The Leapfrog Factor

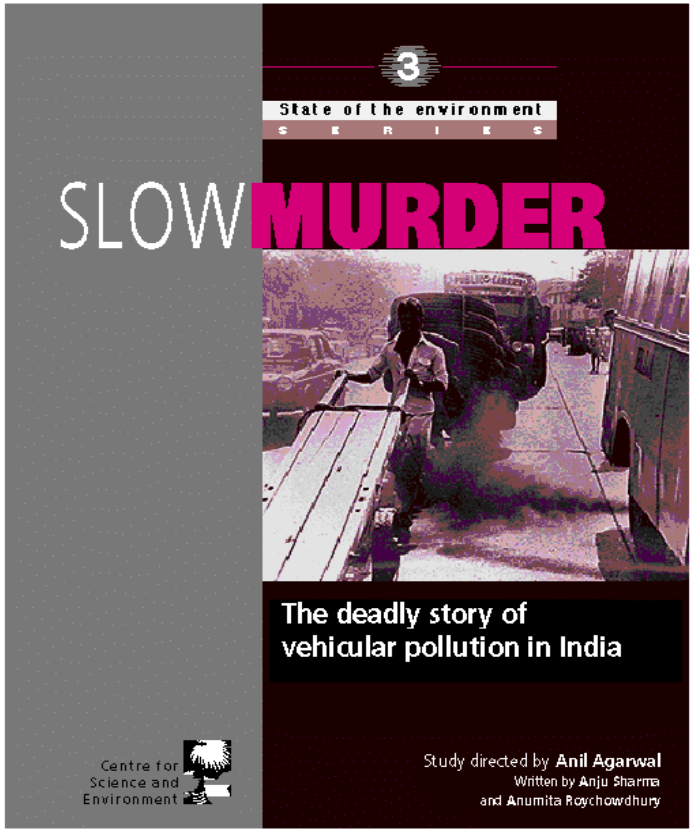
Clearing the air in Asian cities

CSE

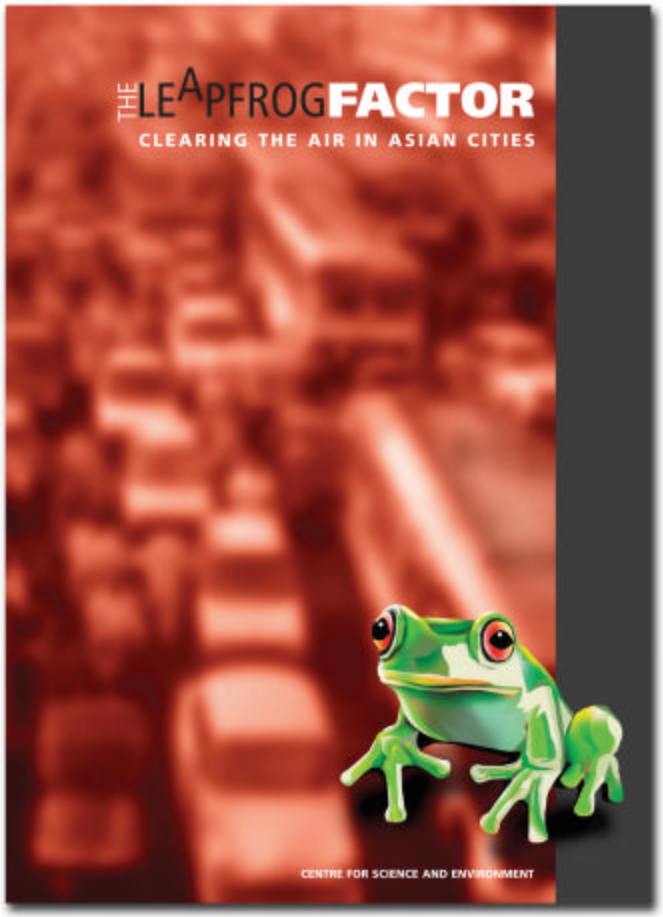
1996: Delhi was a toxic hell
2006: Air is cleaner. New Challenges

1996: The exposé

Slow Murder exposed



2006: Setting the agenda for second generation action



After ten years of action and impact .....

The price of wealth

One person dies every hour in Delhi because of air pollution

In 20 years between 1975 to 1995 the GDP more than doubled in India, but…

Vehicular pollution load went up 8 times.

The industrial pollution load went up 4 times.

GDP doubled

Smog Inc.

We launched the Right To Clean Air Campaign to see through the smokescreen ….

Bad air! We all know about it. But the fact that it gets into our bodies and inflicts fatal injuries is unknown to most of us. Surgeons who have the privilege of seeing inside us have a funny story to tell. They can tell, just by looking at the colour of the lungs, whether the person is from a dirty big city or not.
Actually a shocking tale!

Look at the spotless lung below. The fortunate owner comes from a relatively cleaner place.

Himachal lung

Delhi lung

Capital punishment

Look at these black spots on the lung. The unfortunate owner lives in Delhi and has been breathing polluted air. Air full of carbon particles which accumulate in the lungs (black spots). What you can't see is a cocktail of gases and tiny particles, even smaller than carbon that get into our bodies.
Actually, you are getting polluted.

Scary? But those cars are so sexy!

Roll down the window of your bullet-proof car, Mr Prime Minister
The security threat is not the gun. It's the air of Delhi

Hon'ble Prime Minister,

Here is something that just may convince you: while India's Gross Domestic Product has increased two-and-half times in two decades (1975-1995), the pollution load from industries has gone up four times and from vehicles a shocking eight times.

A study by the Centre for Science and Environment shows that the number of people dying due to air pollution went up by almost 30 per cent in four years between 1991 and 1995. An estimated 52,000 people are dying due to air pollution every year – about 10,000 of them in Delhi itself.

One person dies every hour due to air pollution in the city.

In Delhi vehicles are responsible for 70 per cent of the pollution load. Because of the high toxicity of fumes from transport fuel, one out of every 10-15 people living in Delhi is likely to get cancer.

Your government has failed to arrest this deterioration of air quality in Indian cities. Worse still, it contributes to the pollution in a big way by producing low quality fuel in state-owned refineries. Improving fuel quality is a short-term measure which will go a long way. Vehicles using clean fuel will pollute less.

Seeing your government's inability to tackle air pollution, we present you with a peoples' charter for clean air. This will help to immediately improve the quality of the air we breathe.

Mr Prime Minister, 50 years into Independence, please give us our right to clean air. We hope you will take our concern seriously.

Yours sincerely

Centre for Science and Environment
November 2, 1998

PEOPLES' CHARTER ON CLEAN AIR

FOR AN IMMEDIATE IMPACT

✔ **PRODUCE CLEAN DIESEL OR IMPORT**
Diesel emissions contain deadly particulate matter with traces of the strongest carcinogen known till date. Indian diesel is 250 times dirtier than the world's best.

✔ **REMOVE BENZENE FROM PETROL**
India is moving towards unleaded petrol. But this fuel contains too much benzene. Though we use one hundred times less petrol than USA, the total amount of benzene emissions from Indian vehicles is the same as in the US.

Benzene causes blood cancer and air should have no benzene at all, says WHO. Yet the level of benzene in and around Connaught Place in Delhi is 10 times higher than the European safety limit. If you live in Delhi, your chances of getting blood cancer are twice as high as people living in Bangalore, Chennai and Mumbai.

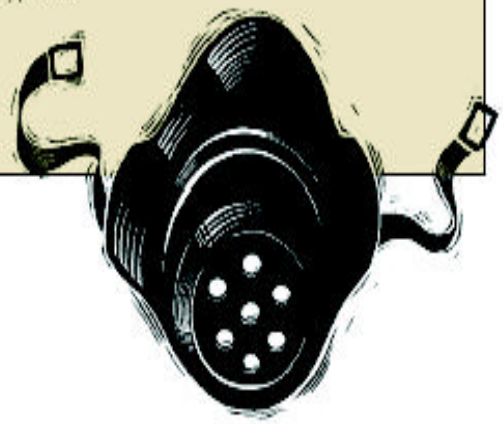
✔ **STOP PRIVATE DIESEL CARS**
Registration of all private diesel models should be banned in cities like Delhi. Cheap government diesel means more diesel cars, including luxury models.

✔ **TAX TO IMPROVE VEHICLE TECHNOLOGY**
Penalise vehicle manufacturers for producing polluting technology. Tax vehicles according to their emission level. Manufacturers will then invest in cleaner technology.

✔ **INTRODUCE EMISSION WARRANTY**
Make the industry accountable for the life-long emission efficiency of all vehicles they produce.

✔ **MAKE EMISSION LEVELS PUBLIC**
Manufacturers must inform buyers of the exact emission levels of their vehicles.

✔ **MONITOR ALL HARMFUL GASES**
Improve air quality assessment. A wide range of poisons are not monitored till date. Alert people about pollution levels in the city. It is done all over the world.



Register your protest to the Prime Minister today
PMO, South Block, New Delhi 110 001
Tel: 301 8939 Fax: 301 6857, 301 9817

Join CSE's Right To Clean Air campaign

CSE
Centre for Science and Environment
41, Tughlakabad Institutional Area, New Delhi 110 062
Tel: 698 3394, 698 1124, 698 6399 **Fax:** 698 5879
Email: cse@cseindia.org **Website:** www.cseindia.org

What has Delhi achieved

On fuel quality

Introduced low sulphur fuels and petrol with 1 per cent benzene

Mandated pre-mix petrol to two- and three-wheelers

On vehicle technology

Enforced Euro II emissions standards in 2000, five years ahead of schedule and Euro III in 2005

On alternative fuels

Implemented largest ever CNG programme – more than 100,000 CNG vehicles in one city within a span of 5 years

Largest ever public transport bus fleet on clean fuels – 10,600 CNG buses

Other cross cutting policy measures

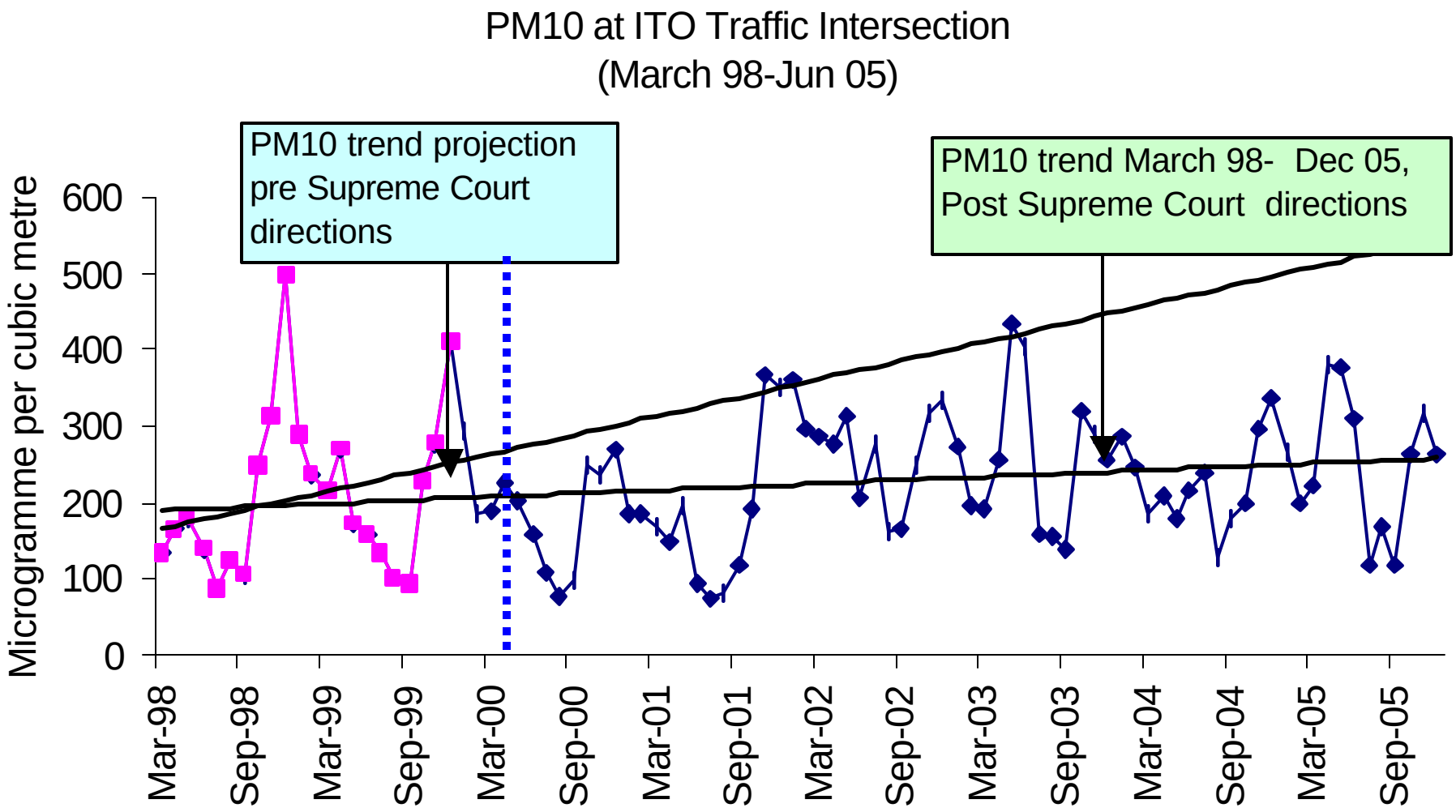
Improved air quality monitoring

Strengthened vehicle inspection programme

Efforts made to bypass transit traffic

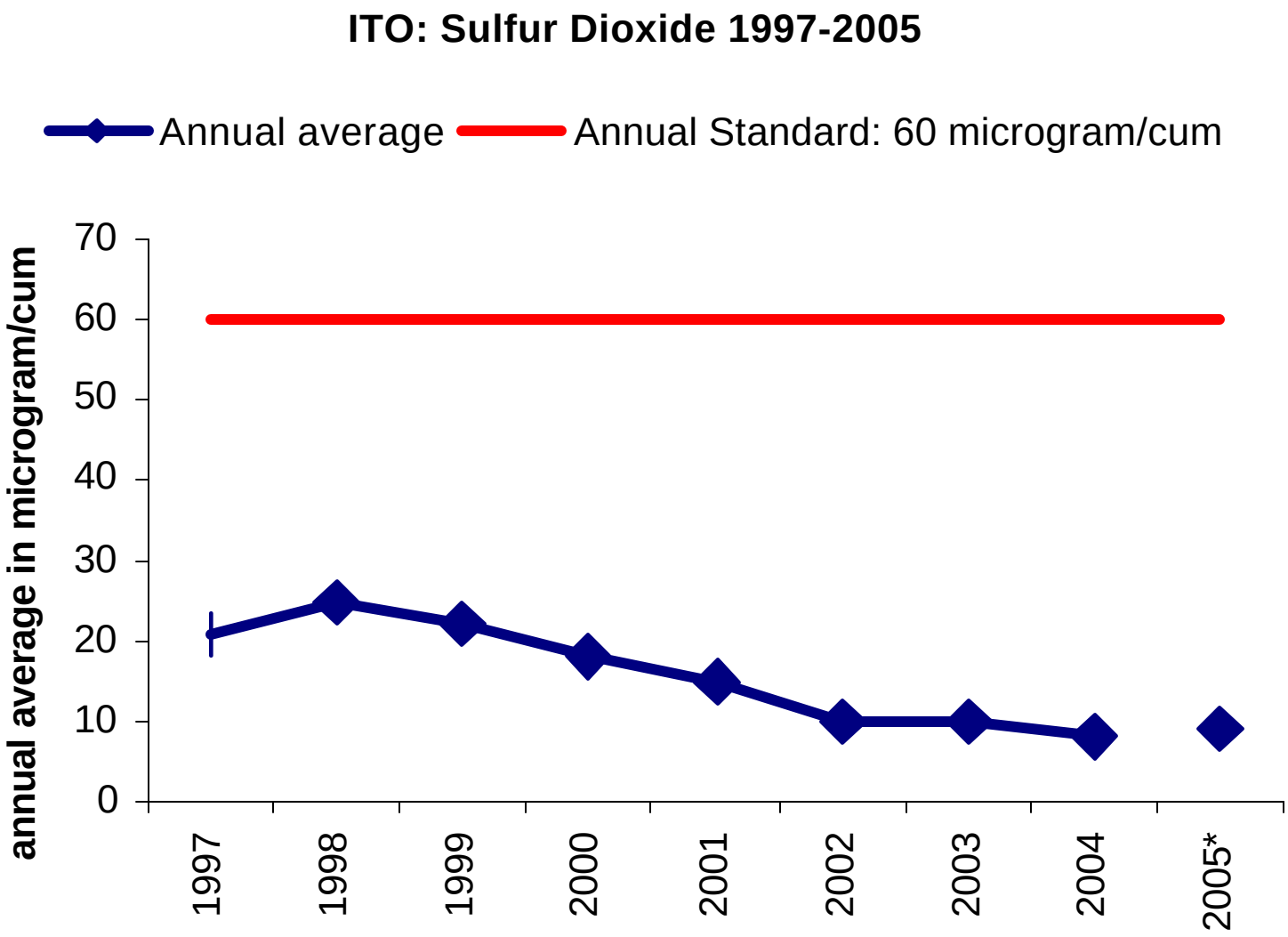
Set up independent fuel testing laboratories to check fuel adulteration

Impact


PM10 at ITO Traffic Intersection
(March 98-Jun 05)
PM10 trend projection pre Supreme Court directions
PM10 trend March 98- Dec 05, Post Supreme Court directions
Microgramme per cubic metre
600
500
400
300
200
100
0
Mar-98
Sep-98
Mar-99
Sep-99
Mar-00
Sep-00
Mar-01
Sep-01
Mar-02
Sep-02
Mar-03
Sep-03
Mar-04
Sep-04
Mar-05
Sep-05

