AIR POLLUTION IN ASIAN CITIES
DIAGNOSIS AND PROGNOSIS

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October 1, 2015

Outline

- Nature of the problem
- Trends, monitoring & measurement
- Consequences (health effects)
- Causes (urbanisation, vehicles, others)
- Policies

Urban air pollution is ubiquitous

Beijing

Shanghai

Metro Manila

Delhi

NOIDA/DELHI
THE HINDU • FRIDAY, MAY 9, 2014

Air pollution is choking Delhi skies

Bindu Shajan Perappadan

NEW DELHI: Alarm bells have started ringing and what environmentalists here have been crying hoarse for long has now been endorsed by World Health Organization (WHO) — Delhi has the most polluted air in the world.

Putting it simply, the city air is choking its residents and children whose lungs are still growing have no possibility of breathing clean air.

"Of course, the city is choking itself and the worst sufferers are children who with their developing lungs bear the brunt of the assault. The city has not been able to maintain good air quality prescribed by its own environment monitoring agency, the Central Pollution Control Board (CPCB), leave alone meet the WHO standards, which are much more stringent," said Dr. T.K. Joshi, head of Centre for Occupational and Environmental Health, Lok Nayak Hospital.

Dr. Joshi, who is also a member of a national task force constituted by the CPCB on maintaining air quality, said the situation has now turned alarming mainly due to the steady rise of particulate matter (PM) in air. They will be meeting this Friday to review the situation.

"As the WHO report has also noted the rise in the concentration of the PM 10 and PM 2.5 matter is most detrimental to human health. PM 2.5 is known to penetrate deepest into the lung tissues and cause major health hazard. The main culprit is the rampant and growing use of diesel – gensets, diesel vehicles – and poor quality fuel," he said.

Stating that till about two years ago, WHO's International Agency for Research on Cancer (IARC) had listed fumes rising out of diesel exhausts as the probable cause of carcinogens, Dr. Joshi noted: "This has now been upgraded to definite carcinogens. So, that should sum up for the city just how dangerous the rise in air pollution level is."

Cautioning about the present danger, Centre of Science and Environment (CSE) executive director, research and advocacy, Anumita Roychowdhury said: "Delhi has lost the gains of its CNG programme. Its air is increasingly becoming more polluted and un-breathable, bringing back the pre-CNG days when diesel-driven buses and autos had made it one of the most polluted cities on earth."

She added that diesel vehicles are known to emit higher smoke, particles and NOx – generic term for mono-nitrogen oxides NO (nitric oxide) and NO2 (nitrogen dioxide) – than their petrol counterparts.

According to WHO and other international regulatory and scientific agencies, diesel particulates are carcinogens. "Even the so-called 'clean' diesel runs with 350 parts per million of sulphur, allows higher limits for NOx and particulate emissions compared to petrol cars," she said.

The CSE in its studies on air quality in Delhi has noted that in 2001, when the CNG programme was on, the annual average level of respirable suspended particulate matter in residential areas stood at 149 microgram per cubic metre. After registering a drop in 2005, the level has shot up to 209 microgram per cubic metre in 2008. The concentration is, thus, around three times higher than the safe levels.

Eight hourly maximum current level of carbon monoxide is touching 6,000 microgram per cubic metre – way above the safe level of 2,000 microgram per cubic metre – though the annual levels have registered a drop, noted the CSE.

WHO ALARM ON DELHI AIR

- The situation is so bad in Delhi that its air has PM 2.5 concentrations of 153 micrograms and PM10 concentrations of 286 micrograms – much more than the permissible limits.
- In comparison, Beijing, which was once considered one of the places with bad air quality has PM 2.5 concentration of 56 micrograms and PM10 concentration of 121 micrograms.
- Air quality is represented by annual mean concentration of fine particulate matter (PM10 and PM2.5 – particles smaller than 10 or 2.5 microns).

- The database covers the period from 2008 to 2013.
- The majority of values are for the years 2011 and 2012.

Apart from Delhi, other cities with poor air quality are Lucknow, Kanpur, Firozabad, Agra, Gwalior and Raipur.

Air pollution is tangible

It stares us in the face…

Man Invents A Giant Air Purifier For A City In Peru

By Loke Shi Ying, 29 Nov 2014

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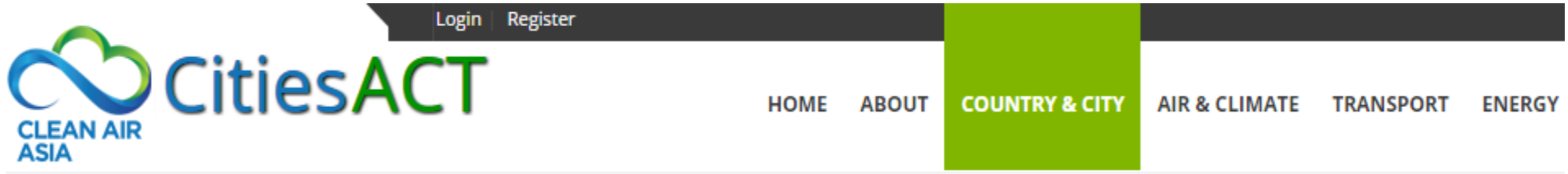
You can suck it out of the air

This is air pollution

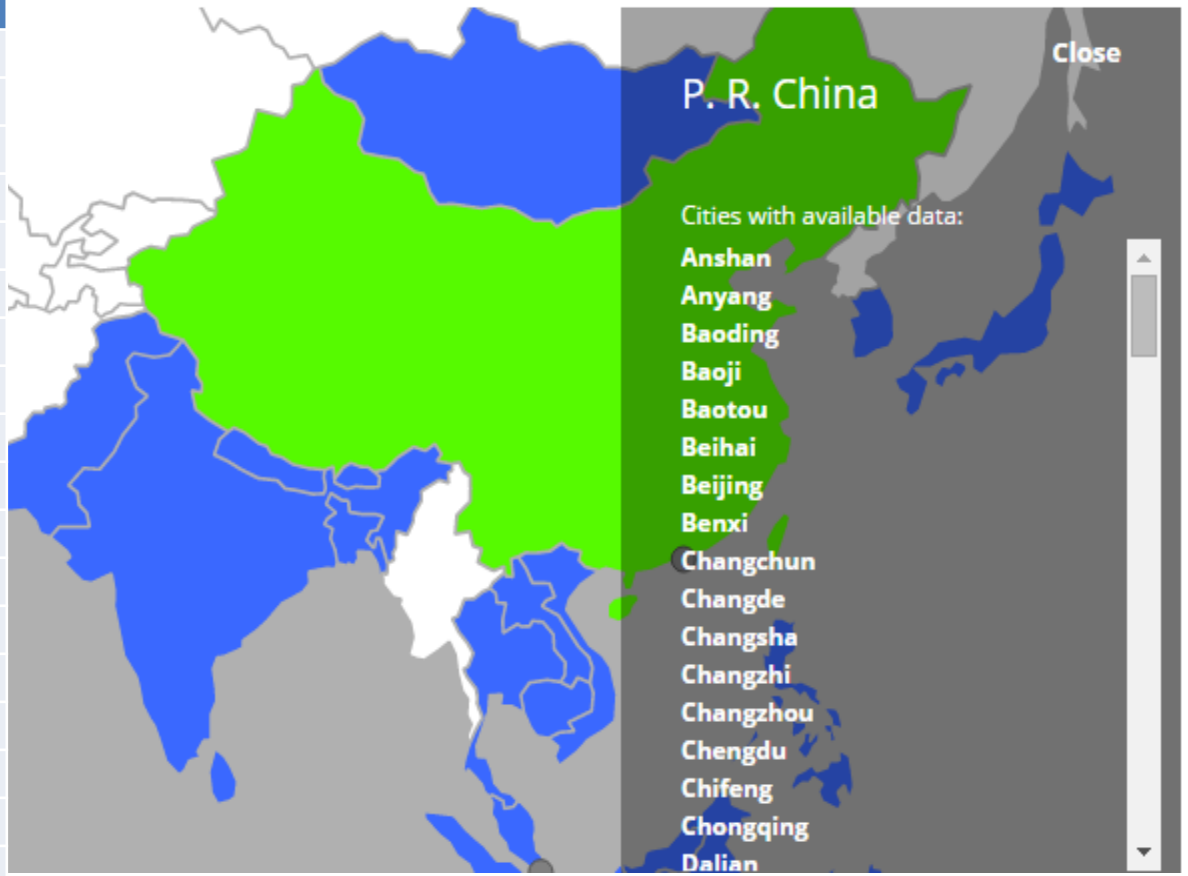
“Clean air free in the cabin”

We do not do a good job in measuring it

Clean Air Asia Database: www.CitiesACT.org



Country	No. of Cities
Bangladesh	3
Bhutan	1
Brunei Darussalam	4
Cambodia	2
China	125
India	178
Indonesia	7
Japan	39
Korea, Republic of	38
Mongolia	15
Nepal	3
Pakistan	5
Philippines	4
Singapore	1
Sri Lanka	1
Taipei, China	26
Thailand	28
Vietnam	9



WHO Database (PM10, PM2.5) for 2011-12

Takeaways

- Large gaps across countries and cities
- Limited time period
- Thin network of monitors (e.g., 9-11 in Delhi)
- PM2.5 monitoring especially weak
- Self reporting (doubts esp. about Chinese data)
- Remote sensing not used
- Crowd sourcing via low cost devices?
- Multiple sources/methods need to be used

We might get better at measuring it

Or maybe not…

Contents lists available at ScienceDirect

Journal of
Environmental Economics and Management

journal homepage: www.elsevier.com/locate/jeem

'Effortless Perfection:' Do Chinese cities manipulate air pollution data?

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ARTICLE INFO

Article history:
Received 25 April 2013
Available online 9 July 2014

JEL classification:
Q53
C23
C14

Keywords:
Air pollution
Manipulation
Discontinuity test
Panel matching

ABSTRACT

This paper uses unique data on daily air pollution concentrations over the period 2001–2010 to test for manipulation in self-reported data by Chinese cities. First, we employ a discontinuity test to detect evidence consistent with data manipulation. Then, we propose a panel matching approach to identify the conditions under which irregularities may occur. We find that about 50% of cities reported dubious PM_{10} pollution levels that led to a discontinuity at the cut-off. Suspicious data reporting tends to occur on days when the anomaly is least detectable. Our findings indicate that the official daily air pollution data are not well behaved, which provides suggestive evidence of manipulation.

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Ghanem and Zhang (2014)

- Can ferret out cities that report dubious data. Identify meteorological conditions under which local officials more likely to manipulate.
- When officials report data used in their own performance evaluation strong incentives for manipulation.
- Manipulation around the cut-off for blue-sky days, even if small has huge impact on individual behavior. If API above 100 but consistently reported below 100, individuals more likely to be exposed to higher levels of pollution.
- If citizens suspect manipulation, less likely to take API alerts seriously. From a public policy perspective, manipulation undermines credibility of public officials, can have tremendous political-economy consequences.

Some trends
(with these caveats in mind)

WHO benchmarks for PM, NO2, SO2

WHOair quality guidelines and interim targets for particulate matter: annual mean concentrations[a]

	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	Basis for the selected level
Iinterim target-1 (IT-1)	70	35	These levels are associated with about a 15% higher long-term mortality risk relative to the AQG level.
Interim target-2 (IT-2)	50	25	In addition to other health benefits, these levels lower the risk of premature mortality by approximately 6% [2–11%] relative to theIT-1 level.
Interim target-3 (IT-3)	30	15	In addition to other health benefits, these levels reduce the mortality risk by approximately 6% [2-11%] relative to the -IT-2 level.
Air quality guideline (AQG)	**20**	**10**	These are the lowest levels at which total, cardiopul-monary and lung cancer mortality have been shown to increase with more than 95% confidence in response to long-term exposure to $PM_{2.5}$.

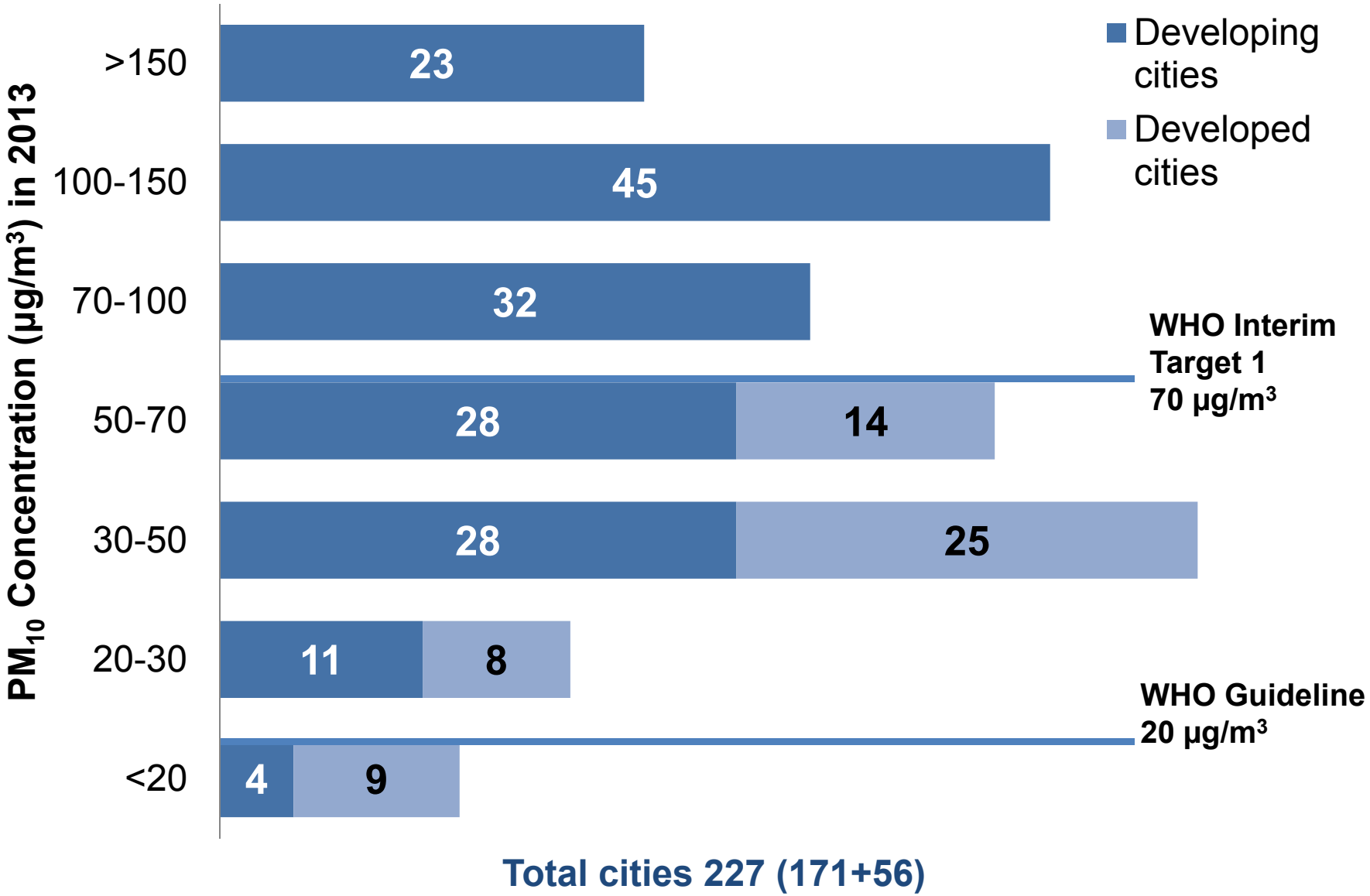
Guidelines

NO_2: **40 $\mu g/m^3$ annual mean**
200 $\mu g/m^3$ 1-hour mean

WHO air quality guidelines and interim targets for SO_2: 24-hour and 10-minute concentrations

