Measurement of Air Quality Indicators

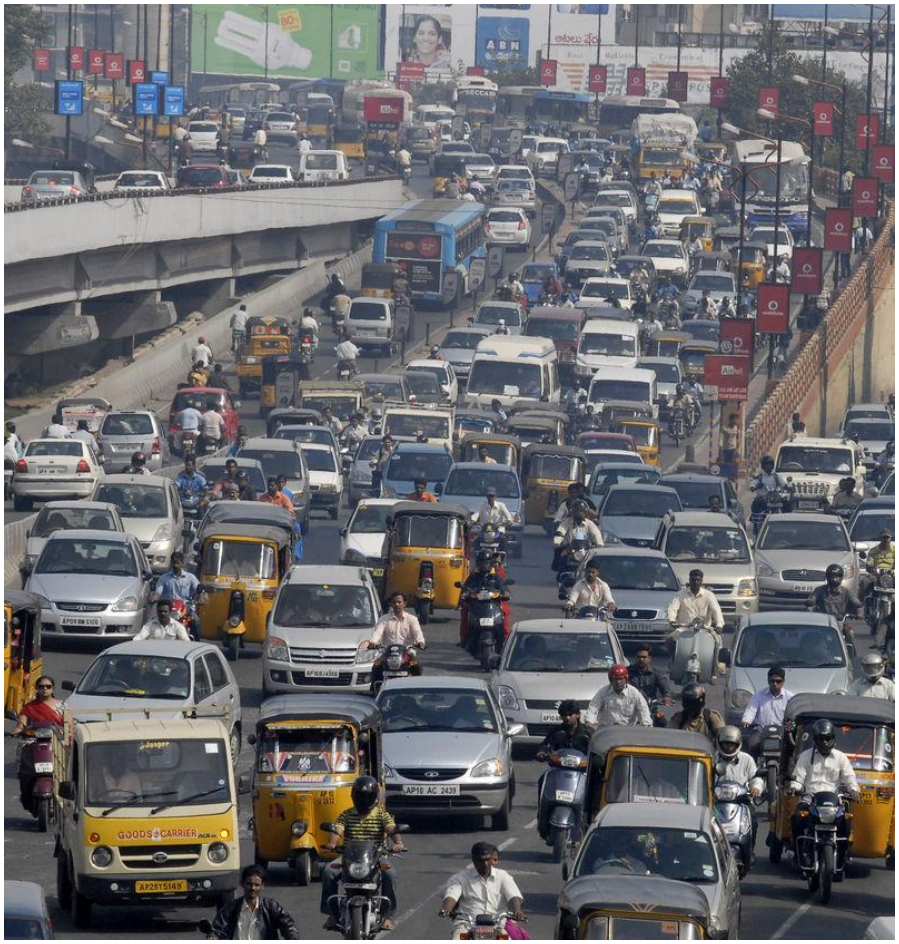
Dr. Sarath Guttikunda
Co-Director @ UrbanEmissions.Info, New Delhi, India
Affiliate Associate Research Professor, Desert Research Institute, Reno, USA

Mr. Rahul Goel
PhD Candidate, Indian Institute of Technology, New Delhi, India

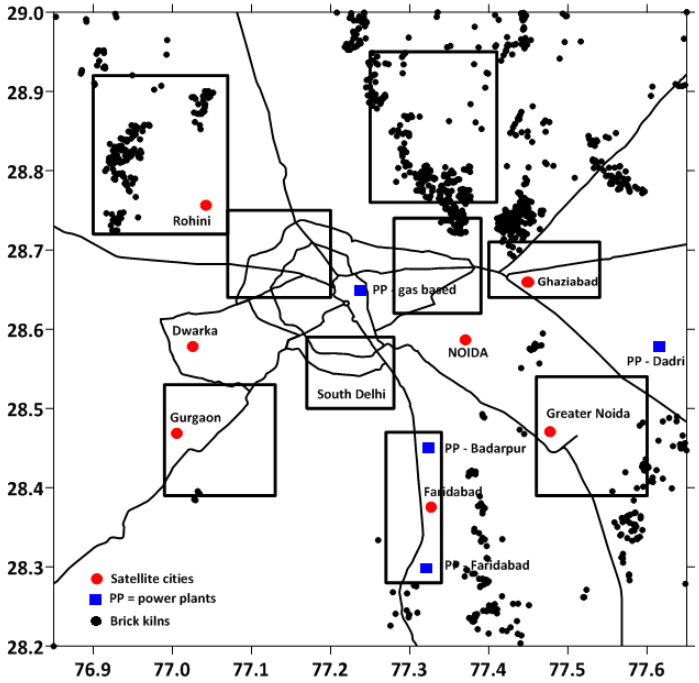
Capacity Building Workshop for Low-Carbon Comprehensive Mobility Plans for Indian Cities