Delhi SO_2 levels

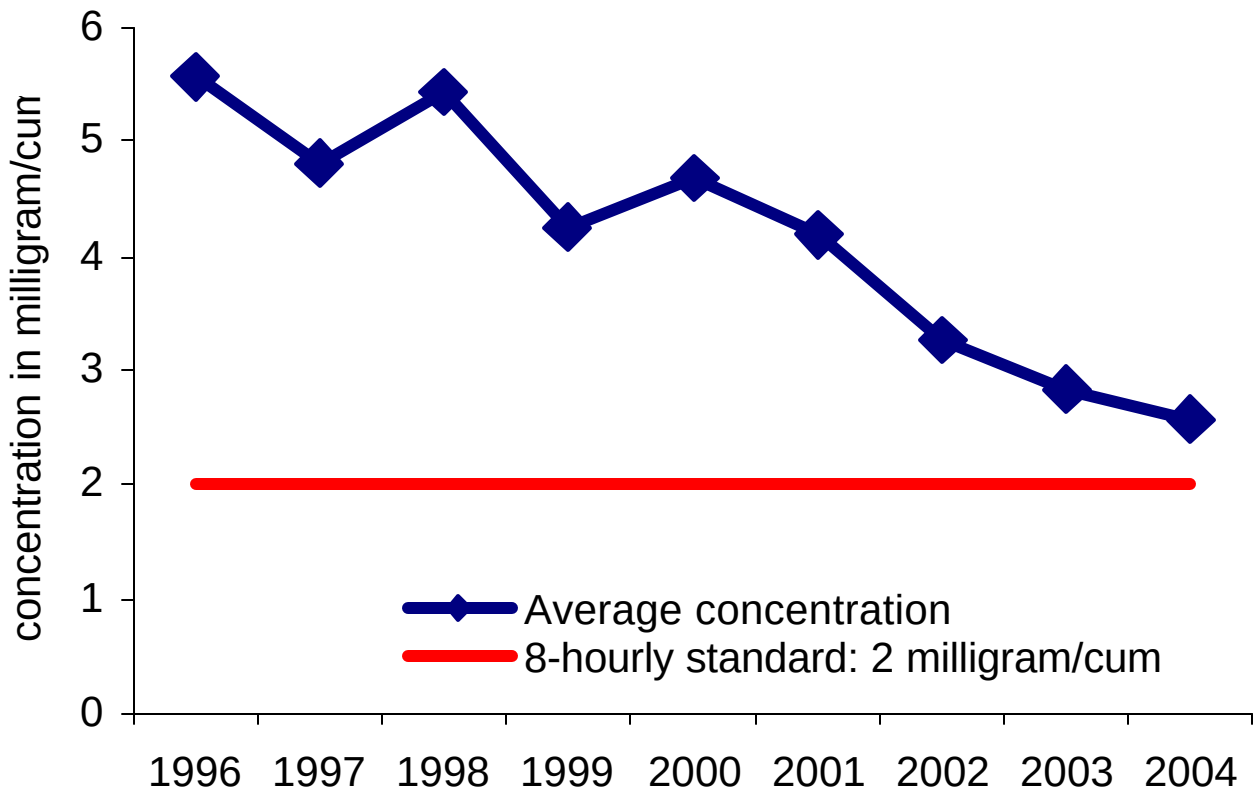
Dips further



Delhi CO levels

Lower despite vehicle growth

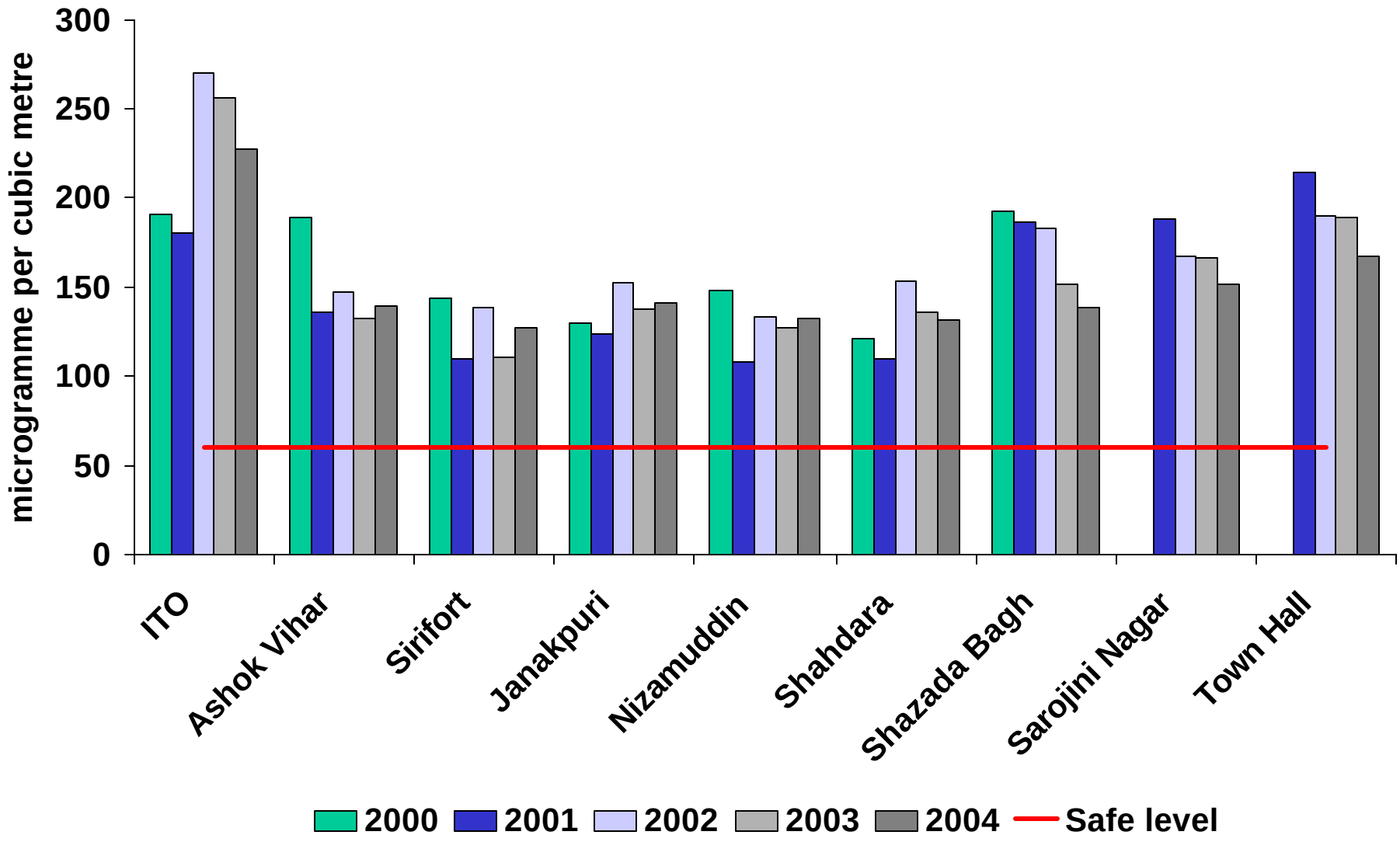
ITO: CO 1996 - 2004



The pollution challenge

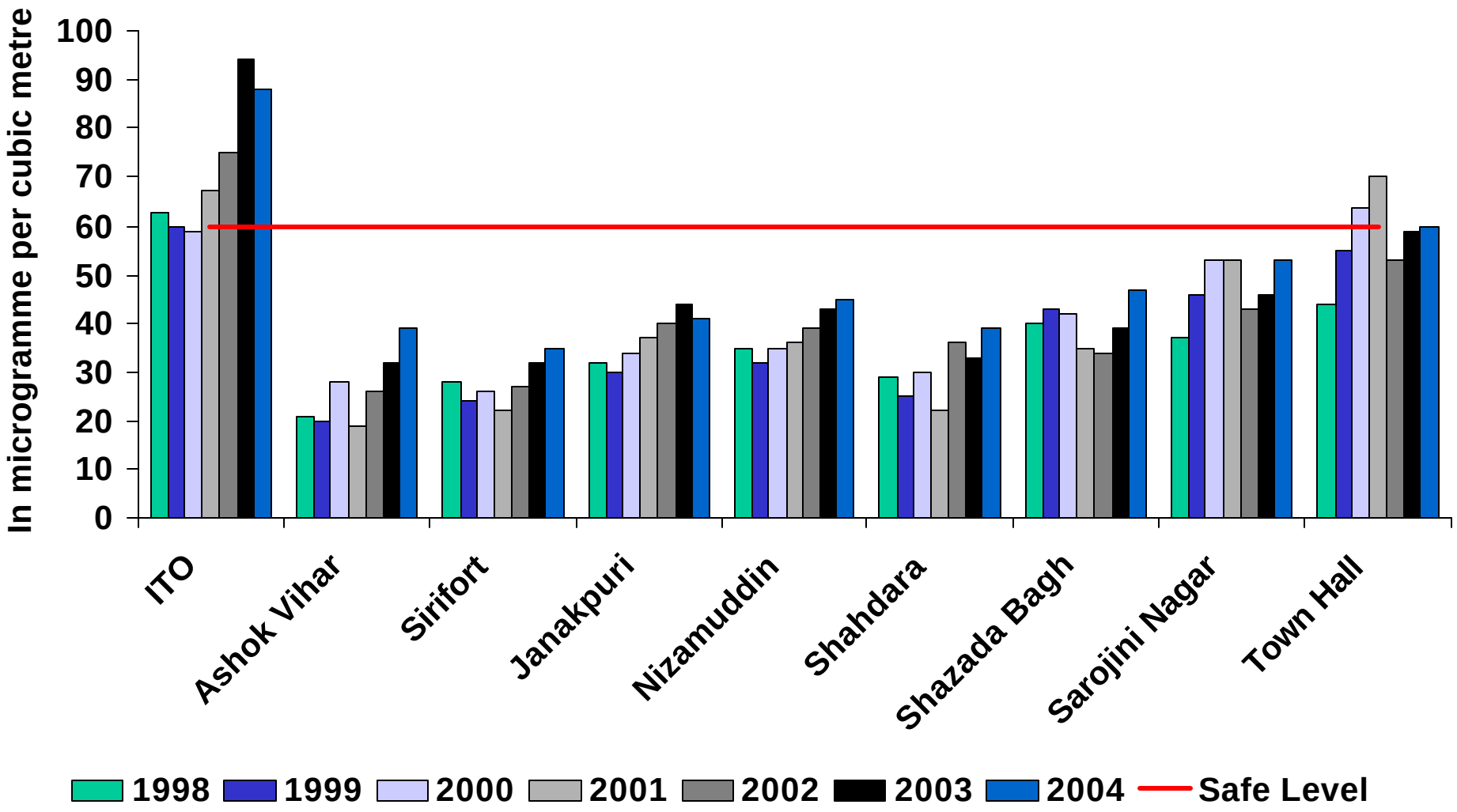
Particulate levels (PM10) have stabilised. But still very high

Explosive increase in vehicles threatens to undo the gains



NOx levels

Though below standards in most stations, rising steadily

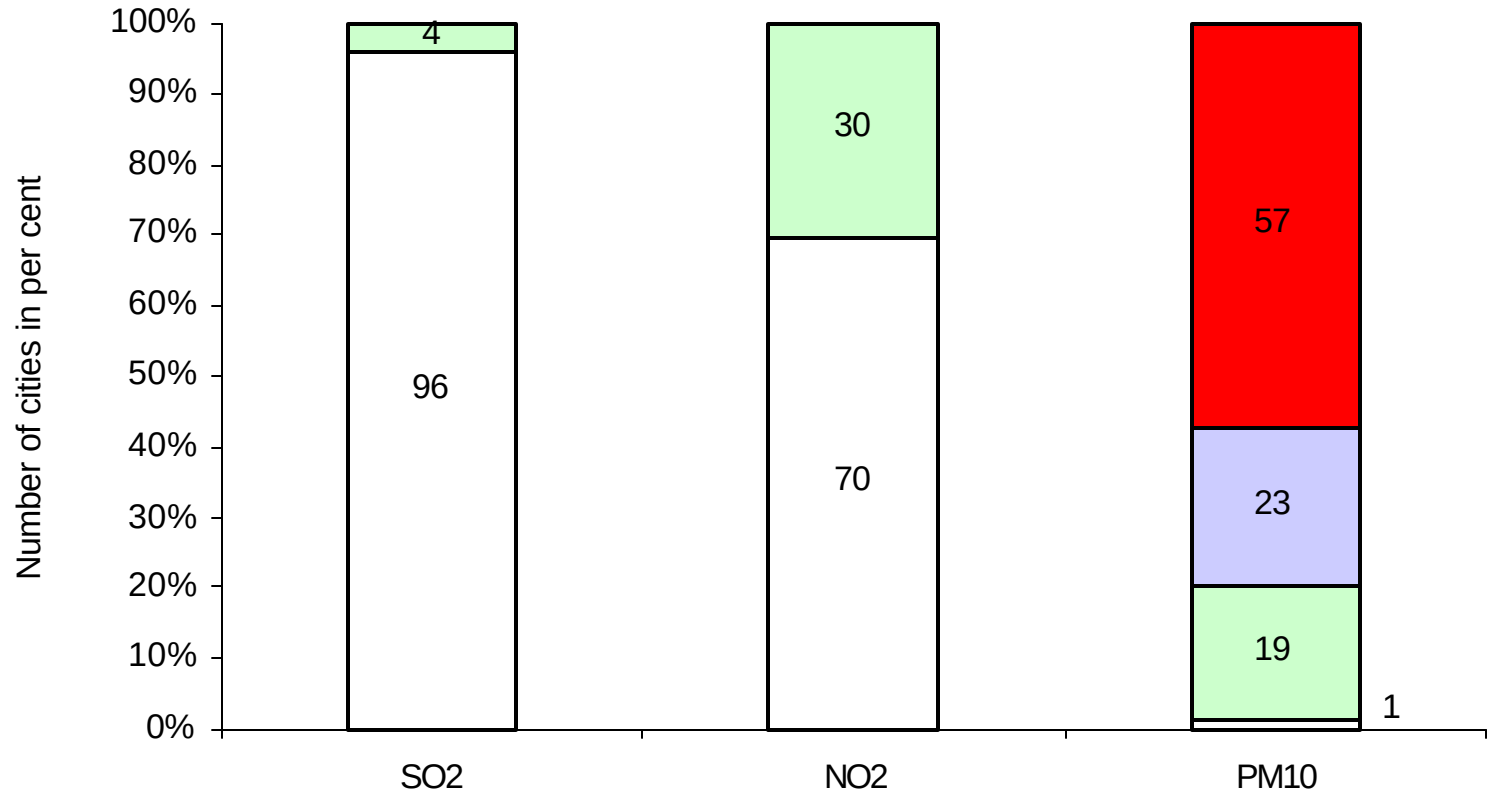


Source: Computed from Central Pollution Control Board Air Quality Data

Need new strategy for the leapfrog

India: Proliferating hotspots

More than half of the cities monitored during 2004 recorded critical levels of PM10



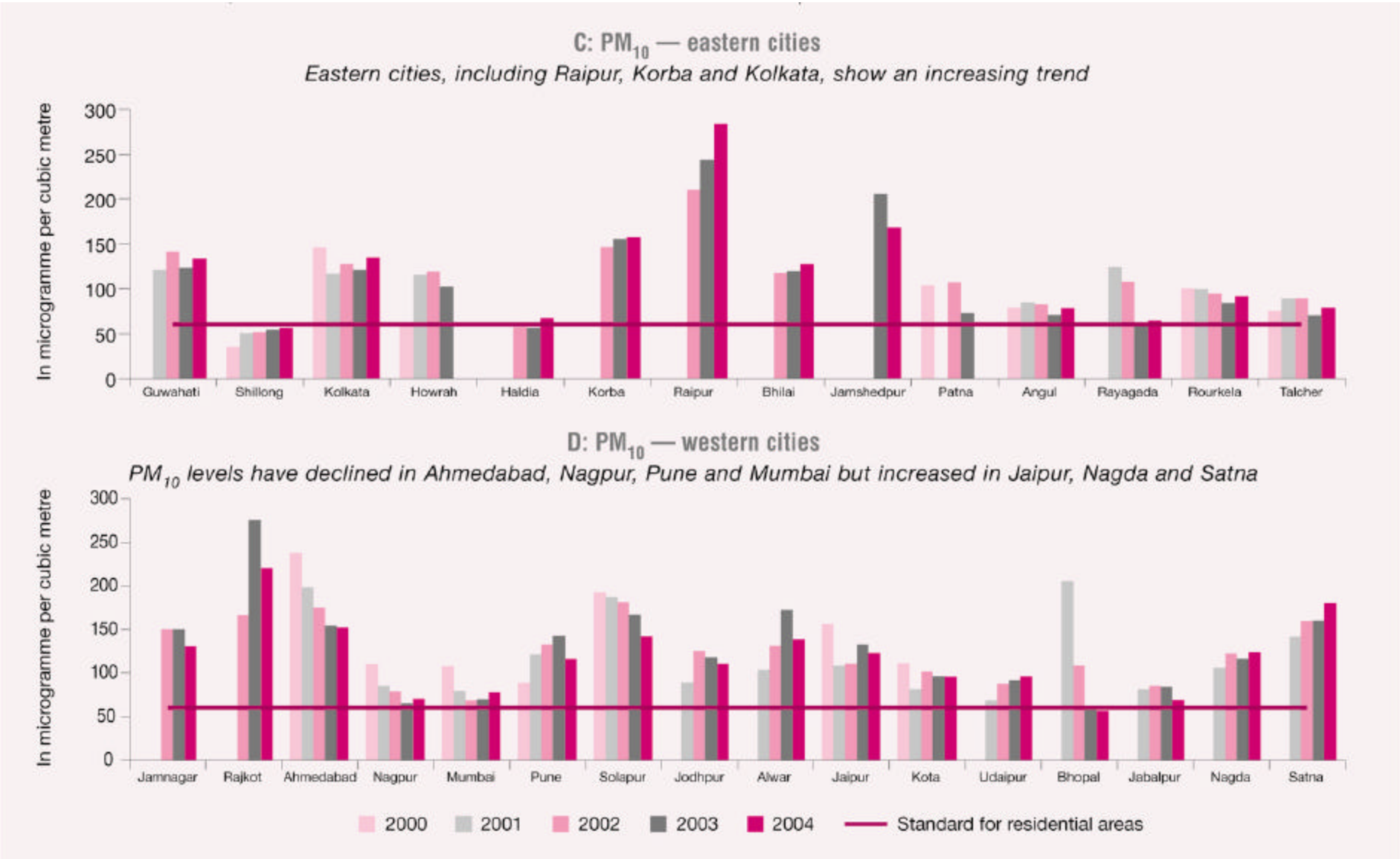
Air Quality Classification:

- Critical Pollution Level* (More than 90 microgramme per cubic metre)
- High Pollution Level* (60 to 90 microgramme per cubic metre)
- Moderate Pollution Level* (30 to 60 microgramme per cubic metre)
- Low Pollution Level* (0 to 29 microgramme per cubic metre)

Particulate pollution: a national crisis

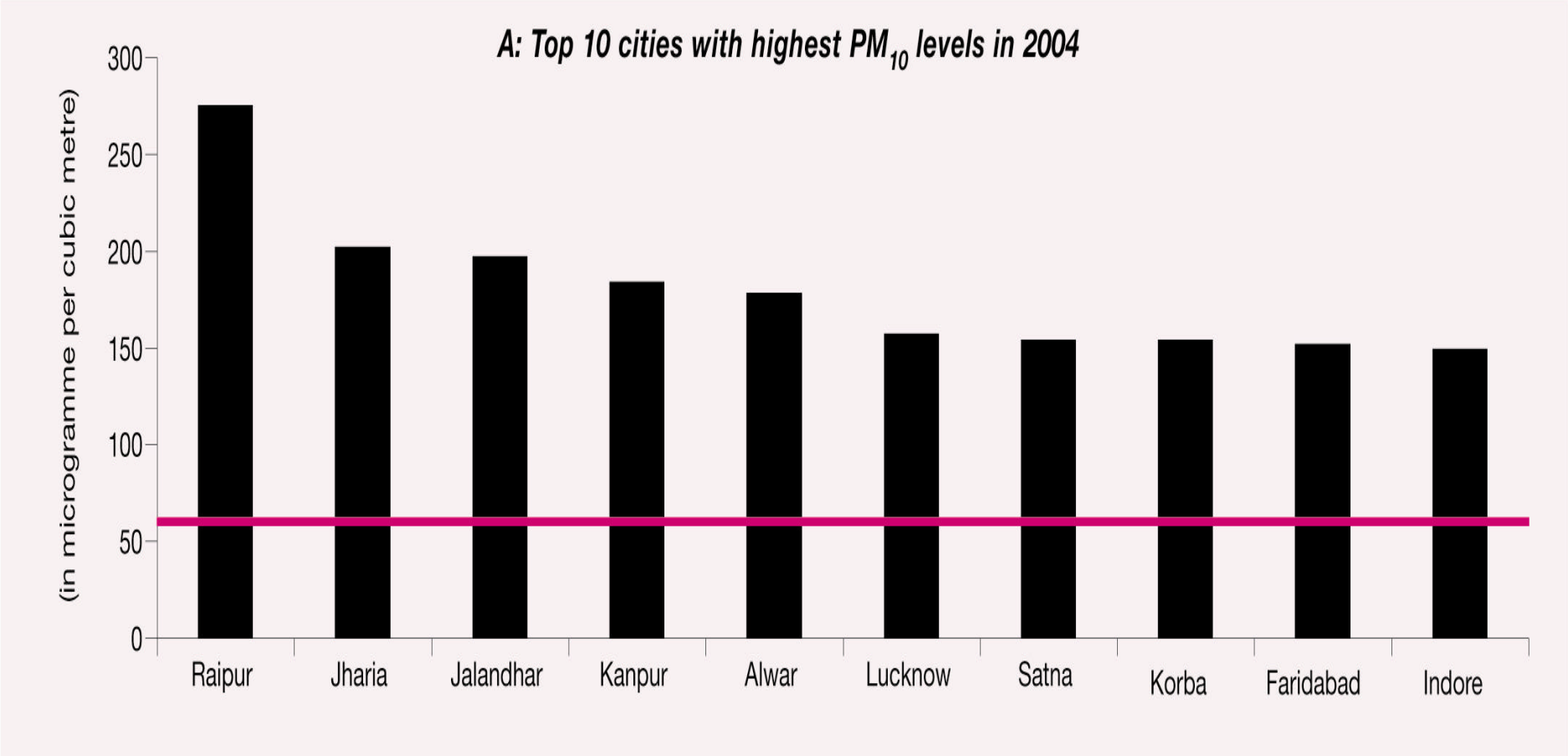
Worst cases of particulate pollution occur in India
High level of PM10 in northern and southern cities

.....High levels of PM10 in eastern and western cities



Most polluted

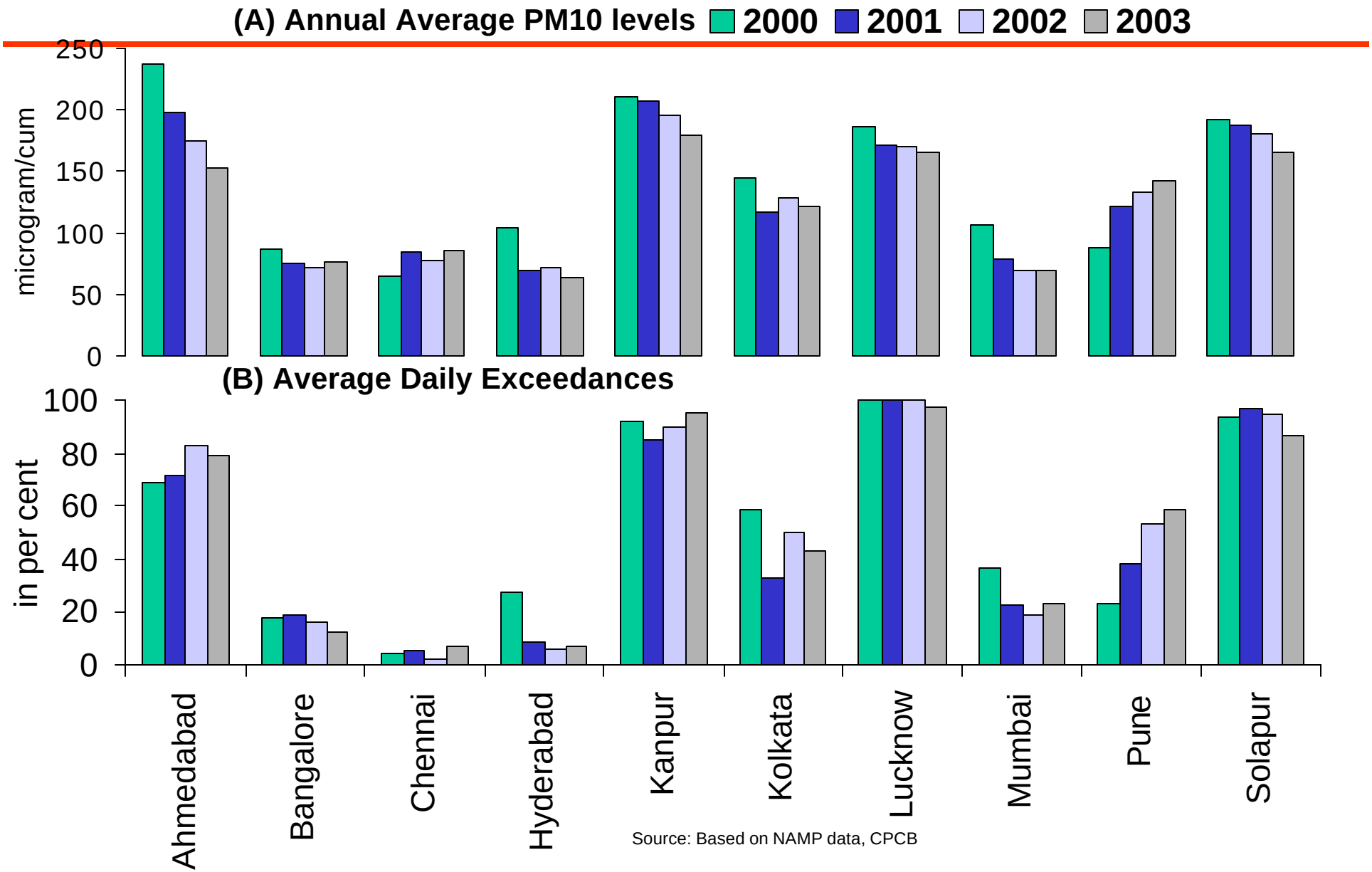
Smaller towns displace mega cities in the dubious list of ten most polluted cities in the country



