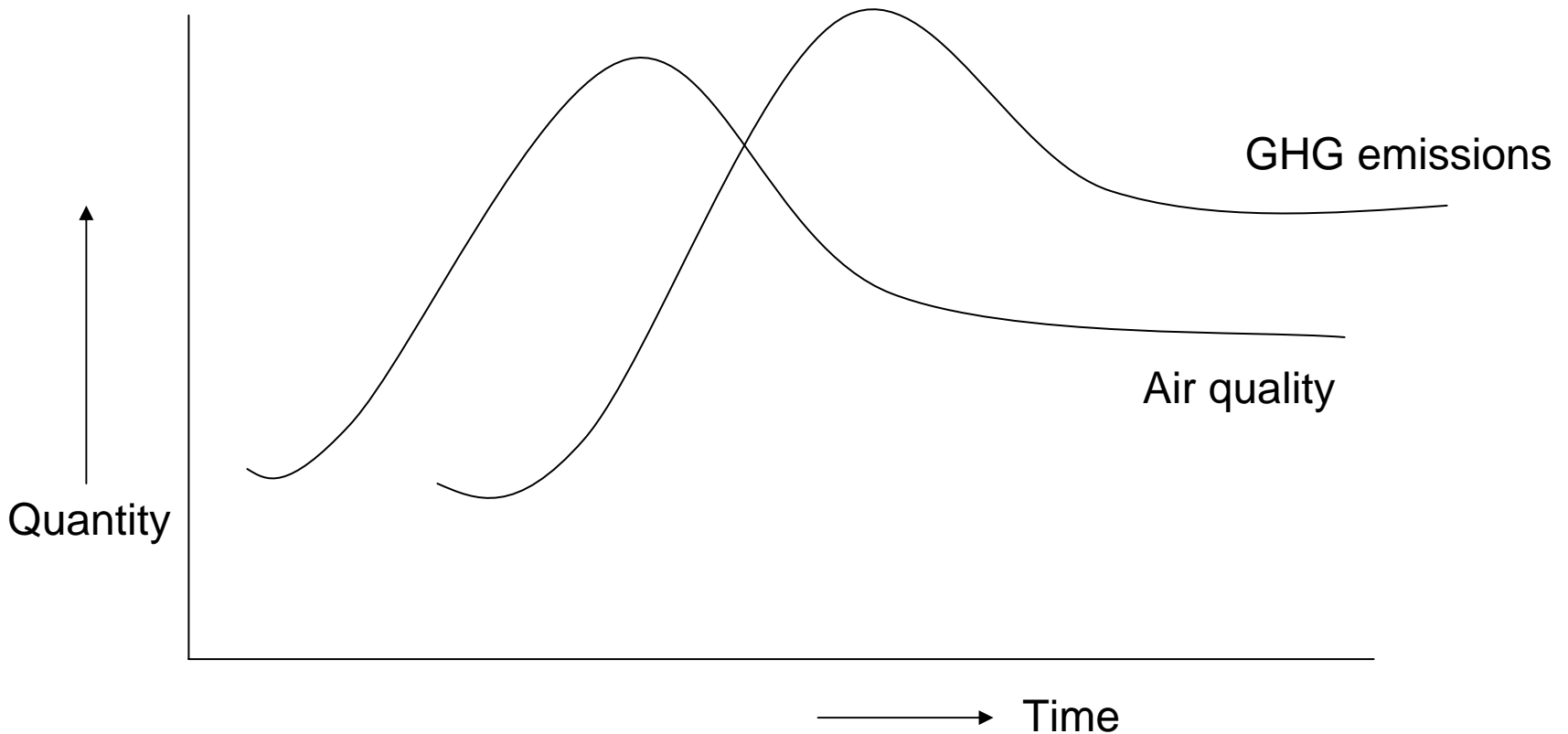
\* Expressed in Market Exchange Rates (Billion 2000 Dollars)