New Delhi, April 12th, 2012

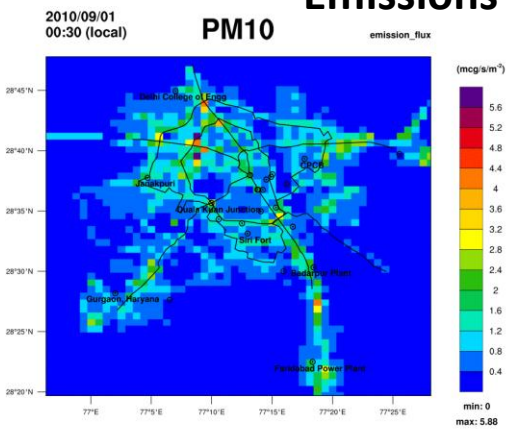
Urban Jungle



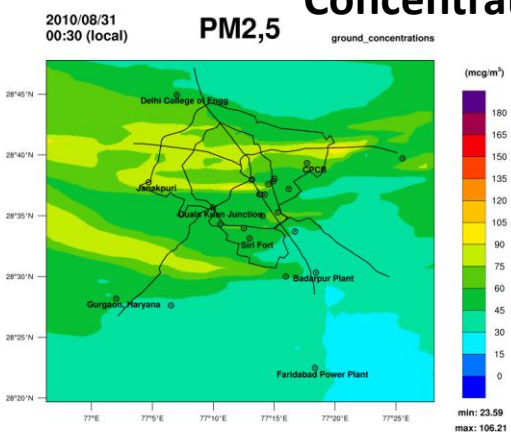
Local vs. Non-Local Sources

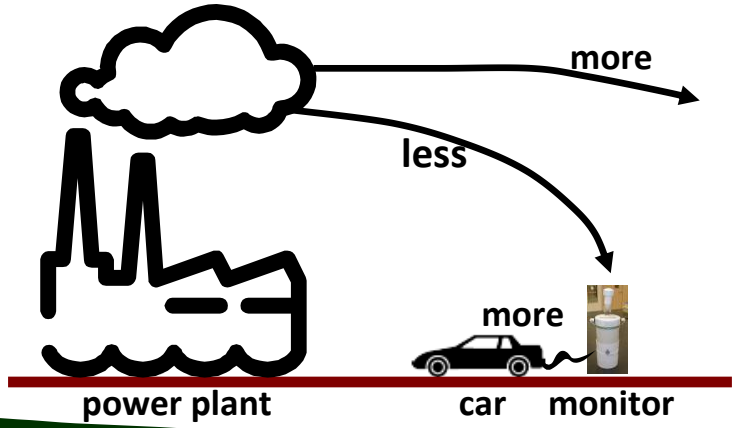


Emissions

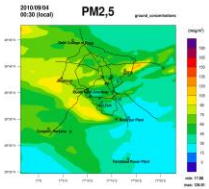


Concentrations





Monitoring



PM, SO2,
NOx, CO,
Ozone, VOC

Concentrations

Contributions

Evaluation

Dispersion
Modeling

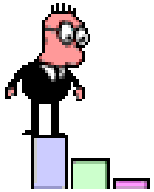
Emissions

SIM-air
Program

Impacts

Costs &
Benefits

Pollution
Control

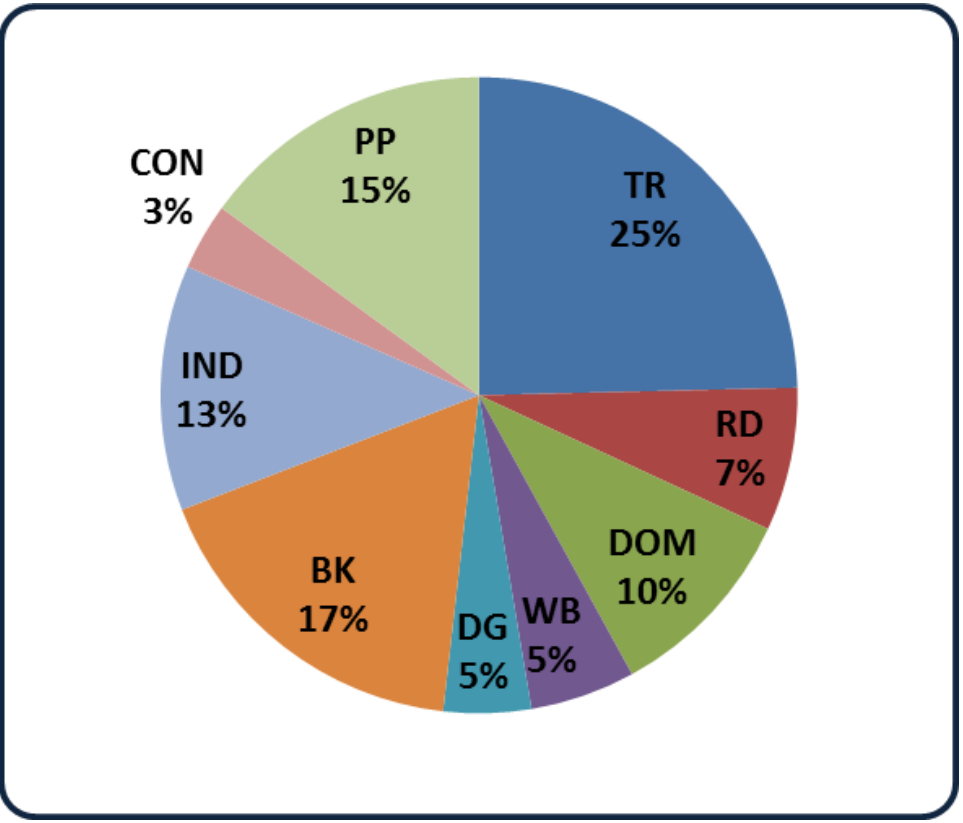


Economic
Technical
Policy

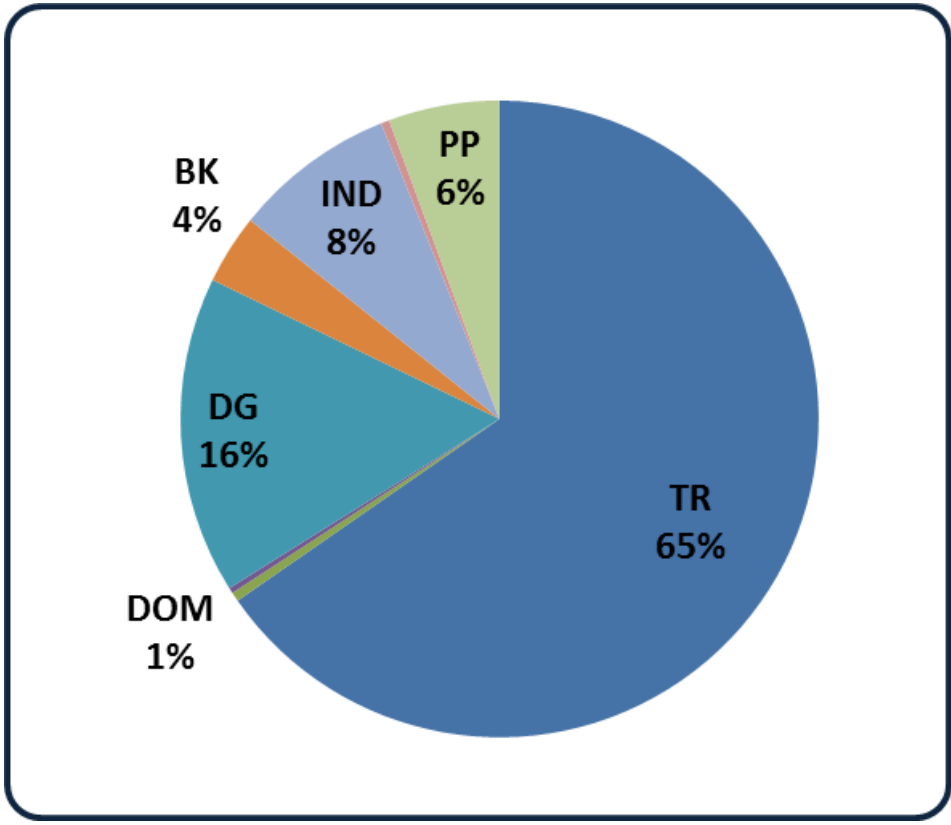
Decisions

2010 Emissions Inventory for Delhi
It's a numbers game !!

$PM_{2.5}$