Source: Computed from Central Pollution Control Board Air Quality Data

Some action makes impact

But daily exposure still high



Source: Based on NAMP data, CPCB

Unknown threat

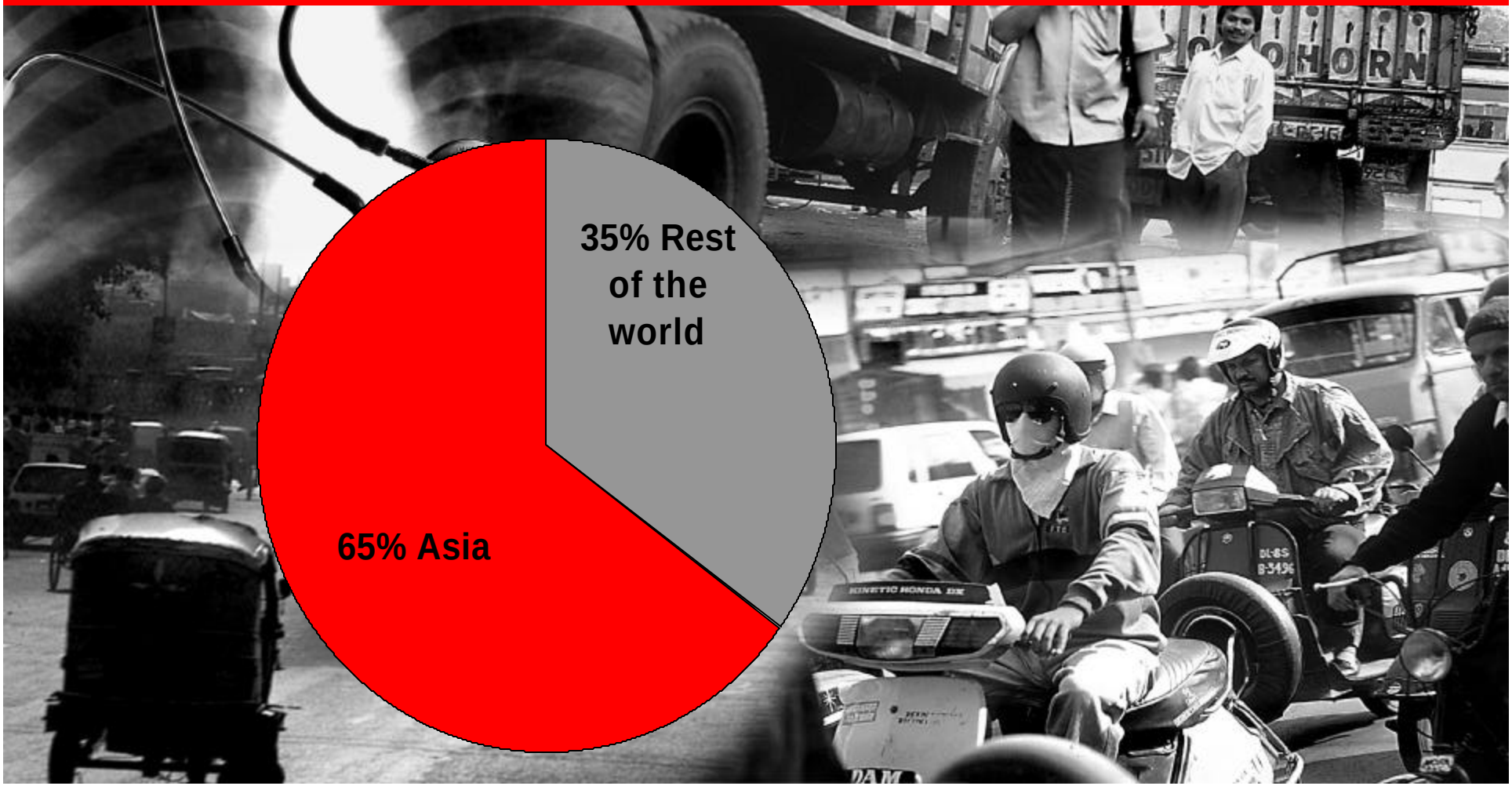
A range of air toxics and other harmful pollutants, rarely ever monitored in Indian cities. Limited data shows:

- Dangerous level of benzene in kolkata, kanpur
- High level of PAH in Mumbai, Kolkata, kanpur
- CPCB warns that most of the sulphur dioxide is converting into lethal sulphate particles that are very harmful
- Ozone a very dangerous pollutant is not even monitored adequately . Limited information shows it is on the rise

Asia: The Gas Chamber

WHO estimates 0.8 million deaths and 4.6 million lost life years every year globally. Two-third of this occurs in Asia.

Premature Deaths Due to Outdoor Air Pollution



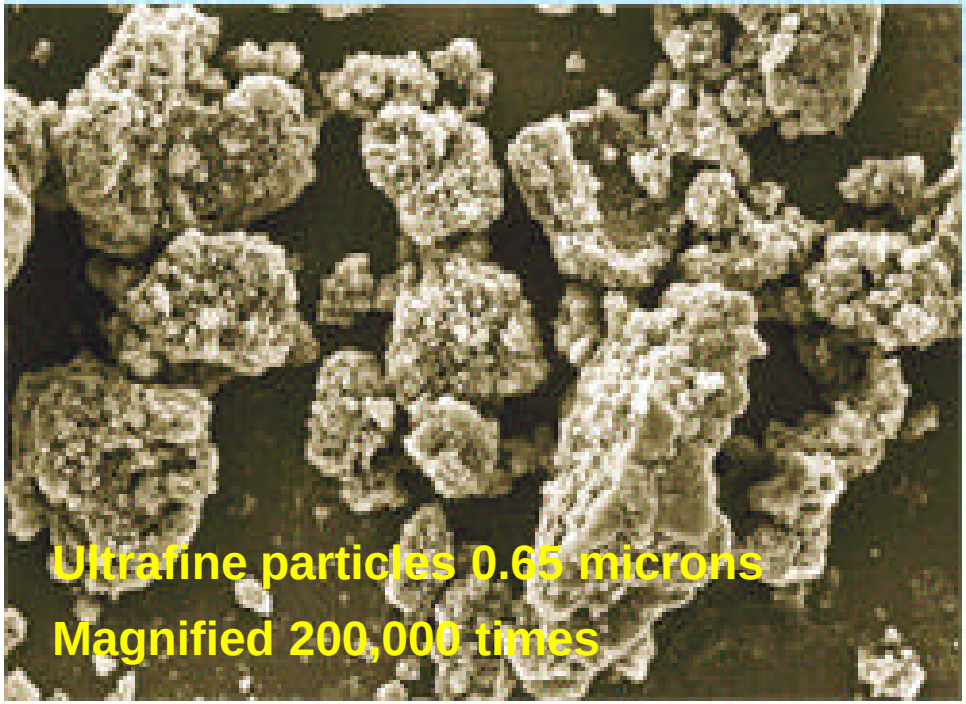
Exploding the myth of safe air

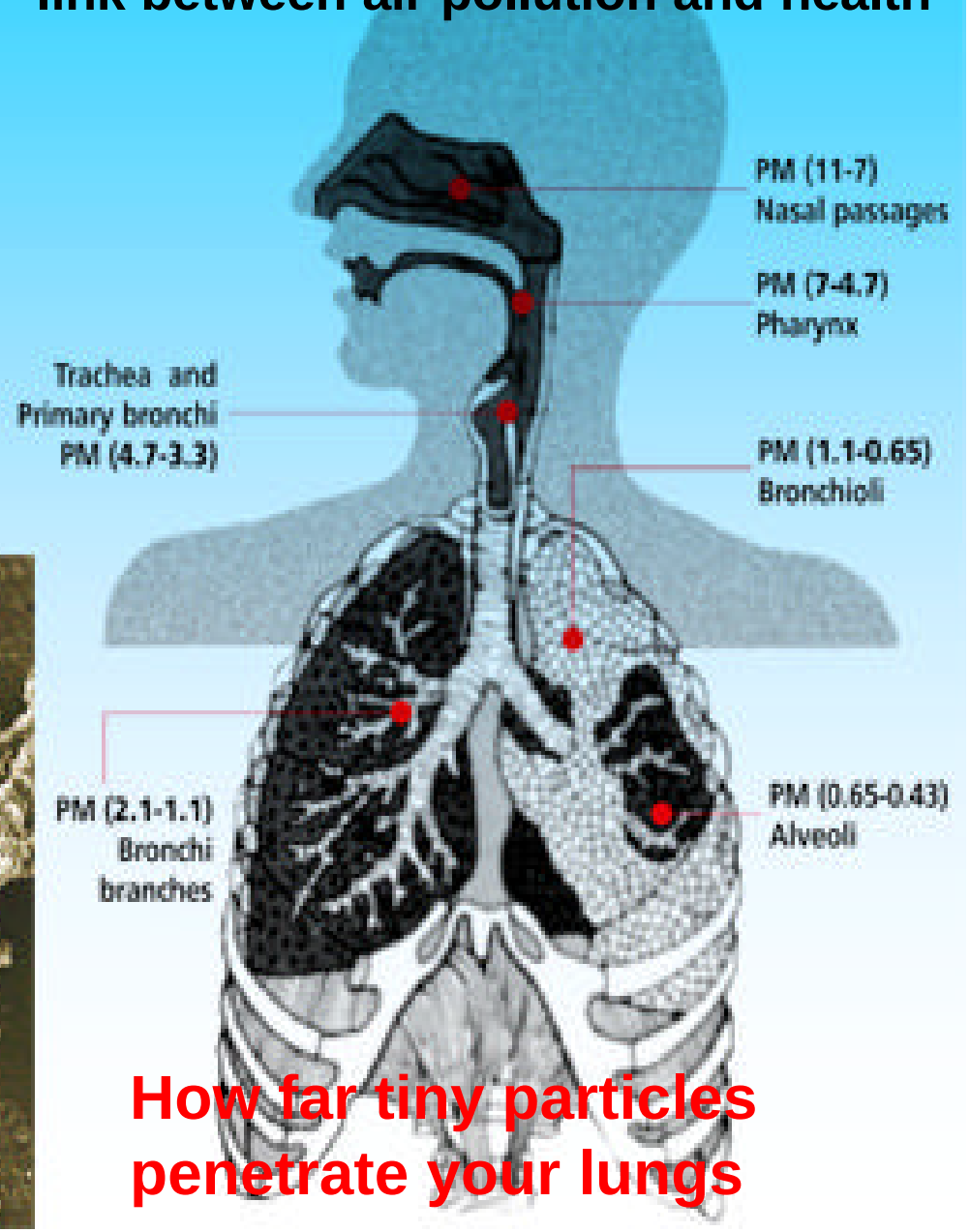
Public health policy still ignores the link between air pollution and health

Particulates and other air toxins like benzene can be lethal even in small doses

WHO mandates no safe level

WHO recommends not only eliminating extreme cases of high pollution but decreasing average exposure levels among all.





How far tiny particles penetrate your lungs

Health burden of Asia

Asian cities on a toxic spiral

Shanghai: Estimated number of excess COPD due to SPM in 1990 -- 173,500. Excess chronic bronchitis cases in 1999 -- 30,800. (SEOHI study)

Taipei,China: 29 percent increase in asthma due to air pollution. (TN Wang et al)

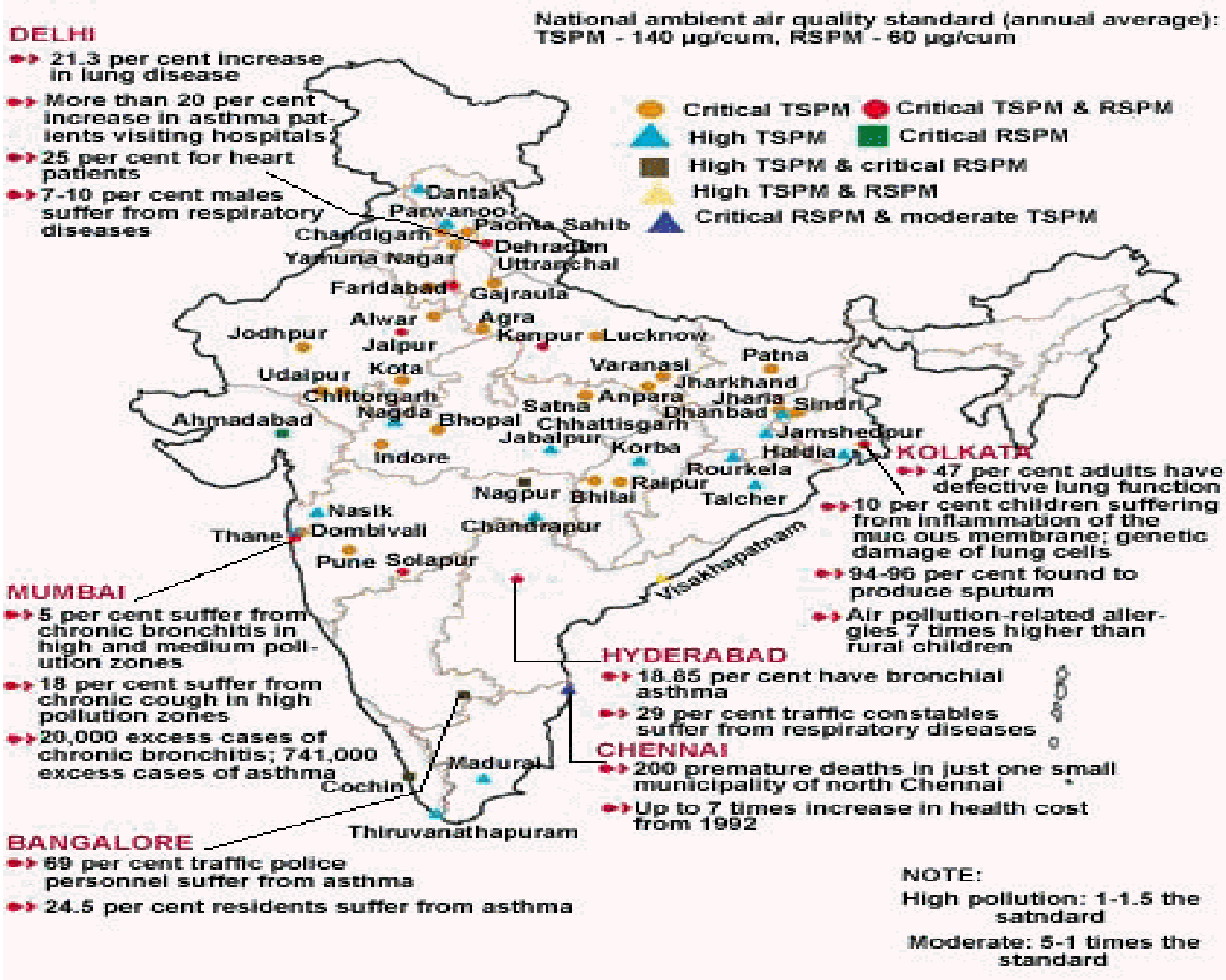
Hong Kong: Respiratory complaints increased among school children aged
8-12 as air pollution increased. (TS Yu et al)

Bangkok: Estimated financial loss 131 Thai Baht per family per month.

Reduction of 20μg/m^3 in annual average PM10 levels can save 65 -175 billion Thai Baht - amounts to 2% of GNP

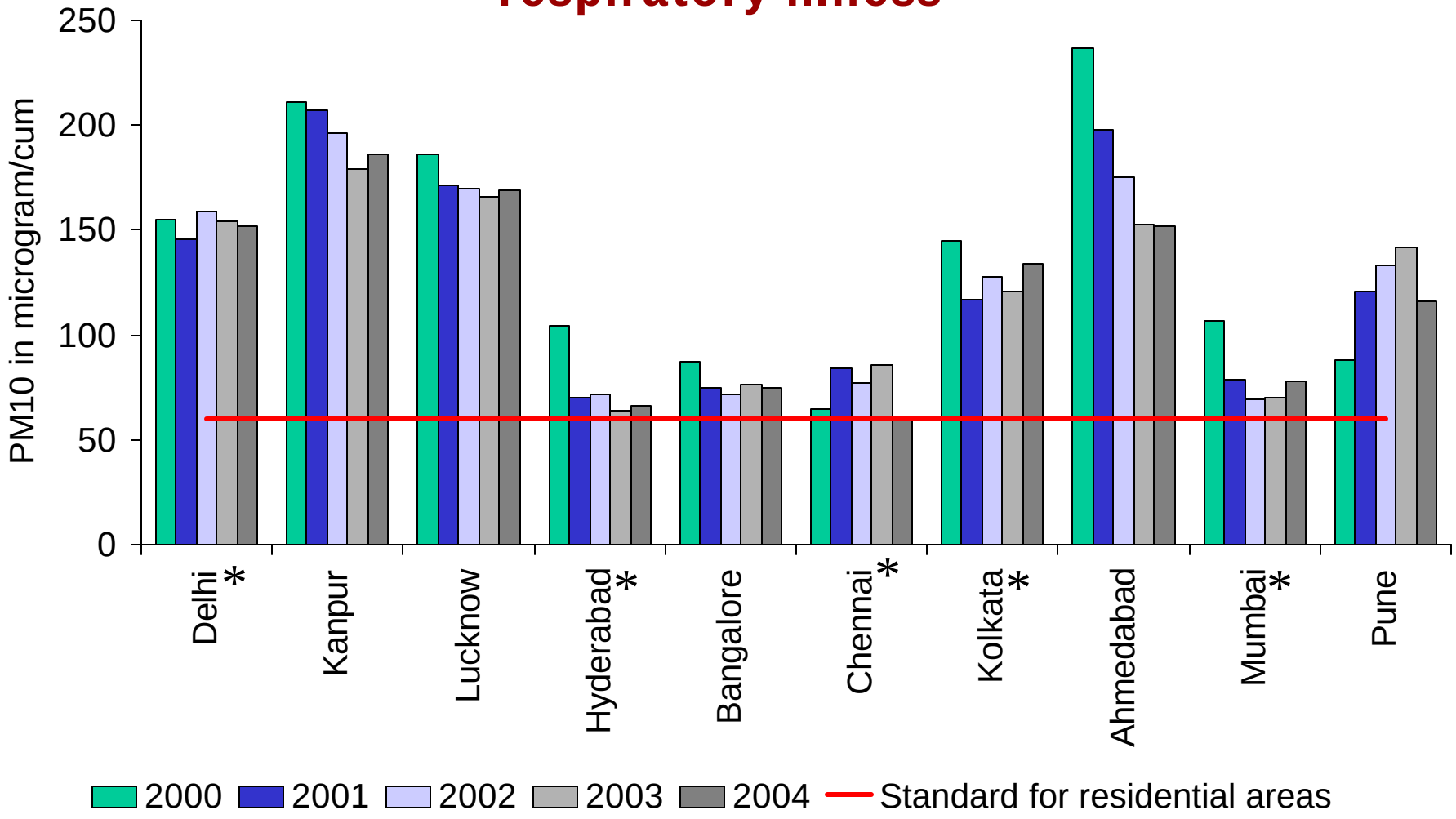
Jakarta: Annual health cost of particulates and lead valued at $2.16 billion – 2% of GNP.

Pollution hotspots and evidence of health damage in Indian cities



Health Benefit

Downward PM10 trend in 5 cities* have led to 13,000 less premature deaths and reduction in respiratory illness[1]



Source: Graph based on NAMP data, CPCB, 1. World Bank 2004, For a Breath of fresh Air

Asia's unique challenges

... underestimating health risks

Asiawide review shows that effects of air pollution are similar to those found in the extensive studies of the West.

The risk in India and Asia could be more if factors unique to Asia are considered

- **Extremely high pollution levels and mixture**
- **Impact of poverty**

This has important implication for environmental monitoring strategies and public health policy in India

We need strong controls at the early stages of economic development

Pollution-Vehicle link

As vehicles emit within the breathing zone of people – cause high exposure.

Evidences mount:

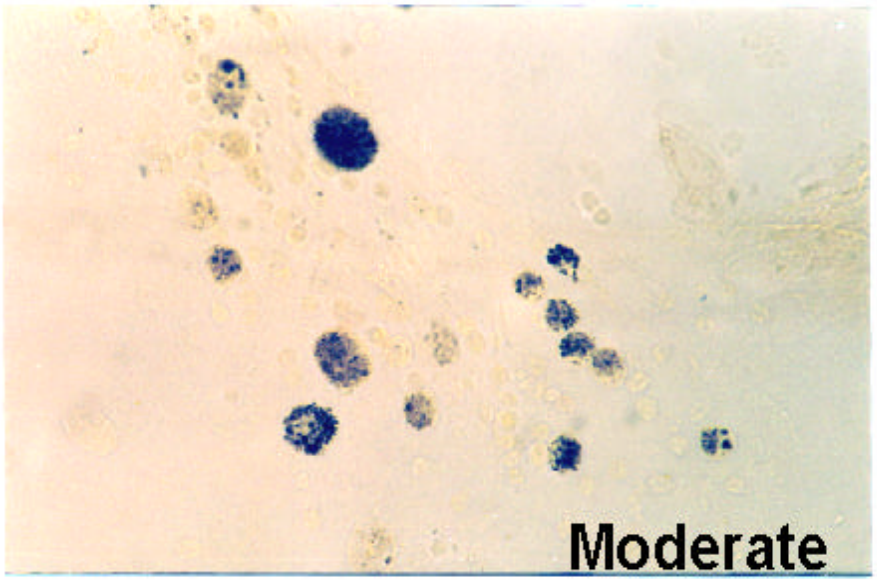
The six cities review by the World Bank: vehicles contribute an average 50 percent of the direct PM emissions but 70 per cent of PM exposure.

