VEHICULAR EMISSIONS & AIR QUALITY IN INDIA

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TERI

OUTLINE

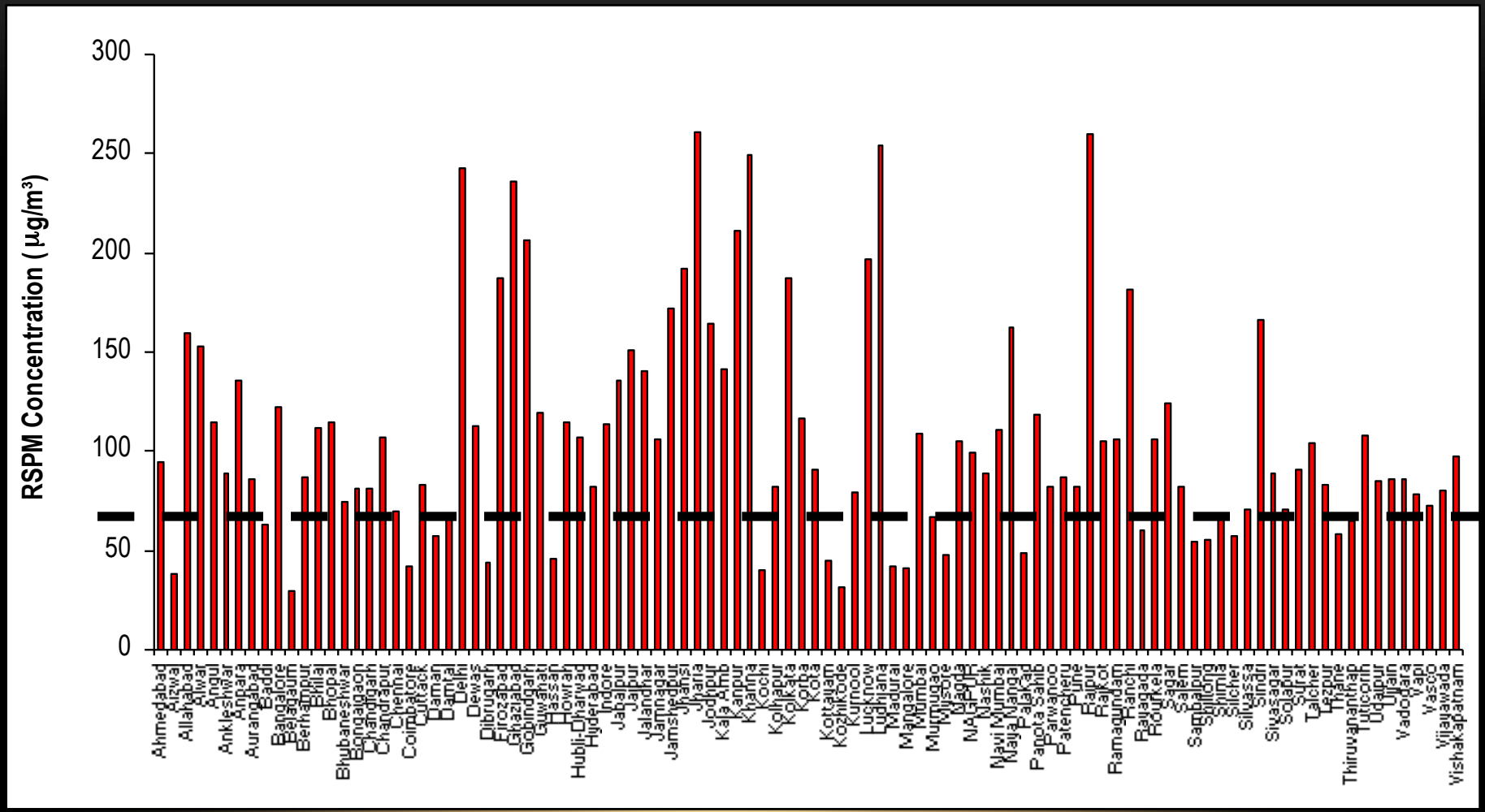
- Air pollution in India
- Share of transport sector
- Regional scale view of air pollution in India
- Impacts of air pollution
- Effects of introduction of advanced vehicular emission norms and improved fuel quality
- Way forward

AIR POLLUTION IN INDIA

NAAQS

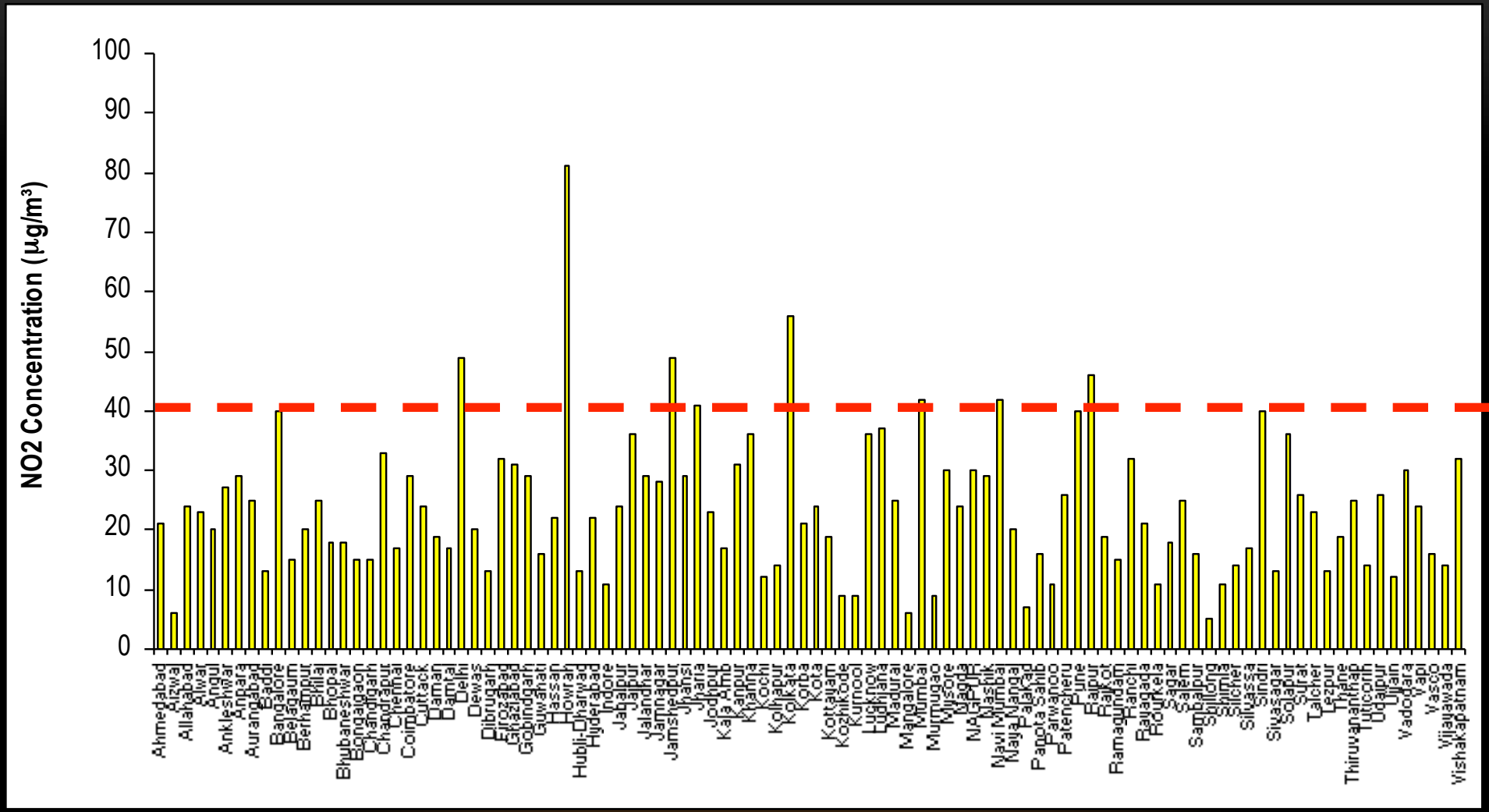
Pollutant	Time Weighted Average	Concentration in Ambient air (Industrial, Residential, Rural and other Area)
Sulphur Dioxide (SO_2), µg/m^3	24 hours* Annual average	80 50
Nitrogen Dioxide (NO_2), µg/m^3	24 hours** Annual average	80 40
Particulate matter (size less than 10µm) or $PM_{10,}$ µg/m^3	24 hours Annual average	100 60
Carbon Monoxide (CO), mg/m^3	8 hourly 1 Hourly	2 4
Ozone (O3), µg/m^3	8 hourly 1 Hourly	100 180
Particulate matter (size less than 10µm) or $PM_{25,}$ µg/m^3	24 hours Annual average	60 40