\*\* Million Metric Tons of Carbon Dioxide

Source: Energy Information Administration. International Energy Outlook 2007



# Future Challenge: Link AQ with GHG emissions





# Part 3: AQM and Climate Change Management in Asia



# Air Quality Management and Climate Change Management in Asia

- Legislation
- Monitoring
- Control strategies





## Legislation/Policy- trend towards long term vision

- China is in the process to draft a macro-policy on environment with section on AQ which looks forward to 2020
- Clean Air SL is promoting a medium term Action Plan up to 2015
- Discussions are ongoing in Viet Nam on development of an Air Quality Management Plan up to 2020, in addition to AQM Action Plan for Hanoi
- Viet Nam and Indonesia are considering the adoption of a Clean Air Act to guide future AQM activities
- However, overall Asia still characterized by low enforcement and implementation of existing legislation



## Ambient Air Quality Standards

- Asia has not reacted to update in WHO guideline values, only substantive discussion on AQ standards in Asia is in India which is revising its ambient standards
- Pakistan remains the largest country in Asia without ambient air quality standards
- Asia is now well behind Europe and USA in terms of regulating PM 2.5
- Regulation of air toxics is still ad-hoc and not wide-spread in Asia



## Monitoring

- India moving towards continuous monitoring, but slowly
- China continues to expand monitoring but controversy emerging on the siting of the stations
- Pakistan and Bangladesh expanding monitoring
- AQM in Philippines and Indonesia hampered by the absence of a functioning air quality monitoring system
- Poor availability of PM 2.5 and Ozone data, while these pollutants should be at the heart of future AQ management in Asia



## Threats to AQ in Asia: power sector

- Renewables continue to be a niche power provider
- Attention coal in Asia focuses on the sheer size of coal use without providing decision makers with hands-on information on how to address environmental implications:
  - Regulations on sulfur levels/ coal washing
  - Requirements on use of desulphurization equipment
  - Efficiency of coal fired power plants
- Response in Asia has been proportional to the use of coal: China – most, India – less, rest – almost nothing
- End-user (energy) efficiency under utilized as an energy management tool in the large majority of Asian countries



## Threats to AQ in Asia: Transport - tailpipe

- While Europe has in 2007 enacted Euro 5 and 6 standards, Asia has not moved in a significant manner in adopting roadmaps for cleaner vehicles and fuels. Constraining factor remains to be the fuel quality
- Uncertainty about the environmental impact of bio-fuels continues to mount following close scrutiny of bio-fuels by the Climate Change community – emerging trend (low) carbon fuel standard
- Discussion on emission standards for 2-3 wheelers is not going anywhere in Asia
- Results from initial environmental impact study e-bikes China show positive results



# Tail-pipe responses: Vehicle Emission Standards in Asia (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									
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 <sup>g</sup>							
Taipei, China	US Tier 1										US Tier 2 for diesel <sup>h</sup>									
Thailand	Euro 1					Euro 2				Euro 3				Euro 4						
Viet Nam											Euro 2									

Notes: Italics – under discussion; a – gasoline; b – Diesel; c – Entire country; d – Delhi, Chennai, Mumbai, Kolkata, Bangalore, Hyderabad, Agra, Surat, Pune, Kanpur, Ahmedabad, Sholapur, Lucknow; Other cities in India are in Euro 2; e – Beijing and Guangzhou (as of 01 September 2006) have adopted Euro 3 standards; Shanghai has requested the approval of the State Council for implementation of Euro 3; f – Euro 4 for gasoline vehicles and California ULEV standards for diesel vehicles; g – As per government regulation 1295-11 from Ministry of Environment and Natural Resources <http://www.cea.lk/acts/reg1295-11.pdf>; h – Gasoline vehicles under consideration

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



## Bio-fuels

- Move towards mandating the use of bio-fuels in Asia has not been matched by growing investments in testing the environmental impacts of bio-fuels
- 2008 will see the publication of both AQ and GHG impacts of the use of bio-fuels in the context of new legislation in Europe and California
- Discussion on bio-fuels in Asia is only starting

Bio-fuels pre-event at BAQ 2008!