NO_x



IND = industries; PP = power plants; DOM = domestic; TR = transport; RD = road dust; WB = waste burning; CON = construction activities; BK = brick kilns; GS = generator sets

Health Alerts & Public Awareness

time dependent geo-referenced

emissions inventory

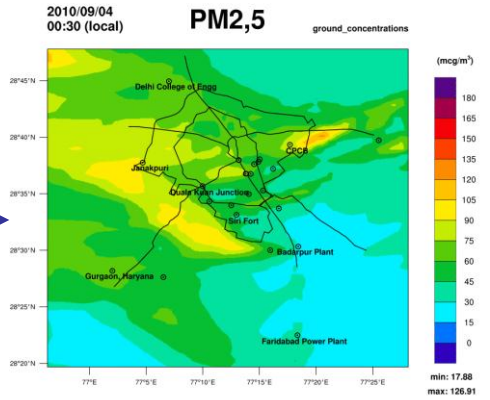
3D meteorology landuse data satellite data

Initial and boundary conditions

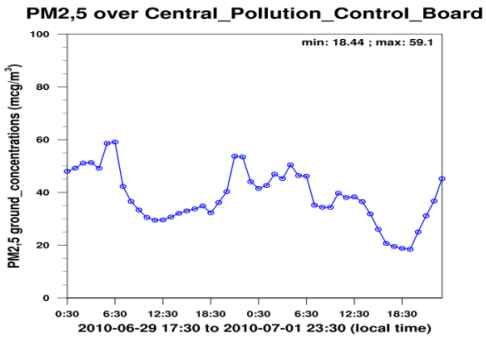
modeling

3D Chemical Transport Modeling

post processing



maps & data



48 hr time series

AQI Scale

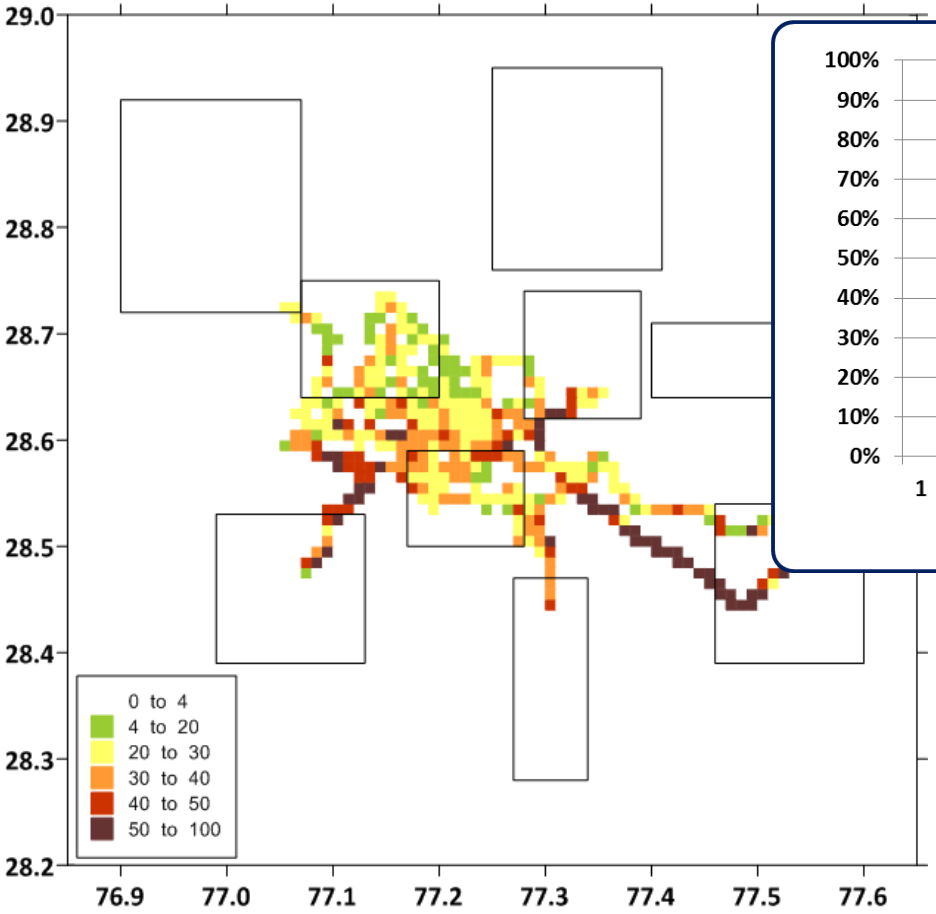
0-50	51-100	101-150	151-200	201-300	>300
Healthy	Moderate	Unhealthy (sensitive groups)	Unhealthy	Harmful	Hazardous