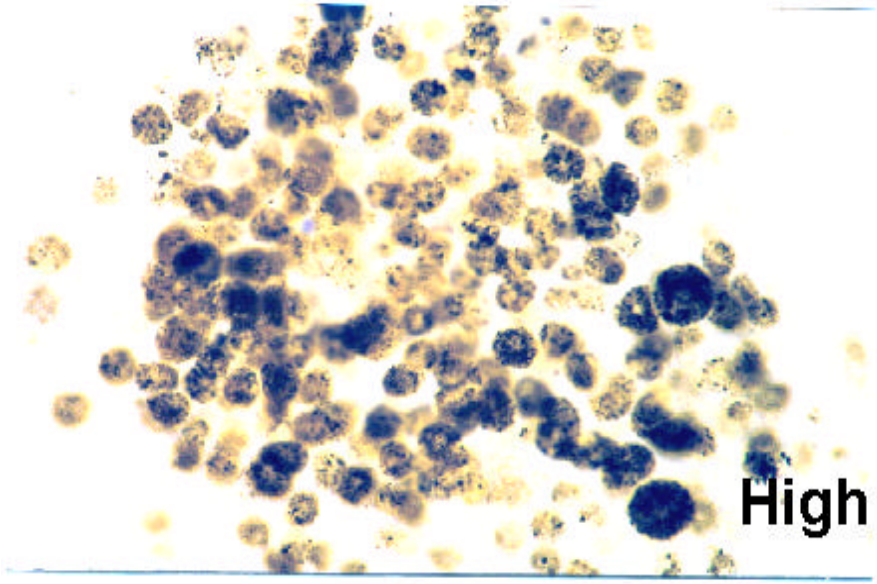
The WHO report of 2005: epidemiological evidences for the adverse health effects of exposure to transport related air pollution is increasing.

•Some of the deadliest air toxics are found in vehicular exhaust. These are carcinogens.

•Latency period of toxic risk is long. Effect of today's exposure will show up later

Alveolar macrophage distribution in sputum

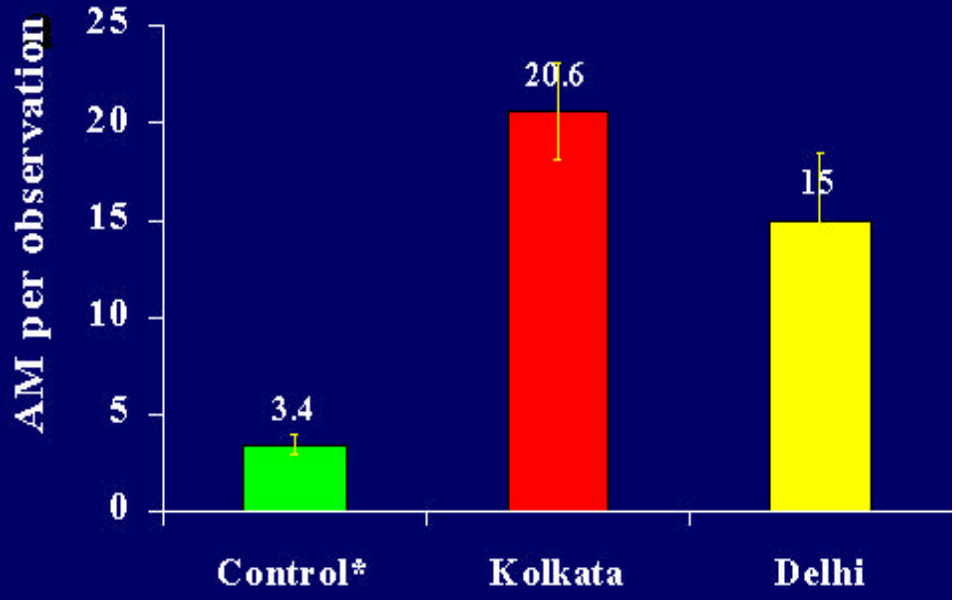




NSE stained

RSPM concentration (annual)

- 80 µg/m^3
- 144 µg/m^3
- 139 µg/m^3

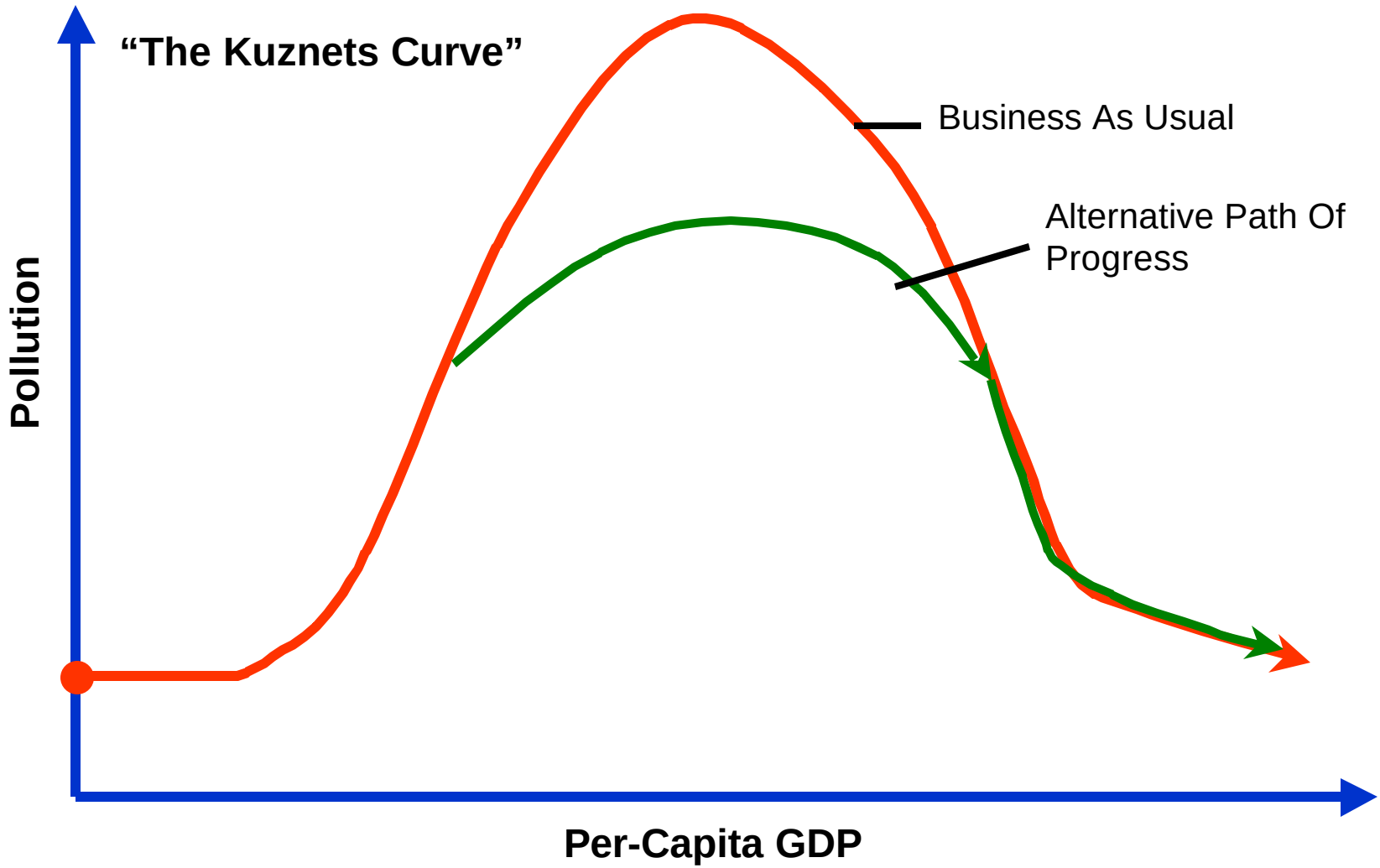


n= 300 control, 835 Kolkata, 720 Delhi

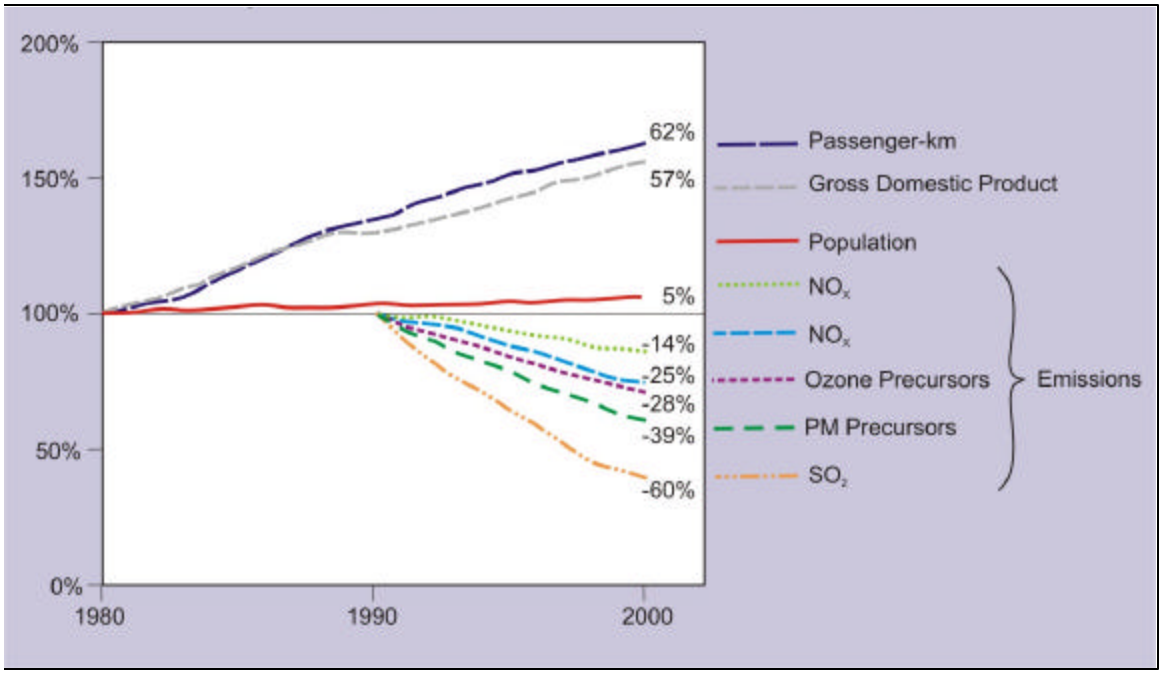
Source: T. Lahiri, Kolkata

The message: Leapfrog

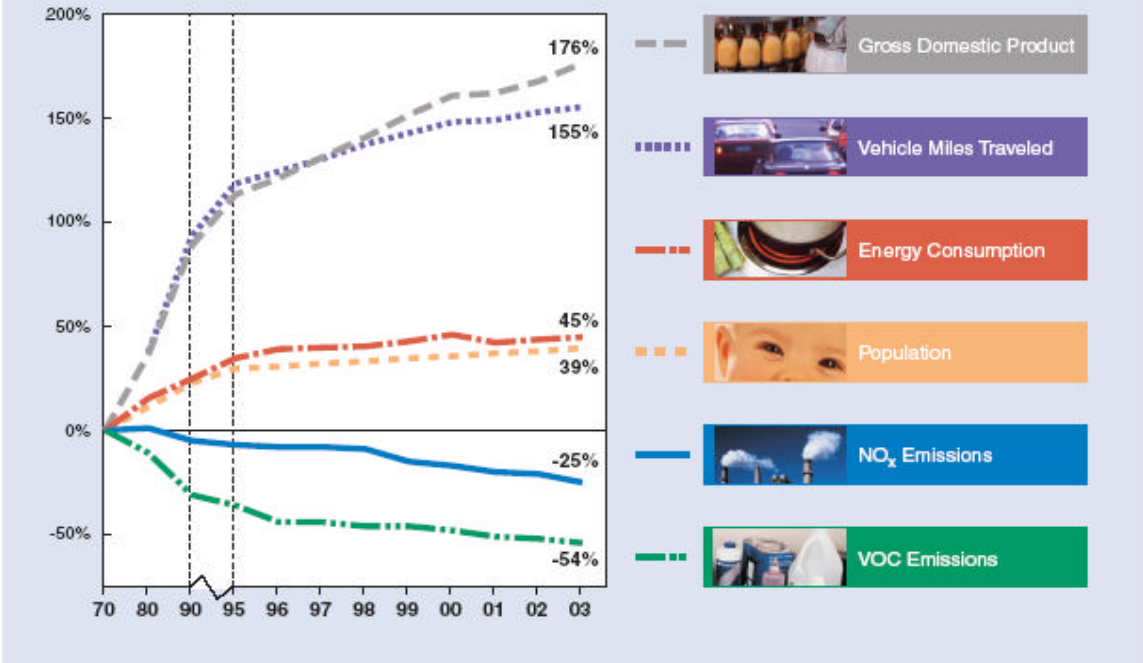
Avoid the polluting pathways of others. Adopt an alternative path that is precautionary and preventive



EU 15: Growth & emissions



USA: Growth & emissions

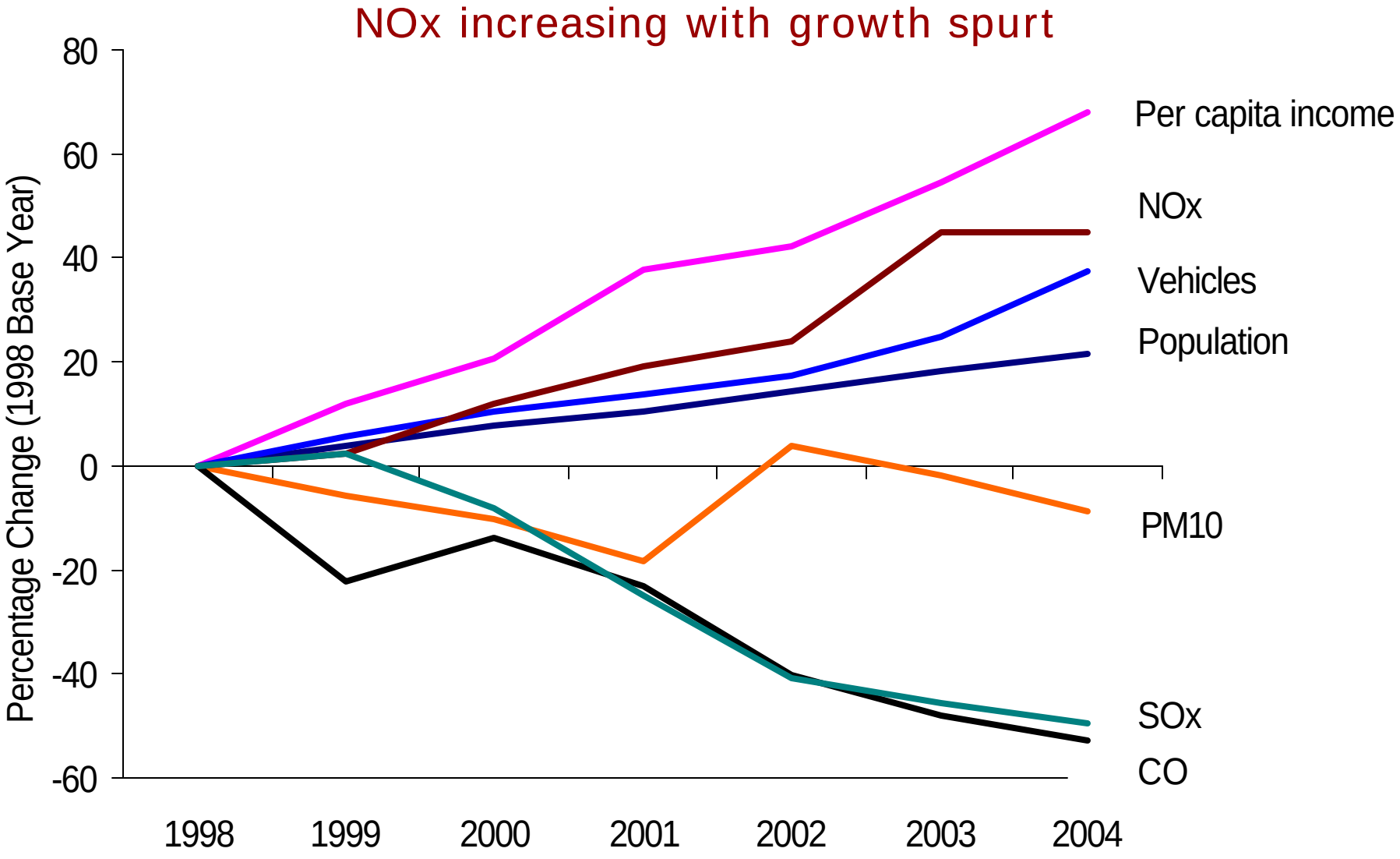


Other countries have shown that despite the steep levels of economic and vehicular growth the emissions can be reduced significantly

The enormous health and environmental benefits from this improvement far outweigh the added cost of clean up

Delhi: Pollution and Growth

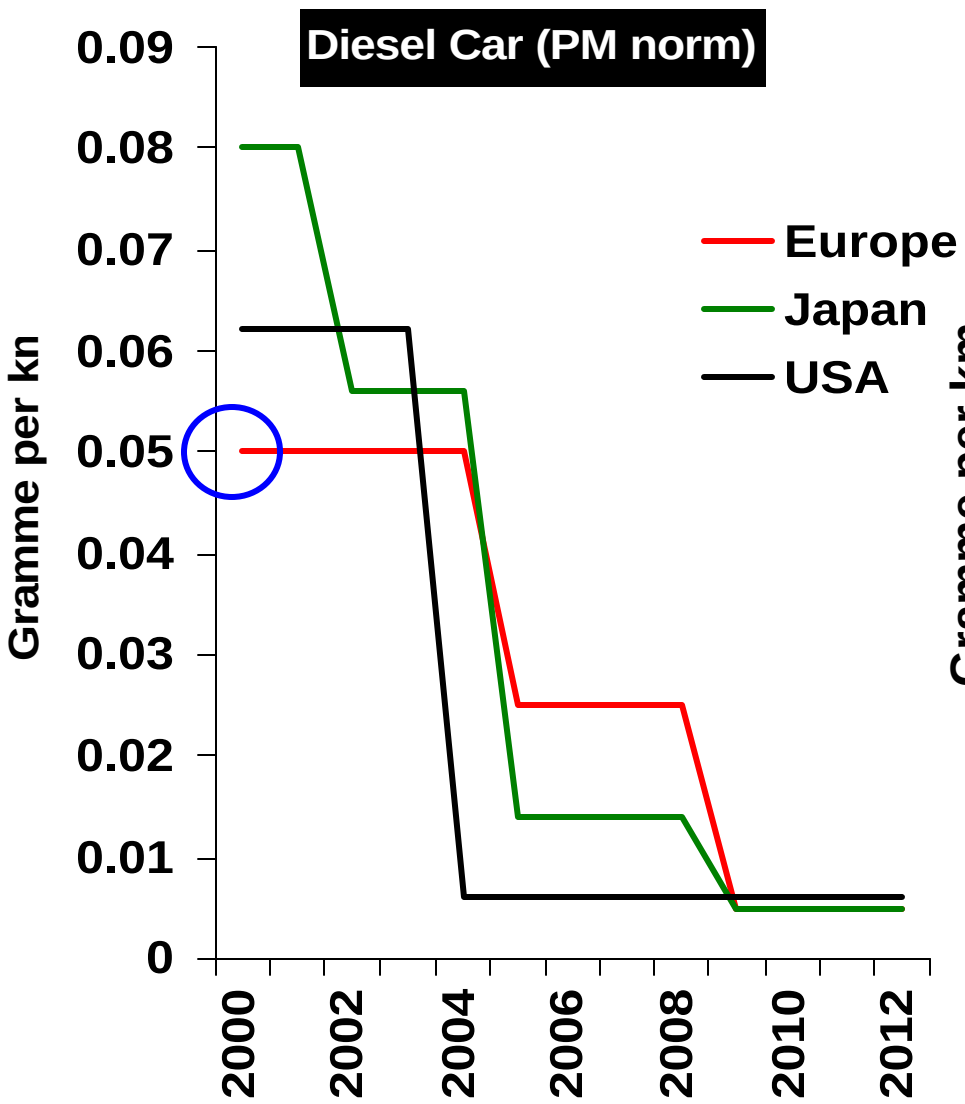
Trend in ambient SO_2 and CO delinked from economic growth. PM10 stabilised.