# Comparative Emission Rates-Including Emissions from Production for E-bikes in China

	Energy Use (kWh/100 pax- km)	CO <sub>2</sub> (g/pax- km)	SO <sub>2</sub> (g/pax- km)	PM (g/pax- km)	CO (g/pax- km)	HC (g/pax- km)	NO <sub>x</sub> (g/pax- km)	Pb <sup>b</sup> (mg/pax- km)
Car <sup>c</sup>	140	306	0.689	0.277	10.06	1.67	1.32	93
Bus	13.06	48.4	0.022	0.065	0.159 <sup>d</sup>	0.015 <sup>d</sup>	0.27 <sup>d</sup>	4
Motorcycle	42.00	128.0	0.08	0.400	12.5 <sup>d</sup>	2.25 <sup>d</sup>	0.15 <sup>d</sup>	53
Bicycle	4.88	4.70	0.014	0.059	Unkn	Unkn	Unkn	0
BSEB	6.12	22.08	0.123	0.125	0.016 <sup>d</sup>	0.007 <sup>d</sup>	0.027 <sup>d</sup>	520
SSEB	8.42	30.44	0.164	0.175	0.019 <sup>d</sup>	0.008 <sup>d</sup>	0.020 <sup>d</sup>	730

<sup>a</sup> Assuming lifespan of 1,000,000 km, 20,000 km, and 50,000 km and average load factors of 50 pax, 1 pax, and 1 pax for bus, bicycle and electric bike, respectively.

<sup>b</sup> Assuming 80% recycle rate and one battery every 10,000 km for electric bikes and one battery every 3 years or 250,000 kilometers for buses, one battery every 3 years or 75,000 km for car, one battery every 3 years or 18,000 km for motorcycle (Wang, Huo et al. 2006).

Note: some fields are Unknown (Unkn) because data are not available for the emission of these pollutants from production processes and/or power plant emissions

<sup>c</sup> Sullivan et al. 1998-LCA of Generic US Car (compare with caution)

<sup>d</sup> Only Use phase emission rate, no production processes included

Note: some fields are Unknown (Unkn) for bicycle because these pollutants are not reported for production processes

Source: Preliminary results: Environmental Impacts of E-Bikes in Chinese Market, Christopher Cherry-University of Tennessee  
Jonathan Weinert-Univ. of CA-Davis & Chevron, Yang Xinmiao-Tsinghua University





## Threats to AQ in Asia: Transport – non-tailpipe

- Intense debates in Europe and USA on fuel efficiency standards for vehicles which will result in growing efficiency of vehicles – Asia is ignoring this debate (so-far)
- Energy demand of rapid urbanization in Asia is largely ignored, congestion is an issue – BRT taking off in a large manner
- Asia is struggling to come to terms with the Nano (1 lakh vehicle)





# Bus Rapid Transit in Asia\*

## Systems in operation (17):

Akita, Japan	Jakarta, Indonesia	Nigata, Japan
Ankara, Turkey	Kanazuwa, Japan	Pune, India
Beijing, China	Kunming, China	Seoul, South Korea
Fukuoka, Japan	Miyazaki, Japan	Shijiazhuang, China
Gifu, Japan	Nagaoka, Japan	Taipei, China
Hangzhou, China	Nagoya, Japan	

## Systems in planning or under construction (37):

Ahmedabad, India	Incheon, South Korea	Shenzhen, China
Bangalore, India	Indore, India	Surabaya, Indonesia
Bangkok, Thailand	Jaipur, India	Surat, India
Bhopal, India	Jinan, China	Taichung, China
Chiang Mai, Thailand	Karachi, Pakistan	Tainan, China
Chengdu, China	Makati City, Philippines	Tienjing, China
Chongqing, China	Metro Manila, Philippines	Wuhan, China
Colombo, Sri-Lanka	Metro Cebu, Philippines	Wuxi, China
Delhi, India	Mysore, India	Vijaywada, India
Guangzhou, China	Pimpri-Chinchwad, India	Vishakhapatnam, India
Huai'an, China	Rajkot, India	Xi'an, China
Hyderabad, India	Shanghai, China	Xiamen, China
	Shenyang, China	