RSPM CONCENTRATION (2009)



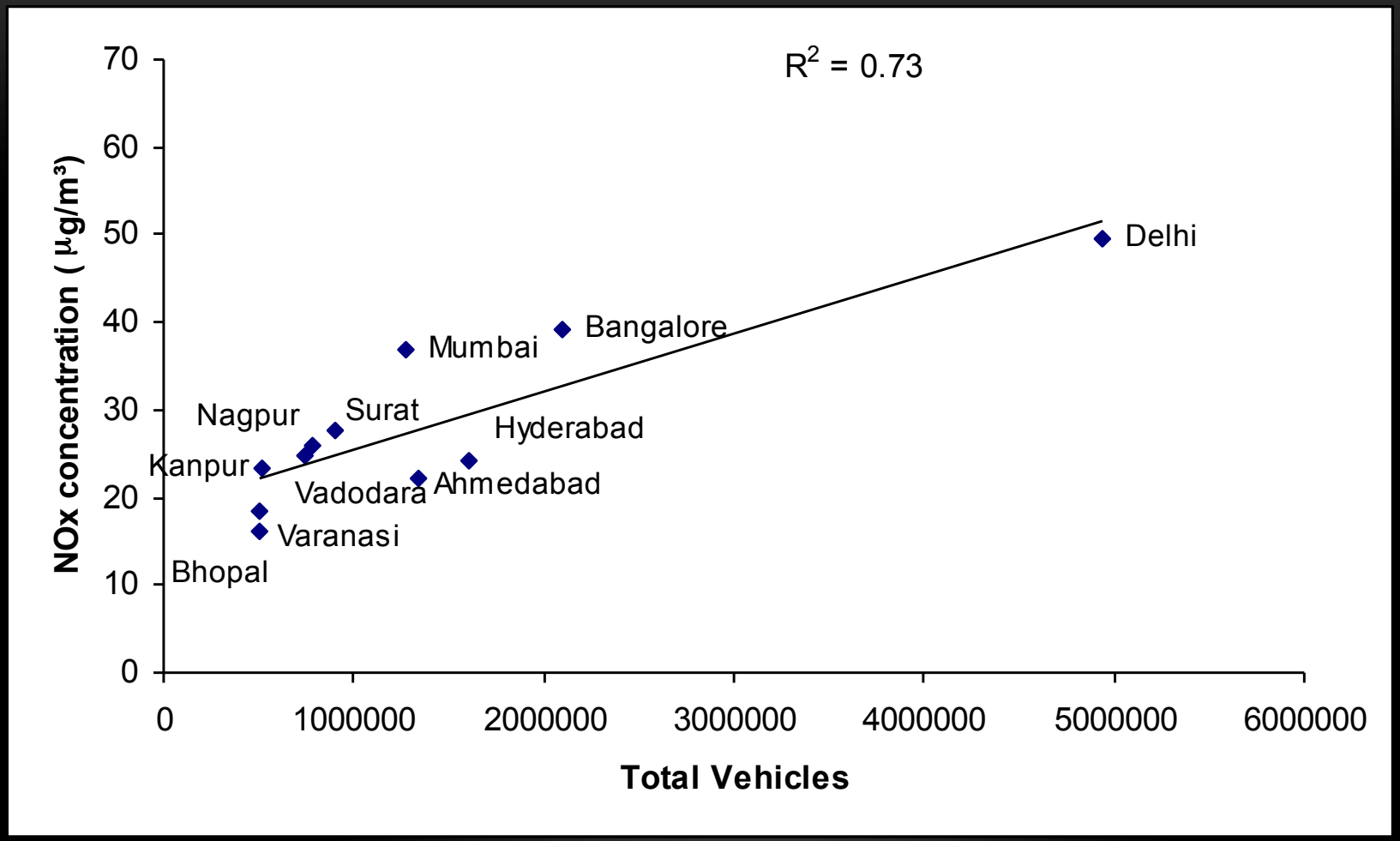
More than 80% cities violate the standards of RSPM

NO2 CONCENTRATIONS(2009)



- *Close to the standards at many places*
- *Highest at Howrah, Kolkata, Delhi*

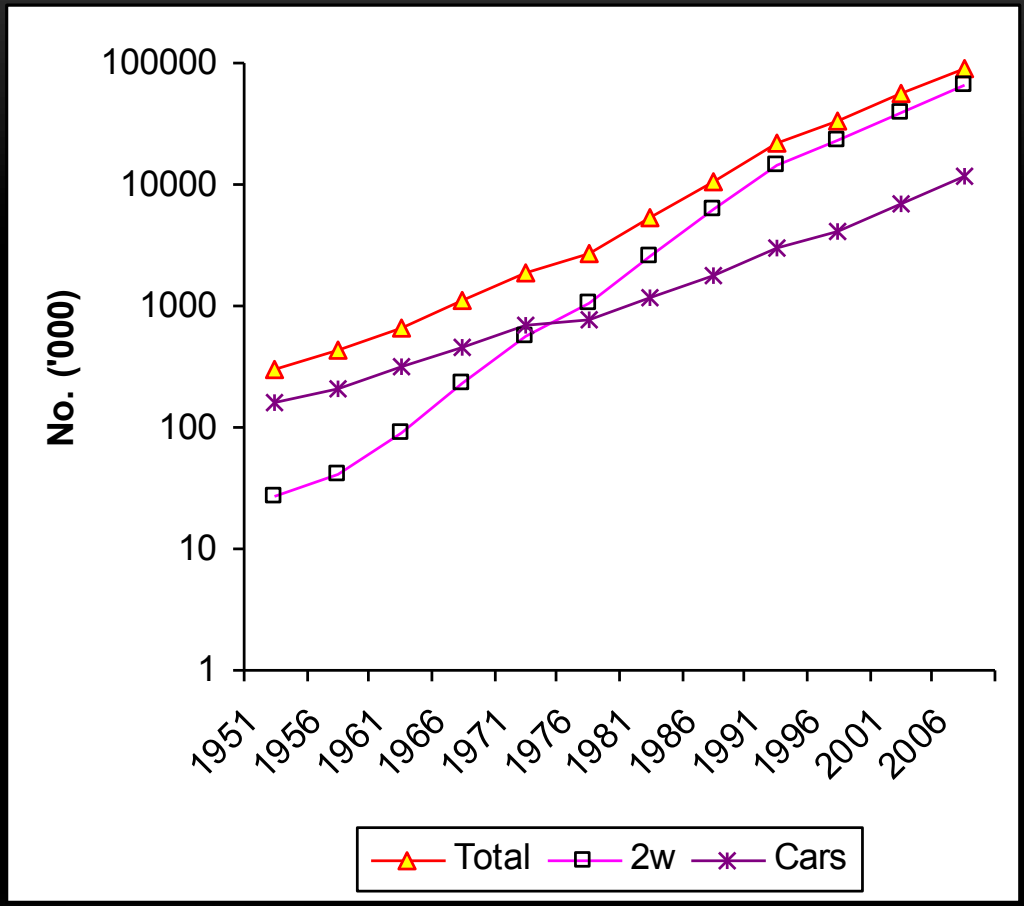
CORRELATION: VEHICLES AND NOX (2007)