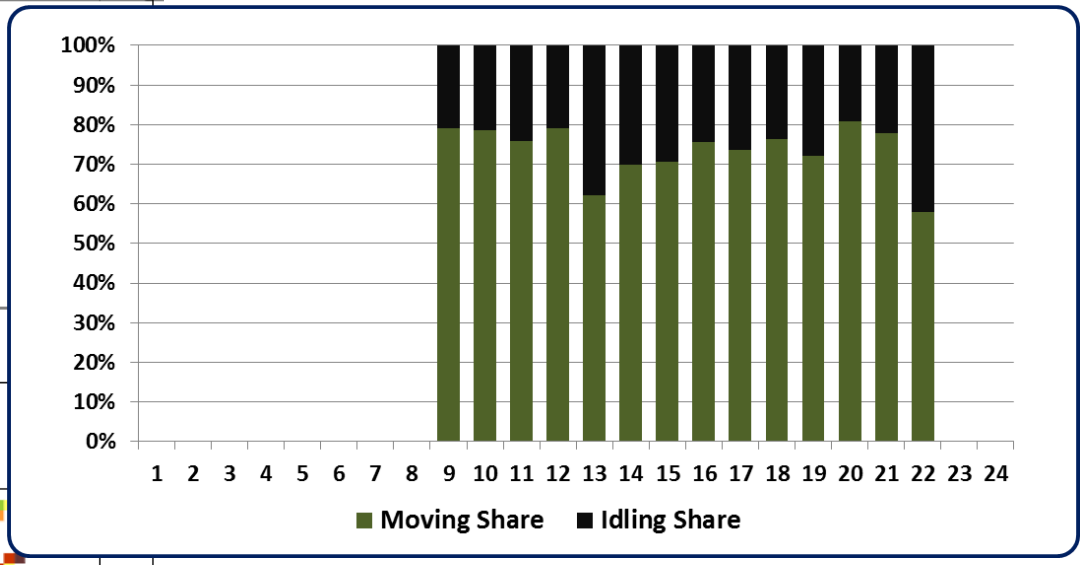
Individual, averages, worst cases, weighted averages

Measurable Indicators for Air Quality

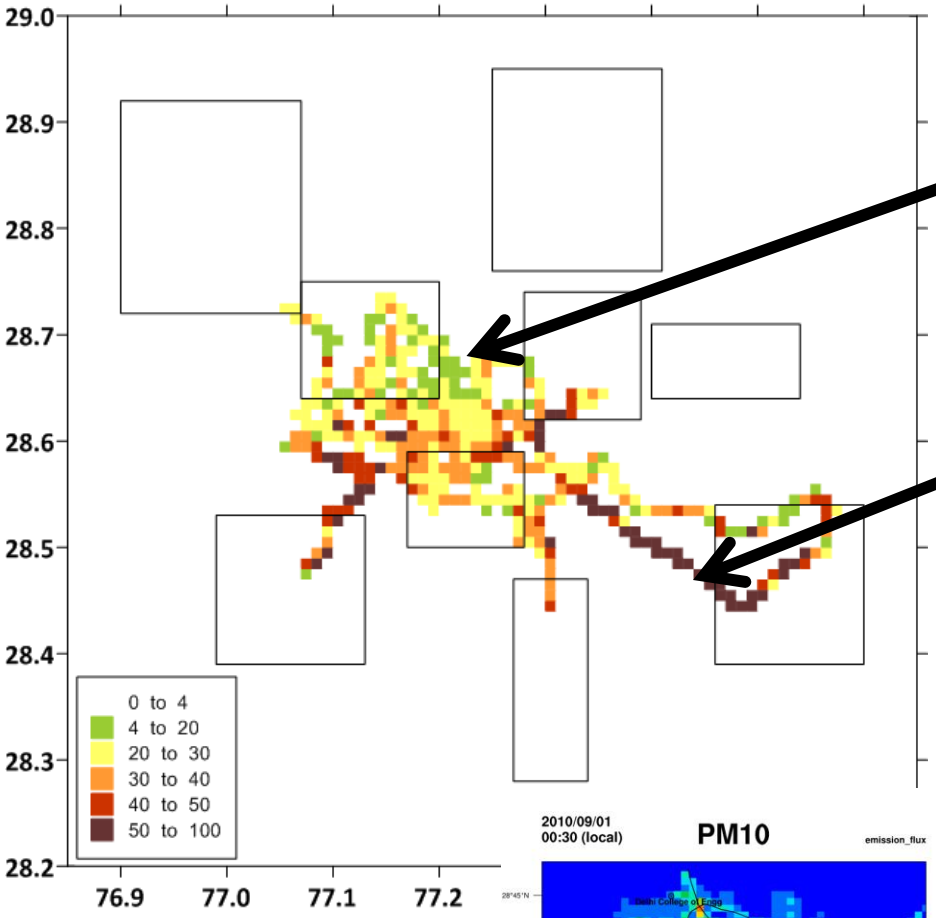
- Idling times by mode, resulting in fuel wastage and more emissions
- Speeds affecting the emission rates by vehicle type
- Exposure rates on the roads effecting personal health
- Age profiles to study the gross polluters

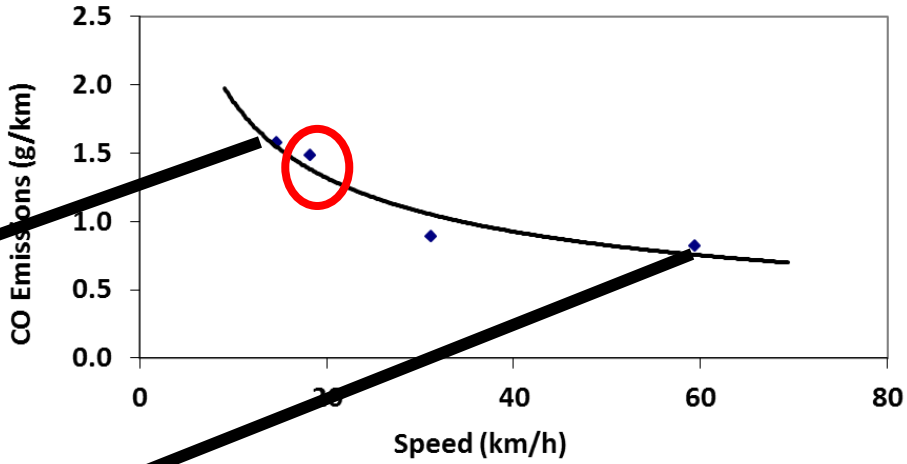
Car moving speeds in Delhi – km/hr

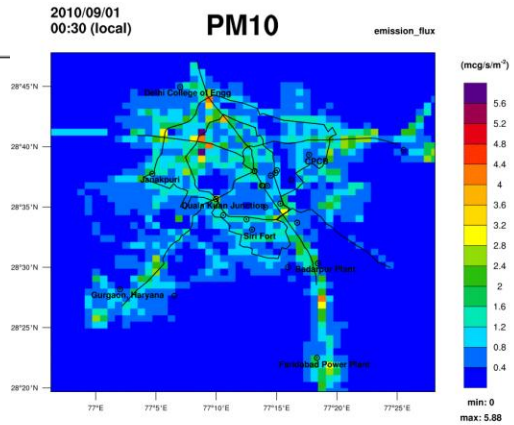




20% of drive time in idling = 24 min of idling for 2 hours of driving
Equivalent of 0.20 lit of petrol/diesel wastage
1 million cars daily waste 200,000 lit
Equivalent of Rs. 1.0 crores @ Rs.50 per lit
Building new roads or flyovers is not an answer