# Addressing challenge of Climate Change

- 4 th. Assessment report, IPPC and COP 13, Bali have meant a big boost for the debate on climate change in Asia. In some cases this has resulted in “annexation” of “clean” energy/transport by the Climate Change community
- However, relatively little is being done in Asia to address Climate Change:
  - Knowledge: data on GHG emissions by sector and city very poor, mostly top down projections
  - Capacity: limited to specialized groups, not mainstreamed in public and private sector
  - Policies: China has Climate Action Plan, India working on it, little operational detail and no vision on how to meet 20% reduction by 2050 (compared to 1990 levels)
  - Investments: little evidence that investments by public and private sector are substantially affected by climate change considerations
- Bali Action Plan does call for “national appropriate mitigation actions by developing country Parties in the context of sustainable development, supported and enabled by technology, financing and capacity building, in a measurable, reportable and verifiable manner” (Bali Action Plan – 1, b, ii.)



## Co-benefit approach

- Co-benefit approach is gaining in popularity:
  - CAI-Asia paper on status of co-benefits in Asia (<http://www.cleanairnet.org/caiasia/1412/article-71843.html>)
  - Japan initiative on establishment of a platform on co-benefits and adaptation
  - GAPF workshop on co-benefits in 2008
  - CAI-Asia – Norway proposal on co-benefits in China
  - BAQ 2008: AQ and Climate Change: Scaling up win-win solutions for Asia
- At implementation level, not that many co-benefits activities: there is a need to improve knowledge, tools, capacity and integrate this in relevant (sector) policies.



## In summary: management response in-adequate

- Public opinion is not getting translated into action: legislation, institutional structures and budgets
- Regulation and management of AQ is not keeping track with rapid economic growth in Asia, imminent danger that past (limited) successes in improving AQ are compromised
- Technologies to reduce emissions are becoming increasingly available at cost effective prices but are not mainstreamed yet
- Climate Change has been able to get the attention of policy makers, media and public, but in Asia this has not yet been translated into action or policy commitments



## Future Challenge

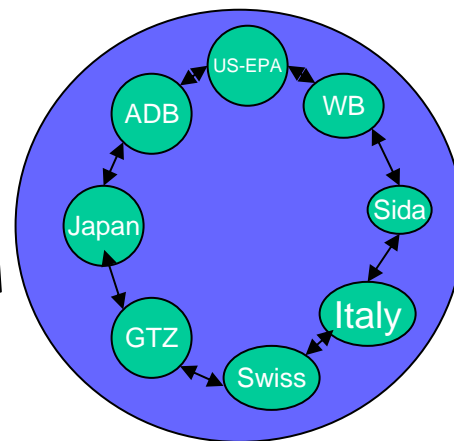
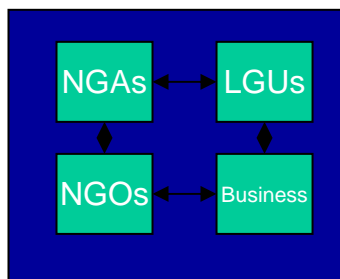
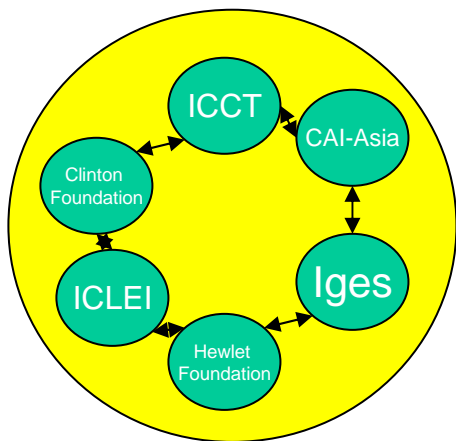
- “Clean” applies both to AQ and Climate Change, the environmental community needs to realize it is divisive to pretend otherwise
- The AQ community will have to come to terms with rapidly growing interest in climate change, develop a dialogue and advance the co-benefit approach
- Yet, at the same time the AQ community should not lose focus of its own objectives and priorities