TRANSPORT SECTOR IN INDIA

PHENOMENAL GROWTH OF PRIVATE VEHICLES

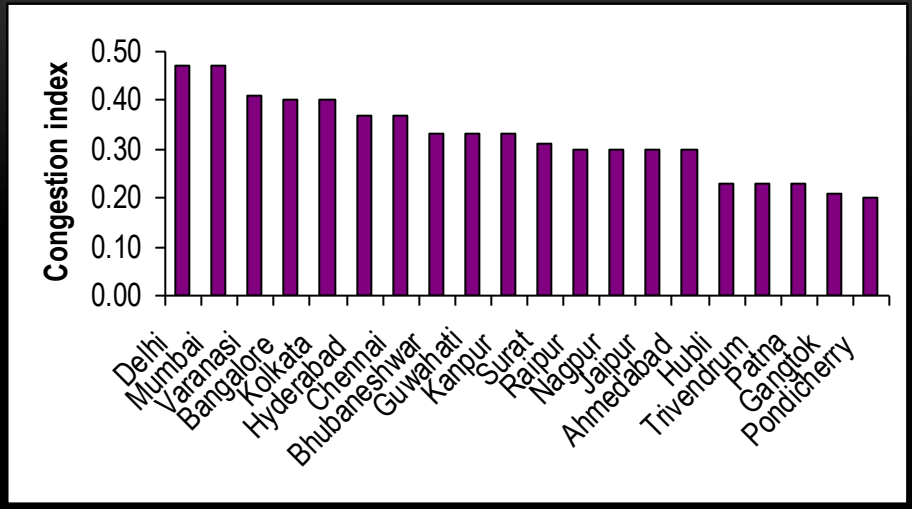
- A developing country phenomena
- Growth in income
- Mobility demands
- Lack of efficient public transport system
- Competitive market

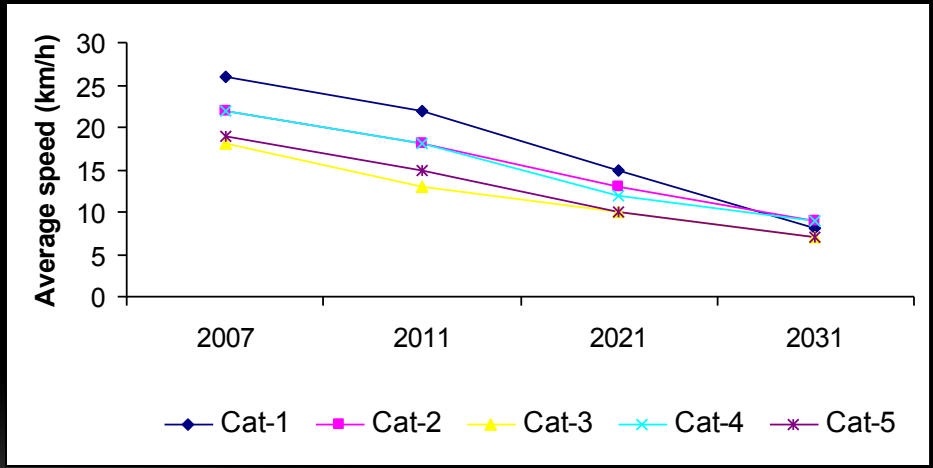


- 27 k two wheelers in 1951 to 26 lakhs in 1981 to 9.1 crores in 2010
- 1.5 lakh cars in 1951 to 11.6 lakh in 1981 to 1.4 crore in 2010

CONGESTION

- About 25000 two wheelers, and 5000 cars added to India's vehicular fleet daily
- Road space almost same
- Limited transport infrastructure
- Traffic jams: waste of fuel, time, emissions, discomfort
- Reduced speeds
- 320 kl of petrol and 100 kl of diesel burnt daily due to the idling of vehicles at traffic intersections in Delhi alone (CRRI, 2003)