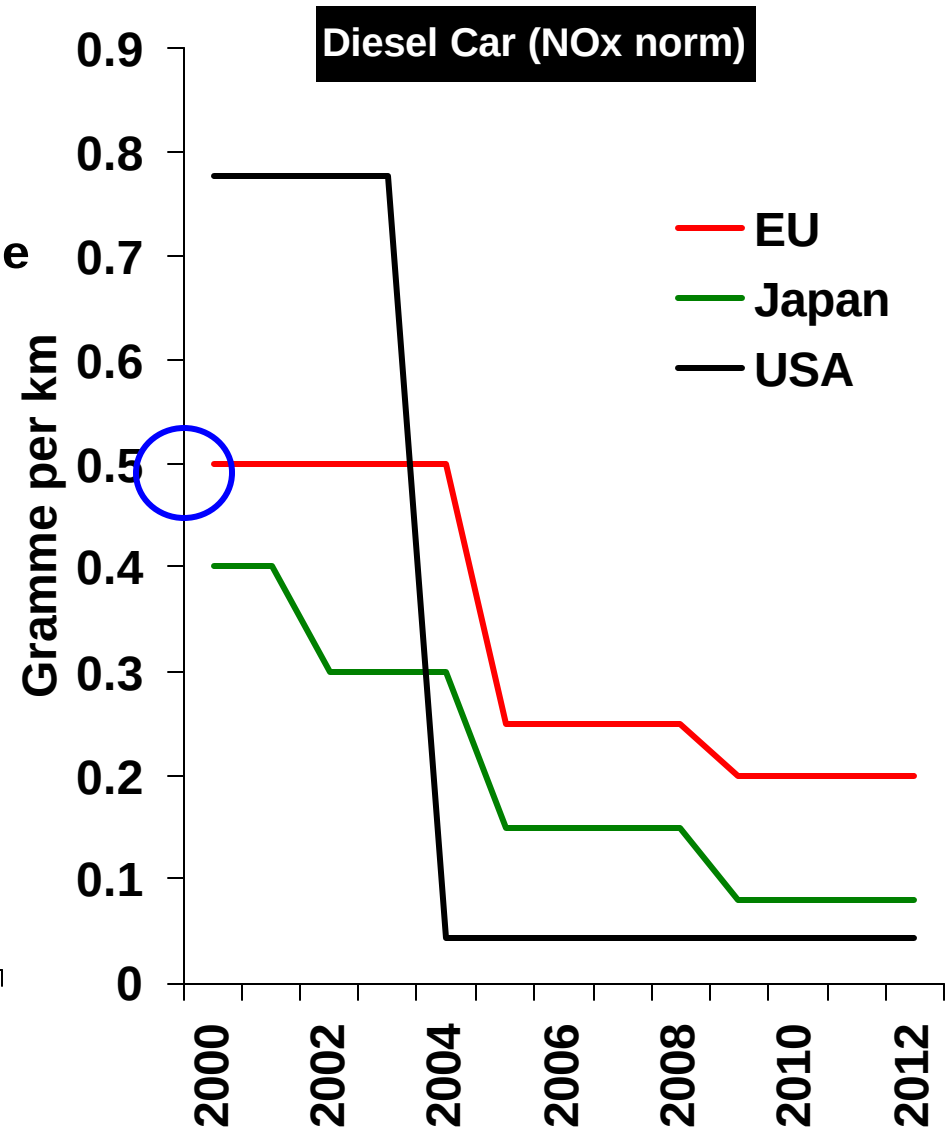


Source: CSE

Technology roadmap: An unfinished agenda

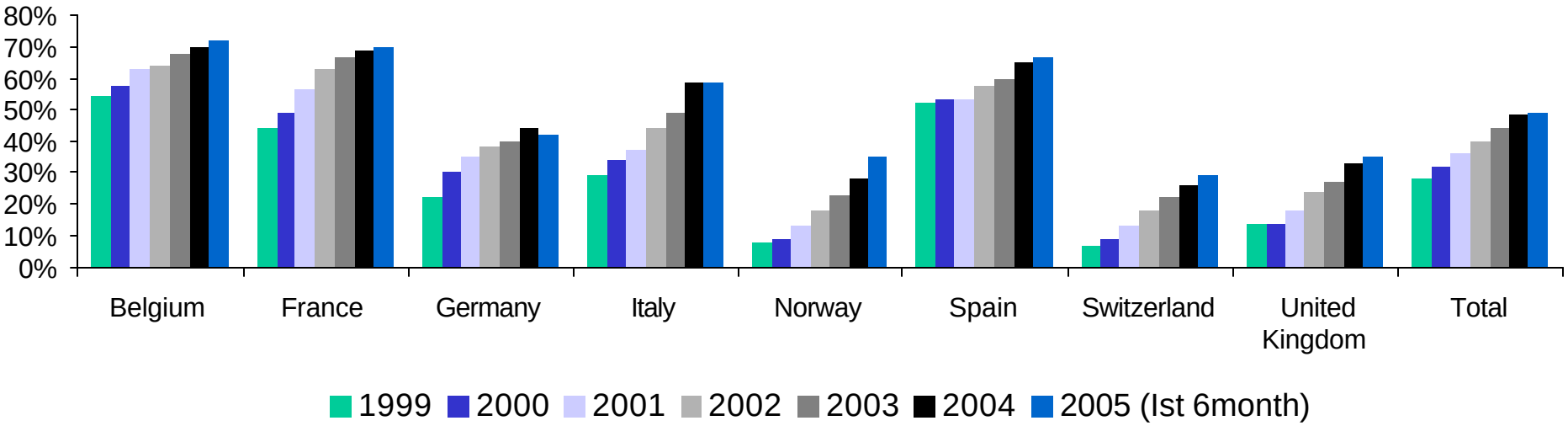
Indian metros today (Euro III)



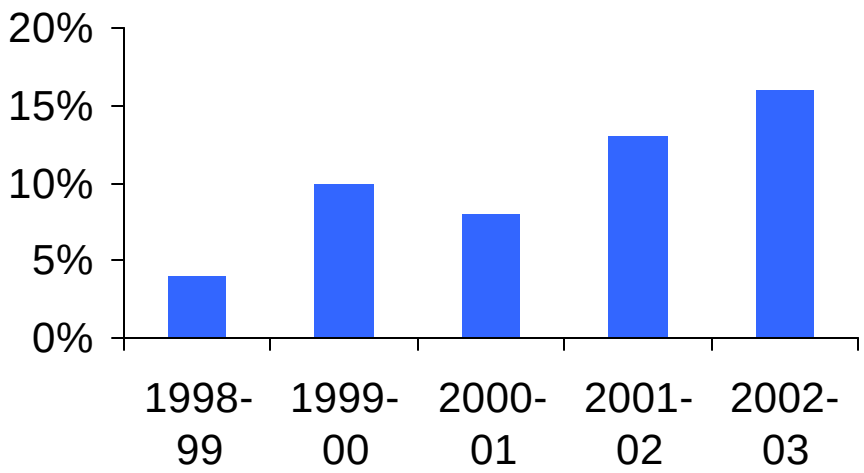


Future: Dieselised

Europe: Share of diesel cars in new sales in Western Europe

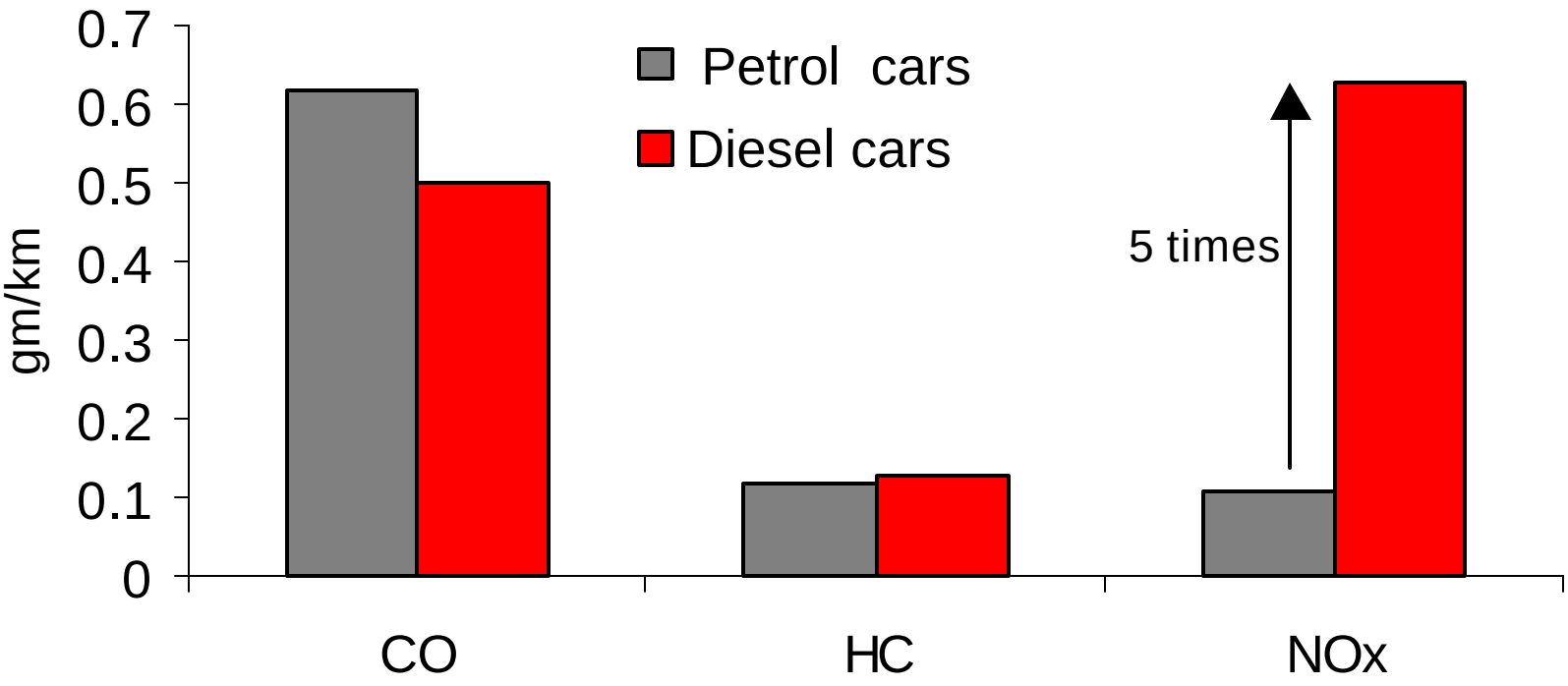


Delhi: diesel car's share in total registrations



Agency	Red alert on diesel exhaust
US EPA (2002)	**Likely human carcinogen**
CARB (1998)	**Toxic air contaminant**
HEI (1995)	**Potential to cause cancer**
NIOSH (1988)	**Potential occupational carcinogen**
IARC (1989)	**Probable human carcinogen**
WHO IPCS (1996)	**Probable human carcinogen**

NOx Threat from Diesel Cars



In India, diesel car models emit nearly 5 times higher NOx compared to petrol car models

Euro III norms allow diesel cars to emit three times more NOx

Concern over diesel is driving the technology leapfrog agenda worldwide

Singapore: Despite the harshest of measures to control vehicle numbers is leapfrogging its diesel emissions standards directly from Euro II to Euro IV in 2006

Japan: "Say No to Diesels" campaign. Sets one of the most stringent global standards

China: targets to introduce Euro IV fuels from 2008 in Beijing

Hong Kong: In 2000 it became the first in Asia to introduce 50 ppm sulphur diesel

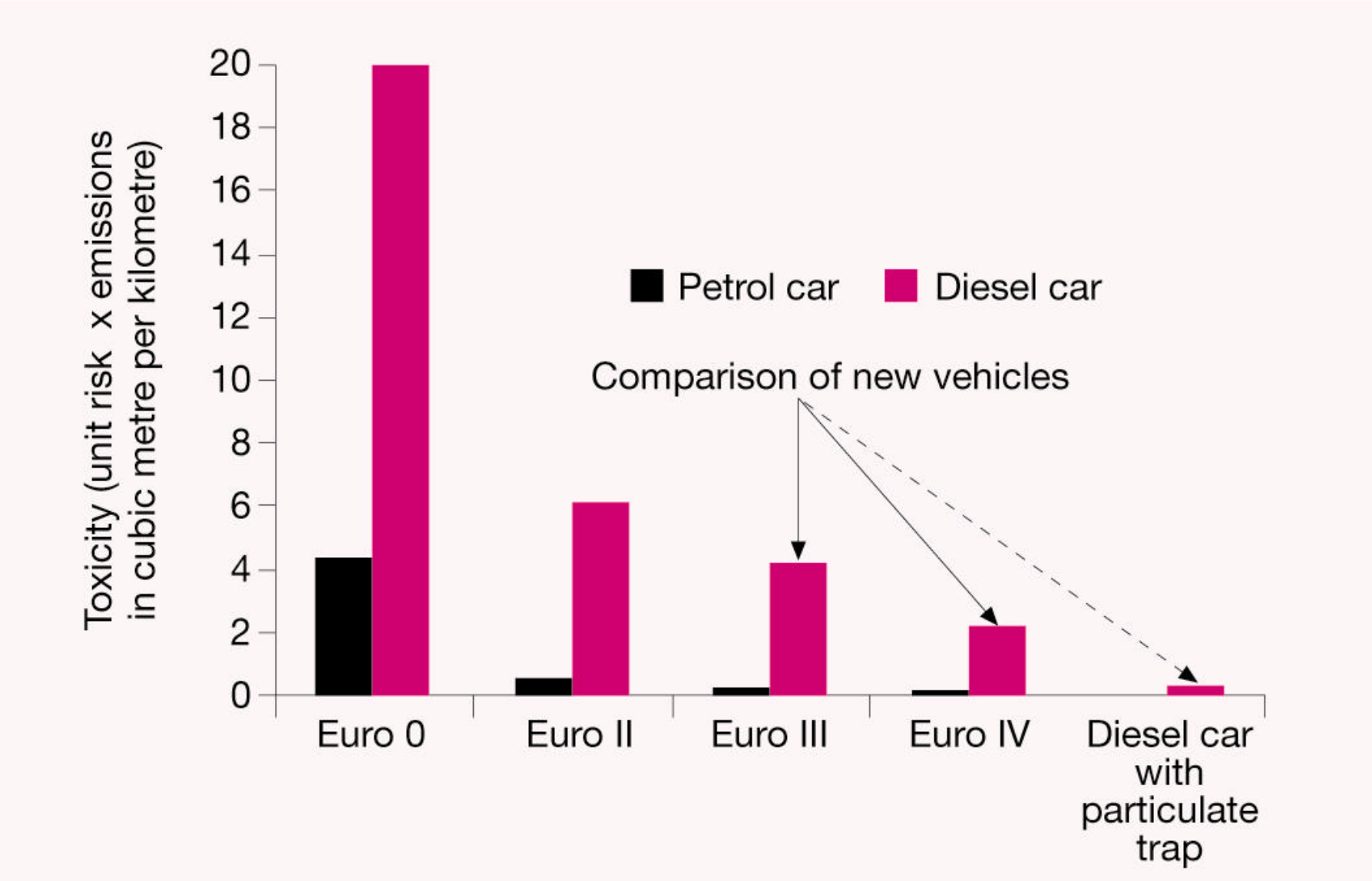
Thailand: targets to introduce Euro IV from 2009 onwards

Europe: PM and NOx levels remain elevated. Germany despite meeting Euro IV std is campaigning for even cleaner diesel vehicles

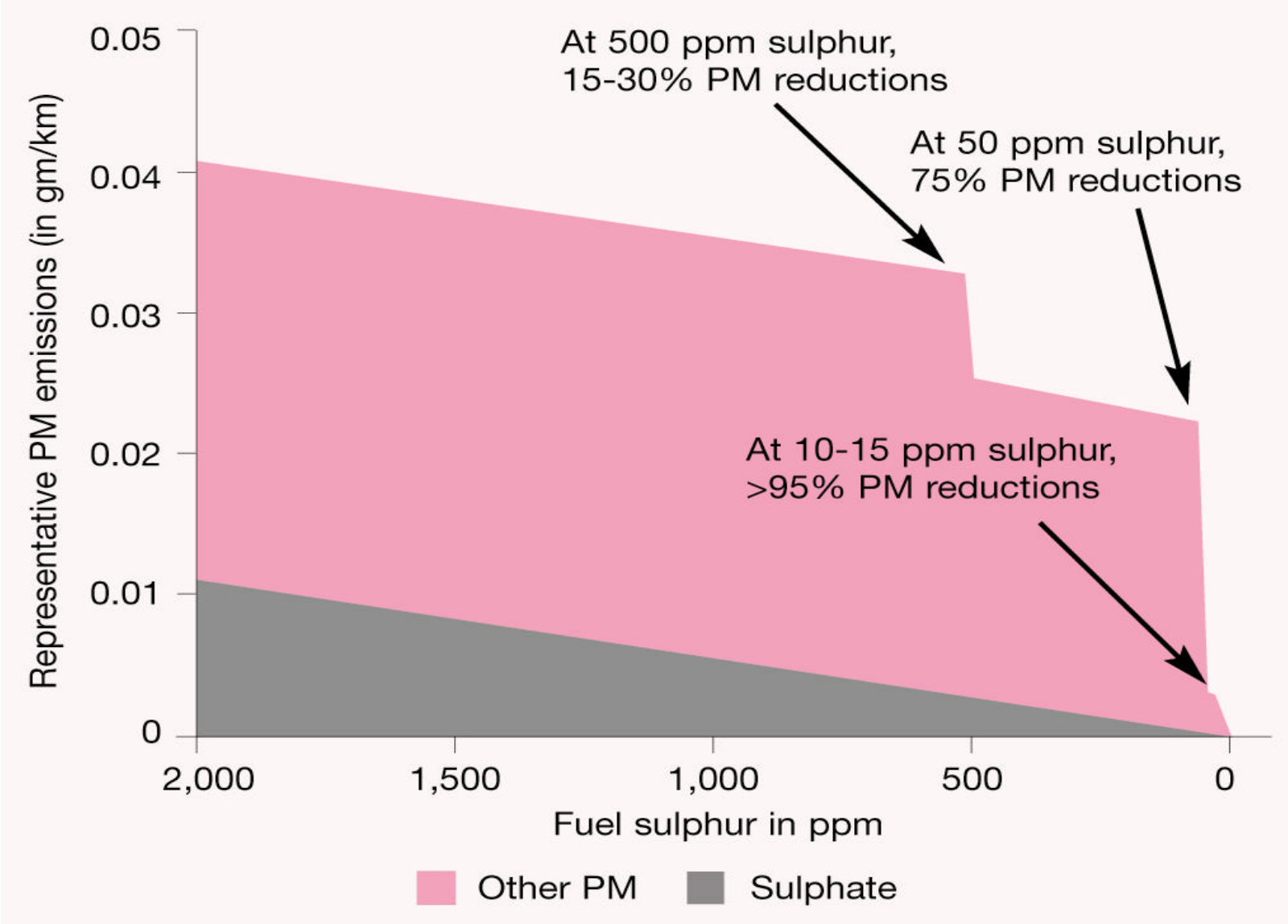
The US: phasing in the most stringent fuel neutral standards

Toxicity of Diesel and Petrol Cars in Europe:

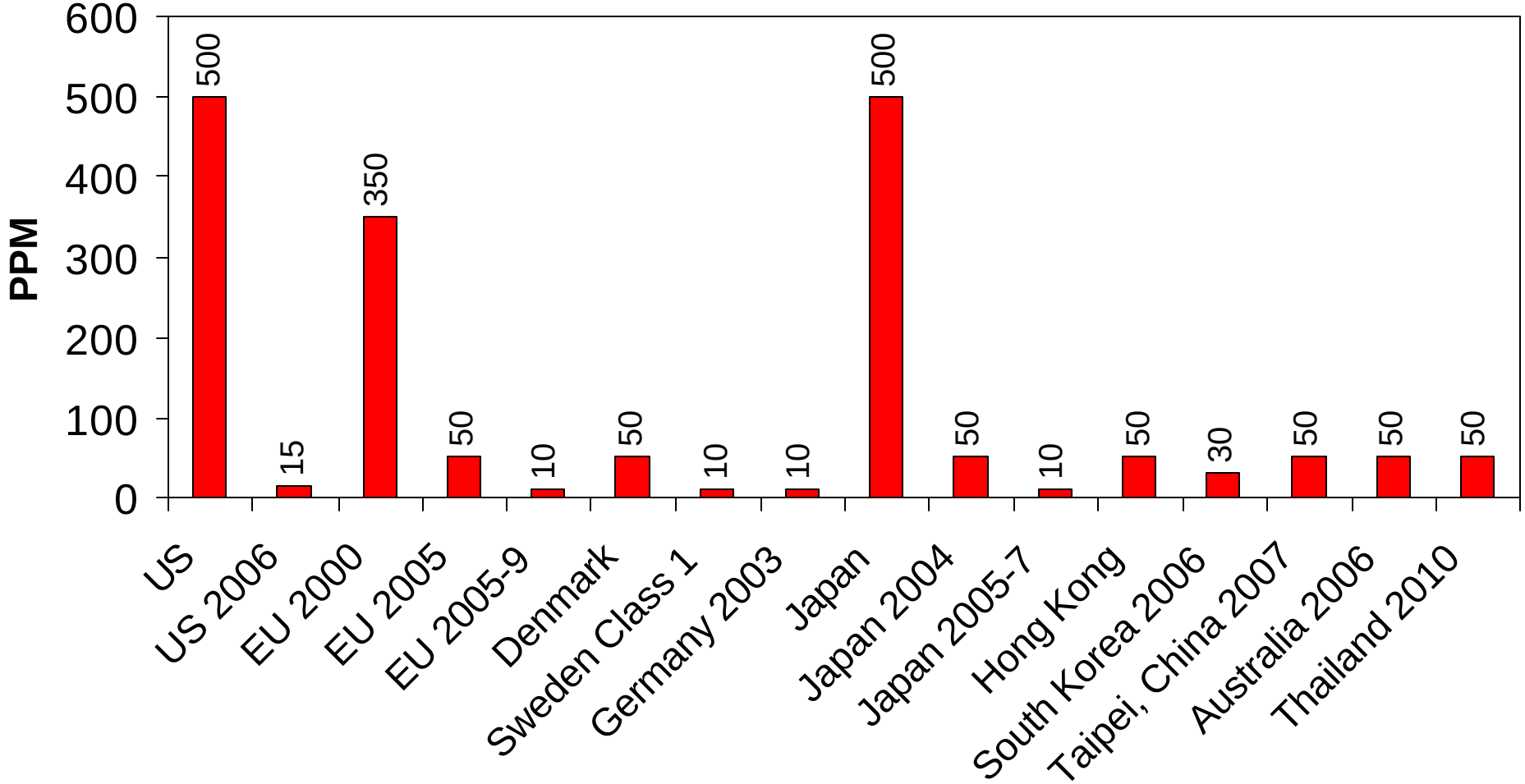
Toxicity of diesel emissions much higher than petrol