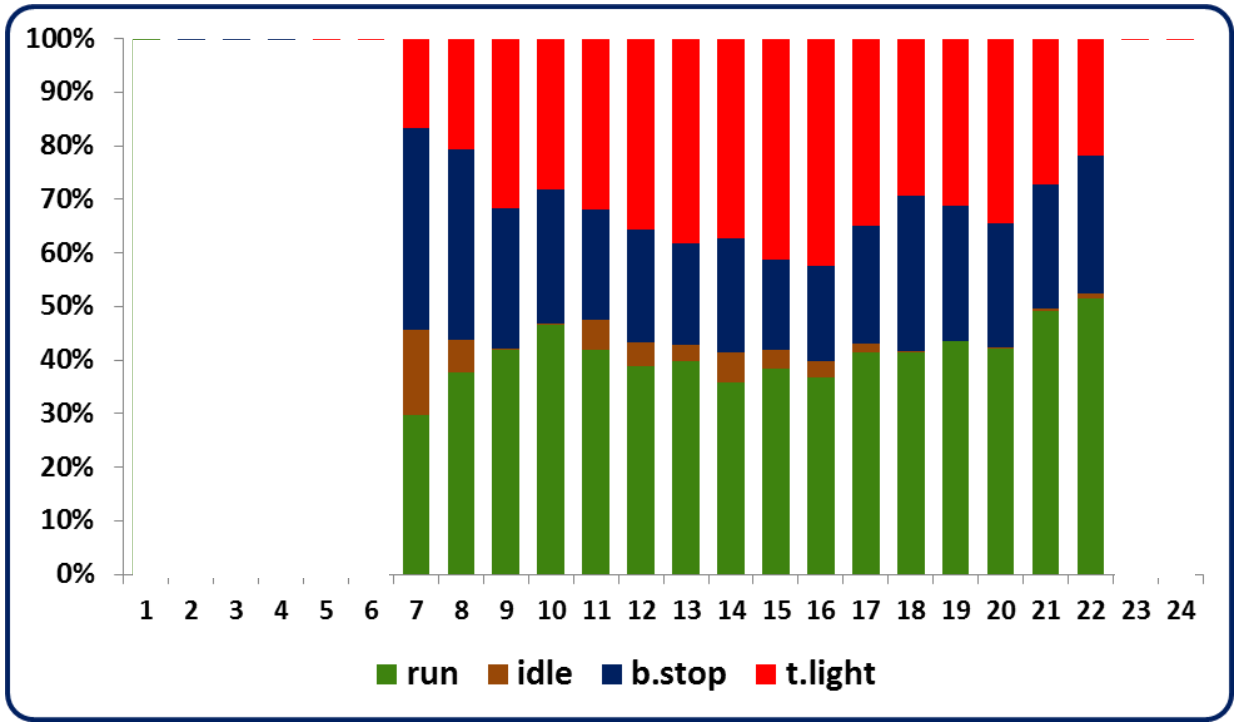






	Hour	mins run	mins idle	kmph speed	% idle	
1	0-1	0.0	0.0		0%	
2	1-2	0.0	0.0		0%	
3	2-3	0.0	0.0		0%	
4	3-4	0.0	0.0		0%	
5	4-5	0.0	0.0		0%	
6	5-6	0.0	0.0		0%	
7	6-7	0.0	0.0		0%	
8	7-8	0.0	0.0		0%	
9	8-9	67.3	15.8	40.1	19%	
10	9-10	145.3	41.2	33.1	22%	
11	10-11	184.2	47.0	28.8	20%	
12	11-12	168.3	41.2	25.0	20%	
13	12-13	140.3	75.2	23.3	35%	
14	13-14	142.0	59.5	28.0	30%	
15	14-15	114.4	47.6	28.1	29%	
16	15-16	153.9	49.9	26.7	24%	
17	16-17	173.5	62.0	30.5	26%	
18	17-18	146.5	45.1	32.1	24%	
19	18-19	124.9	48.4	21.9	28%	
20	19-20	105.1	24.9	26.2	19%	
21	20-21	77.4	22.0	32.8	22%	
22	21-22	14.0	10.1	38.5	42%	
23	22-23	0.0	0.0		0%	
24	23-24	0.0	0.0		0%	
	mins	1757.0	589.7	28.5	21.4	
	hrs	29.3	9.8		836	km

Buses in Delhi



Idling shares – sample GPS data from DIMTS

BRT pilot for 6km

Bus fleet was updated during 2010 CWG

Need to focus on fleet operations

Mail Today, March 1st, 2009

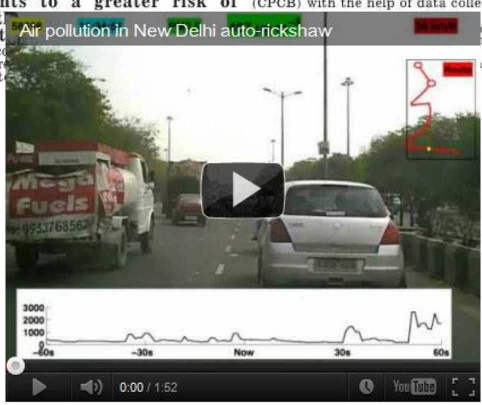

Capital has more toxic particles in its air than other major Indian metros

DELHI IS INDIA'S ASTHMA CAPITAL

By Meenal Dubey in New Delhi

DELHI has the highest levels of Respirable Suspended Particulate Matter (RSPM) among the four metros, exposing its residents to a greater risk of ast…