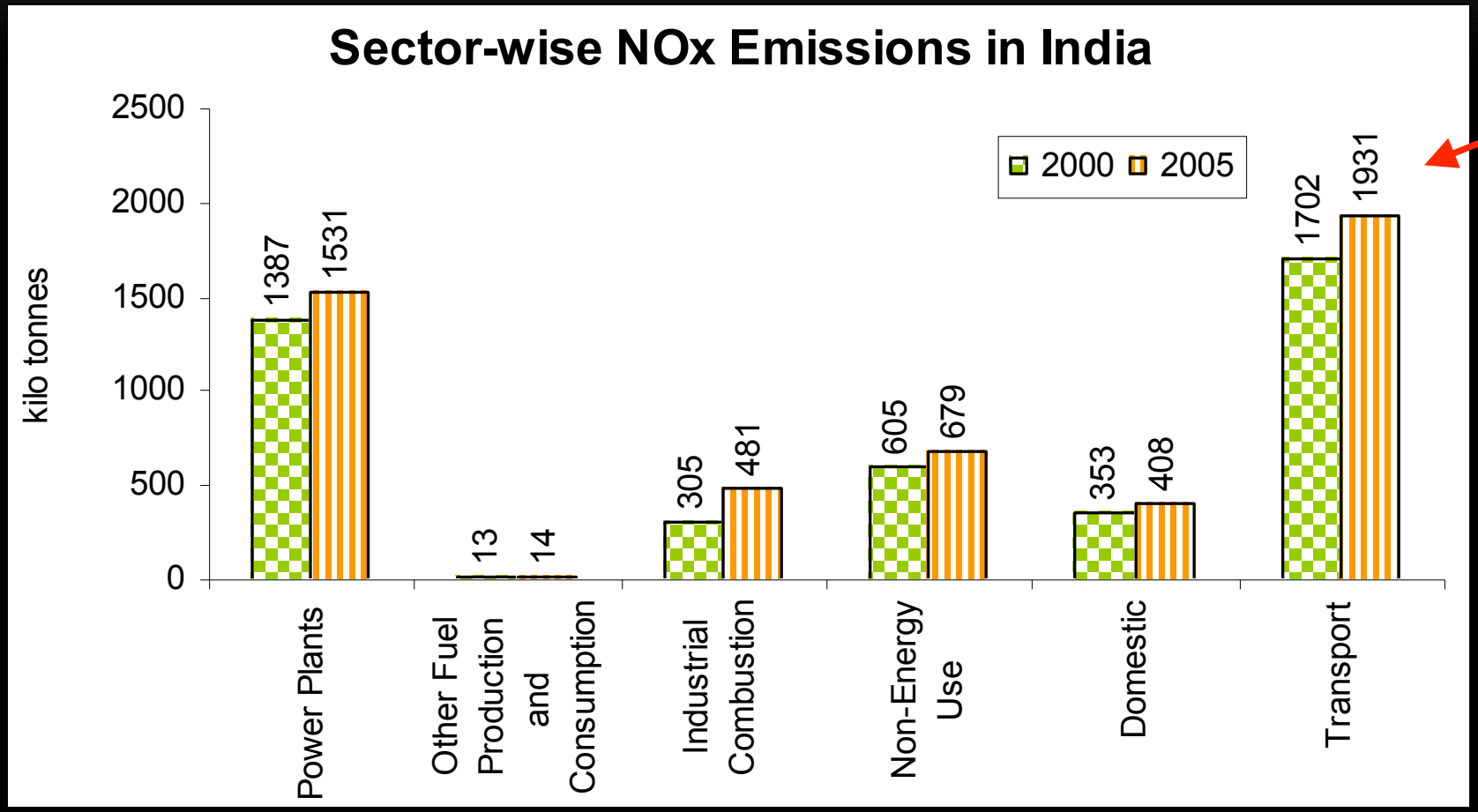




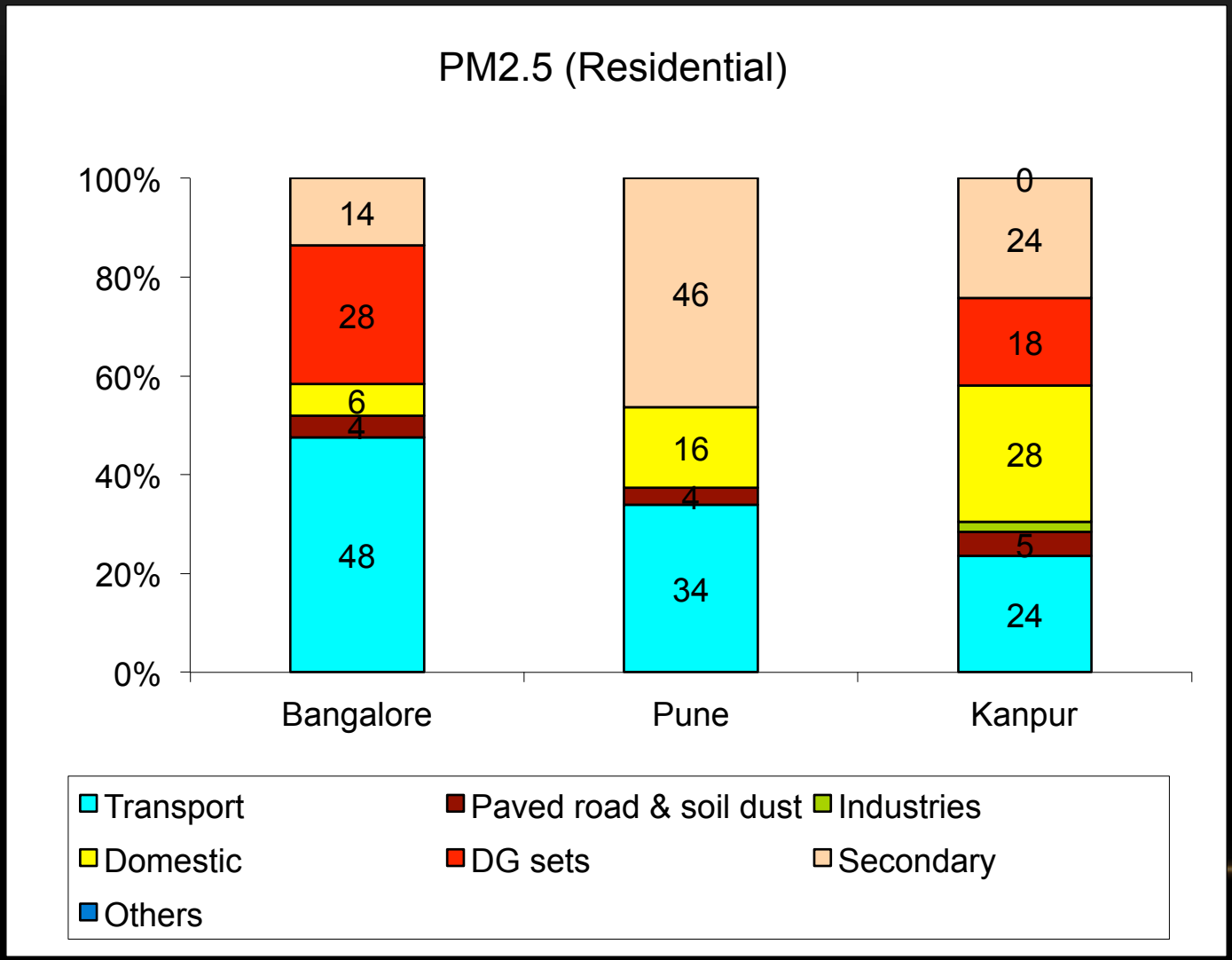
Data source : WSA, 2008

SHARE OF TRANSPORT SECTOR IN AMBIENT AIR POLLUTION: SOURCE APPORTIONMENT STUDY

EMISSIONS AT COUNTRY LEVEL

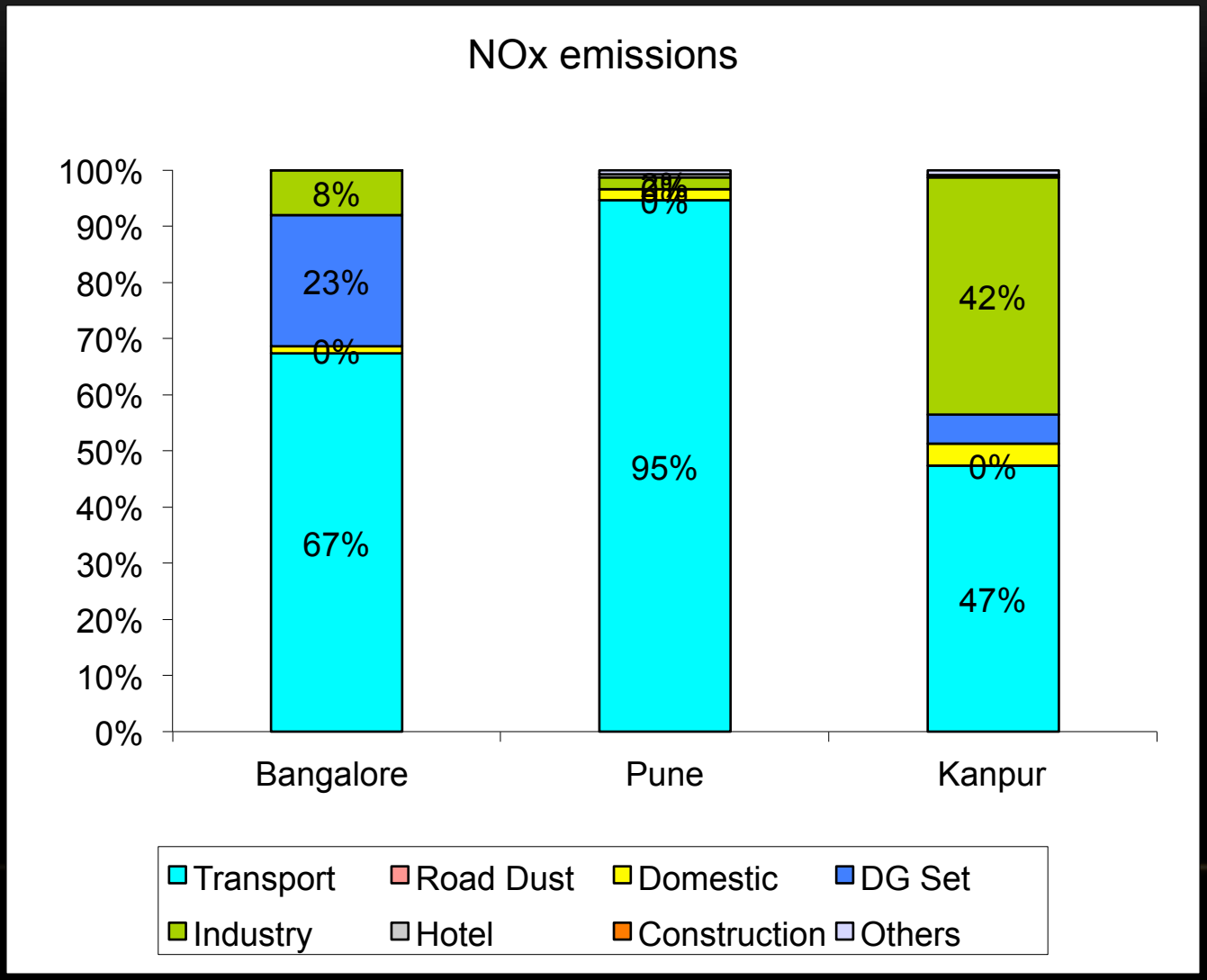


SHARE OF TRANSPORT SECTOR IN DIFFERENT CITIES