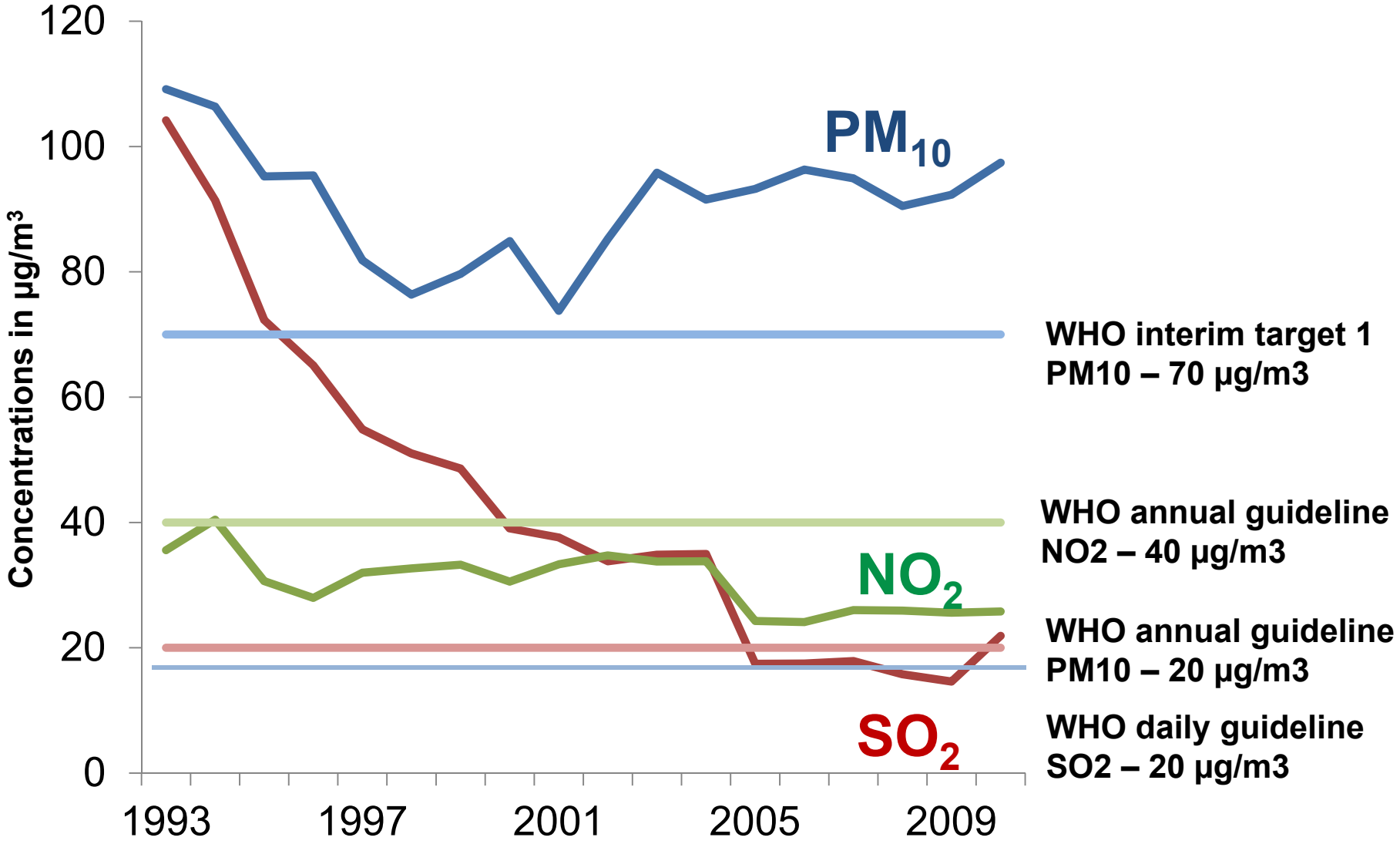
	24-hour average ($\mu g/m^3$)	10-minute average ($\mu g/m^3$)	Basis for selected level
Interim target-1 (IT-1)[a]	125	–	
Interim target-2 (IT-2)	50	–	Intermediate goal based on controlling either motor vehicle emissions, industrial emissions and/or emissions from power production. This would be a reasonable and feasible goal for some developing countries (it could be achieved within a few years) which would lead to significant health improvements that, in turn, would justify further improvements (such as aiming for the AQG value).
Air quality guideline (AQG)	**20**	**500**	

6 of 10 cities in developing Asia have very poor air quality (97% fail WHO Guideline)

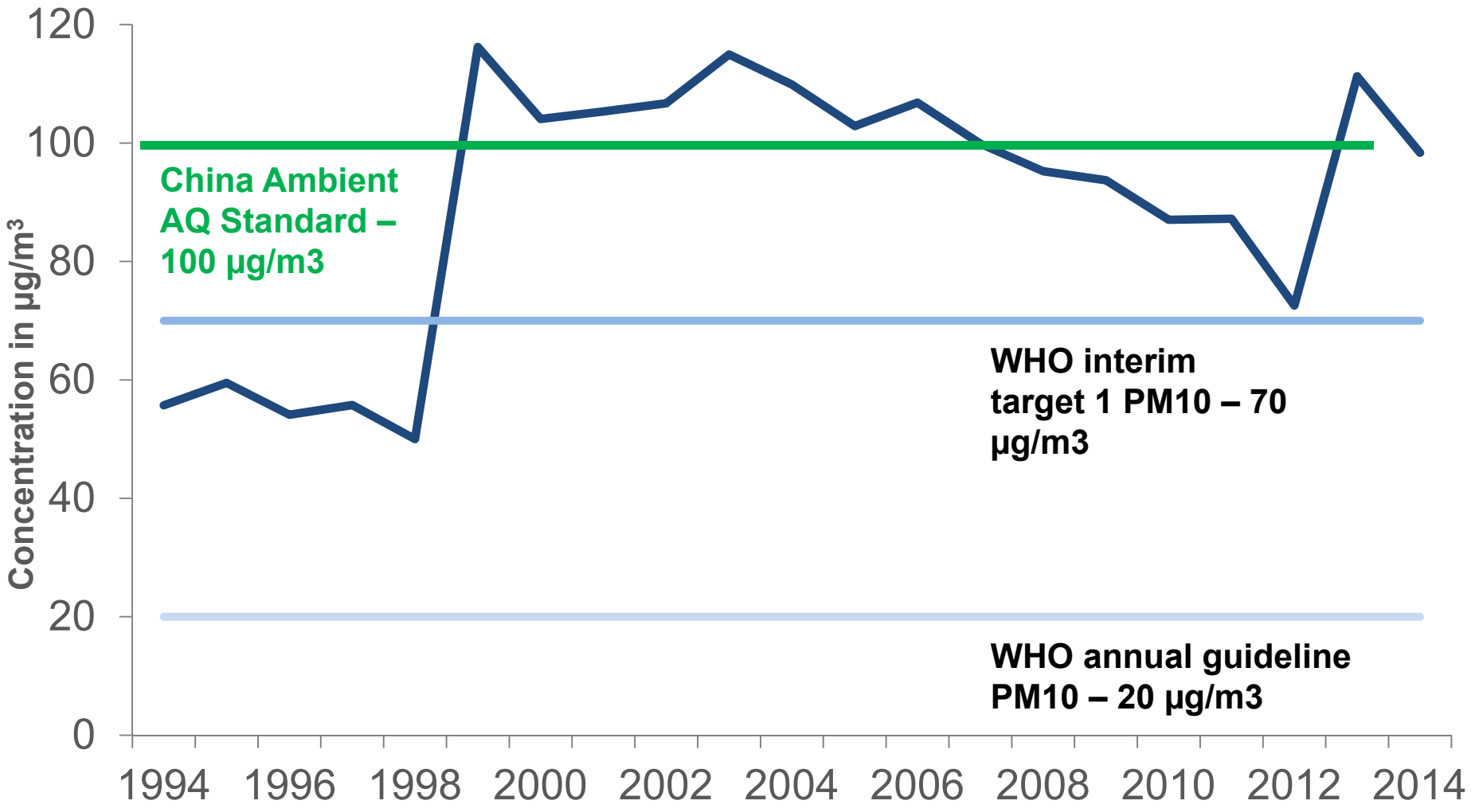


Total cities 227 (171+56)

Particulate pollution in Asia is getting worse again



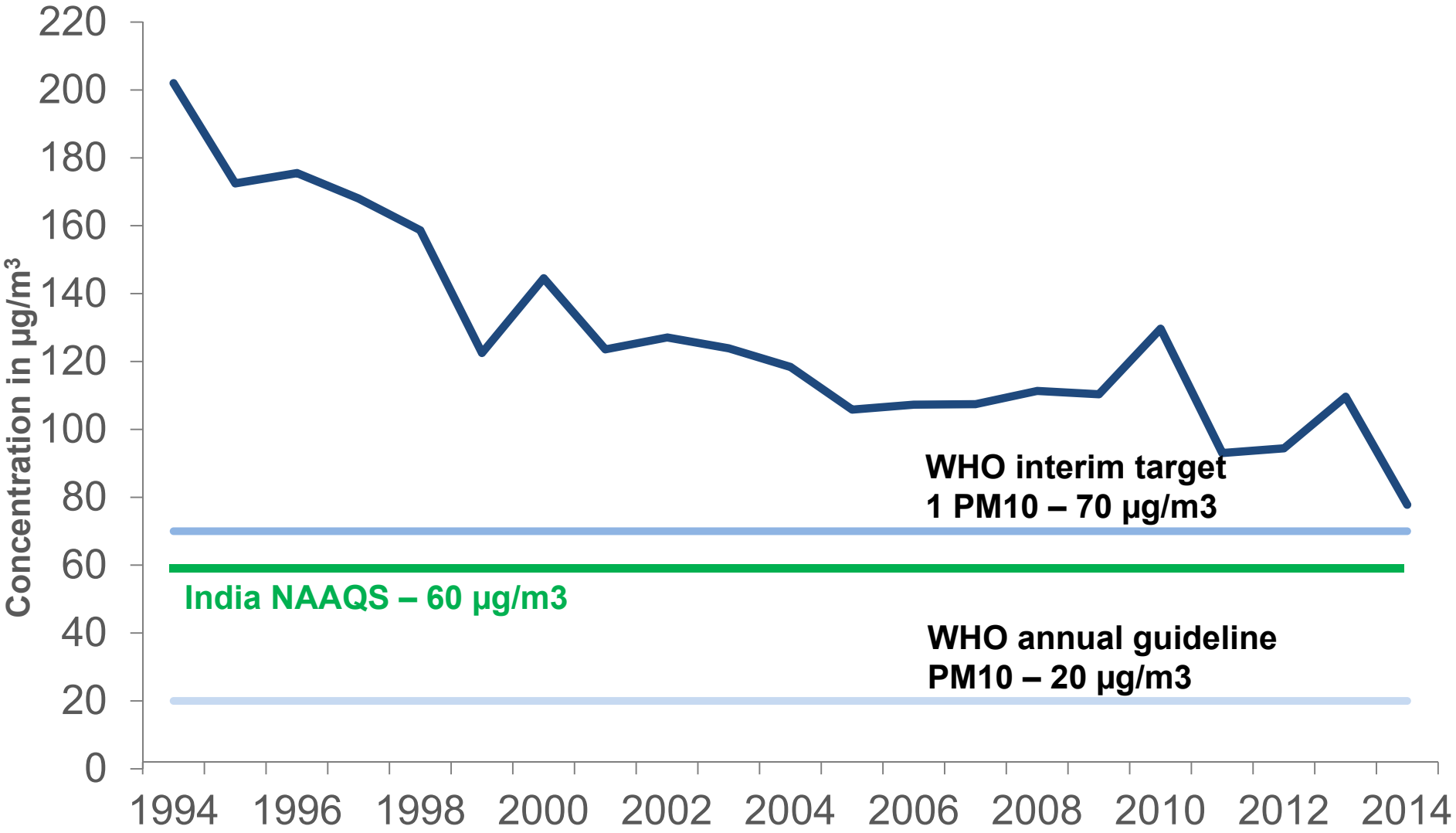
Annual average PM_{10} level in China (1994-2014)



Particulate pollution in China

- In 2010, 94 cities in failed to meet the WHO IT-1 for PM_{10}(70μg/m^3), while 23 of these cities exceeded the national standard (100μg/m^3)
- More than half (52% in 2010 and 59% in 2013) of these were medium-sized cities (population 1-5 million)
- By 2016 a new ambient air quality standard will be implemented (70μg/m^3)

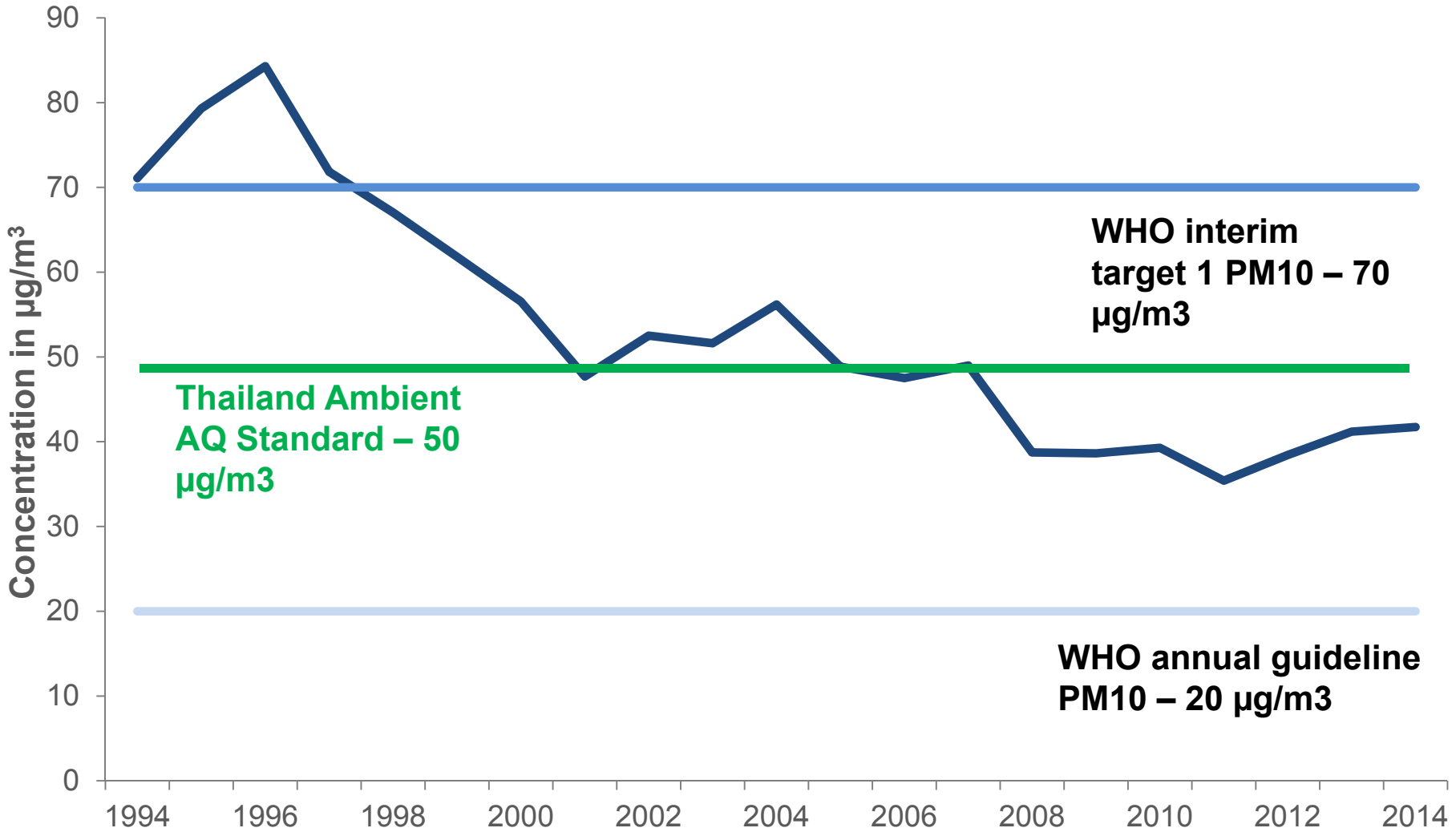
Annual average PM_{10} levels in India



Particulate pollution in India

- “Critically polluted” cities increased from 49 to 89 (2005-10)
- In 2005, about 75% of cities exceeded the standard--78% in 2010.
- Levels of PM10 among highest in Delhi National Capital Region--annual average 260 µg/m3--more than 4 times national annual standard (60 µg/m3) & 13 times WHO standard (20 µg/m3)
- Due to seasonal and other factors levels twice as high in winter.
- In 33 out of 35 metropolitan cities PM10 conc. exceeded standard.
- Close to half Indian cities experience severe particulate pollution.
- Half of urban population of the country exposed to particulate pollution that exceeds the standard.
- As much as a third of the urban population is exposed to critical levels of particulate pollution.
- Groups vulnerable to air pollution elderly, children and the poor.

Annual average PM_{10} level in Thailand (1994-2014)



Source: Clean Air Asia, 2015.