RSPM was recorded at a shocking 149 mg/cu m, according to a report published by the Central Pollution Control Board (CPCB) with the help of data collected



Smoke alarm in Delhi

Continued from page 1

'Vehicles are the main culprits for the high RSPM levels'

See what you breathe

A LOOK AT THE AMOUNT OF POLLUTANTS IN THE CAPITAL'S AIR

Respirable Suspended Particulate Matter (RSPM)

City	2006	2007	2008 (Jan-Aug)
Delhi	136	159	149
Kolkata	166	99	104
Mumbai	86	92	118
Chennai	57	37	54

Sulphur Dioxide (SO_2)

City	2006	2007	2008 (Jan-Aug)
Delhi	9	4	4
Kolkata	7	8	7
Mumbai	9	11	8
Chennai	7	9	7

Nitrogen Oxide (NO)

City	2006	2007	2008 (Jan-Aug)
Delhi	43	36	43
Kolkata	53	58	63
Mumbai	29	40	34
Chennai	10	9	10

MAIN CULPRITS

80,000 vehicles

18,000 trucks

Children suffer

The Capital's polluted air is harming its children the most, with asthma cases rising among them

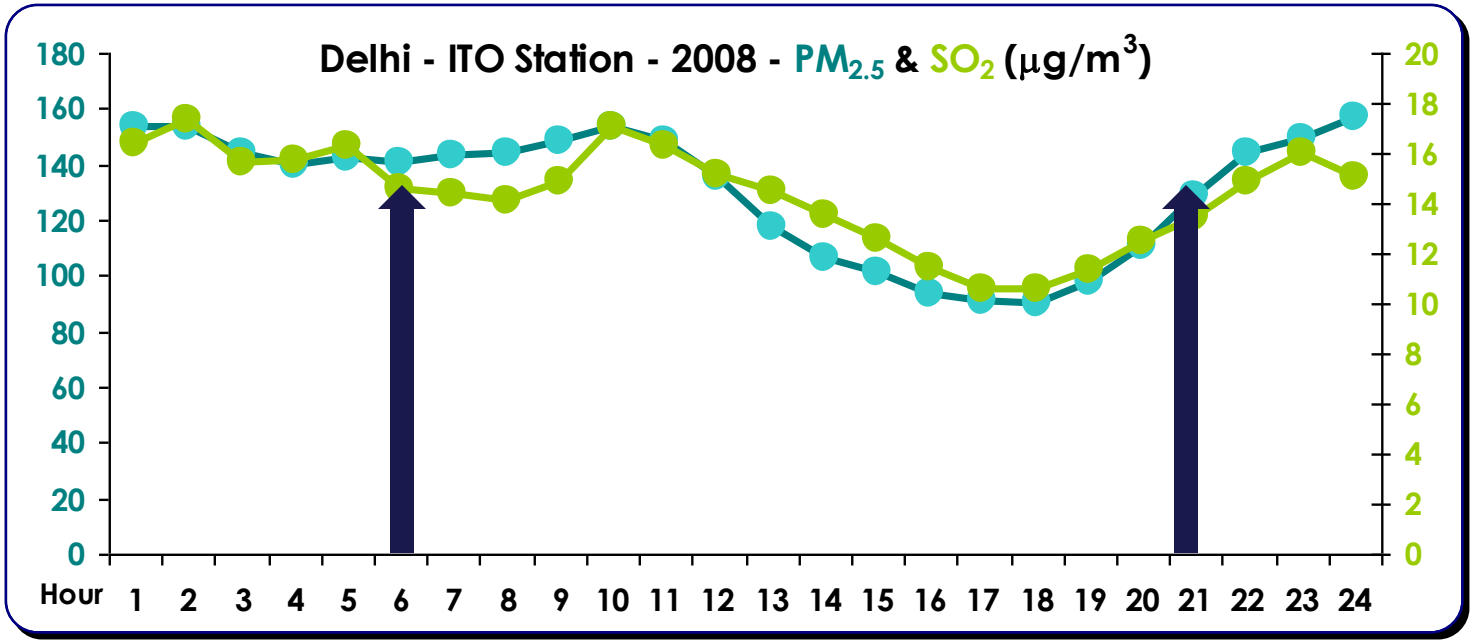
Govt says things will improve in 3 years

Dust Trak Model 8543 (TSI)