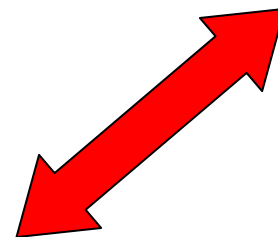
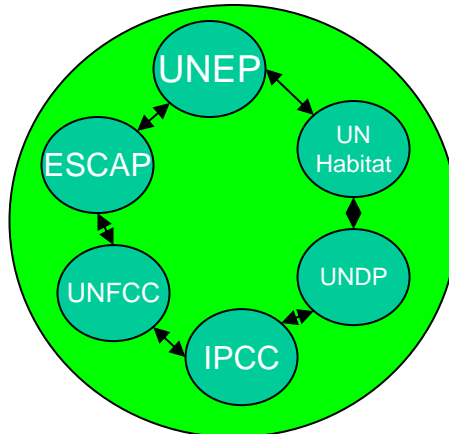
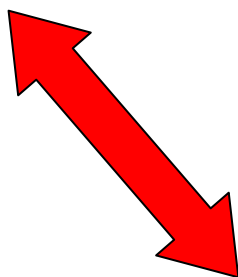
## Part 4: the way forward

# Synergy between main actors, or the lack of it

International Foundations  
And NGOs



Multilaterals and bilateral  
development organizations



UN Agencies

- Knowledge
- Capacity building

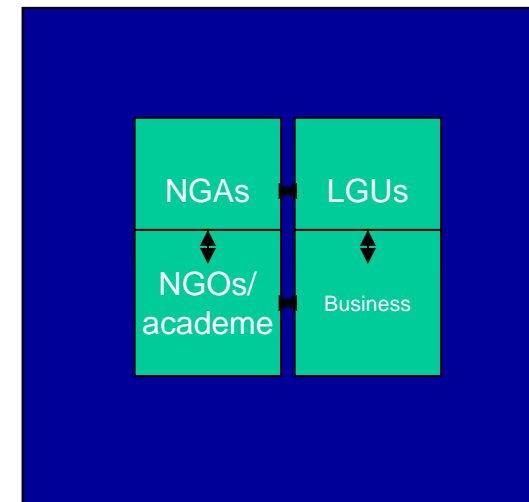
- Policies
- Investments





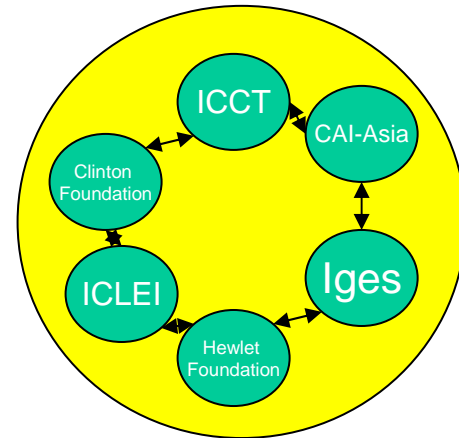
# Synergy in developing countries

- Certain formal mechanisms exist, driven by legislation, but generally limited effective coordination between national and local government levels
- AQ community and CC community still wide apart
- Some countries have made progress in developing air quality management capabilities since last Benchmarking exercise in 2004-2005, but overall progress has been disappointing
- Political leadership (PRC and Hong Kong) is key in advancing AQ agenda



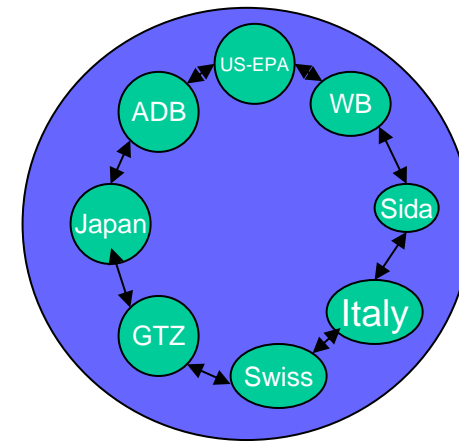
# Synergy among international Foundations and NGOs