Particulate pollution in Thailand

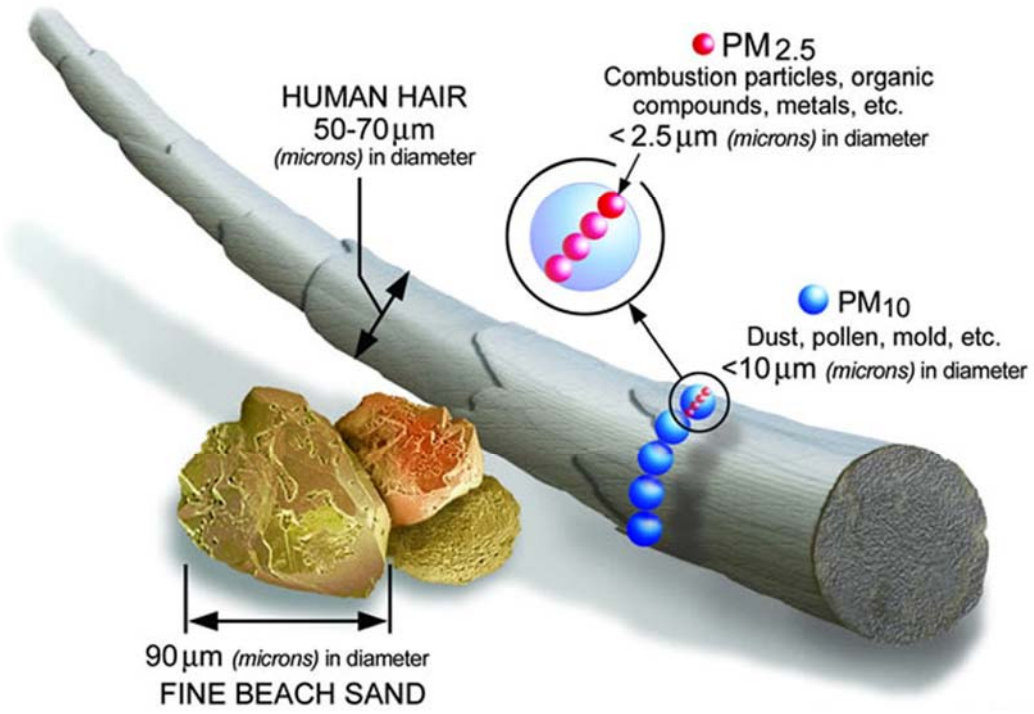
- In 2013, 8 cities exceeded the NAAQS for PM_{10} (50 $\mu g/m^3$), all of which were small-sized cities.
- While only 30% of cities with data exceeded the NAAQS, most did not meet the WHO annual guideline value of 20 $\mu g/m^3$
- It is noted that by 2014 average PM_{10} level in the country was 42 $\mu g/m^3$. Bangkok the only large-sized city in Thailand had an annual average PM_{10} level of 41 $\mu g/m^3$ between 2010 and 2014

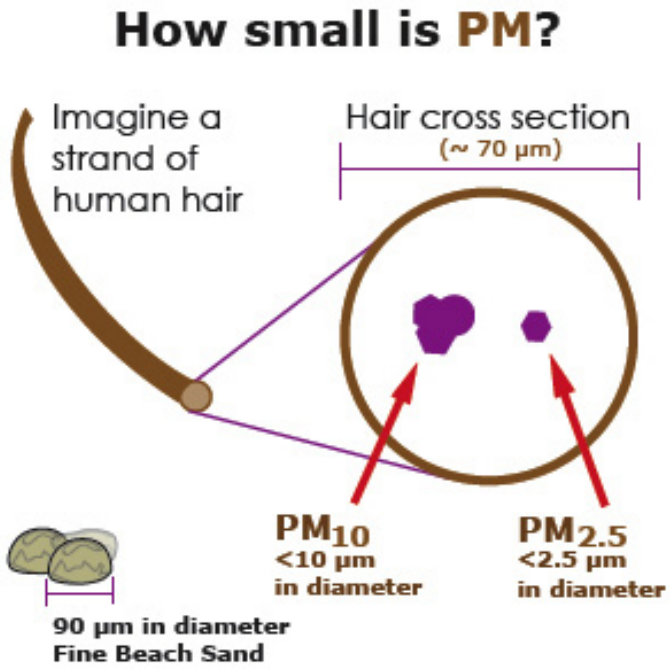
Stylised facts

- Chinese cities are on average more dirty
- Monitoring in India is getting worse
- Thai data is better and more active monitoring

How does polluted air kill?

Particulates are nasty esp. PM10 and PM2.5



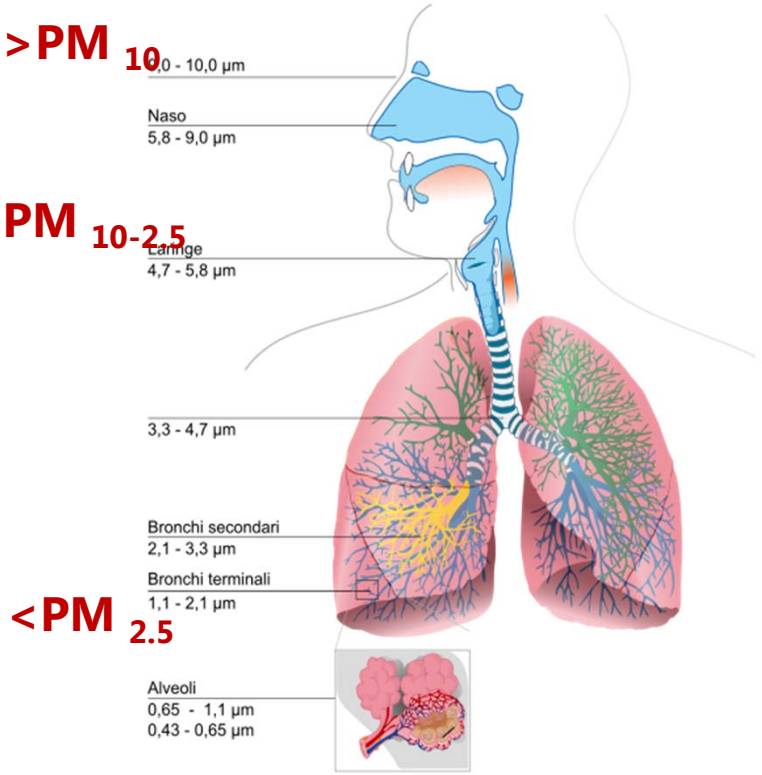


Outdoor air pollution is a leading cause of cancer deaths

- **Outdoor air pollution** is carcinogenic to humans (Group 1). Sufficient evidence that exposure to outdoor air pollution causes lung cancer.
- **Particulate matter**, a major component of outdoor air pollution, was also classified as carcinogenic to humans.
- Finer size particulates are more harmful to health

More information available at http://www.iarc.fr/en/media-centre/iarcnews/pdf/pr221_E.pdf

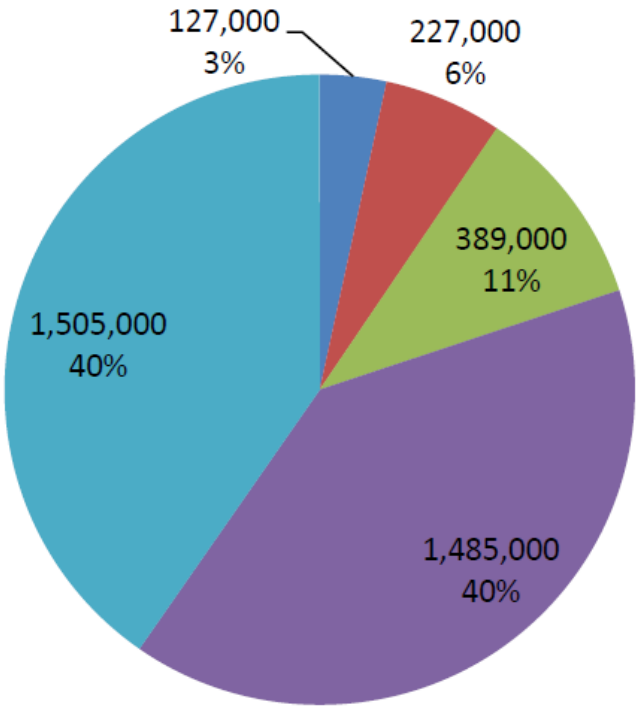
How deep do they go?



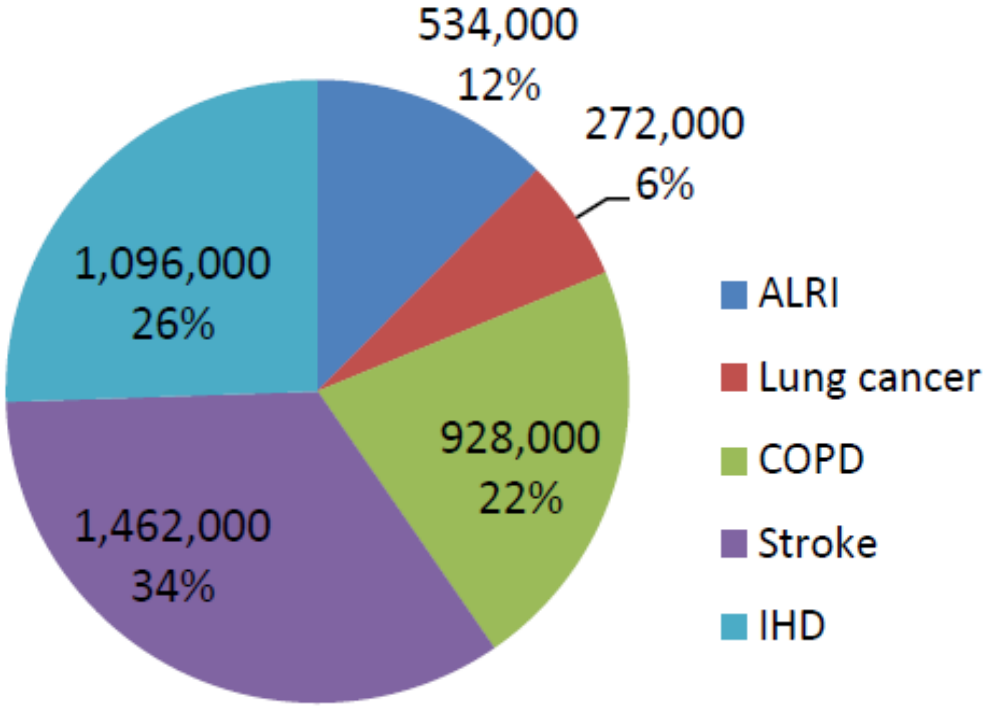
Source: International Agency for Research on Cancer (IARC) of WHO 2013