Exposure risk is ~2 times more for passengers in three wheelers

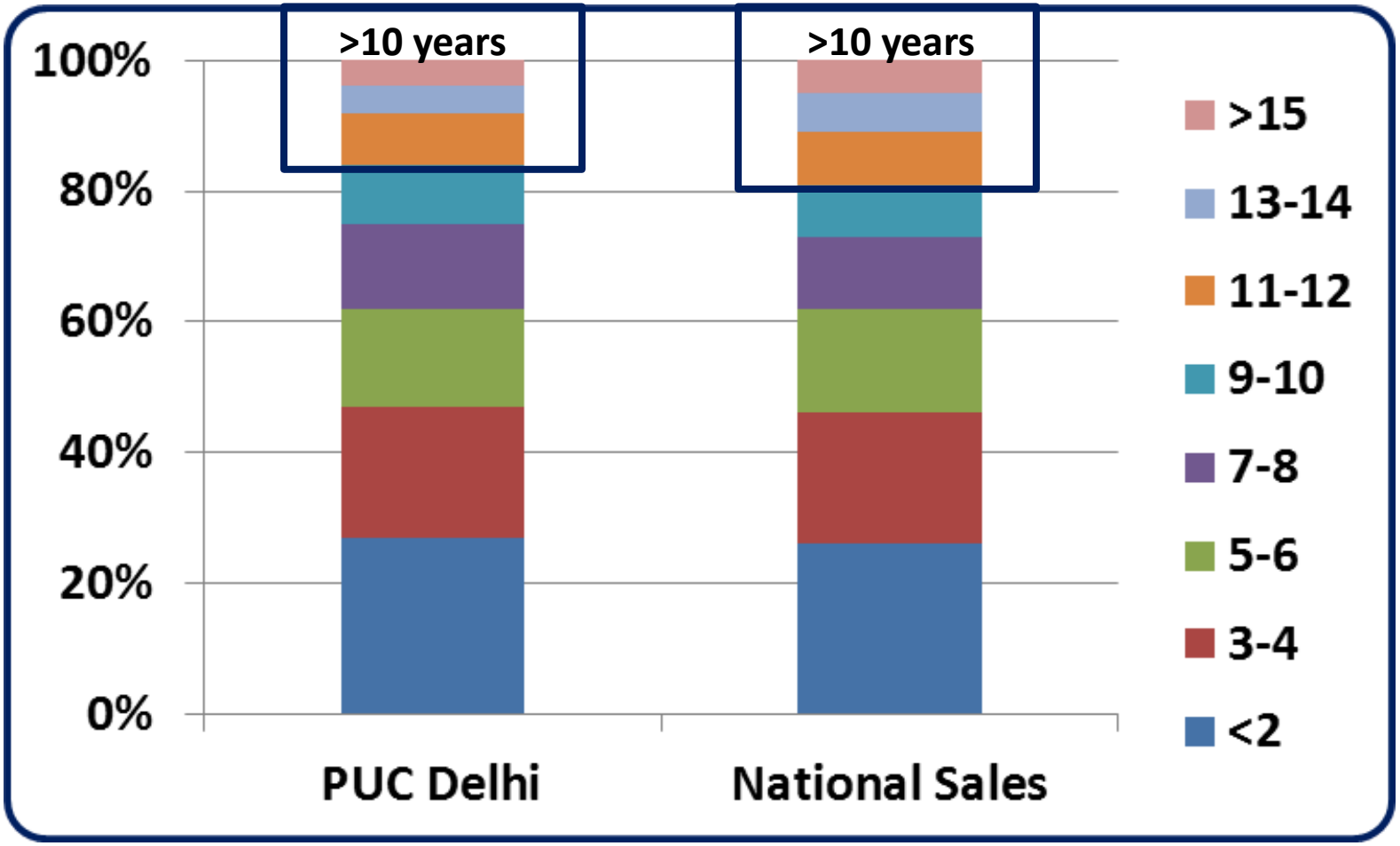
Mortality risk is estimated at ~8,500 per annum

Truck pollution linger hours after they stop !!



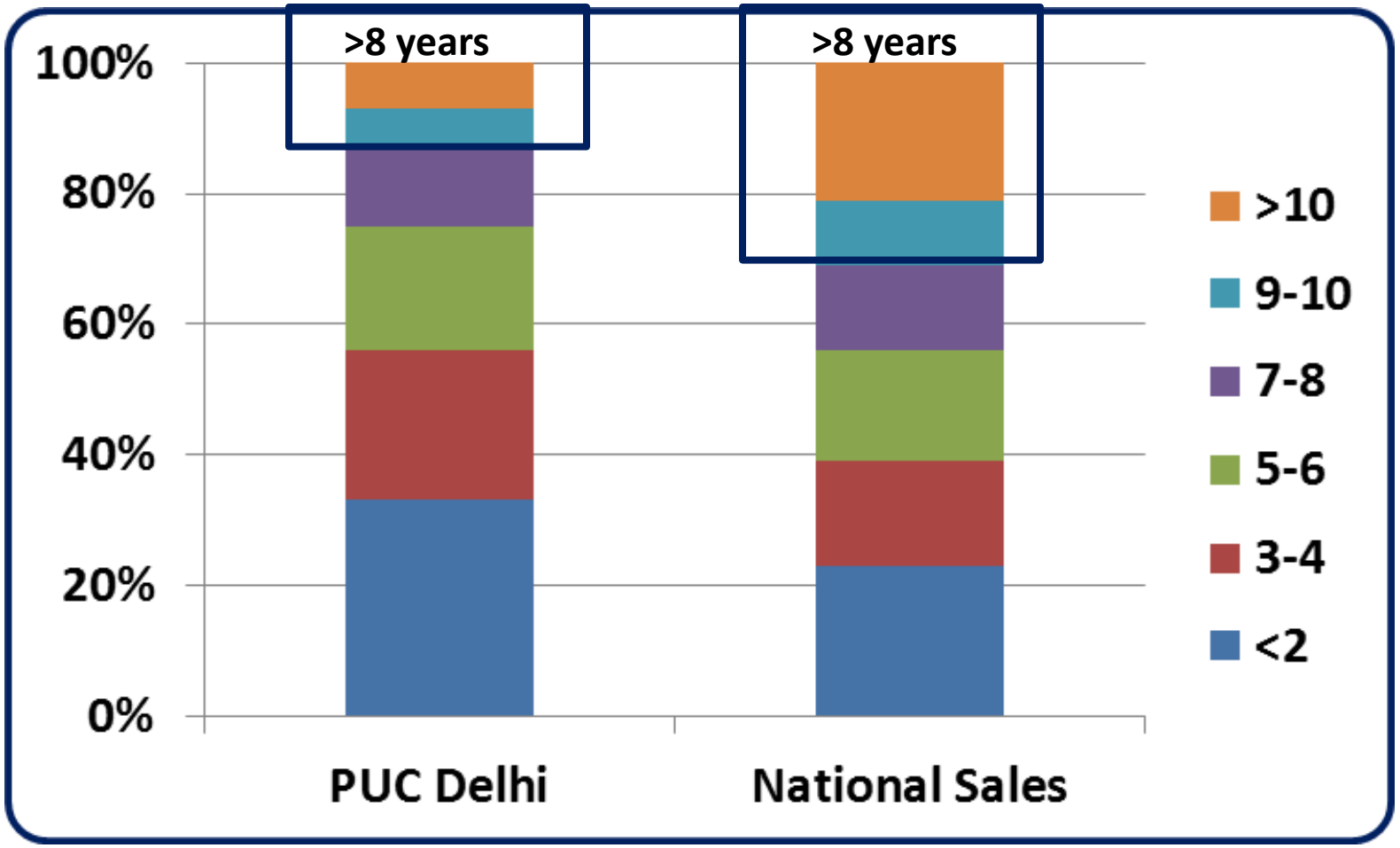
PM Emissions			Cummulative
Heavy Duty Trucks	**Total Sample**	27	
	> 2000 gm/km	4	15%
	1000 - 2000 gm/km	7	41%
	500 - 1000 gm/km	4	56%
	0 - 500 gm/km	12	100%
	> avg (500 gm/km)	15	**56%**
	Total Emissions (gm)	28,654	
	> 2000 gm/km	11,904	42%
	1000 - 2000 gm/km	9,603	75%
	500 - 1000 gm/km	2,723	85%
	0 - 500 gm/km	4,424	100%
	> avg (500 gm/km)	24,230	**85%**