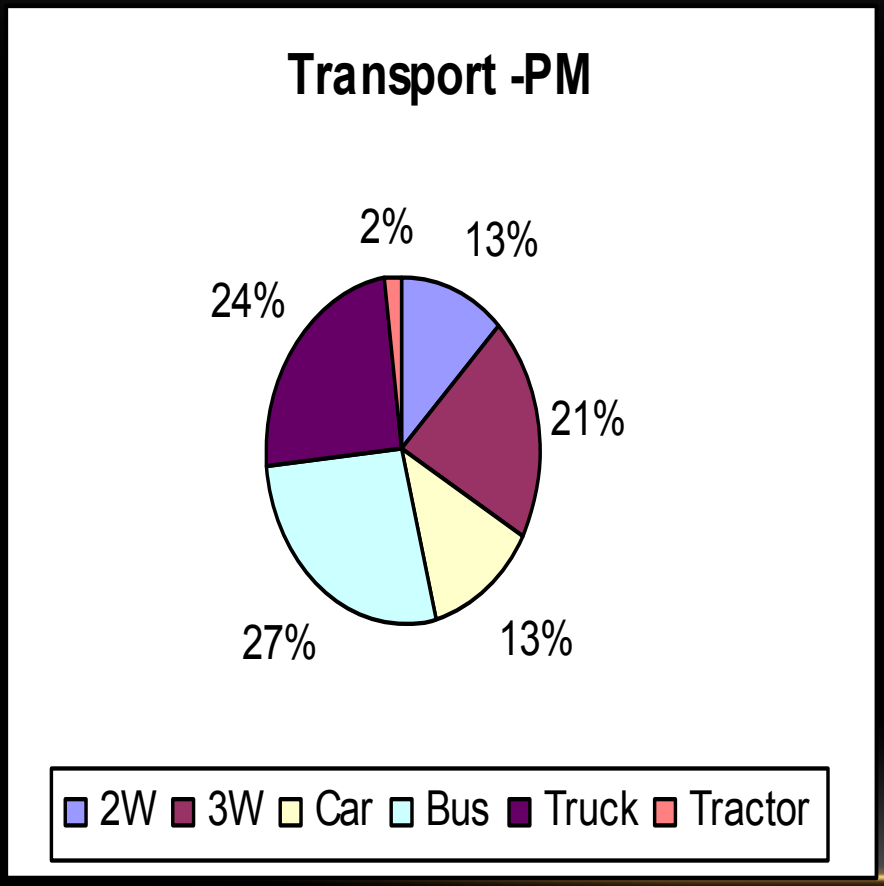


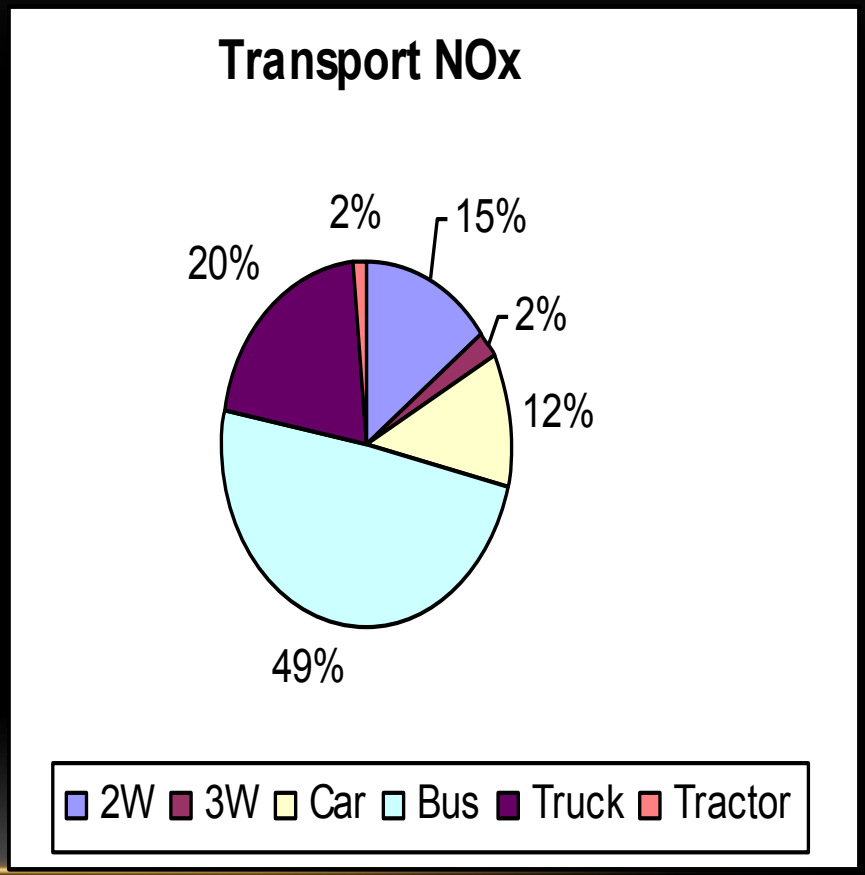
- Share of transport sector increases if we move from PM10 to PM2.5 (finer fractions)
- In non-industrial cities, it is the largest source

SHARE OF TRANSPORT IN NOX EMISSIONS



SHARE OF COMMERCIAL VEHICLES (BANGALORE)