Main causes are heart disease and stroke

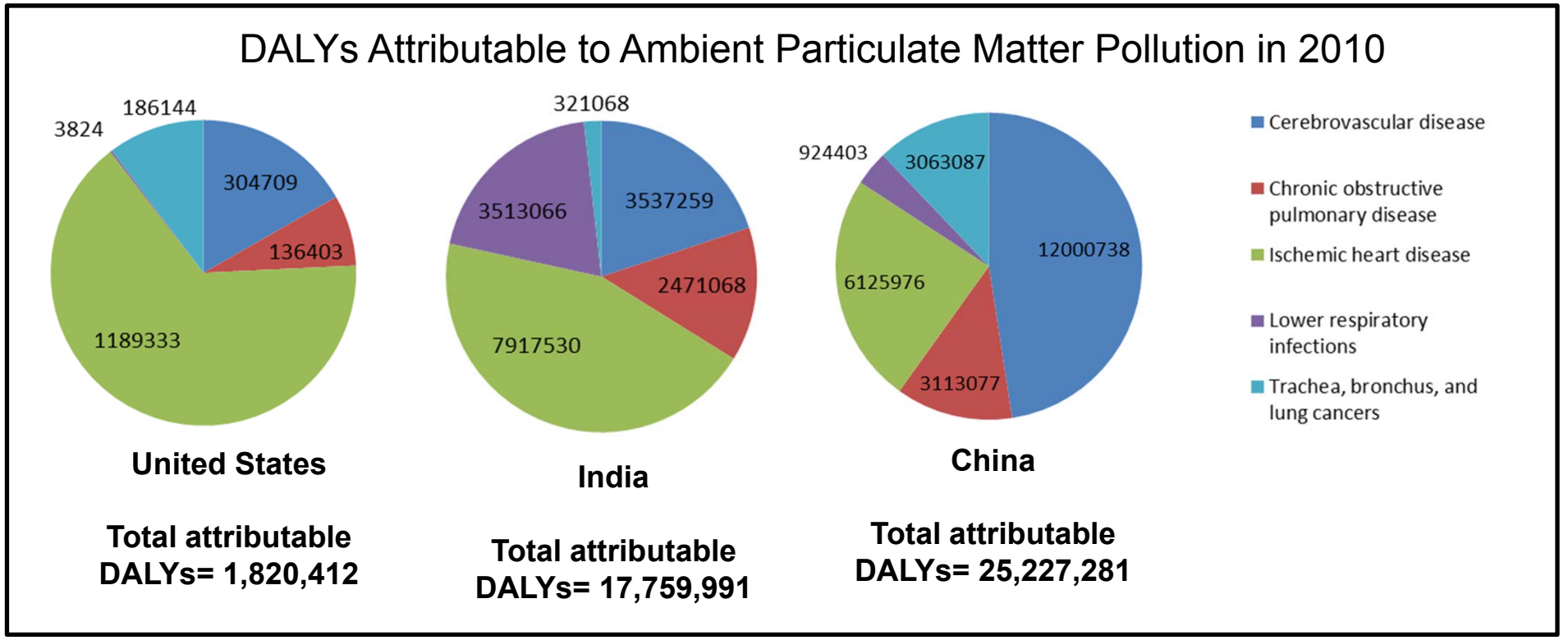
Outdoor pollution



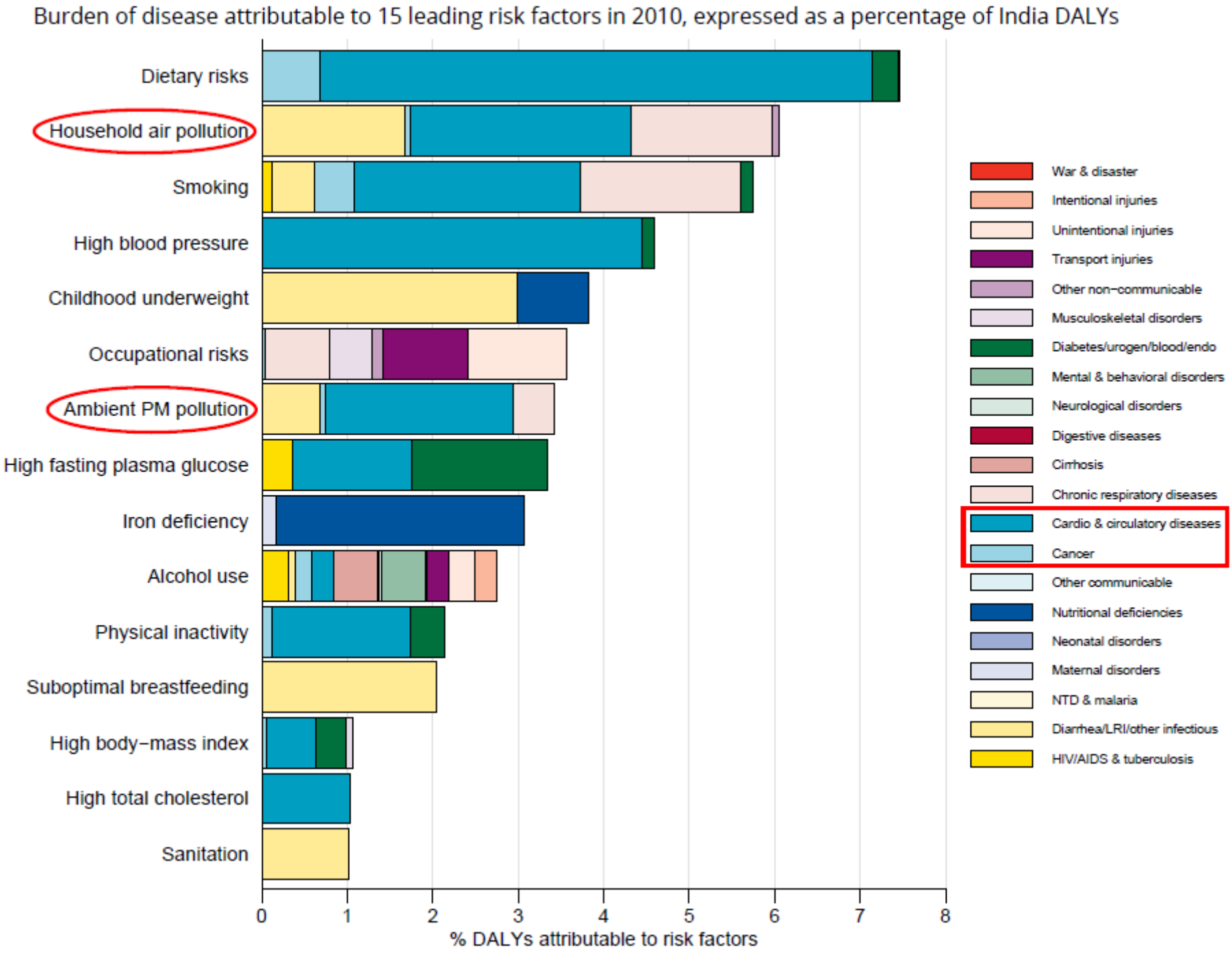
Indoor pollution

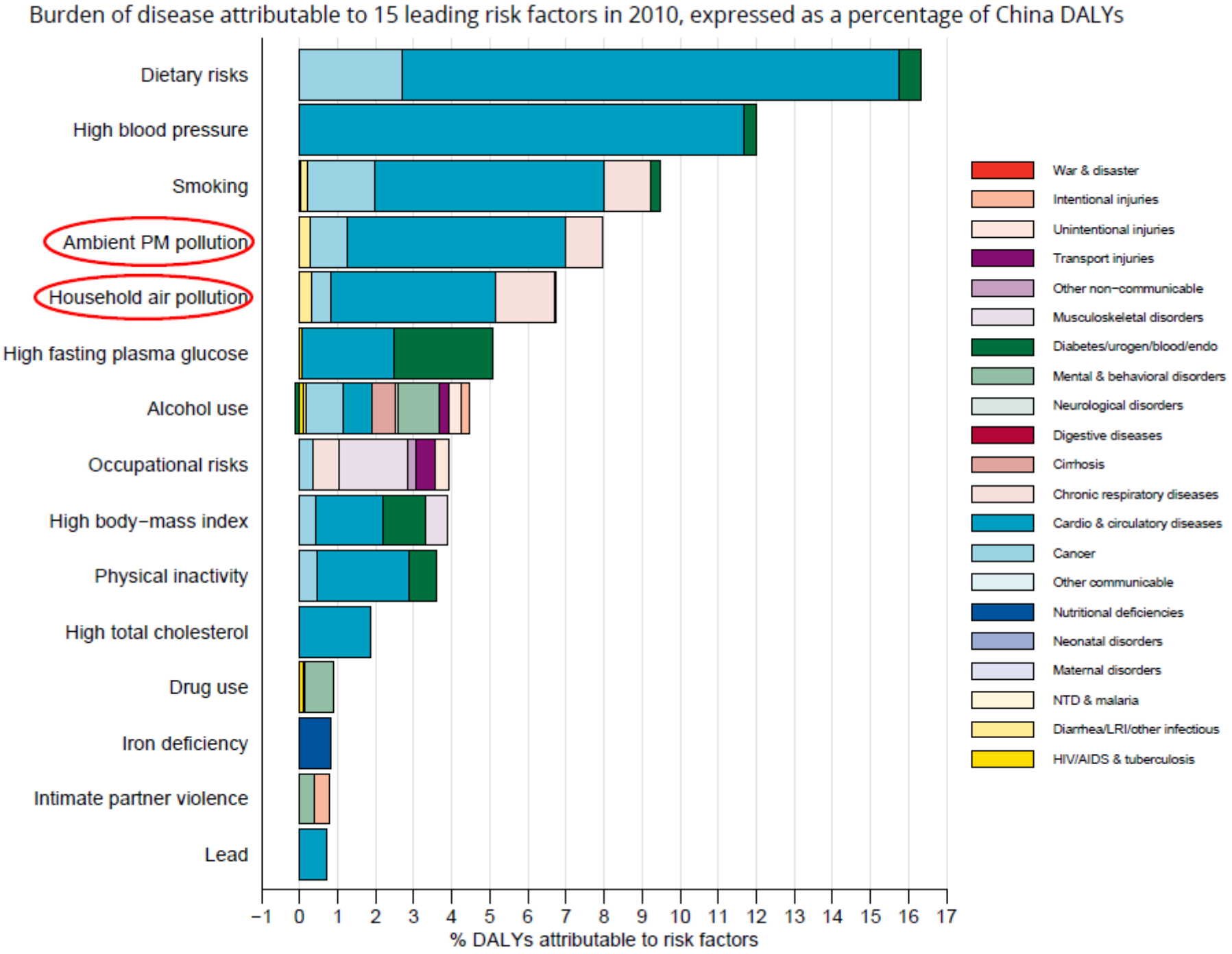


DALYs due to outdoor $PM_{2.5}$ by disease



DALY = Disability adjusted life year = premature death + ill health + disability


Burden of disease attributable to 15 leading risk factors in 2010, expressed as a percentage of India DALYs
Dietary risks
Household air pollution
Smoking
High blood pressure
Childhood underweight
Occupational risks
Ambient PM pollution
High fasting plasma glucose
Iron deficiency
Alcohol use
Physical inactivity
Suboptimal breastfeeding
High body−mass index
High total cholesterol
Sanitation
0
1
2
3
4
5
6
7
8
% DALYs attributable to risk factors
War & disaster
Intentional injuries
Unintentional injuries
Transport injuries
Other non−communicable
Musculoskeletal disorders
Diabetes/urogen/blood/endo
Mental & behavioral disorders
Neurological disorders
Digestive diseases
Cirrhosis
Chronic respiratory diseases
Cardio & circulatory diseases
Cancer
Other communicable
Nutritional deficiencies
Neonatal disorders
Maternal disorders
NTD & malaria
Diarrhea/LRI/other infectious
HIV/AIDS & tuberculosis


Burden of disease attributable to 15 leading risk factors in 2010, expressed as a percentage of China DALYs
Dietary risks
High blood pressure
Smoking
Ambient PM pollution
Household air pollution
High fasting plasma glucose
Alcohol use
Occupational risks
High body−mass index
Physical inactivity
High total cholesterol
Drug use
Iron deficiency
Intimate partner violence
Lead
−1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
% DALYs attributable to risk factors
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Transport injuries
Other non−communicable
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Cardio & circulatory diseases
Cancer
Other communicable
Nutritional deficiencies
Neonatal disorders
Maternal disorders
NTD & malaria
Diarrhea/LRI/other infectious
HIV/AIDS & tuberculosis

What are the consequences of air pollution for Asia?

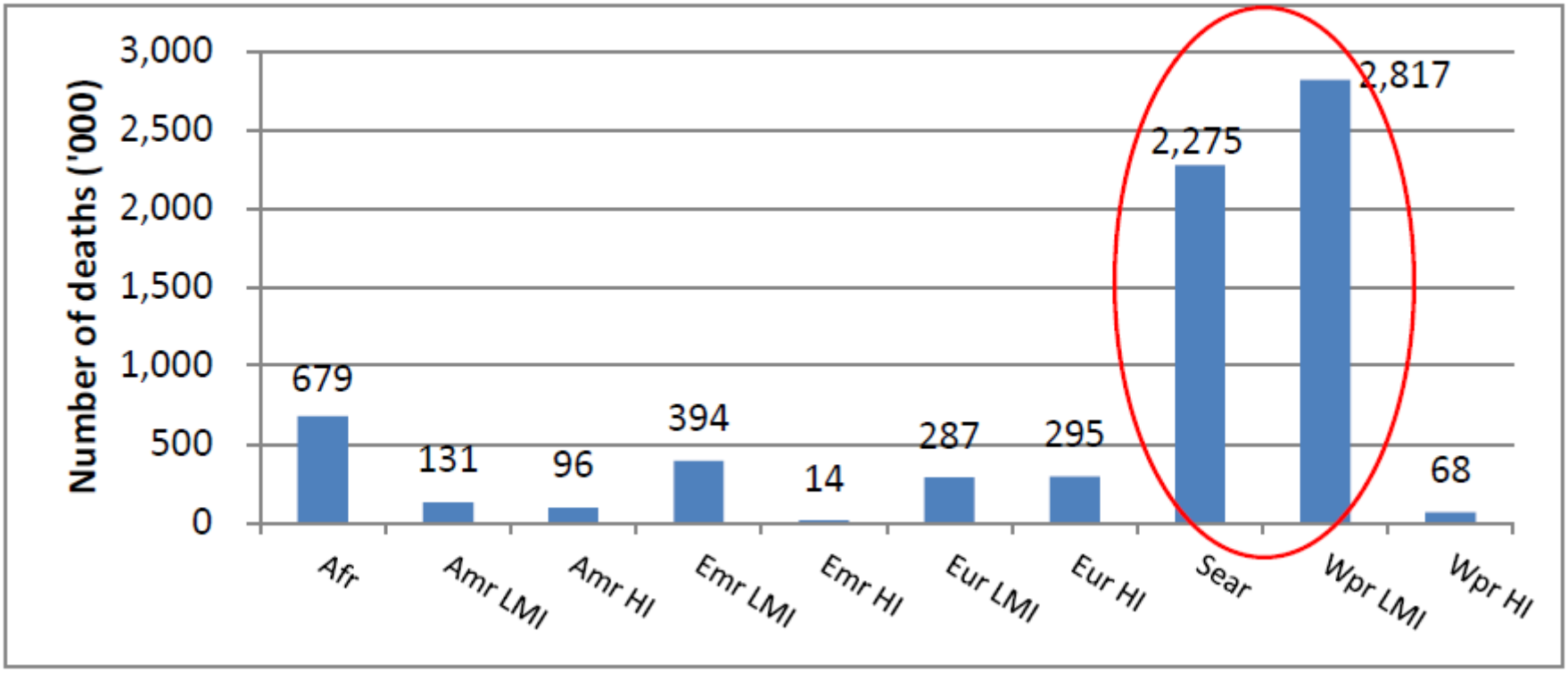
Air pollution kills people (and/or makes them very sick)

- 7 million people died from air pollution worldwide (1 in 8 of all deaths) of which 5.1 million were in developing Asia
- 3.7 million deaths due to ambient (outdoor) air pollution (AAP/OAP)
- 4.3 million deaths due to household (indoor) air pollution (HAP/IAP)
- **Asia bore the brunt of it**

All heath data from Global Burden of Disease (2012)

5.1 million died due to air pollution in developing Asia

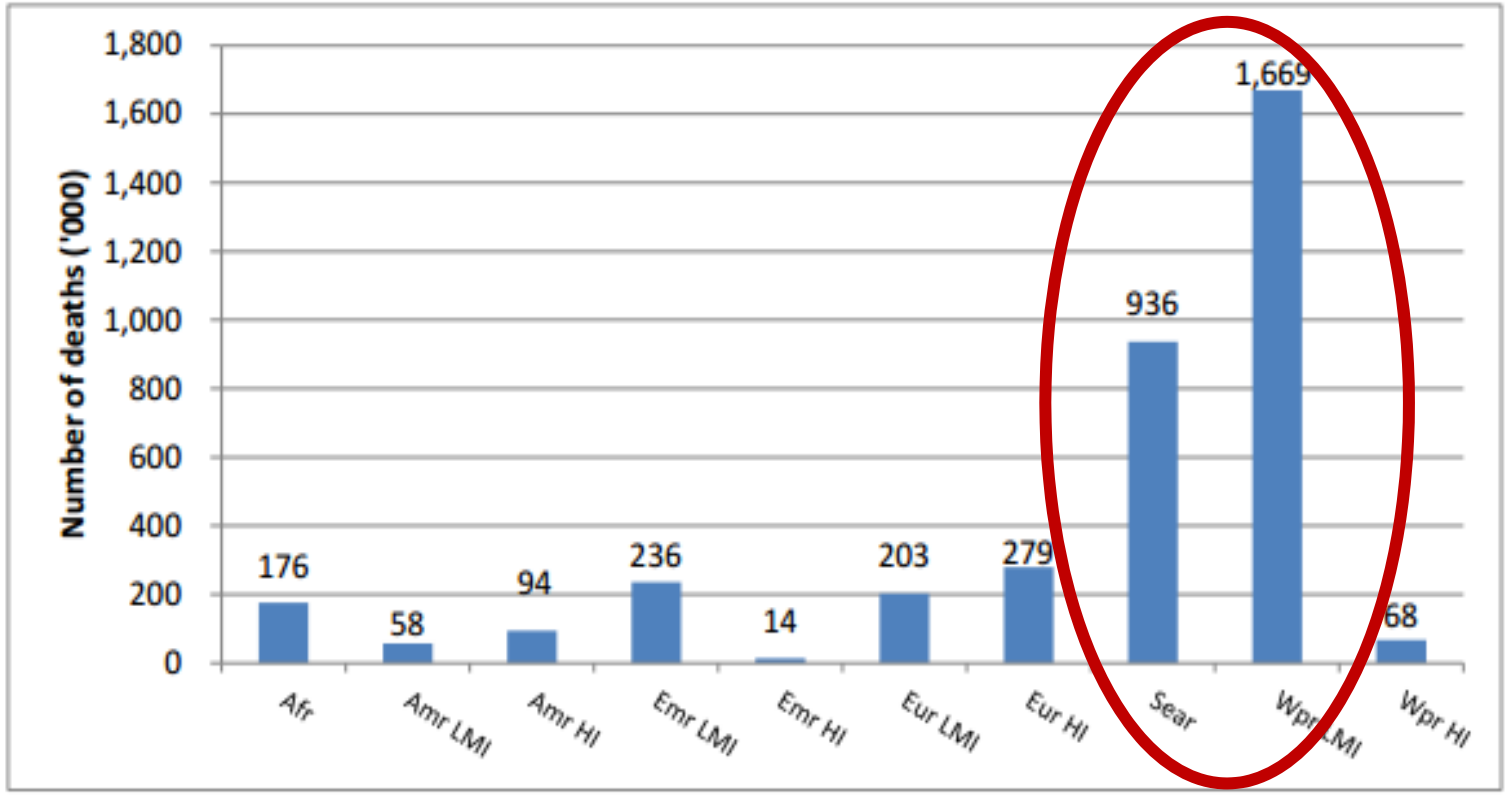
Total deaths attributable to the joint effects of HAP and AAP in 2012, by region



Asia had the largest outdoor air pollution burden

2.6 million Asians died due to outdoor air pollution

Total deaths attributable to OAP/AAP in 2012, by region



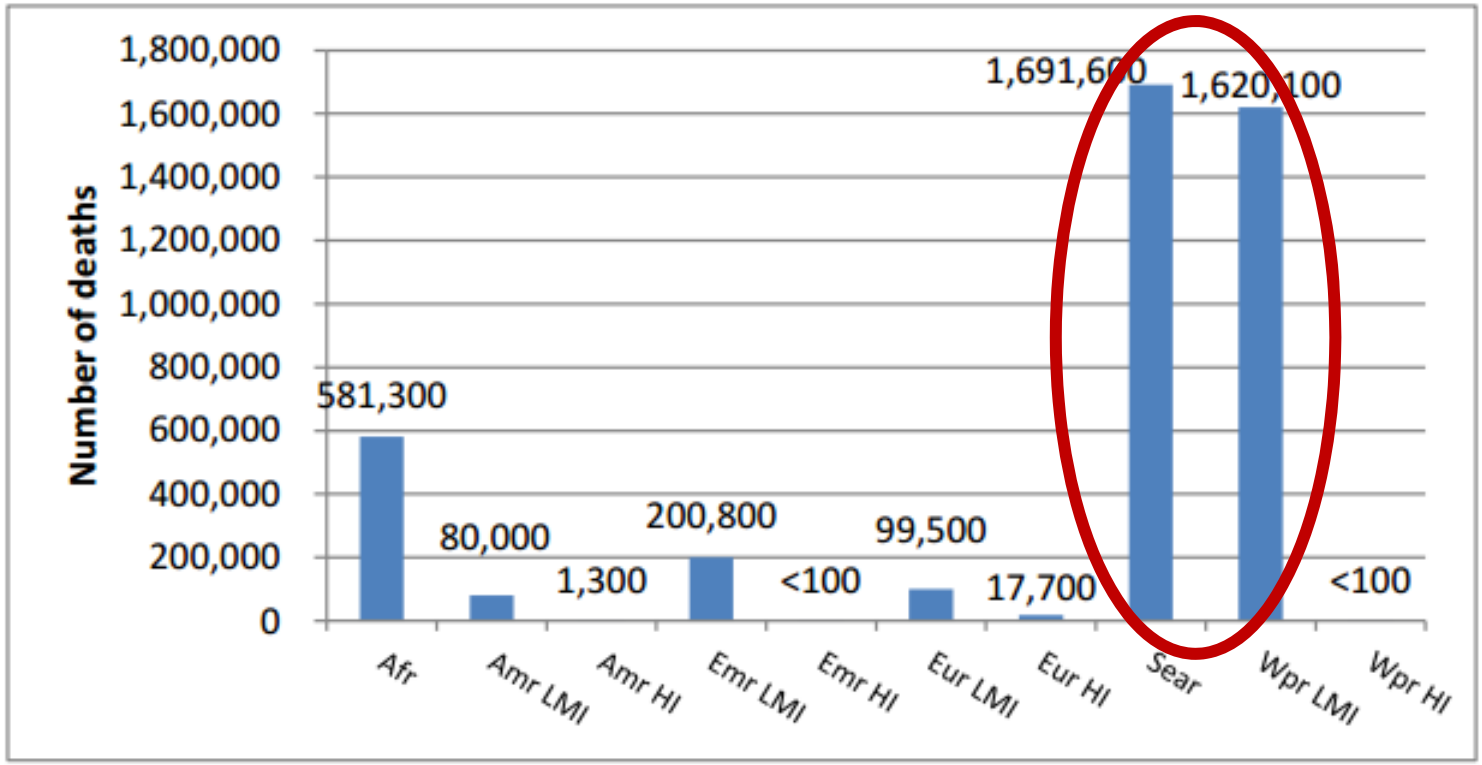
Afr: Africa, Amr: America
Emr: Eastern Mediterranean
Eur: Europe

Sear: South-East Asia
Wpr: Western Pacific
LMI: Low and middle income, HI: High income