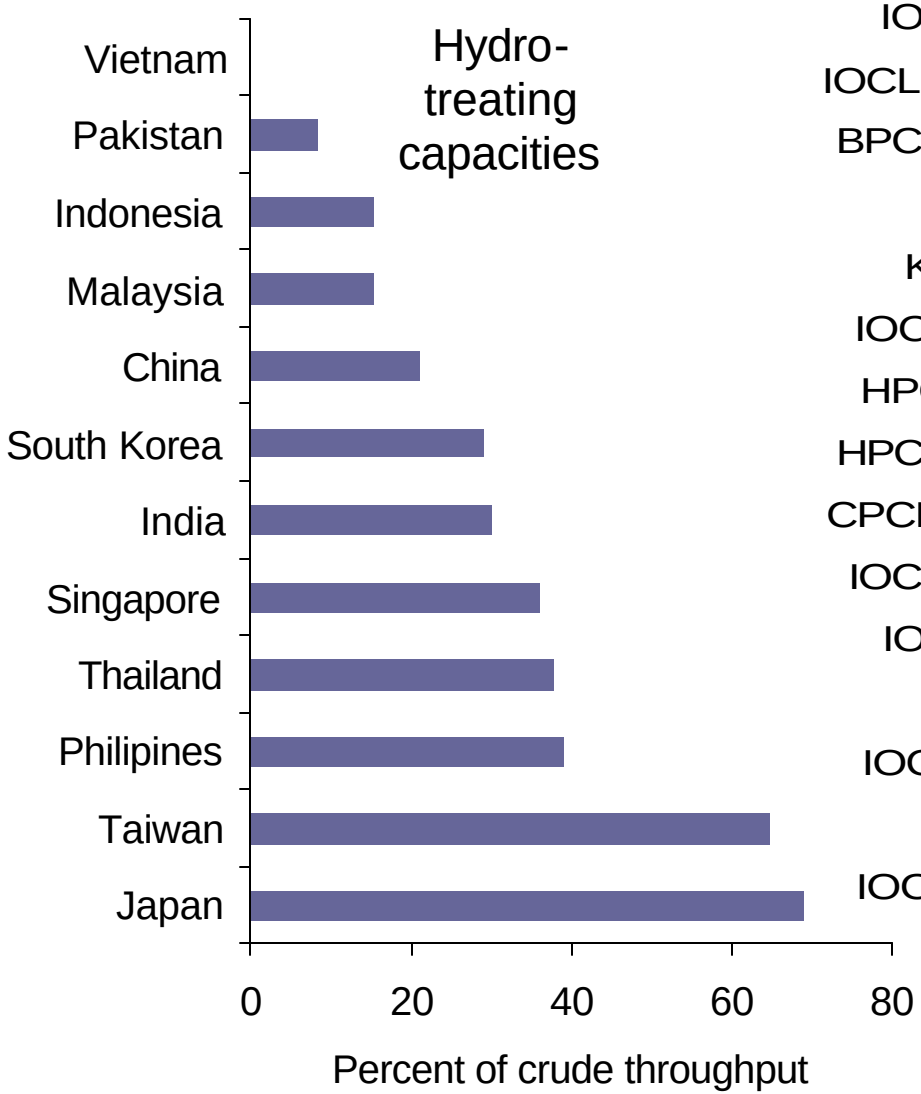
Only ultra low sulphur diesel can enable advanced emissions control devices that can cleanse diesel PM



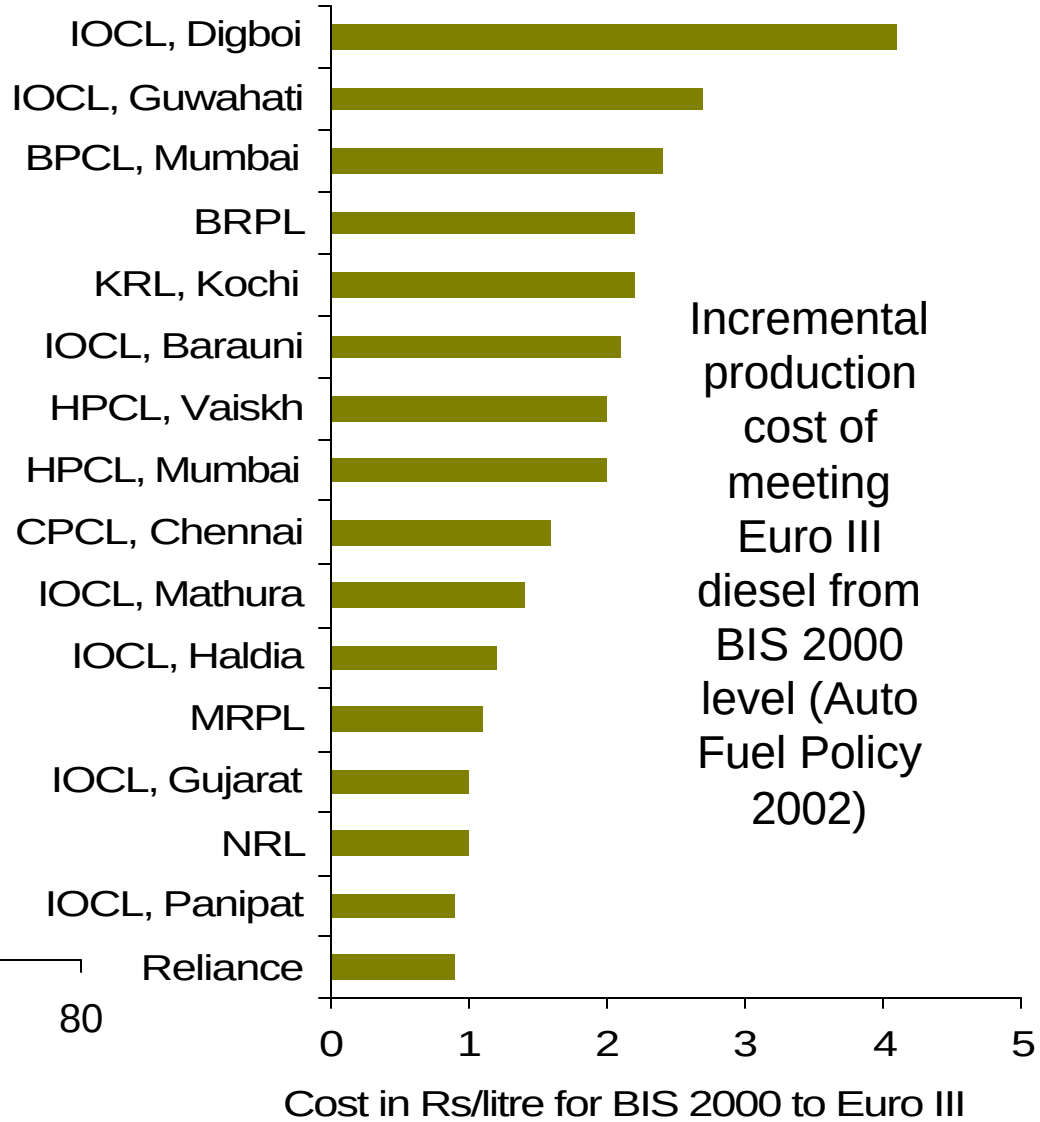
Ultra low sulphur diesel fuel is spreading across the globe to enable new technologies. But Indian refineries block the way



-- India's hydro-treating capacity compares well in the Asian region
-- Some refineries are more capable, can produce cleaner fuels at competitive costs
-- Incremental cost of ultralow sulphur fuels much lower than typical variation in global prices. Tax policy can offset costs

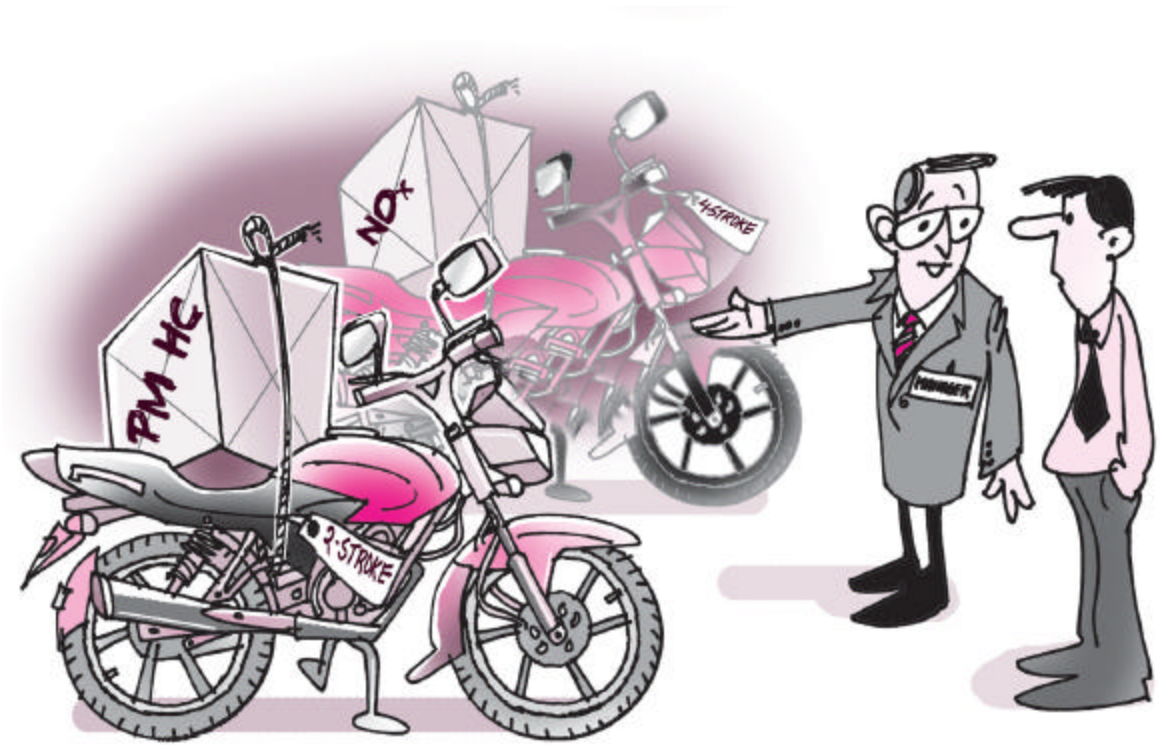


Source: Trans Energy Associates, USA

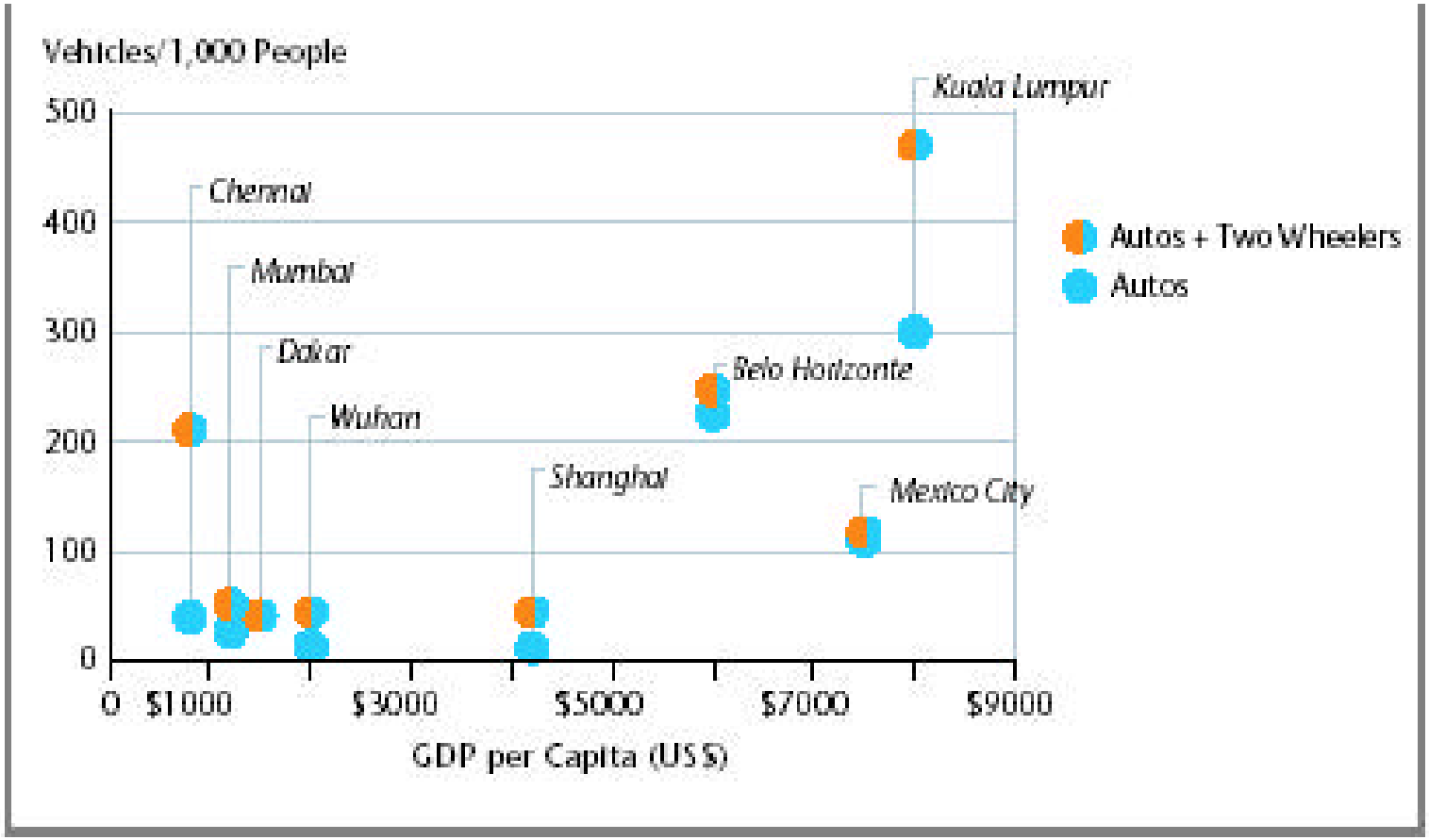


Source: Auto Fuel Policy 2002

Two-wheelers: An Asian dilemma



An Asian dilemma



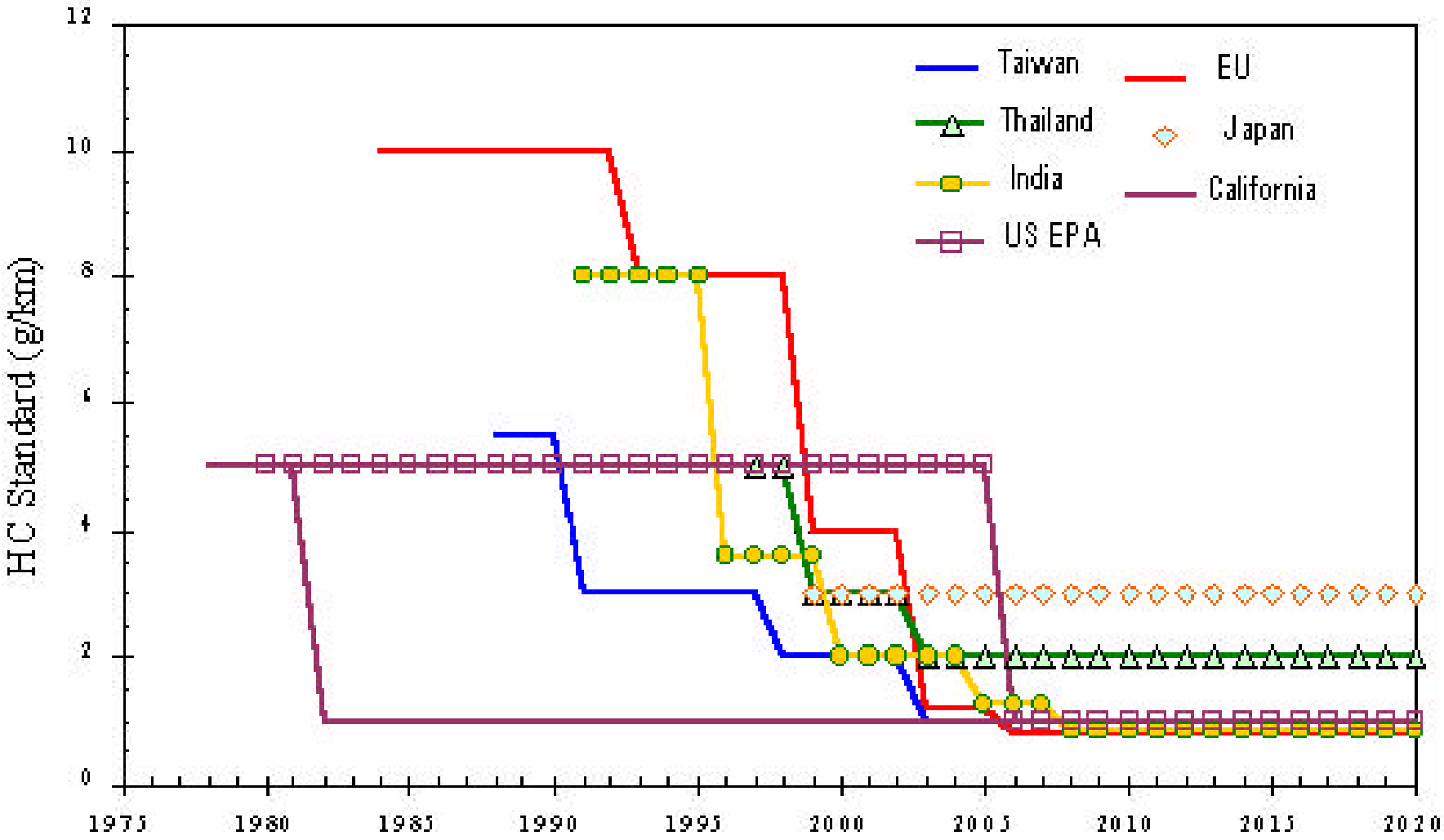
-- Inclusion of motorised two-wheelers in Indian cities with low GDP brings their motorisation rates at par with the cities with a much higher per capita income.

-- **Vehicles of middle income classes – 70 to 80 percent of the fleet. Very polluting**

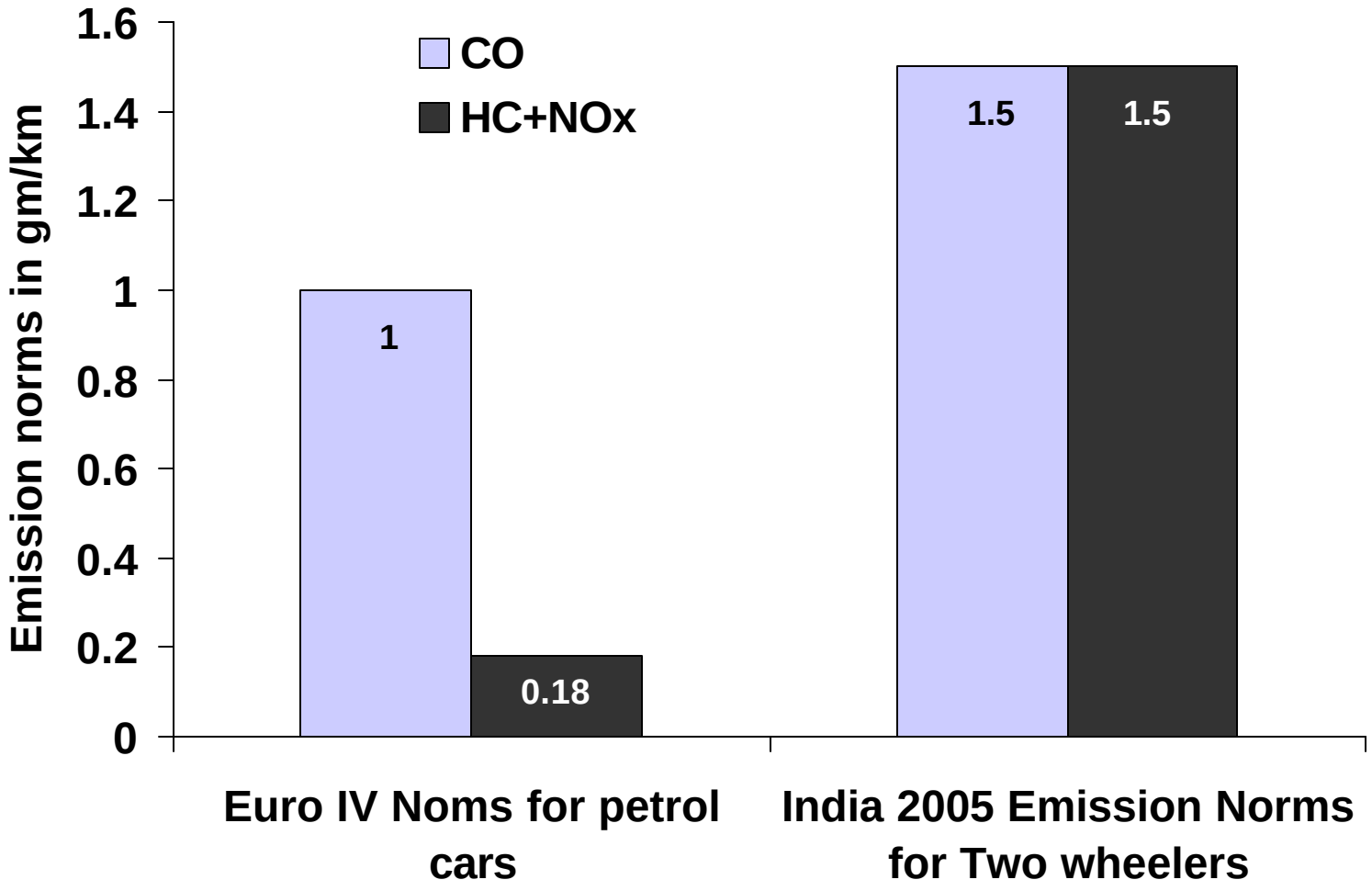
Source: Mobility 2030, WBCSD

Europe and US catching up

HC Emission Standards for 100cc two-wheelers



Even after meeting the most stringent emissions standards a new two wheeler in India emits 1.5 times more CO and 8 times more HC+NOx than Euro IV car in Europe