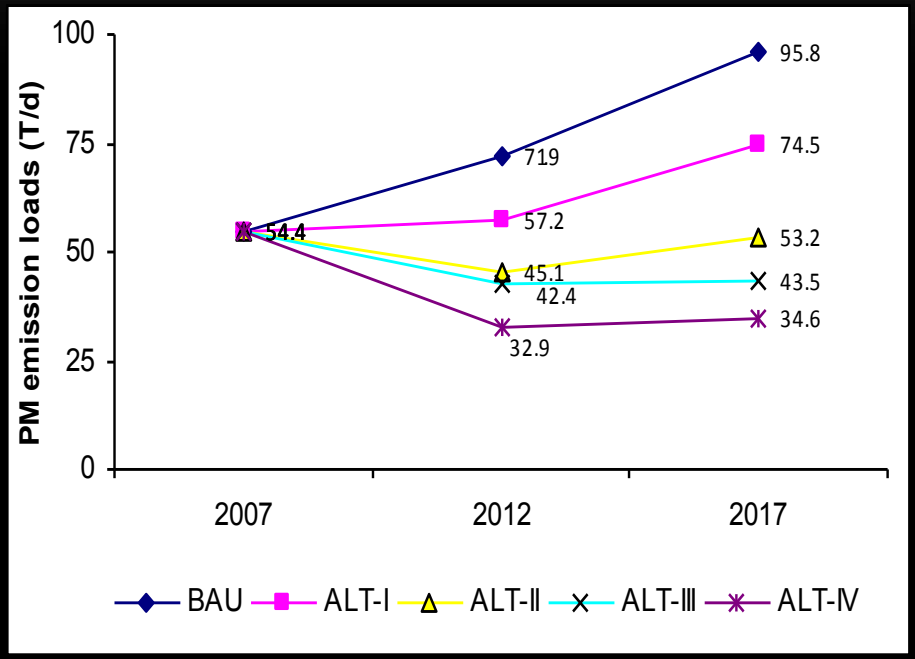
ALTERNATE SCENARIO DESCRIPTION

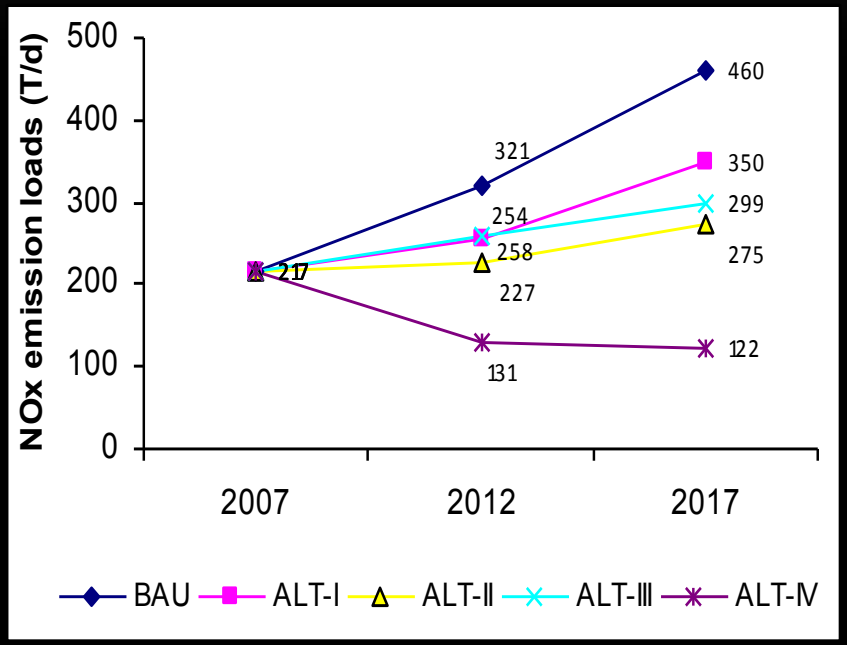
Sectors	Alternate-I	Alternate-II	Alternate-III	Alternate-IV
Description	**Strategies** to reduce the air pollution loads across various sectors.	**Stringent scenario with many more strategies** as compared to Alternate- I scenario.	Scenario that contains **additional set of measures** that are not a part of the common control options (e.g., introduction of **FES, installation of (DOC/DPF)**	**Scenario with measures that are more oriented towards meeting the air quality standards in future**
Transport	• **BS-V in 2015** • Ban on 10 year old commercial vehicles • Metro • PTS - **diesel** • I&M • DOC in BS-II buses and DPF in BS-III buses	• **BS-VI in 2015** • Ban on 10-yr old com. and 15-yr old private vehicles • Metro • PTS -**CNG** • Electric vehicles • I&M • Conversion of public transport to CNG	•**BS-VI in 2015** •Ban on 15 yr old com. vehicles in 2012 and 10 yr old in 2017 •Metro •PTS-diesel •Electric vehicles •I&M •**DOC/DPF** after introduction of BS- IV fuel in 2010 to: *Old Buses and Trucks* • *F*uel efficiency standards	• **BS-V in 2015** • Ban on 10 yr old com. vehicles • Metro • PTS- **CNG** • Electric vehicles • I&M • Conversion of public transport (commercial 3 & 4 w) to CNG • **By-passing of trucks** around Bangalore

ALTERNATE SCENARIO DESCRIPTION (CONTD.)

Sectors	Alternate-I	Alternate-II	Alternate-III	Alternate-IV
Industries	Ban new air polluting industries in city limits	• Ban on any new air polluting industries in city limits • Shift from solid to liquid fuel	• Ban on any new air polluting industries in city limits • Shift from solid fuel to liquid fuel	• Ban on any new air polluting industries in city limits • Shift from solid fuel to liquid fuel
DG sets		• Inspection and maintenance	• Inspection and maintenance • DOC and DPF applied to commercial DG sets (>12 kVA)	• **No power cuts i.e. no usage of DG sets in the city**
Road dust re-suspension		• Wall to wall paving	• Wall to wall paving	• Wall to wall paving • Reduction of road dust re-suspension due to by-passing of trucks
Construction		• Better construction practices	• Better construction practices	• Better construction practices

ESTIMATED EMISSIONS LOADS FOR PM10 AND NOX UNDER THE BAU & ALT SCENARIOS





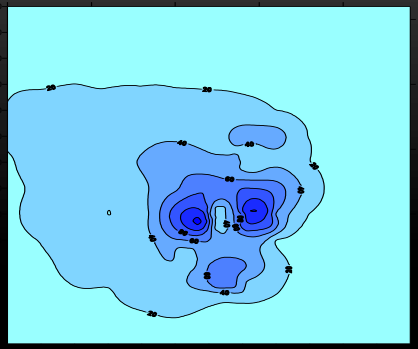
%PM reduction w.r.t. BAU

Scenario	2012	2017
ALT-I	-20%	-22%
ALT-II	-37%	-44%
ALT-III	-41%	-55%
ALT-IV	-54%	-64%

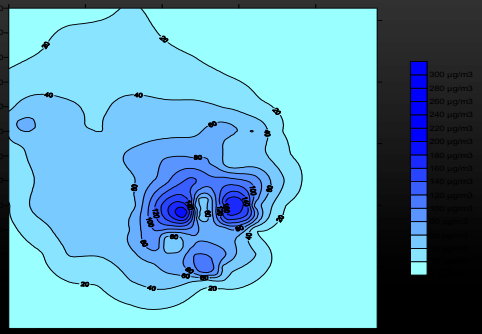
% NOx reduction wrt BAU

Scenario	2012	2017
ALT-I	-21%	-24%
ALT-II	-29%	-40%
ALT-III	-20%	-35%
ALT-IV	-59%	-73%