- Objectives of many of the international foundations and NGOs do not promote active coordination and cooperation
- No coordination on which cities they work and these organizations continue to crowd-out each other in a limited number of cities in Asia
- Limited exchange on tools and instruments and policy work
- No structured dialogue with UN and/or multi-bilateral organizations on how NGOs and Foundations can help UN and Multi/bilaterals reach out in better manner to the cities in Asia



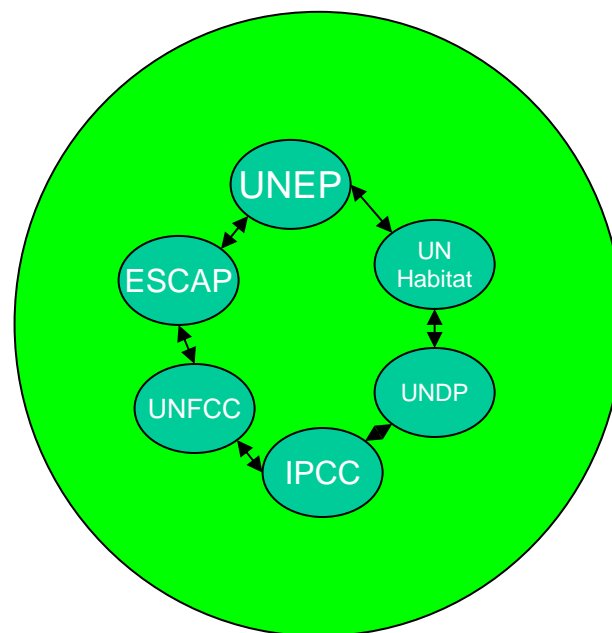
# Synergy among multi- and bilateral development organizations

- Multi- and bilateral development organizations weak in terms of in-house capacity and expertise on Air quality management.
- Coordination is often on an ad-hoc and project/program basis to develop a co-financing arrangement
- AQ and CC are typically (not yet) topics for in-country coordination
- There is a larger willingness to coordinate on climate change because amounts involved are larger and commitment of leadership larger

