



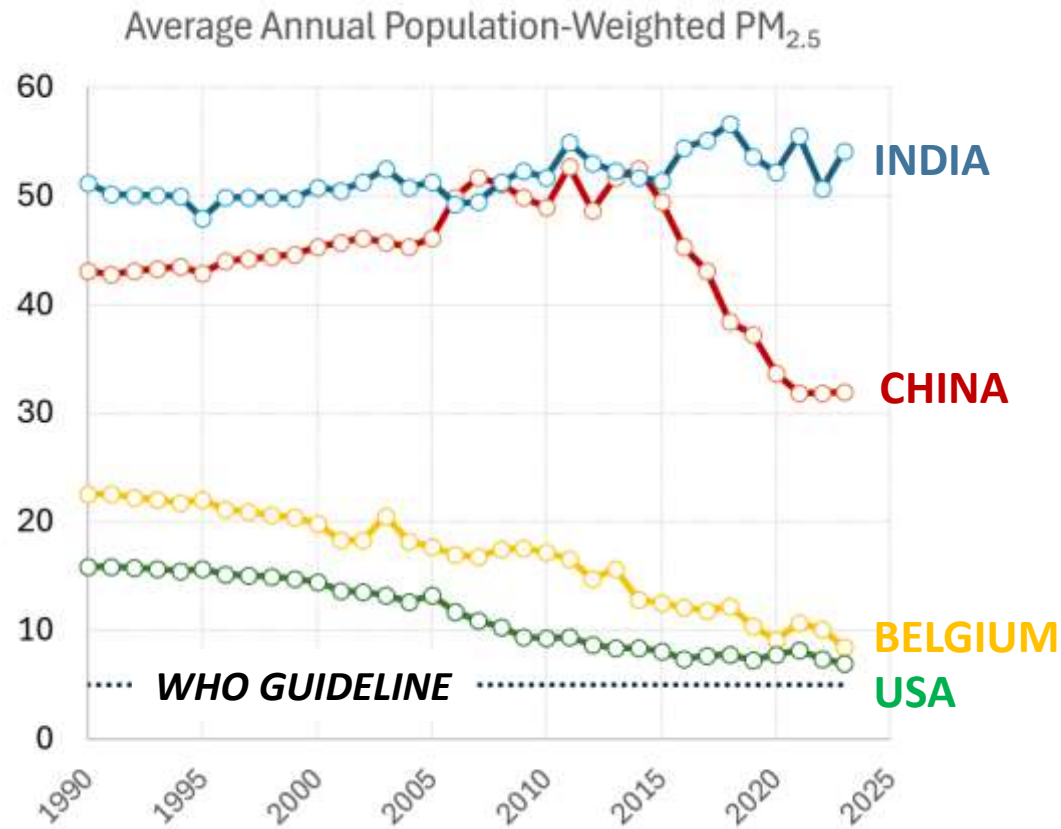
PRESENTED AT THE ECT CONFERENCE, OCTOBER 22, 2026, DELHI

No Soft Landing: Why BS 7 Must Aim High

Dr. Ameya Joshi

BS VII Standards : An opportunity for India to tackle a tough air quality problem

Air quality in India is still far from the WHO guideline –
BS VII presents an opportunity to make a change



Source: State of Global Air 2025

India ranked 176 out of 177 countries for environmental performance ...

Indicators across 12 issue categories representing critical sustainability challenges in environmental public health, ecosystem vitality, and climate change

<https://epi.yale.edu/2026/results/indicator/EPI>

Environmental Performance Index

Click on a country name to see that coun

Environmental
Performance
Index

Country	Rank	EPI Score	10-Year Change	Regional Rank	Regional Average
Estonia	1	74.79	23.22	1	54.93
Luxembourg	2	74.24	10.2	1	64.74
United Kingdom	3	71.51	5.12	2	64.74
Finland	4	71.04	5.05	3	64.74
Netherlands	5	70.49	11.17	4	64.74
Germany	6	69.93	8.47	5	64.74
France	7	69.82	6.58	6	64.74
Norway	8	69.24	6.82	7	64.74
Sweden	9	69.2	3.49	8	64.74
Austria	10	66.8	3.87	9	64.74