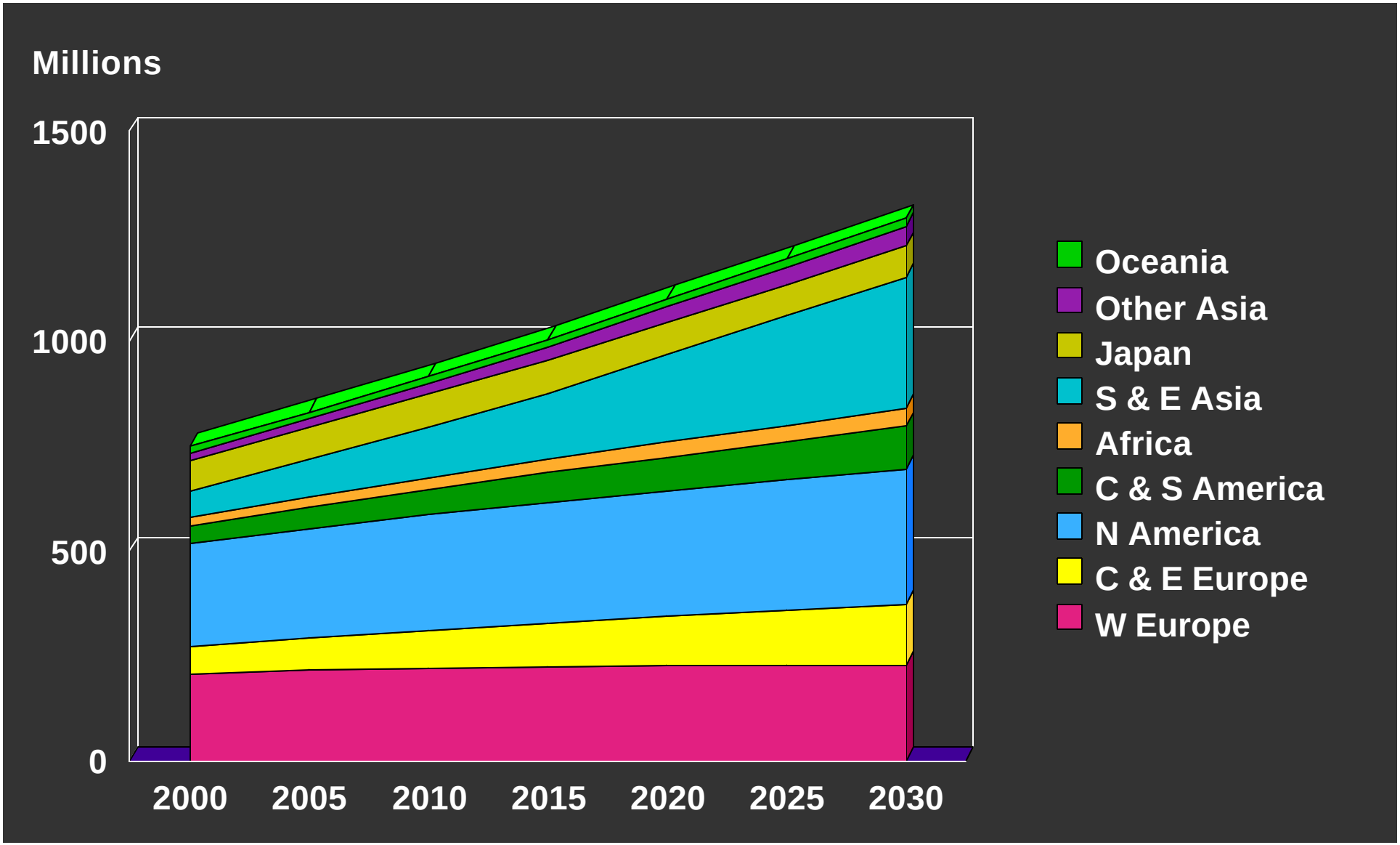
Need paradigm shift to create clean technology pathways

Only resolving the problem of conventional two-stroke engines is not enough. Need radical transition to advanced technology concepts. Technology solutions exist. Enable them.

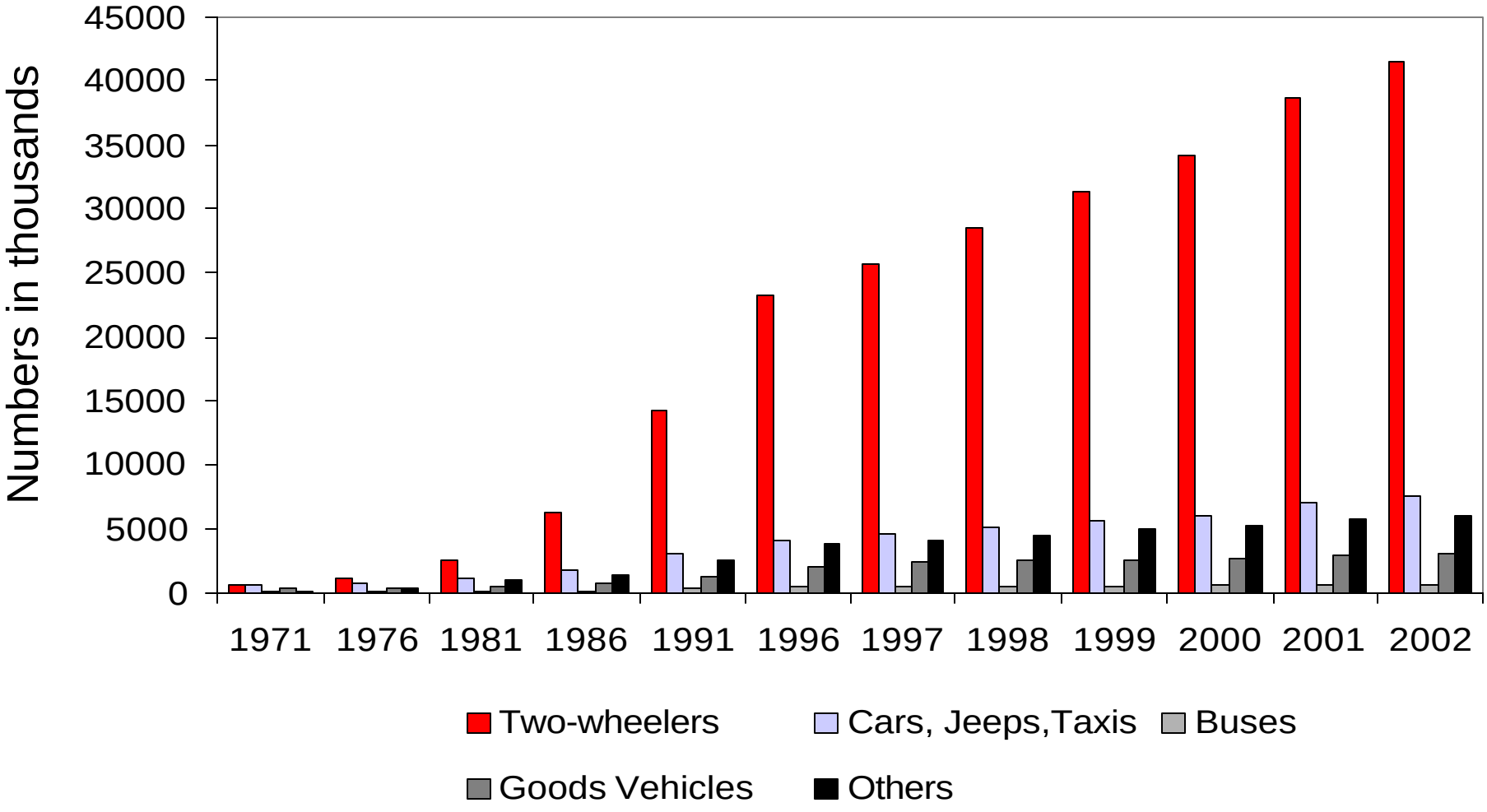
Taiwan, at comparable level of emissions standards has made transition to more advanced technology solutions that include EMS motorcycles fitted with closed loop systems, electric two-wheelers etc

The challenge of explosive numbers

Global Vehicle Forecast



Vehicle revolution in India



Source: MORTH

Energy insecurity

Energy use in the transport sector is a complex challenge -- transport energy demand has grown at 1.2 times the GDP growth rate.

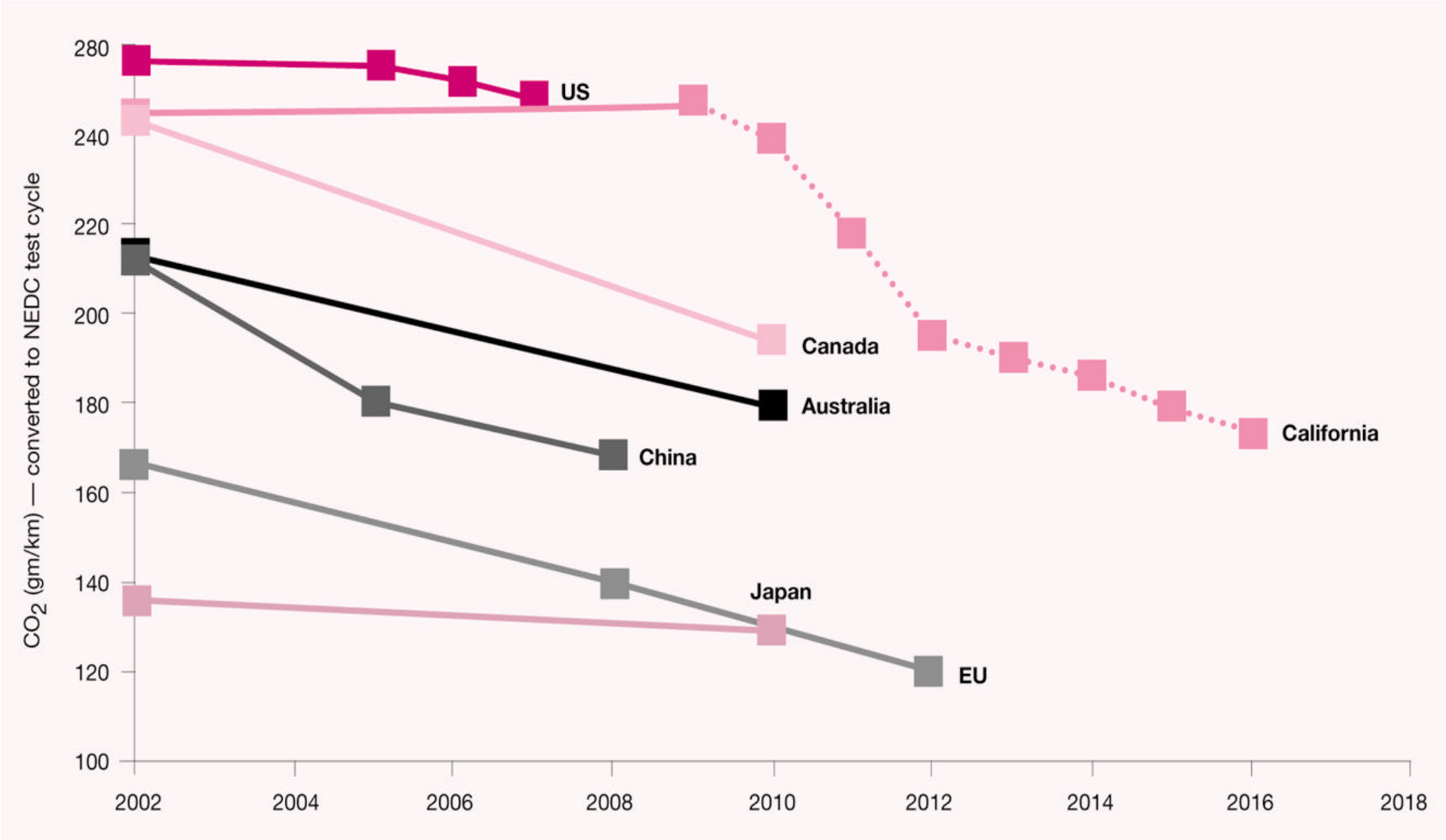
The total demand for transport energy is expected to grow three fold in Delhi.

Tax sops to the car industry to sell more cars

If India adopts the Japanese 2005 equivalent fuel economy standards, the fuel saving can go upto 35 per cent

Race of Vehicle Fuel Economy Regulations

China leads. Plugs diesel loophole – tighter standards for SUVs, additional taxes on diesel cars, narrow difference in diesel and petrol prices



MOBILITY CRISIS

The challenge of explosive numbers in Delhi

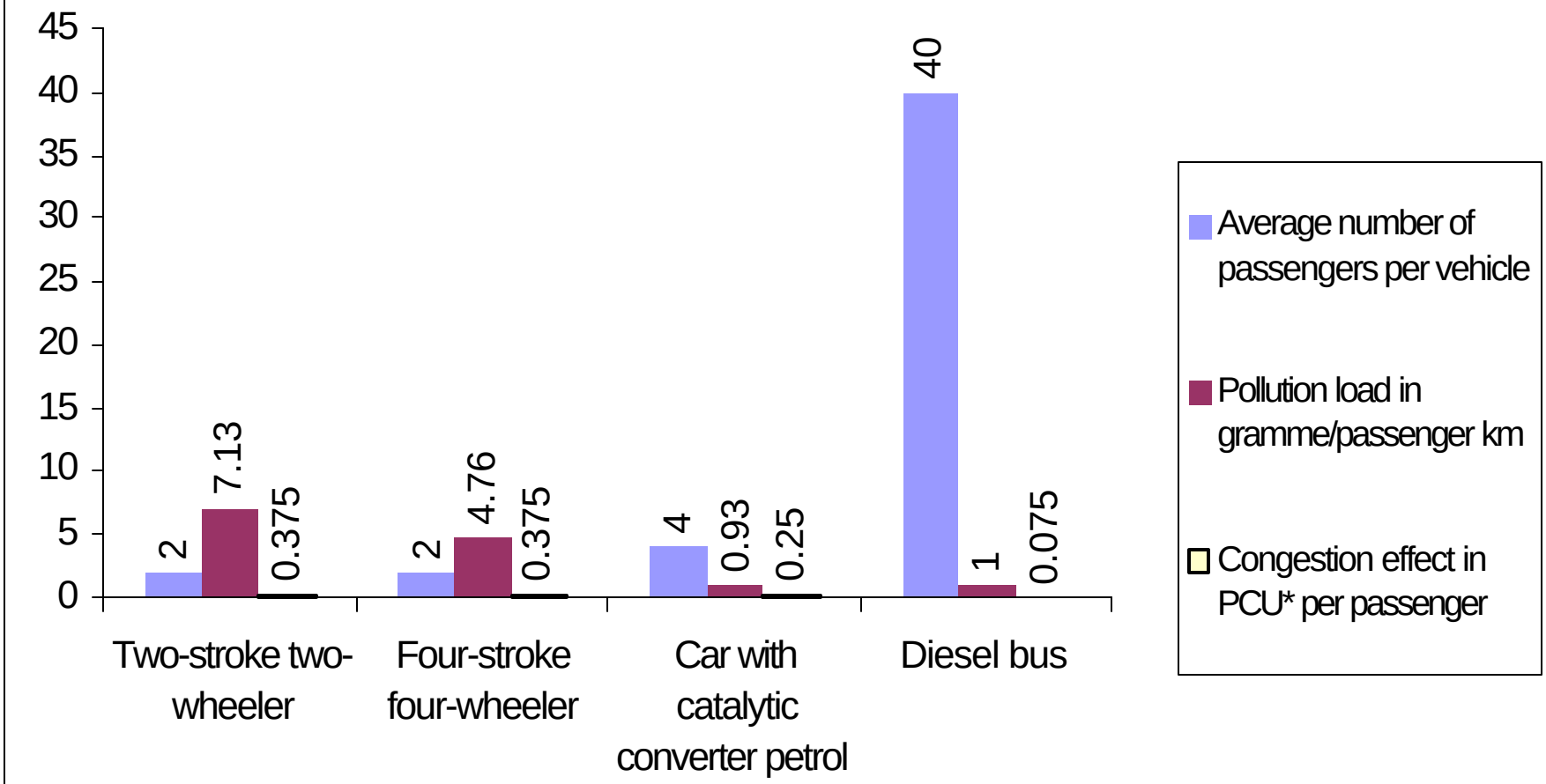
2001 and 2021: population expected to grow by 67 per cent. Vehicular trips per day by 131 per cent

Delhi's road network increased nearly three times from 1971-72 to 2000-01, but vehicle numbers have increased by 16 times

Around 385 personal four-wheelers and 569 two-wheelers are registered every day in Delhi

Crawling peak hour traffic

Personal vehicles use more road space, pollute more, meet less travel demand



Note: * one car is equal to one PCU, 1 bus = 2.5 PCU, 1 scooter = 0.75 PCU

Source: Anon 2003, Draft urban transport policy, Ministry of Urban Development, Delhi

Pollution impact of congestion

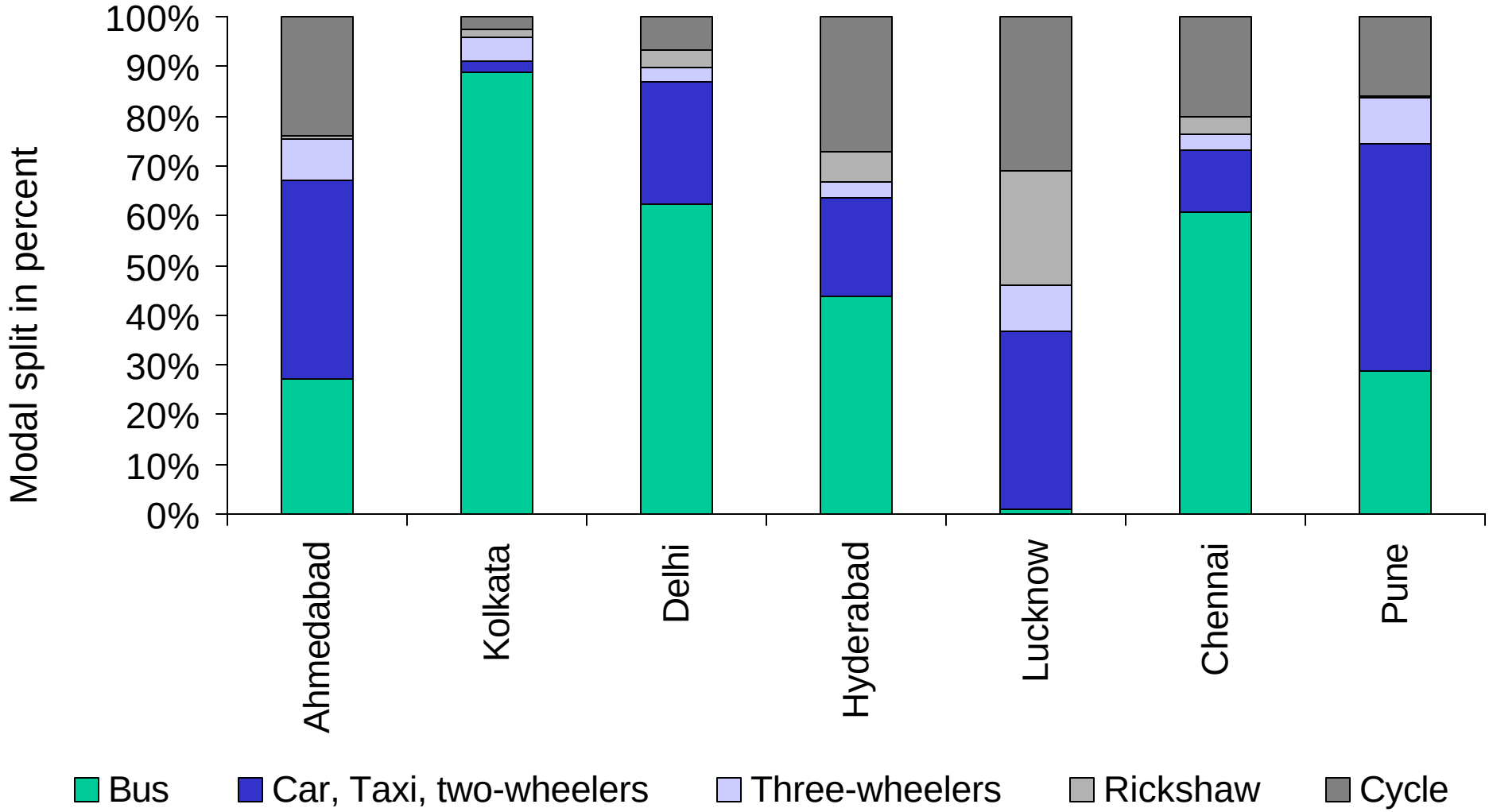
Vehicle Emissions vis-à-vis Speed

Speed (kilometer per hour)	Autos Change in emissions with speed (gm/km)			Buses Change in emissions with speed (gm/km)		
	CO	HC	NOx	CO	HC	NOx
10 km/hr	**33.02**	**4.47**	**2.53**	**22.60**	**5.70**	**22.30**
25 km/hr	21.20	2.60	2.17	14.40	2.30	16.40
50 km/hr	**9.80**	**1.30**	**2.24**	**8.20**	**0.00**	**11.90**
75 km/hr	6.40	0.93	2.97	-	-	-

Source: E A Vasconcellos, 2002, Urban Transport, Environment and Equity — the Case for Developing Countries, Earthscam Publications Ltd, London