Gross Polluters - 4 Wheelers



Data from 323 PUC testing centers in Delhi

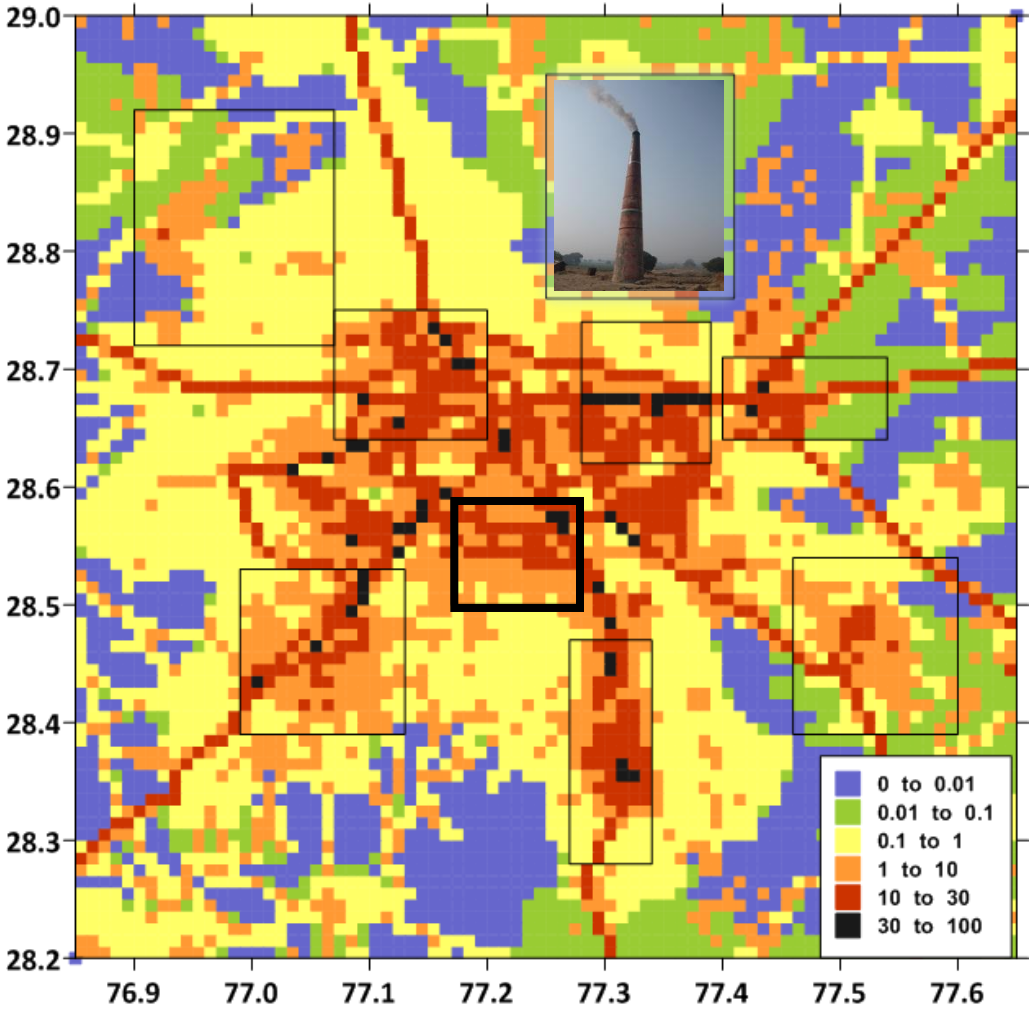
Gross Polluters - 2 Wheelers



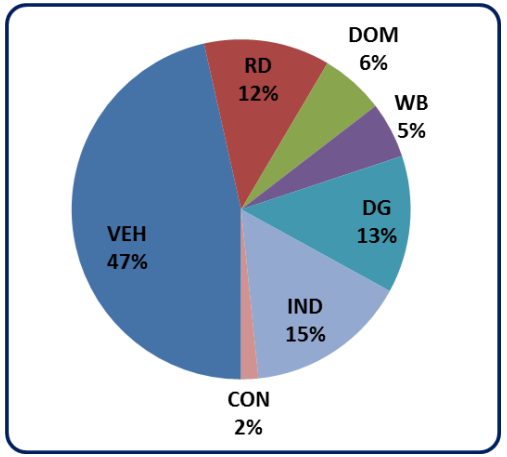
Data from 323 PUC testing centers in Delhi

% ground based emissions in south Delhi

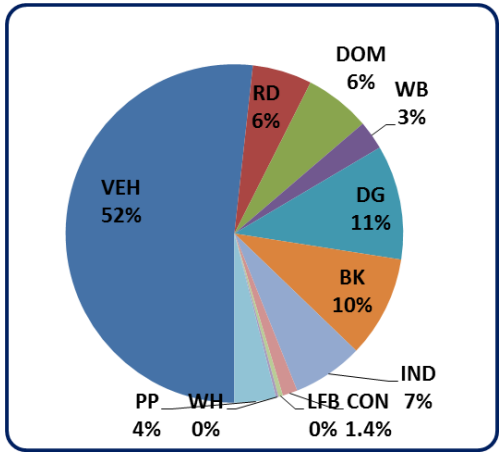
Gridded Vehicle Exhaust $PM_{2.5}$ Emissions (tons/grid)



Emissions



Concentrations



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WB = waste burning; CON = construction activities; BK = brick kilns; DG = diesel generator sets; LFB = landfill burning

Thank you

Questions?

Dr. Sarath Guttikunda

@ www.urbanemissions.info

New Delhi, India

April, 2012