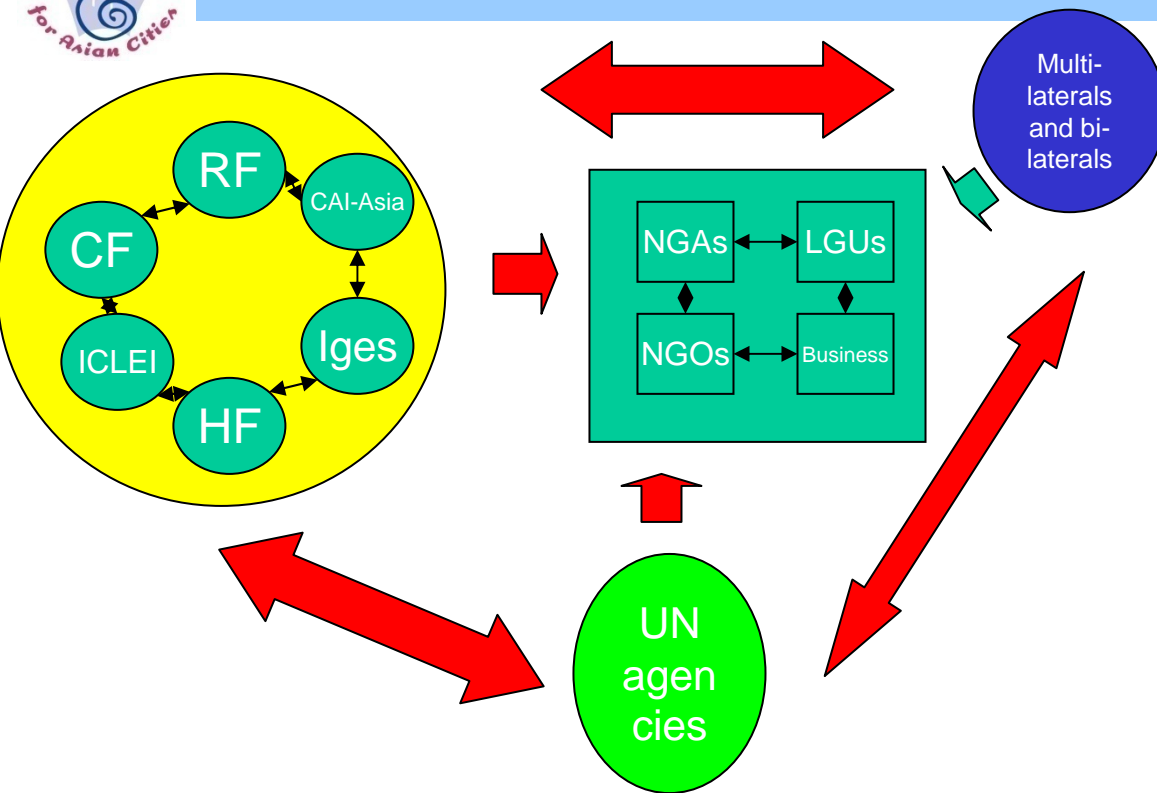


# Synergy among UN-Organizations

- Limited capacity and resources in the various organizations makes it difficult to move into operational work with individual cities, as consequence coordination is high level
- External groups not well aware of distribution of tasks within the UN system
- Joint CAI-Asia/UNEP Regional dialogues indication of positive joint initiatives
- Emerging alliance between CAI-Asia and UNEP: GAPF interesting forum



# Scenario for developing coordination and synergy



## 3 step approach:

- Int. NGOs and foundations continue to work on their own without significant coordination but exchange info.
- Int. NGOs and foundations maintain their individual focus and locations where they work in Asia but improve coordination and cooperation to increase synergy and impact
- Int. NGOs and Foundations develop integrated programs and combine fundraising activities to streamline and combine activities

Jan-  
Nov. '08

Dec. '08-  
Nov '09

Dec '09 --

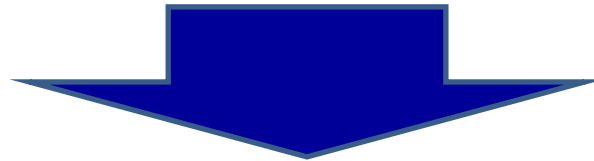
- Develop improved coordination and cooperation among international NGOs and foundations working with Asian cities on AQM and GHG reduction with the aim to improve interaction with Multi- and bi-laterals, the UN agencies and Asian stakeholders



# Japanese Proposal to establish a regional Platform on Co-benefits and Adaptation

## ● The 17<sup>th</sup> Asia-Pacific Seminar on Climate Change

-Good Governance for Climate & Development-  
➔ Proposal on Establishing an “Regional Platform on Co-benefits Approach and Integrated Adaptation”