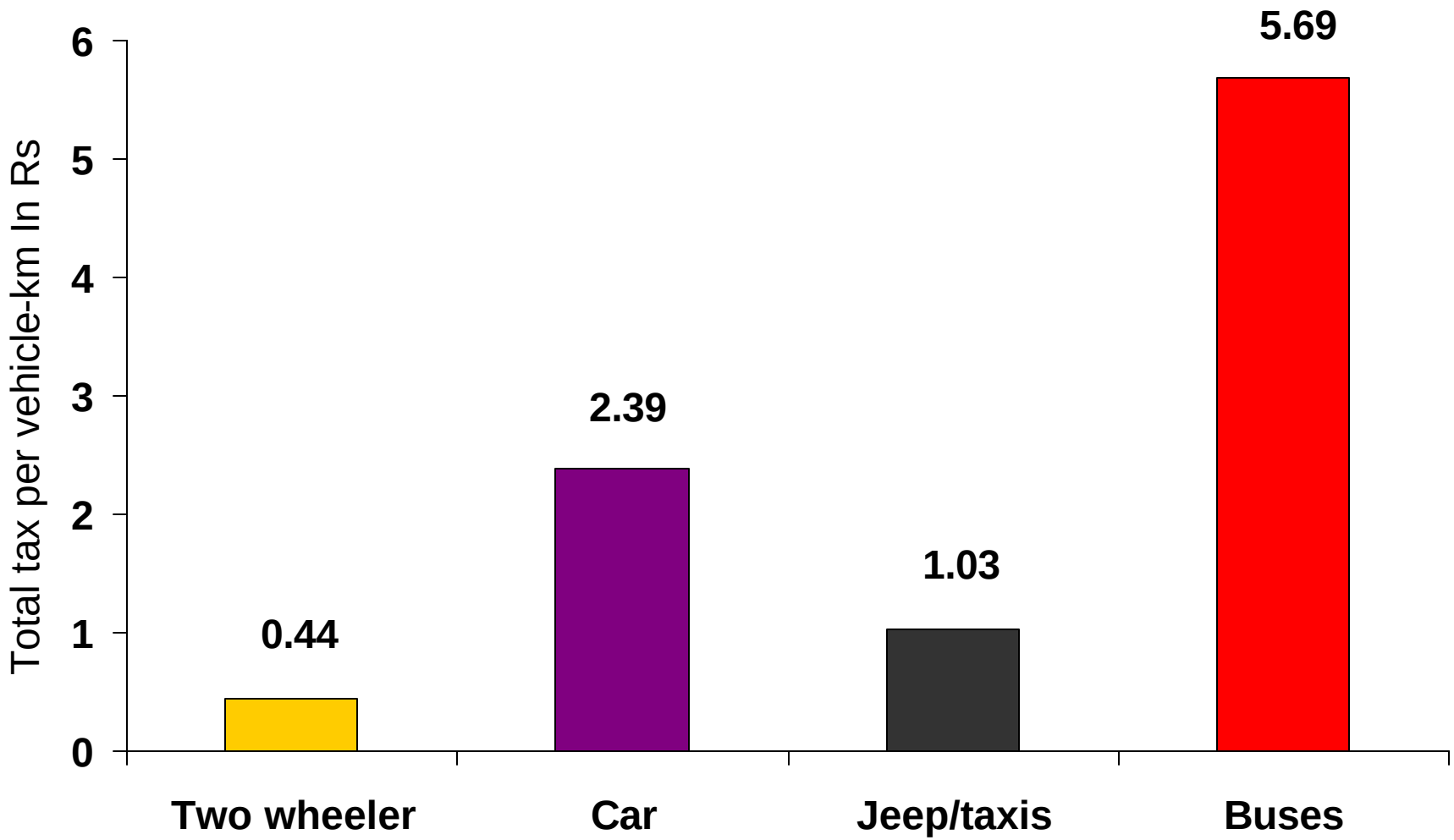
Modal split: Our cities are different

While personal vehicles form over 90 per cent of all vehicles, bus transport still meets over 60 to 80 per cent of the travel demand



Source: World Bank 2002

Buses are taxed higher than cars



Delhi's transport challenge

By 2021 - even with present bus services, and implementation of metro rail and integrated rail and bus transport (IRBT) there will be a shortfall of nine million trips per day.

Delhi government takes lead in developing a transport plan to meet the explosive demand.

The proposed public transport projects includes:

-- The high capacity bus system with dedicated corridors

-- The monorail

-- The electric trolley bus system

-- Integrated rail-cum-bus transit

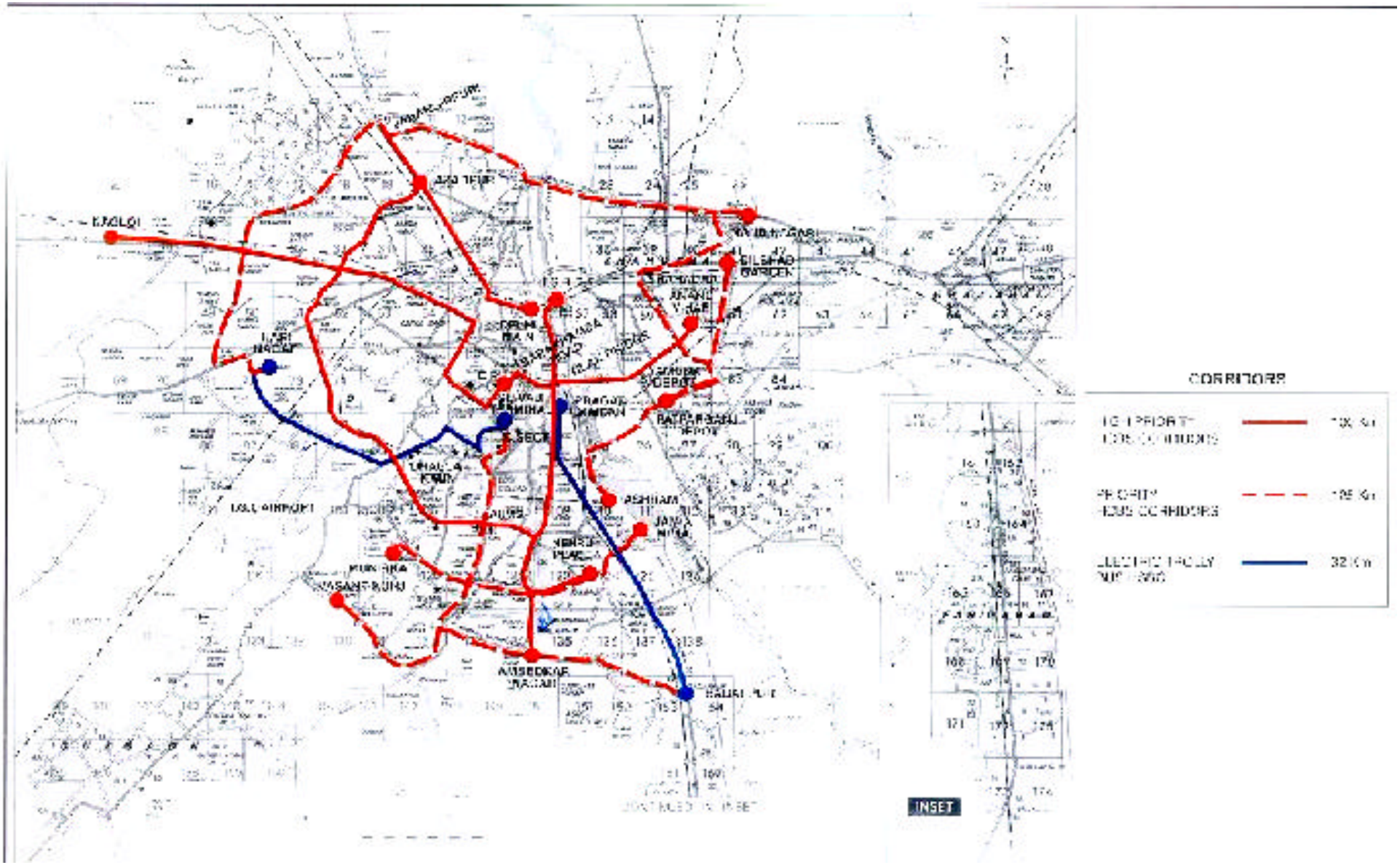
High capacity bus rapid transit is being implemented as the priority project

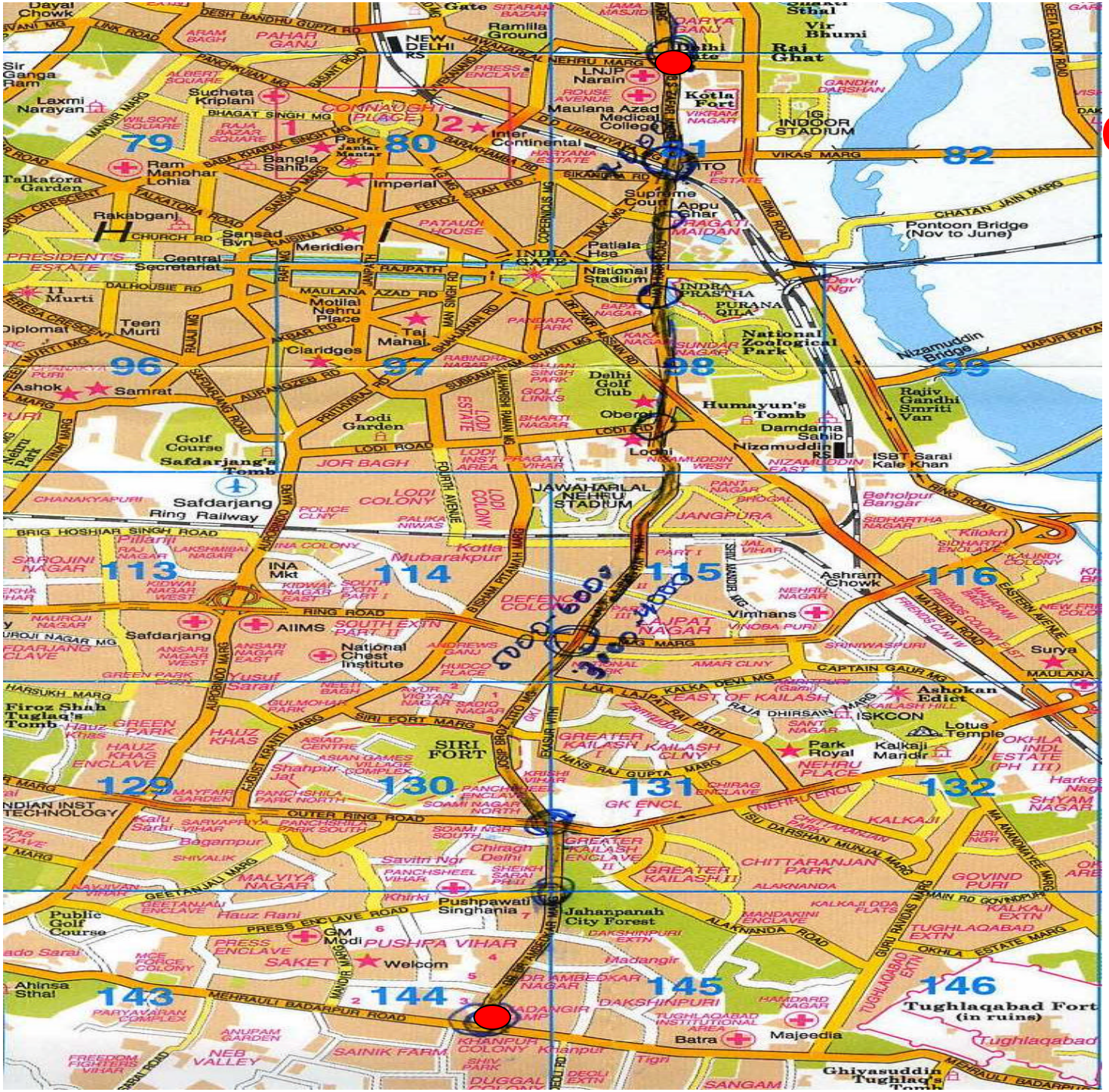
Bus based systems are more cost effective… can be implemented within a short time span

The cost structure of various mass transportation systems

Mode	Capital cost* per route Km ($ m)	Operating cost per passenger km** US cents
Metro	40 to 90	15 to 23
Bus priority lanes	< 0.5	3 to 8
High capacity busways	2.0 to 10.0	8 to 12
Light Rail Transit	10 to 30	12 to 15

Transport plan of Delhi

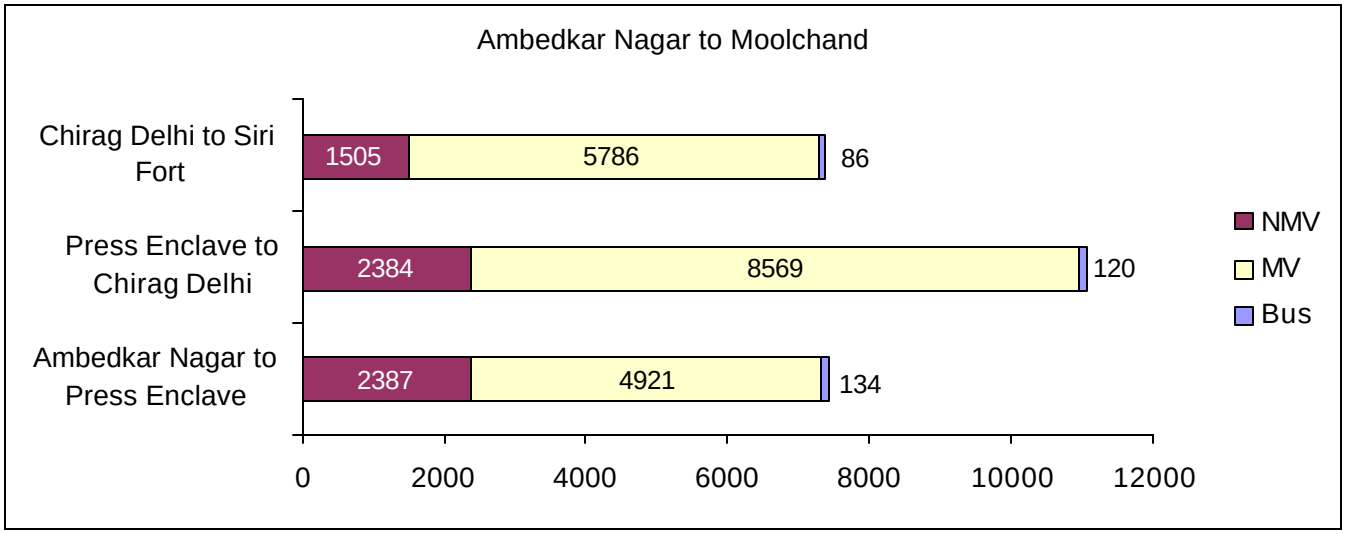


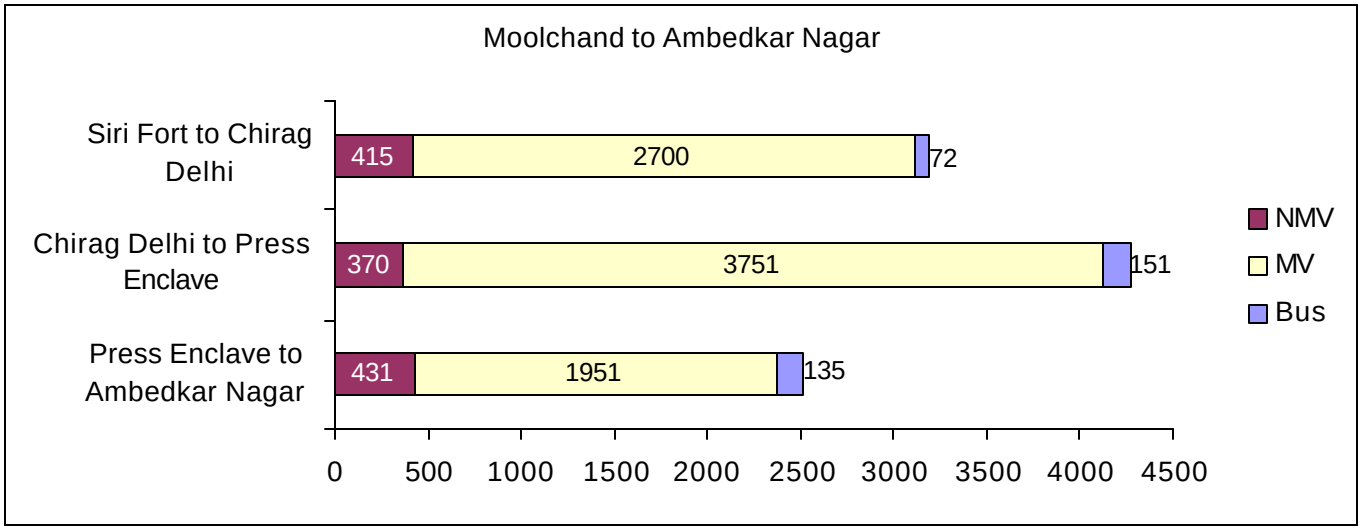


High Capacity Bus Corridor

Ambedkar Nagar to Delhi Gate

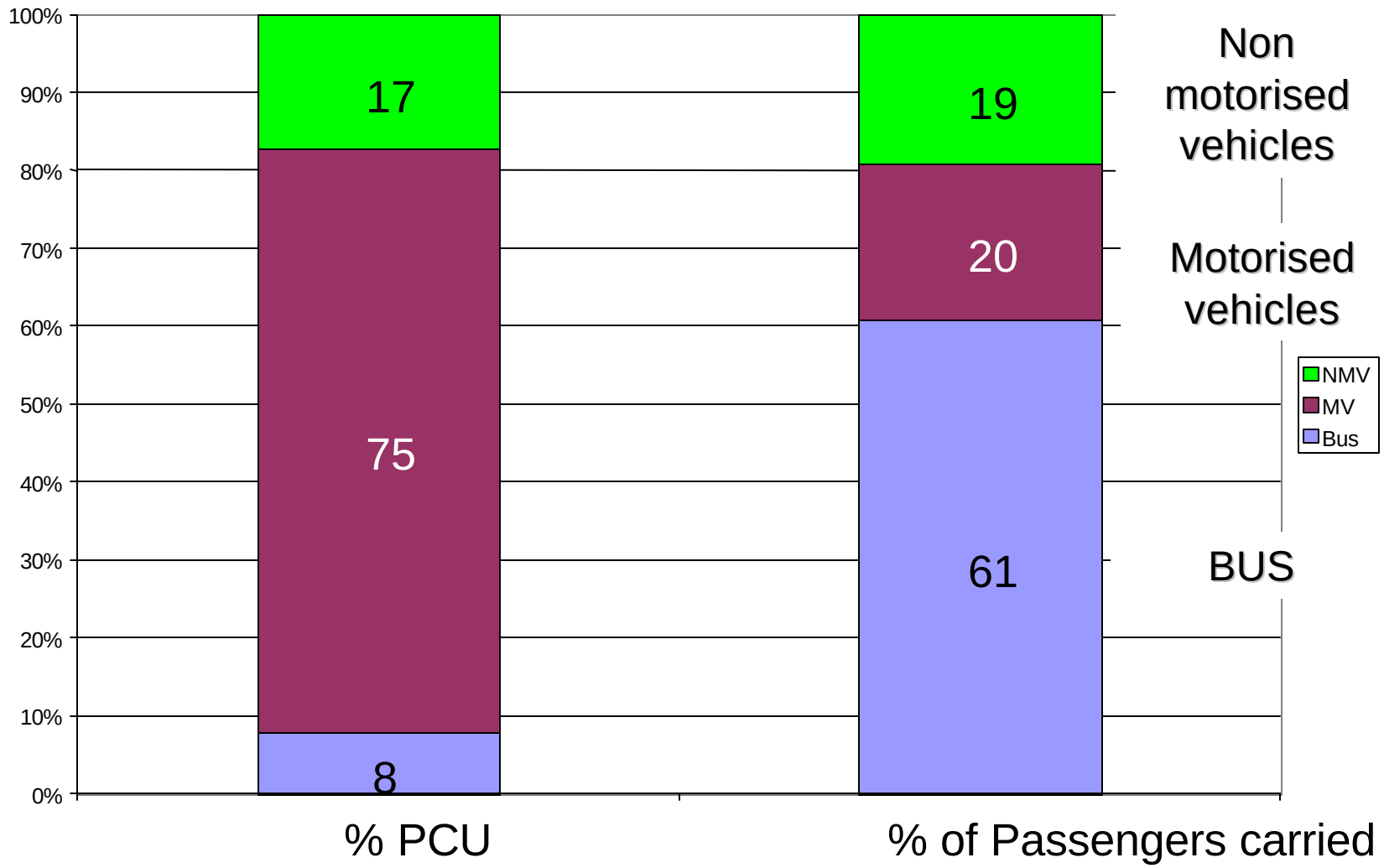
Joint traffic survey on HCBS corridor in Delhi reconfirms that our cities are different





Volume of bus and bicycle traffic is significant and growing

MODAL SHARE BY VOLUME AND PASSENGERS CARRIED AT AMBEDKAR NAGAR



The challenge of integration and management

The city needs to integrate all forms of transport to maximise access and mobility

Without easy transfers from one mode to the other passenger demand for each mode can remain small. Travel cost can increase.

Poor coordination can seriously hamper operations

Need good management system to create the interface for different modes of transport

The Way Ahead

Reinvent Mobility

Build public transport to leverage change
Manage mobility
Restrain cars
Use direct levers

Technology roadmap

Leapfrog emissions and fuel standards Get clean diesel or restrict dieselisation Improve two wheelers emissions Expand alternative fuel fleet

Fuel economy standards

Other measures:

Effective I&M and emissions warranty Strong fiscal incentive for change
Improve air and health surveillance

The Changemakers