Asia had the largest indoor air pollution burden

3.3 million Asians died due to indoor air pollution

Total deaths attributable to IAP/HAP in 2012 by region



Afr: Africa, Amr: America
Emr: Eastern Mediterranean
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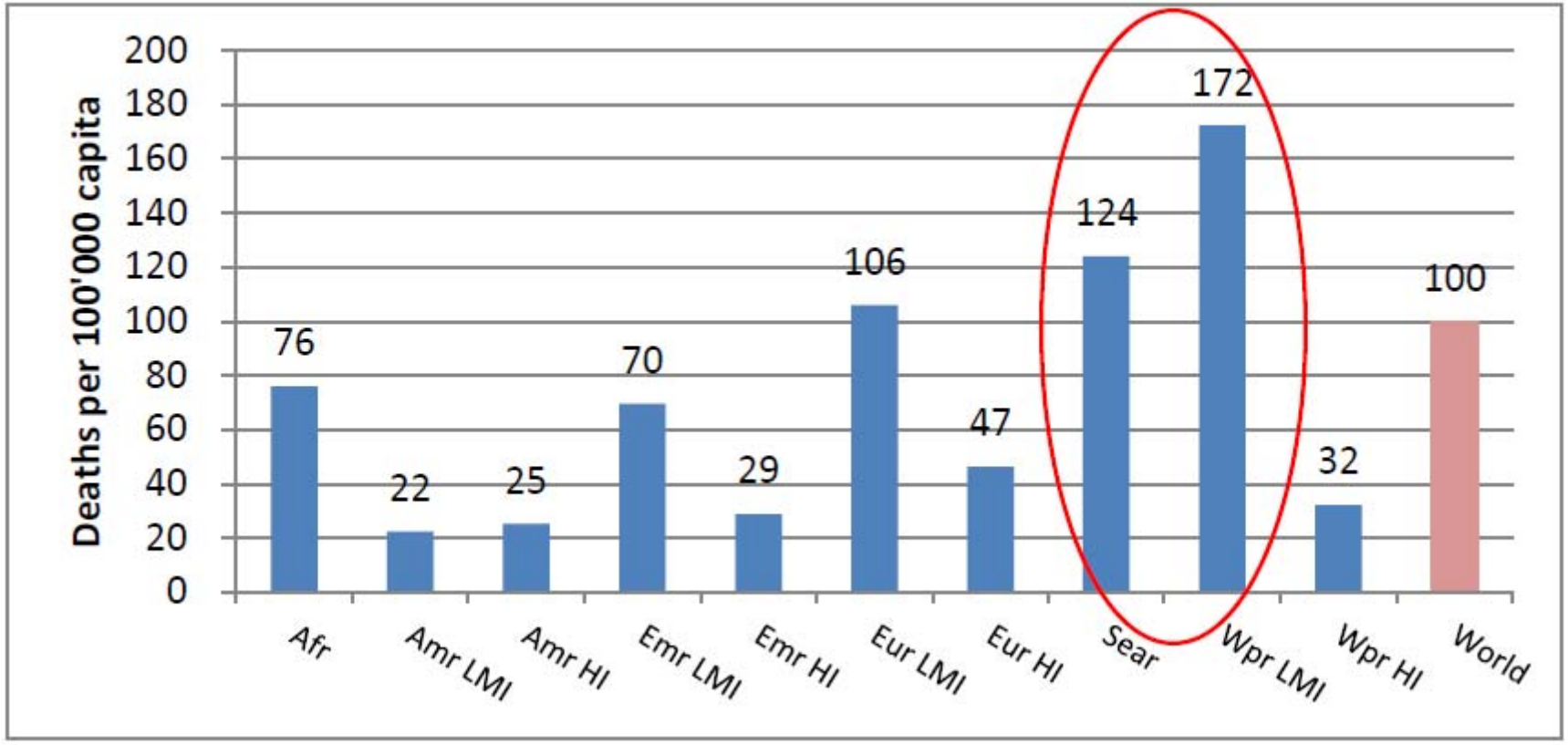
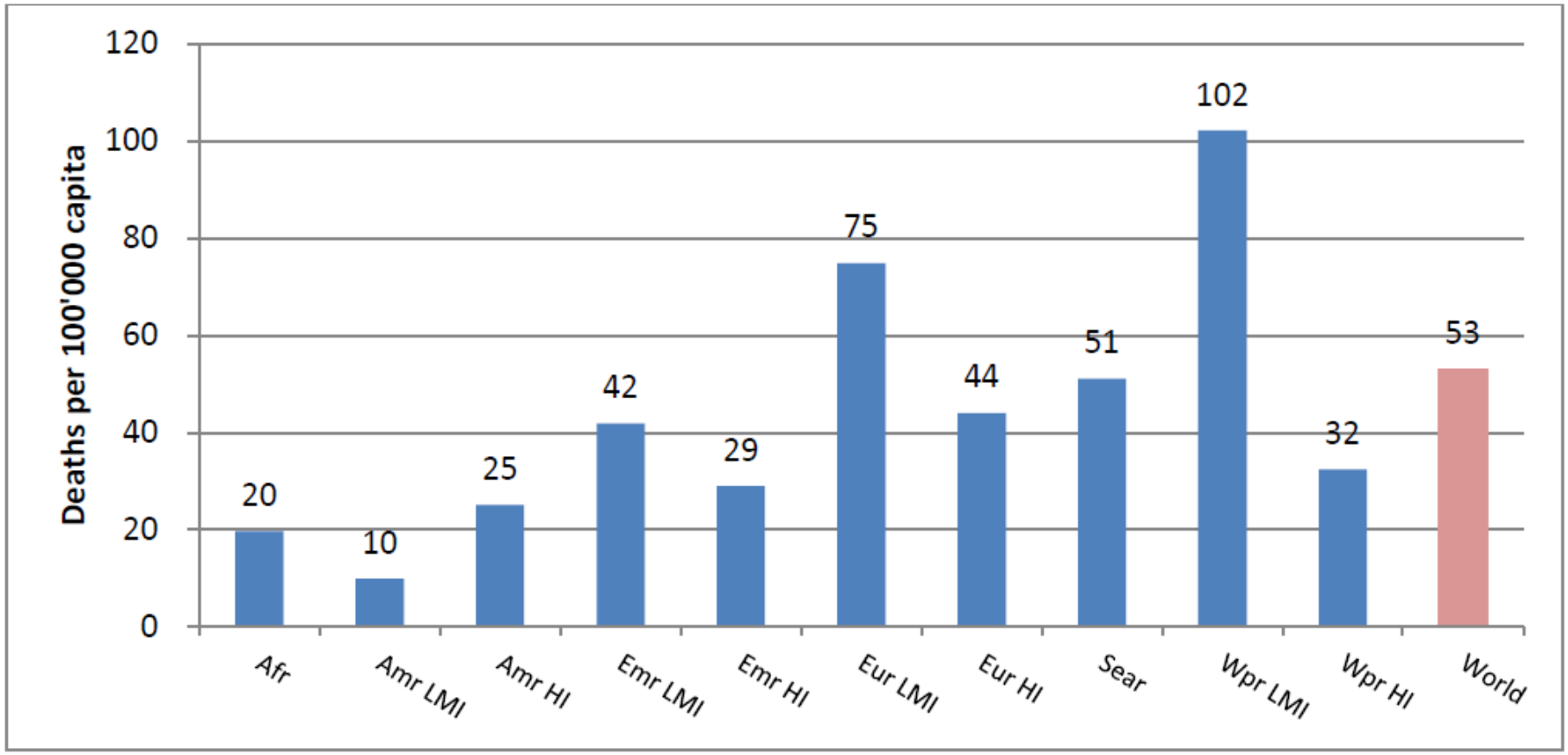
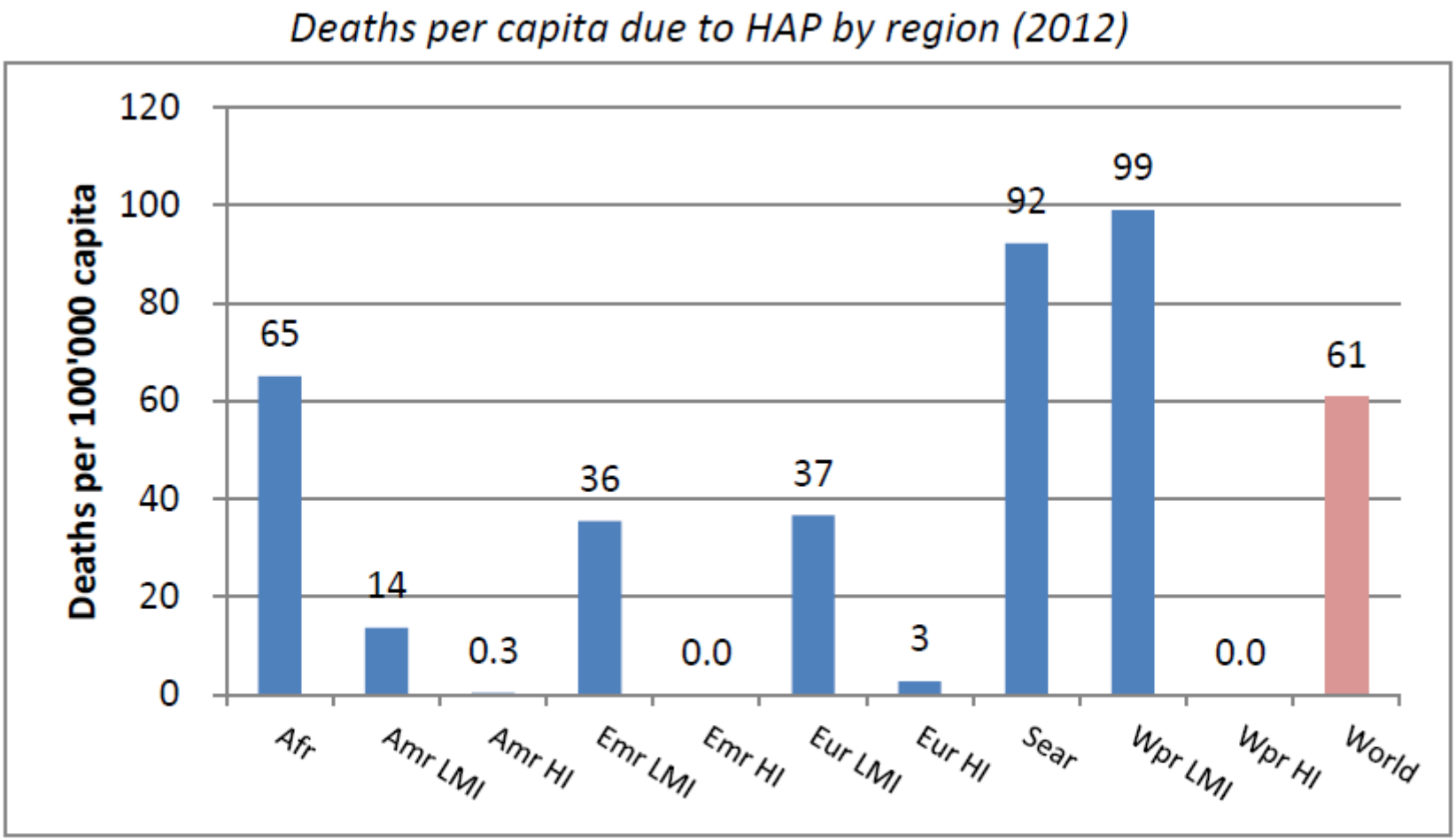
Asia also had the highest per capita deaths due to air pollution

Deaths per capita attributable to the joint effects of HAP and AAP in 2012, by region



Deaths per capita due to AAP by region (2012)





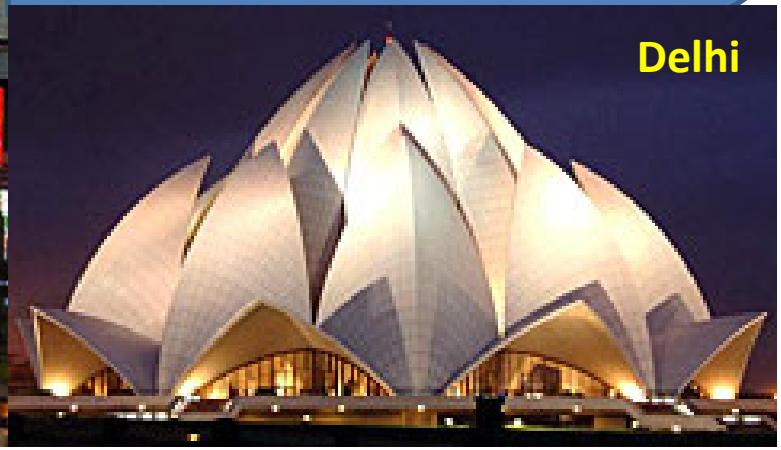
HAP: Household air pollution; Amr: America, Afr: Africa; Emr: Eastern Mediterranean, Sear Wpr: Western Pacific; LMI: Low- and middle-income; HI: High-income.

More and more people are living in cities and the air in cities is polluted

By 2015, the number of megacities is projected to grow to 36...

...23 of these megacities will be located in Asia.