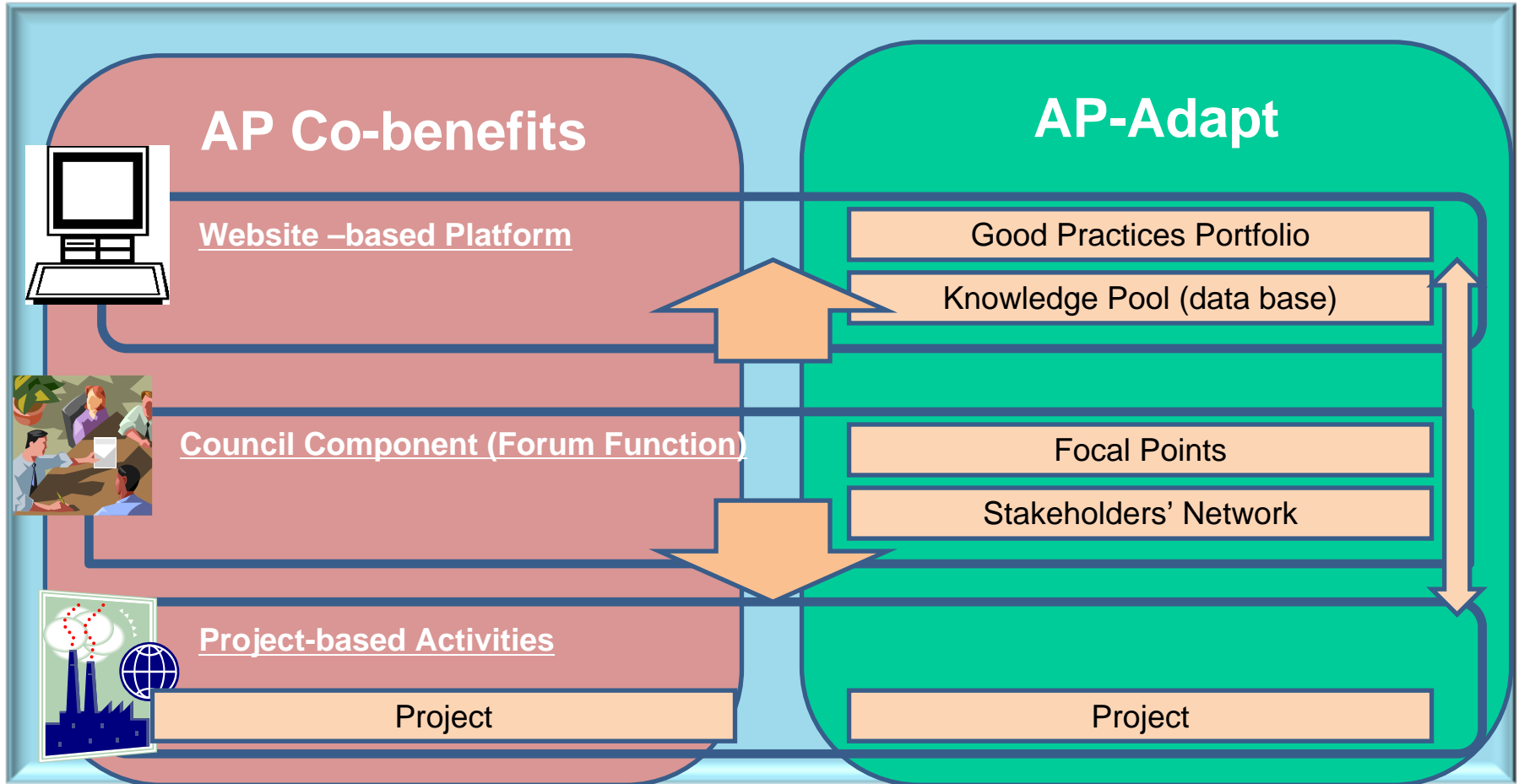
**Needs for a soft mechanism that supports activities under the positive linkage between climate & development .**

**Co-benefits & Integrated Adaptation are priority areas.**

Source: Kotaro Kawamata, Climate Change Division, Ministry of the Environment, Japan: Bali, December 2007

# Proposed (draft) structure Asia Pacific Platform

Proposed AP Platform for Climate and Development will be made up with 2 major areas – Co-benefits area and Adaptation area. Each area may have 3 major components, including website-based platform, council (forum component), and Project-based activities.



Source: Kotaro Kawamata, Climate Change Division, Ministry of the Environment, Japan: Bali, December 2007



## Proposed Next steps

- Continue consultations with possibly interested organizations
- Develop initial “lead group” and aim for snowball effect
- Aim for 2 meetings in 2008:
  - Pre-event at the BAQ 2008 workshop
  - Common activity at COP 14 to formally announce cooperation