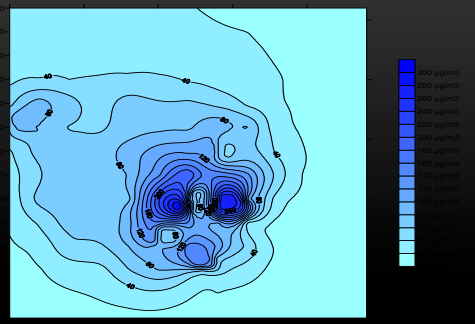
NOX CONCENTRATION (µG/M3) FOR BAU & ALT SCENARIOS



BAU
2007

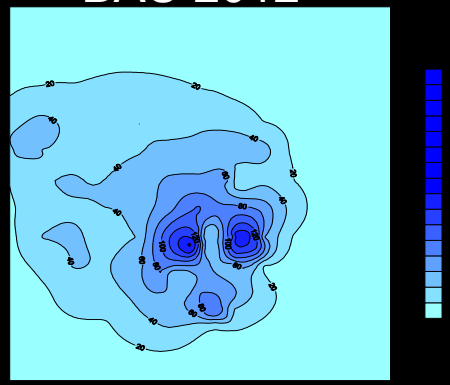


BAU 2012

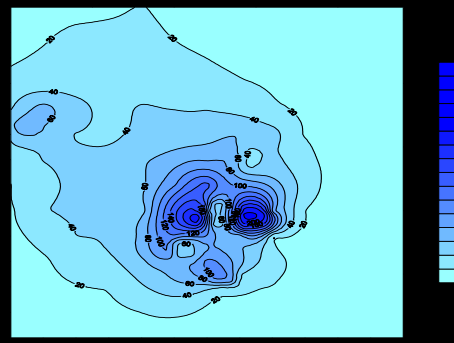


BAU 2017

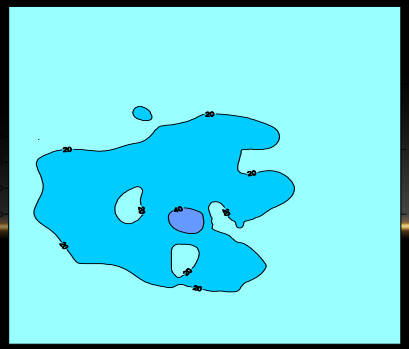
- Alternate scenarios show a significant decrease compared to BAU scenario (both in 2012 & 2017)
- Alt. IV scenario, has maximum reduction and all the areas in the study domain comply against the residential area standards



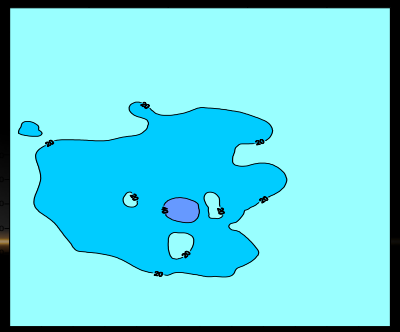
Alt III 2012



Alt III 2017



Alt IV 2012

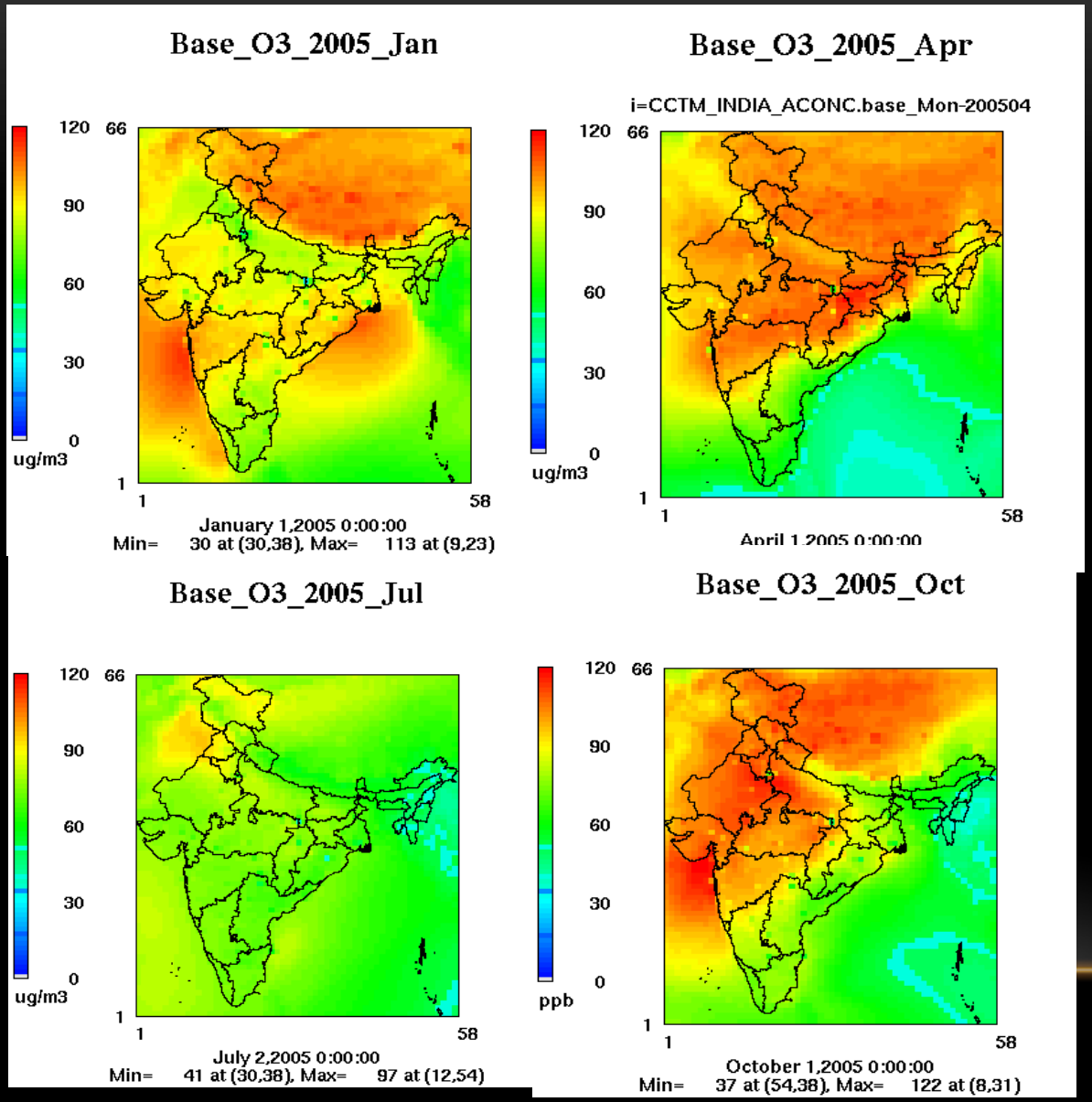


Alt IV 2017

REGIONAL SCALE IMPACTS OF NOX

- While considerable attention paid to PM, NOx still remains almost unattended
  - Health impacts
  - Leads to secondary particulate formulations
  - Acid rain
  - Important pre-cursor to Ozone formation
- Regional scale impacts of NOx