- World Resources Institute



44 million

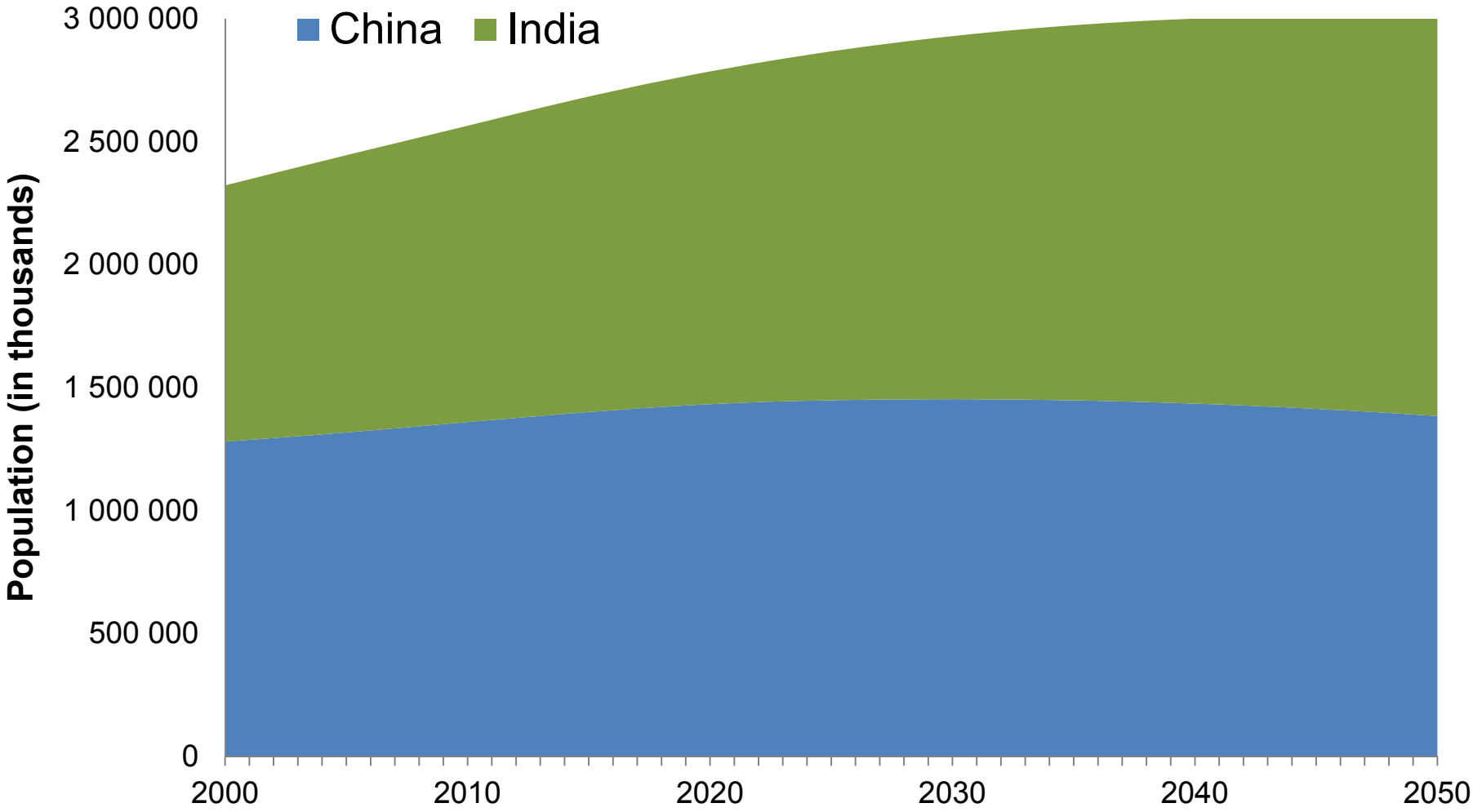
people added to Asian cities every year

120,000

people a day

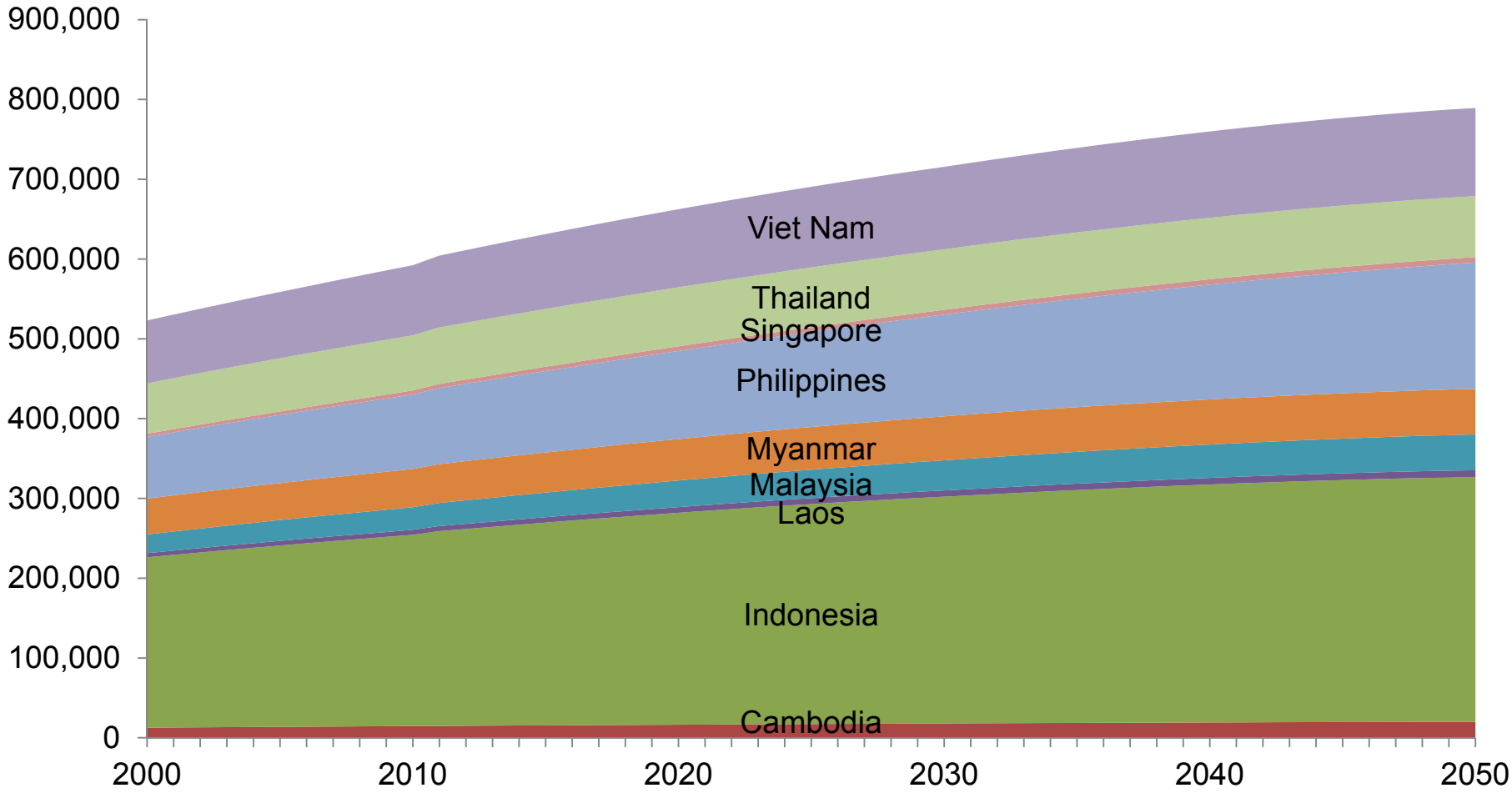
Source: ADB

Population growth in China and India



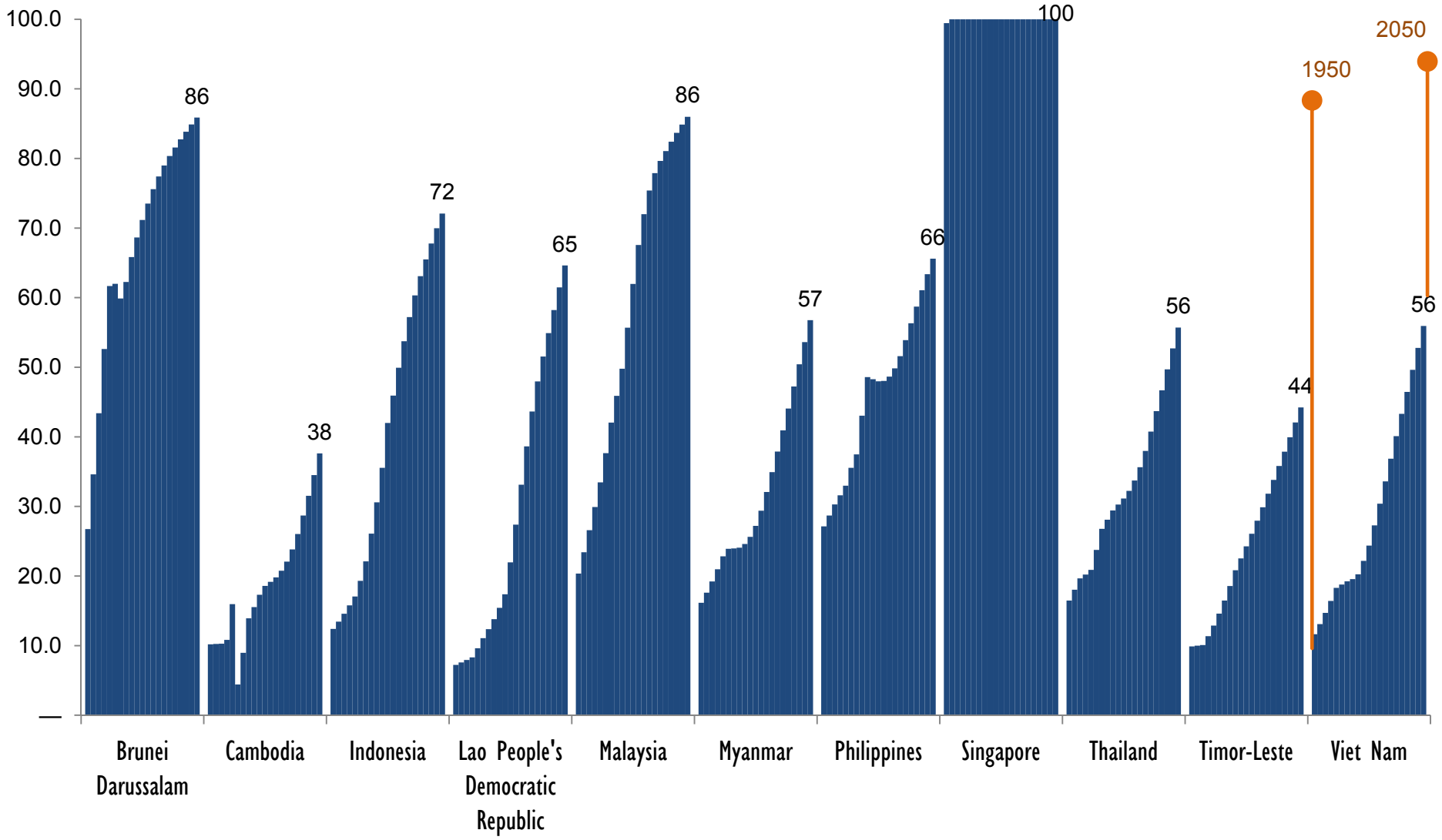
Source: Data from the United Nations population prospects

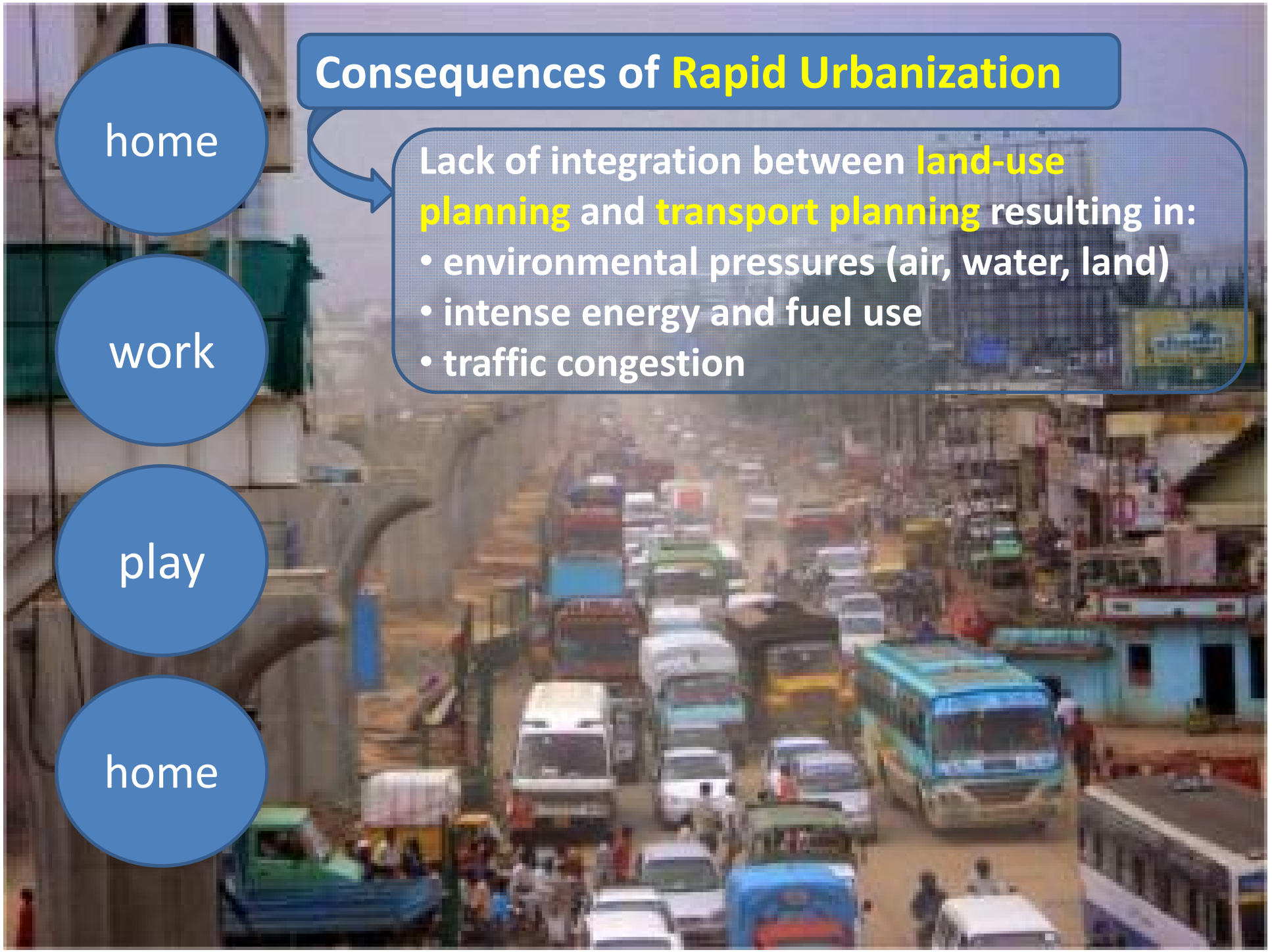
Population growth in Southeast Asia



33% increase; 10% of world population by 2050

Urbanization i.e., more cities larger cities



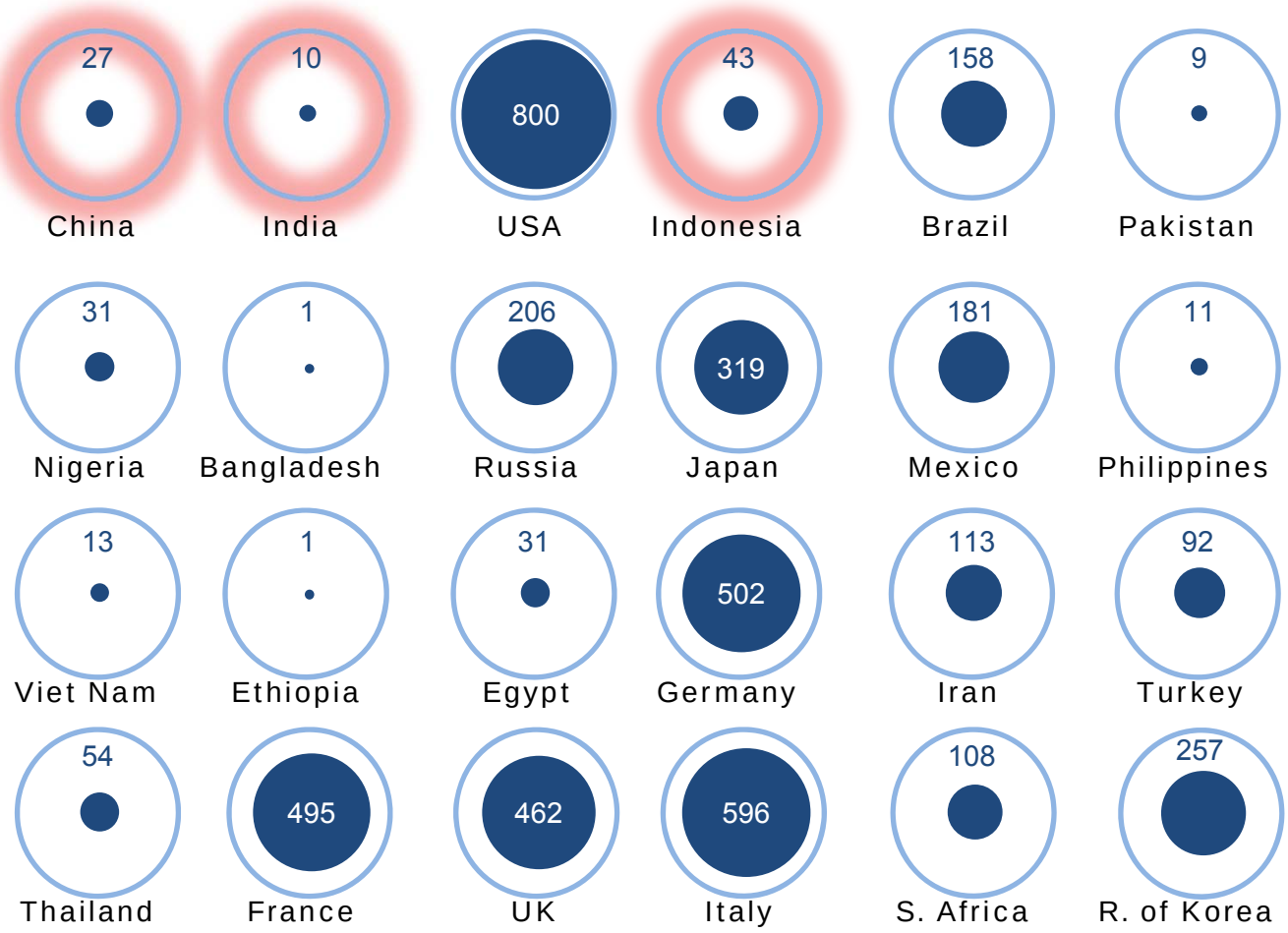


Consequences of Rapid Urbanization

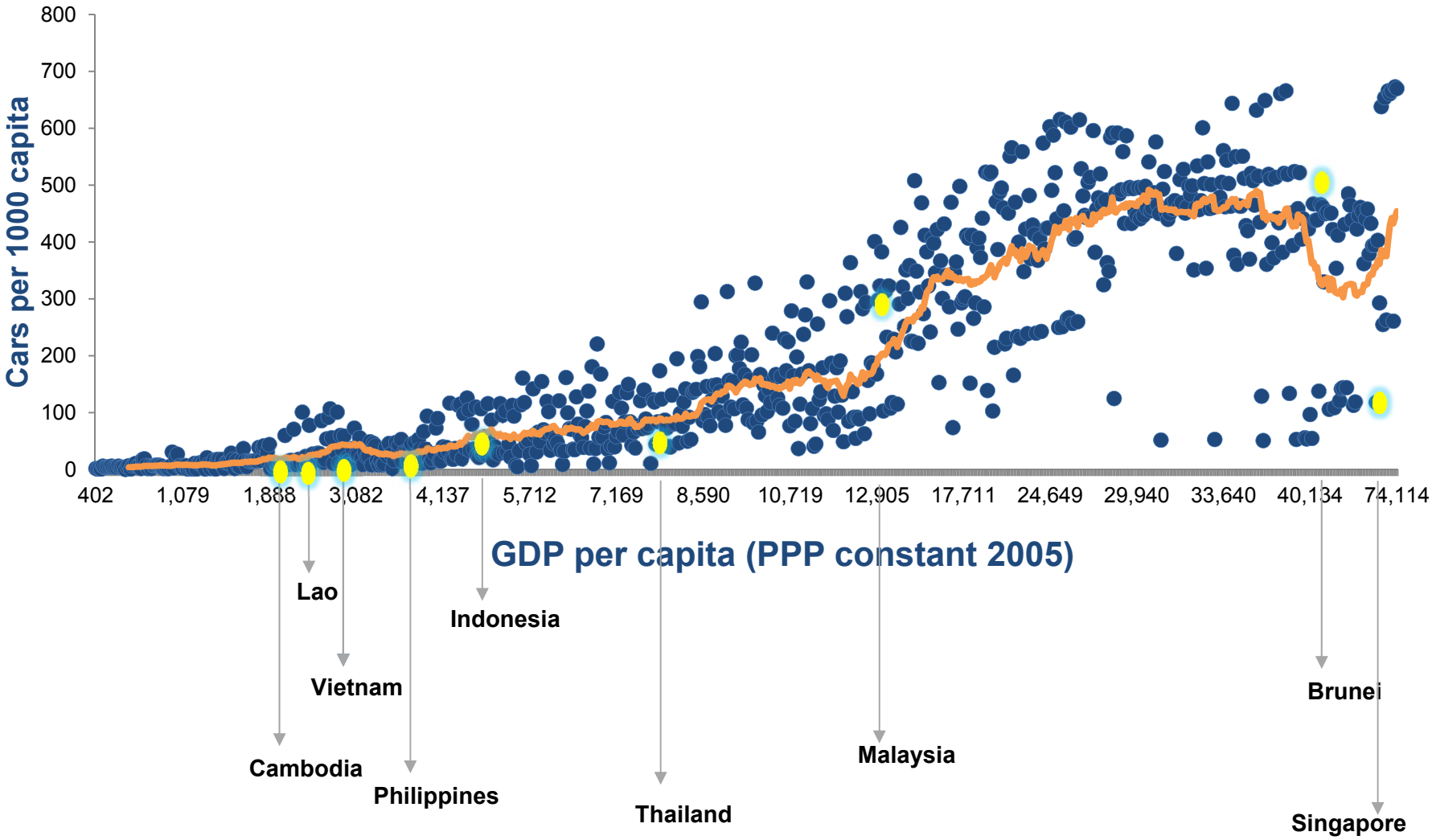
Lack of integration between land-use planning and transport planning resulting in:

- environmental pressures (air, water, land)
- intense energy and fuel use
- traffic congestion

Cars per 1000 People

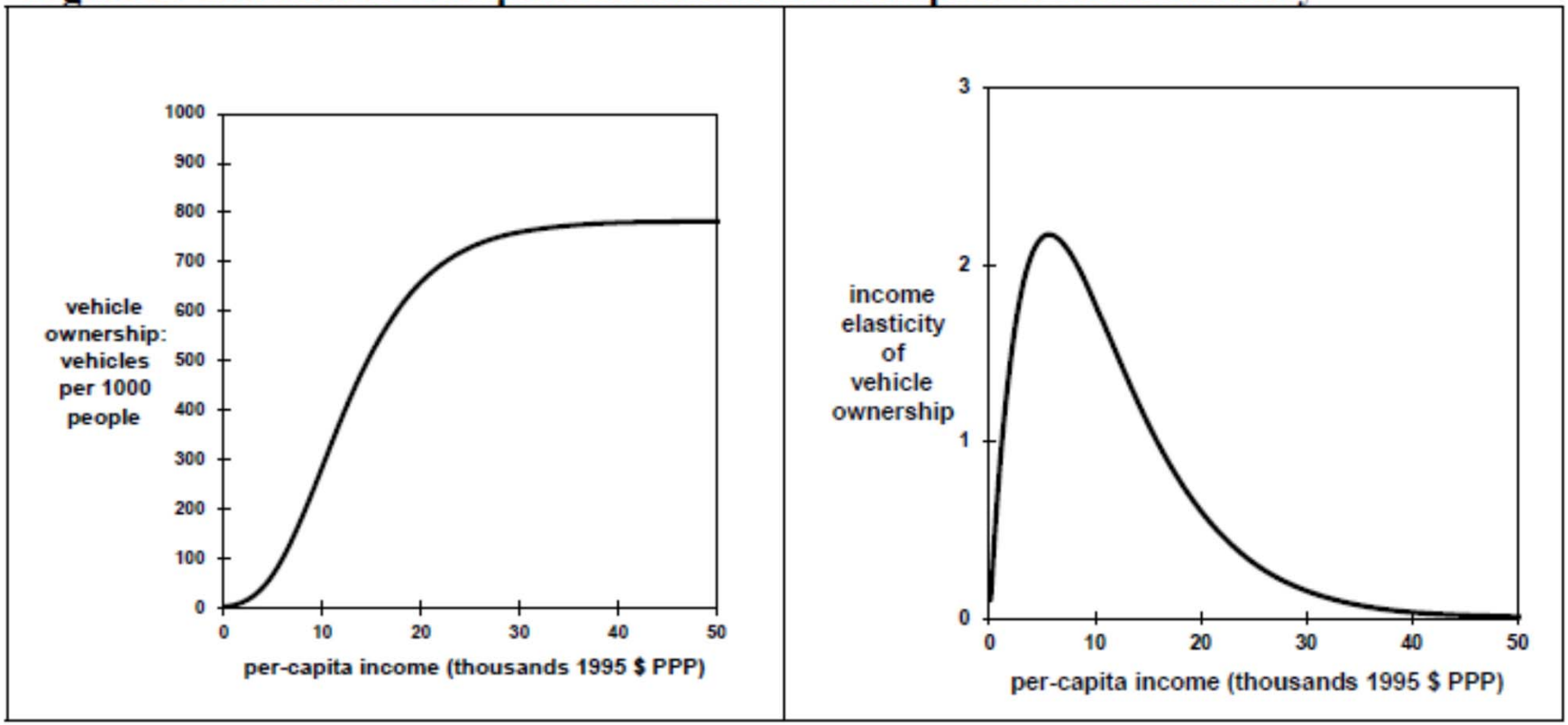


Vehicle Ownership



Source: Data from the World Bank and Clean Air Asia

Figure 3. Illustrative Gompertz function and its implied income elasticity



Energy use for transport

- The transport sector consumes nearly ~60% of the world's petroleum supply
- ~80% of the total transport energy demand goes to road transport

Source: IEA

Air pollution and cities

- Impacts of vehicle emissions most visible in cities. With more vehicles polluting, higher density populations that are exposed to polluted air and buildings that prevent dissipation of emissions the impacts are compounded greatly.
- Fast growing cities where economic growth drives transport growth but where stricter emissions regulations have not yet been put in place have the dirtiest air.

The rise of diesel in Europe: the impact on health and pollution

In a bid to reduce CO2 emissions in the 90s, Europe backed a major switch from petrol to diesel cars but the result was a rise in deadly air pollution

Diesel cars: Is it time to switch to a cleaner fuel?

By Richard Anderson
Business reporter, BBC News

16 July 2015 | Business

Volkswagen's rigging of emissions tests for diesel cars comes after nearly 20 years of the technology being incentivised in Europe in the knowledge that its adoption would reduce global warming emissions but lead to thousands of extra deaths from increased levels of toxic gases.

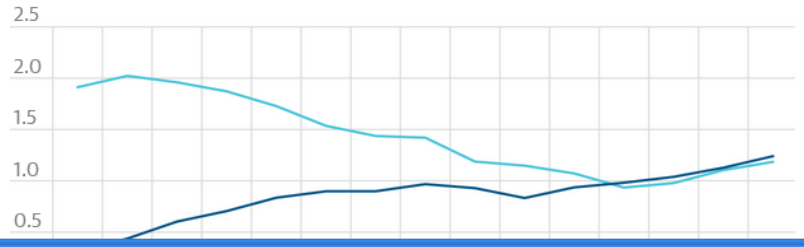
Diesel was a niche market in Europe until the mid-1990s, making up less than 10% of the car fleet. Diesels produce 15% less CO_2 than petrol, but emit four times more nitrogen dioxide pollution (NO_2) and 22 times more particulates - the tiny particles that penetrate the lungs, brain and heart.

Following the signing of the Kyoto protocol climate change agreement in 1997, most rich countries were legally obliged to reduce CO_2 emissions by an average of 8% over 15 years.

Japanese and American car makers backed research into hybrid and electric cars, but the European commission was lobbied strongly by big German car makers BMW, Volkswagen and Daimler, to incentivise diesel. A switch to diesel was said by the industry to be a cheap and fast way to reduce the carbon emissions that drive climate change.

Petrol, diesel and alternative fuels

Millions of vehicle registrations by fuel type, UK
Petrol | Diesel | Alternative



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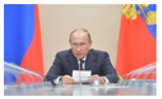

Russia launches first airstrikes against targets in Syria

Can we break the link between urbanisation and air pollution?

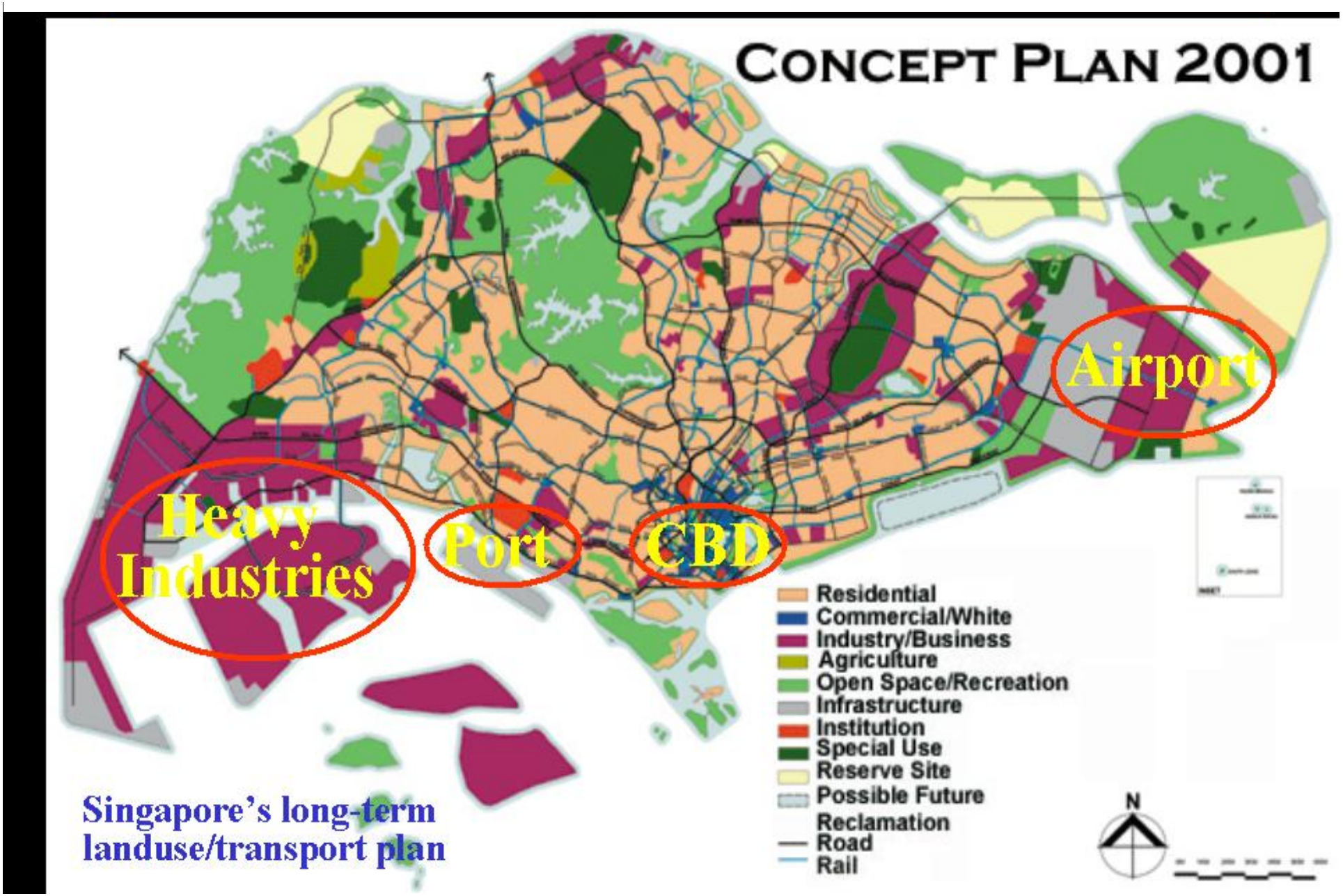
Policies for Indian cities

- Vehicle standards and alternative fuels
- Urban travel demand management
- Regulations for coal-fired power plants
- Power shortages and diesel generators (DG sets)
- Domestic fuels -- biomass (indoor air pollution)
- Alternative technologies for brick kilns
- Construction
- Resuspended/road dust
- Open waste burning

Land use and urban form play a key role

- Dense and compact city or an ever expanding one?
- Worrying increase in urban sprawl (esp. India)
- Built-up area is growing at faster rate than population in nearly all of the largest 100 Indian cities
- Average density of the 53 million-plus cities declined by 25% from the 1990s to the 2010s (from 40,000/sq km to 30,000/sq km).

Long term planning for land use



High density urban development

Multi modal integration

Seamless integration: Dhoby Ghaut Interchange

Demand side management

Vehicle population control measures in China

Several cities in China have implemented policies and regulations to manage the number of vehicles:

- **Shanghai:** Provisions on the Administration of Auction of Non-profit Passenger Vehicle Quotas
- **Guiyang:** Interim Regulations on Managing the License Plate of Small Passenger Vehicles
- **Shenzhen:** Interim Provisions of Shenzhen Municipality on the Incremental Control of Cars
- **Beijing, Hangzhou, and Shijiazhuang:** Regulations on controlling the number of small passenger vehicles
- **Guangzhou and Tianjin** implementing on trial basis

Beijing

CITY	BEIJING
Policy	Vehicle Lottery
Description	• License plates are distributed via **lottery** • Applicants register online to participate in the lottery • Only applicants registered in Beijing are allowed to register • Lotteries are held every month
Scope	Passenger cars for public and private individuals and enterprises
Implementing body	Beijing Municipal Commission of Transport
Year of Implementation	2011

Source: http://www.rff.org/files/sharepoint/WorkImages/Download/EfD-DP-14-01.pdf

Shanghai

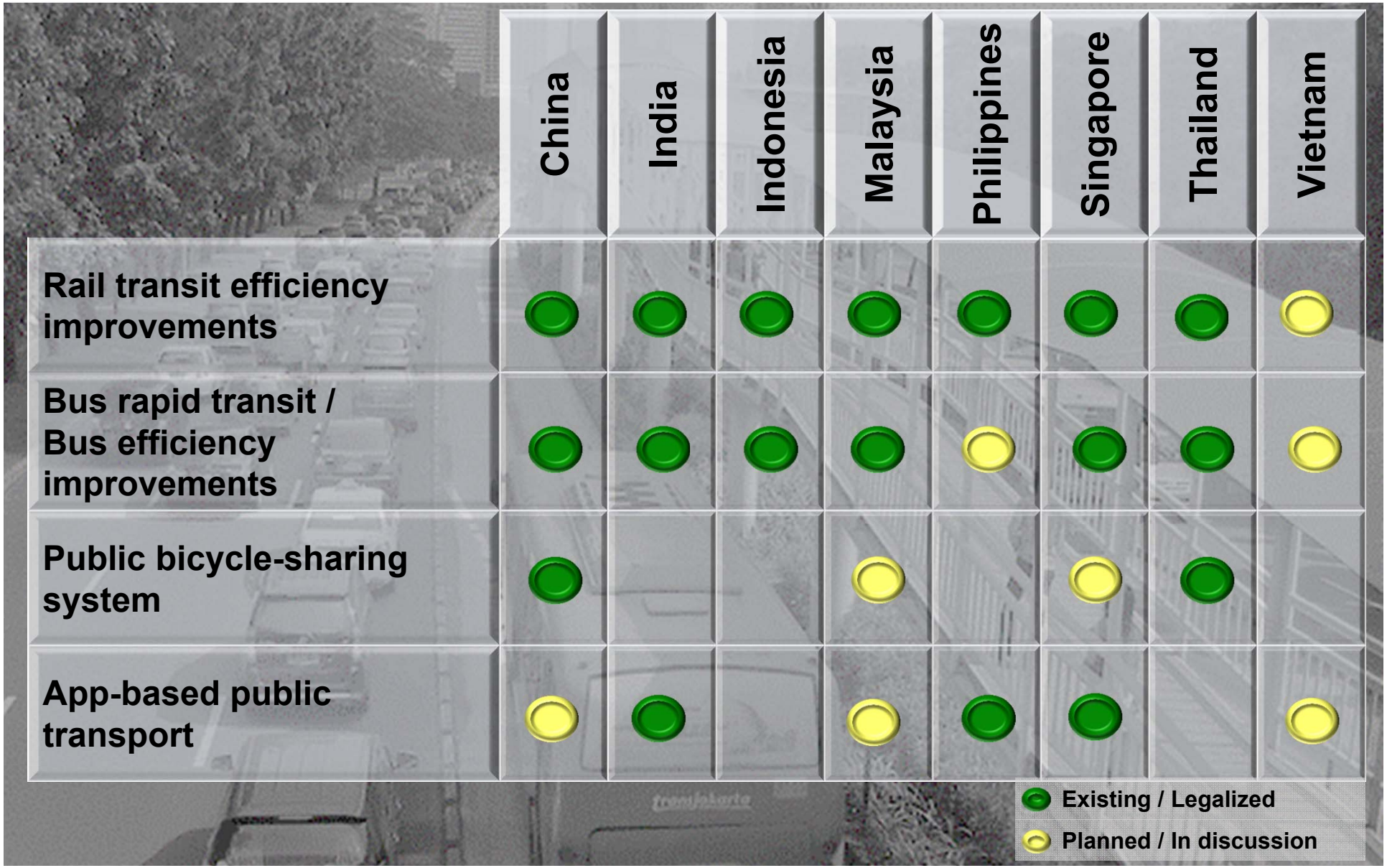
CITY	SHANGHAI
Policy	Provisions on the Administration of Auction of Non-profit Passenger Vehicle Quotas
Description	• Quotas on newly increased passenger vehicles per year for non-profit individuals and enterprises • Quota determined by motor vehicle quota administration office • Quotas are **bid** by private individuals and enterprises, as well as public office in the case of public vehicles
Scope	Passenger vehicles (public and private)
Implementing body	
Year of Implementation	1994

Source URL:
http://www.shanghai.gov.cn/shanghai/node27118/node27386/node27408/n30601/n31187/u26ai35512.html

Shenzen

CITY	SHENZEN
Policy	Interim Regulations on Managing the License Plate of Small Passenger Vehicles
Description	• The law stipulates methods and procedures for residents joining in car license lottery and bidding; and imposes strict punishment on providing false information in application process and disguised dealing of license plates. • Uses a car increment index to determine the number of license plates for auction • License plates are **auctioned** to bidders
Scope	Small passenger vehicles
Implementing body	Index Control Management Center (municipal government)
Year of Implementation	

Public transport status



Policies for air quality management

- Only Afghanistan and Myanmar do not have national ambient air quality standards (discussions in Myanmar to develop these).
- While only half of Asian countries have $PM_{2.5}$ standards and monitoring several have shown interest in doing
- Increased availability of air quality data but of variable quality.
- Communicating health implications of monitoring results only in few countries.
- Several cities have Clean Air Plans though extent of implementation is unclear; increased interest in emergency response and alert systems.
- Active discussions on strengthening vehicle emission, fuel efficiency and economy standards. Technological standards need to be linked with air quality standards to maximize benefits.