OZONE FORMATION



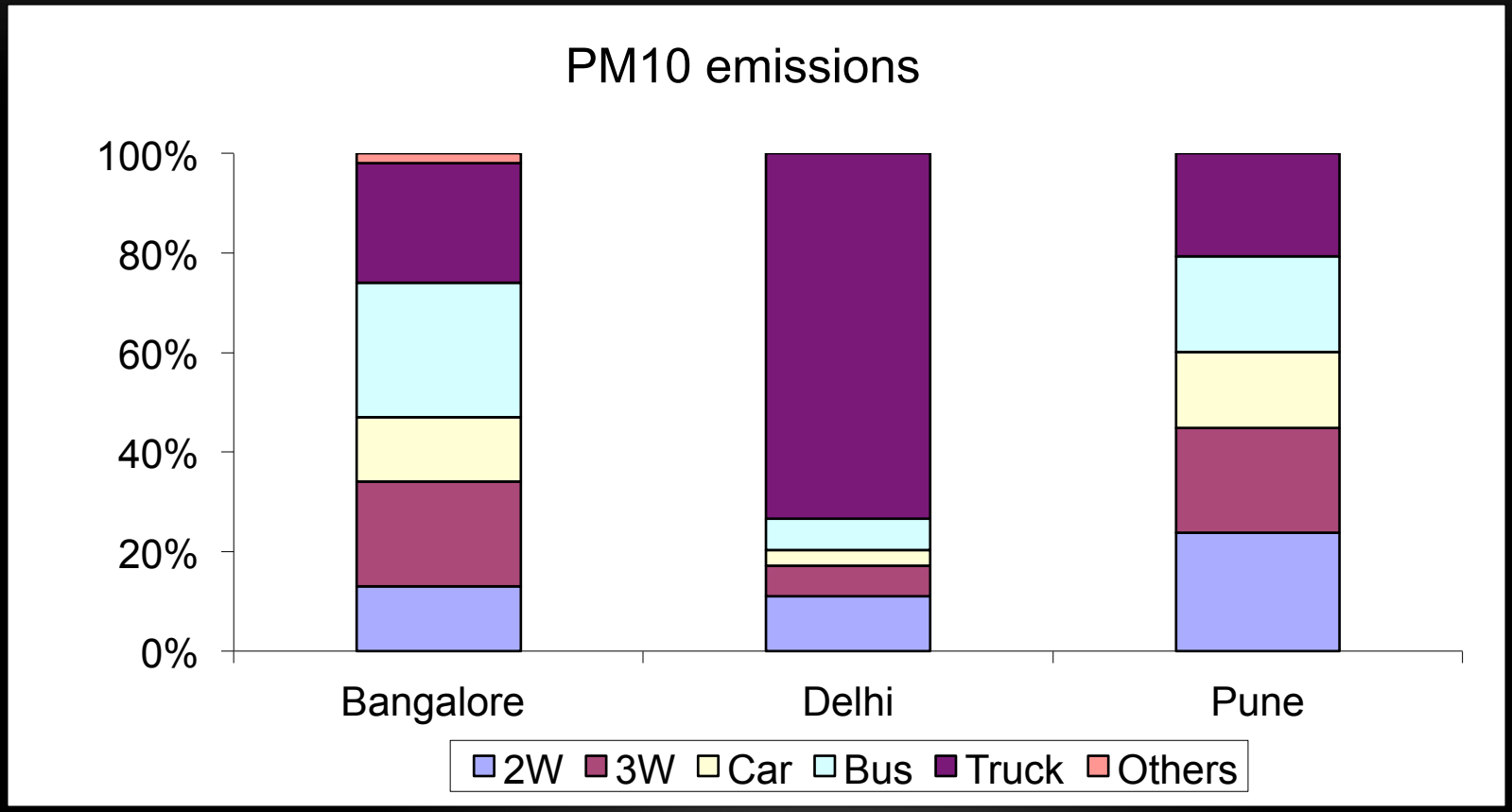
- NOx is an important pre-cursor for Ozone formation
- Ozone values higher during April and October which generally have more sunshine than the winter and monsoon months of January and July, respectively.
- Not only health but agricultural productivity is impacted

IMPACTS

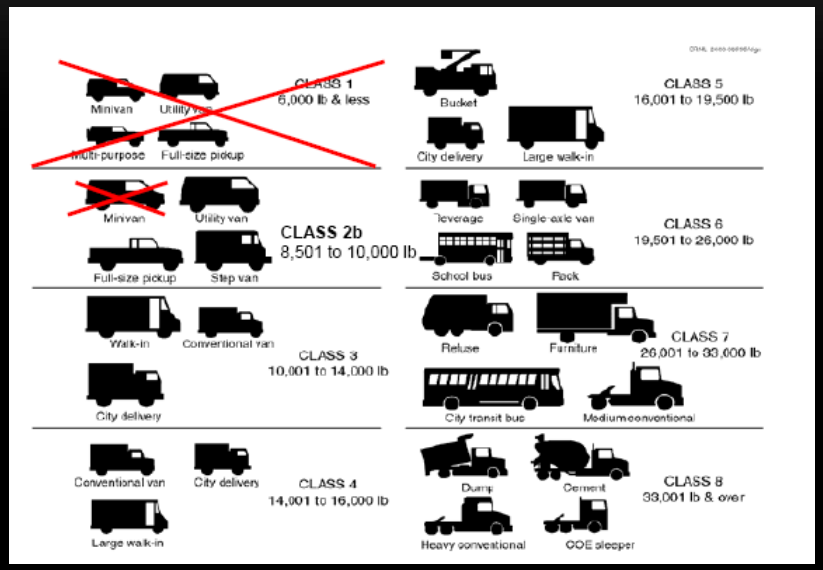
- Sufficient evidence to document the causal relationship with the onset of childhood asthma, non-asthma respiratory diseases, impaired lung function, cardiovascular mortality and morbidity.
- As per TERI's estimates, about 50,000 deaths could be attributed annually to ambient air pollution in the country.
- Institute of Economic Growth (Delhi), 2003 estimated the annual damages from the urban air pollution in 15 major cities as Rs 111392 million.
- ICCT, 2012 suggests that about 9500 excess deaths were avoided due to advancement of vehicular emission norms during 2000-2011. Moreover, by the year 2035, 48000 mortalities could be avoided annually, if stringent actions like advancement to improved vehicular emissions norms, provision of ULSD, improvement of fuel efficiency etc could be taken in the short timeframe.
- Effects on vegetation, visibility, ecology etc

EMISSIONS FROM COMMERCIAL VEHICLES

SHARE OF COMMERCIAL VEHICLES



U.S. HDV GHG AND FUEL EFFICIENCY FINAL RULE



- 26 % share in the transportation fuel used in the U.S.
- Sets separate standards for engines and vehicles, ensures improvements in both
- Sets separate standards for fuel consumption, CO2, N2O, CH4 and HFCs. Fuel consumption and CO2 standards are aligned.
- Incentives for advanced technologies (e.g. EVs and Hybrids)

Benefits

530 million barrels less oil
J $50 billion in fuel savings
J $42 billion in net savings

J 270 MMT lower GHGs
J $8 billion in new hardware
J $49 billion in net benefits

Source : EPA

STRATEGIES TO REDUCE EMISSIONS FROM HD COMMERCIAL VEHICLES

- Technological advancements – emissions control, fuel efficiency improvements
- Fuel quality improvements
- Better I&M programs
- Effective traffic planning
    - Plying restrictions
    - Bye-passing of transit traffic
- Installation of control devices in older vehicles
- Fleet modernization programs

THANKS