Most Asian countries now have AQ standards

Countries	$PM_{2.5}$		PM_{10}		TSP		SO_2			NO_2			O_3		CO ('000)	
	24-Hr	Annual	24-Hr	Annual	24-Hr	Annual	1-Hr	24-Hr	Annual	1-Hr	24-Hr	Annual	1-Hr	8-Hr	1-Hr	8-Hr
Afghanistan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bangladesh	√	√	√	√	-	-	-	√	√	-	-	√	√	√	√	√
Bhutan (Mixed)	-	-	√	√	√	√	-	√	√	-	√	√	-	-	√	√
Brunei	-	-	√	√	-	-	-	-	-	-	-	-	-	-	-	-
Cambodia	-	-	-	-	√	√	√	√	√	√	√	-	√	-	√	√
China: Grade I	-	-	√	√	√	√	√	√	√	√	√	√	√	-	√	-
China: Grade II	-	-	√	√	√	√	√	√	√	√	√	√	√	-	√	-
China: Grade I*	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	-
China: Grade II*	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	-
Hong Kong SAR	-	-	√	√	√	√	√	√	√	√	√	√	√	-	√	√
Hong Kong SAR*	√	√	√	√	-	-	-	√	-	√	-	√	-	√	√	√
India**	√	√	√	√	-	-	-	√	√	-	√	√	√	√	√	√
India***	√	√	√	√	-	-	-	√	√	-	√	√	√	√	√	√
Indonesia	-	√	√	-	√	√	√	√	√	√	√	√	√	-	√	-
Japan	√	√	-	-	√	-	√	√	-	-	√	-	√	-	-	√
Lao PDR	-	-	√	√	√	√	√	√	√	√	-	-	√	-	√	√
Malaysia	-	-	√	√	√	√	√	√	-	√	√	-	√	√	√	√
Mongolia	√	√	√	√	√	√	-	√	√	√	√	√	-	√	√	√
Myanmar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nepal	-	-	√	-	√	-	-	√	√	-	√	√	-	-	-	√
Pakistan	√	√	√	√	√	√	-	√	√	-	√	√	√	-	√	√
Philippines	√	√	√	√	√	√	-	√	√	-	√	-	√	√	√	√
Republic of Korea	-	-	√	√	-	-	√	√	√	√	√	√	√	√	√	√
Singapore	√	√	√	-	-	-	-	√	√	√	-	√	√	√	√	√
Sri Lanka	√	√	√	√	-	-	√	√	-	√	√	-	√	-	√	√
Taipei,China	-	-	√	√	√	√	-	√	√	√	-	√	√	√	√	√
Thailand	√	√	√	√	√	√	√	√	√	√	-	√	√	√	√	√
Viet Nam	√	√	√	√	√	√	√	√	√	√	-	√	-	√	√	√

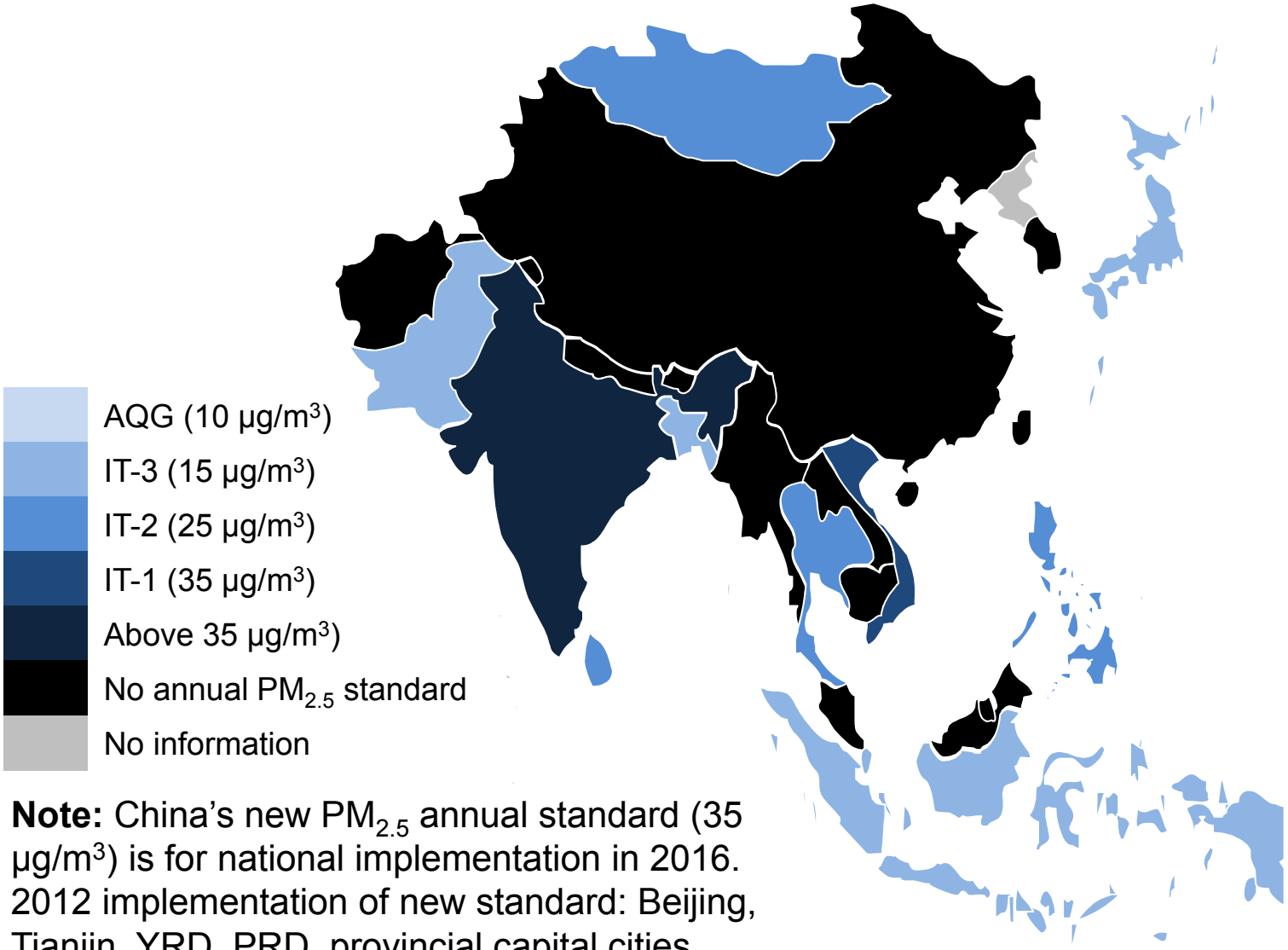
NOTES:

China: Grade I = applies to specially protected areas, such as natural conservation areas, scenic spots, and historical sites;
China: Grade II = applies to residential areas, mixed commercial/residential areas, cultural, industrial, and rural areas;

HK* = Proposed air quality objectives for Hong Kong SAR
India** = NAAQS for Industrial, Residential, Rural and Other Areas
India*** = NAAQS for Ecologically Sensitive Areas
China* = Revised standards GB 3095

Source: Clean Air Asia, 2013

$PM_{2.5}$ annual standards



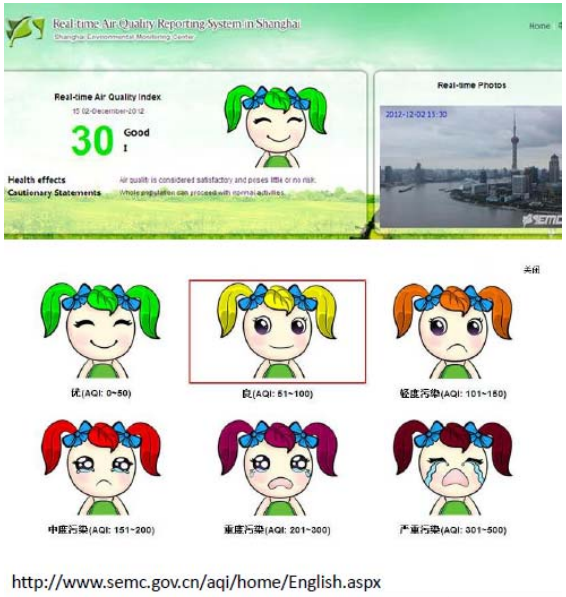
Note: China's new $PM_{2.5}$ annual standard (35 µg/m^3) is for national implementation in 2016. 2012 implementation of new standard: Beijing, Tianjin, YRD, PRD, provincial capital cities

Air quality monitoring against standards

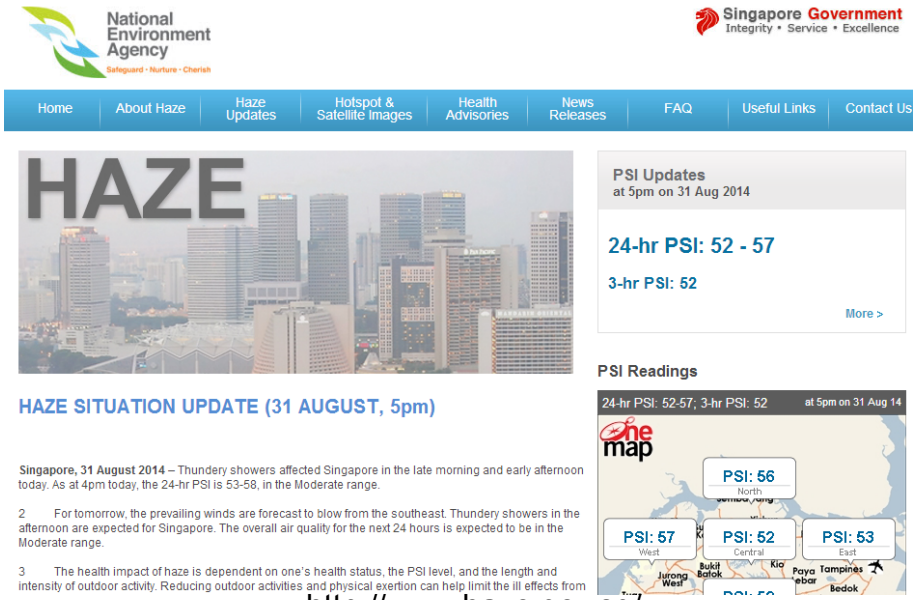
Countries and Major Cities		Pollutants							
		TSP	PM_{10}	$PM_{2.5}$	Pb	NO_2	SO_2	O_3	CO
India	With standard/GV		✓	✓	✓	✓	✓	✓	
• Delhi	Monitored	✓	✓	✓	✓	✓	✓	✓	✓
• Mumbai	Monitored	✓			✓	✓	✓		
Indonesia	With standard/GV	✓	✓	✓	✓	✓	✓	✓	✓
• Bandung	Monitored		✓		✓	✓	✓	✓	✓
• Jakarta	Monitored	✓	✓		✓	✓	✓	✓	✓
Lao PDR	With standard/GV	✓	✓		✓	✓	✓		✓
• Vientiane	Monitored								
Mongolia	With standard/GV	✓	✓	✓	✓	✓	✓	✓	✓
• Ulaanbaatar	Monitored		✓			✓	✓	✓	✓
Nepal	With standard/GV	✓	✓		✓	✓	✓		✓
• Kathmandu	Monitored								
Philippines	With standard/GV	✓	✓	✓	✓	✓	✓	✓	✓
• Manila	Monitored	✓	✓	✓		✓	✓	✓	✓
Sri Lanka	With standard/GV		✓	✓		✓	✓	✓	✓
• Colombo	Monitored		✓						

Reporting air quality information
Social media and mobile technology

https://www.worldaqi.com/

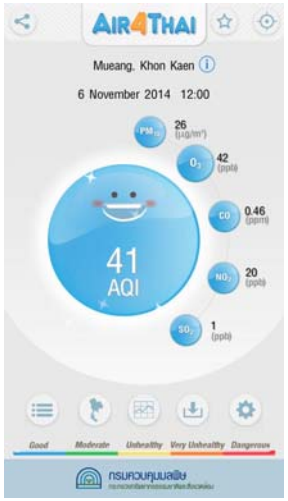


http://www.semc.gov.cn/aqi/home/Index.aspx



http://www.haze.gov.sg/

http://hedleyindex.sph.hku.hk/html/en/



http://air4thai.pcd.go.th/web/

Clean Air and Climate Change Planning
Increased interest: alert & emergency response plans

Country	Notes
Japan	• Guideline on administrative measures for emergent status on Ox air (Ox standard developed in 1973) • Tentative guideline for issuing alert on $PM_{2.5}$ air pollution in 2013 ($PM_{2.5}$ standard developed in 2009)
Korea	• Asian dust early warning system since April 2002 • Behavioral Guidelines based on Clean Air Index for public • O_3 alert and Protective Actions for general public, vehicle drivers, relevant agencies and businesses
PR China	• MEP: Guidance on how to develop AP emergency response plan (April 2013) • As of June: 16 provinces and 99 cities have emergency response plans
Singapore	• Singapore move to an integrated air quality reporting index, where $PM_{2.5}$ will be incorporated into the current PSI as its sixth pollutant parameter (1 April 2014)
PRC Hong Kong	• Health Focus: from AQI(1995) to AQHI(30Dec2013), health advices to public according to AQHI
Bangladesh, Brunei, Malaysia, Thailand	• Unhealthy alerting when AQI is above 100

Efforts at global level
Sustainable Development Goals

- **Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable**
  - by 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality, municipal and other waste management

- http://sustainabledevelopment.un.org/content/documents/4518SDGs_FINAL_Proposal%20of%20OWG_19%20July%20at%201320hrsver3.pdf

Platform/Event

Better Air Quality (BAQ) Conference

- **Leading event on air quality in Asia**, covering air quality, climate change, transport, energy, and industry
- It has grown into a **community of practitioners , policy makers and businesses** who meet every two years for **networking**, **learning and sharing experiences**
- BAQ has proven to **influence policies**, **initiate new projects and establish partnerships**
- Organized by Clean Air Asia in partnership with the host city, national environment ministry, ADB and World Bank, and several supporting organizations

WCAC
17TH IUAPPA WORLD CLEAN AIR CONGRESS
9TH BETTER AIR QUALITY CONFERENCE
BAQ
BUSAN, SOUTH KOREA
29 AUG - 2 SEP 2016

BAQ BETTER AIR QUALITY CONFERENCE sri lanka 19-21 November 2014 8th EST REGIONAL ENVIRONMENTALLY SUSTAINABLE TRANSPORT FORUM IN ASIA

BAQ BETTER AIR QUALITY HONG KONG 5-7 DEC 2012

BAQ 2010 BETTER AIR QUALITY SINGAPORE 9 to 11 November

BAQ BETTER AIR QUALITY 2008 12-14 NOVEMBER BANGKOK THAILAND

BAQ Better Air Quality 2006 13 - 15 December Yogyakarta Indonesia

BAQ 2004 AGRA, INDIA 6 - 8 DECEMBER

BAQ 2003

BAQ Better Air Quality 2002

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Acknowledgment:

I would like to thank Clean Air Asia especially Candy Tong, Kaye Patdu, Glynda Bathan and David Guerrero for sharing data and information and assistance with the paper.