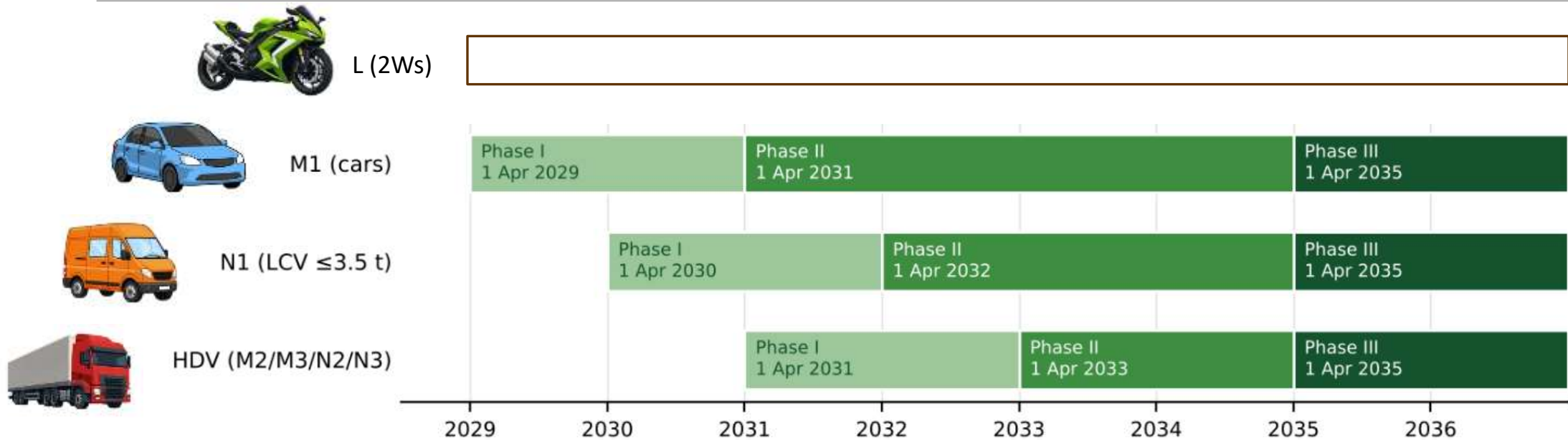
Rwanda	167	26.42	-0.52	41	34.63
Indonesia	168	26.24	1.82	22	36.84
Mauritania	169	25.34	0.22	42	34.63
Liberia	170	25.27	2.32	43	34.63
Maldives	171	25.06	4.54	6	31.81
Burundi	172	24.39	1.96	44	34.63
Viet Nam	173	23.82	-1.94	23	36.84
Mali	174	23.56	1.86	45	34.63
Bangladesh	175	23.46	4.41	7	31.81
India	176	22.46	7.47	8	31.81
Laos	177	21.78	3.63	24	36.84

Environmental Performance Index 2026

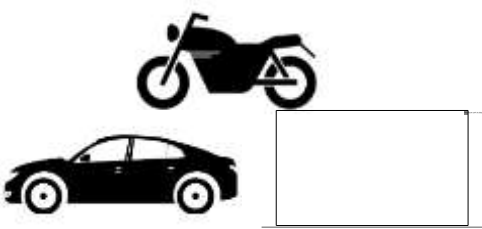
EPI Measurement

Environmental Performance Index

BS-VII Proposal: A Strong Opening — Now Let's Build the Innings



Area	BS-VI (current) → BS-VII draft	Recommendation for BS-VII Final
Tailpipe limits	M1/N1 : Numerically unchanged, HDV : NO _x 460 → 200 mg/kWh	Reduce gas limits for L/M1/N1
Particle number	PN limit for DI only → All Vehicles, PN ₂₃ → PN ₁₀	PN limit for L-category
Test cycle (light-duty)	MIDC; WLTP → 3-phase WLTP per AIS-215 for M1 and N1	RDE for L-category
RDE conformity factor	M1: NO _x 1.43, PN 1.5 → 1.0	Phased CF for 2W
Evaporative emissions	2.0 g/test → 1.5 g/test	Diurnal test temp increased to 40 C



Recommendations for reducing transport emissions

Several already implemented in draft, others to be clarified

1. BS VII should be **technology and fuel agnostic**, and apply to **all vehicles including two-wheelers**
2. Test procedures should include real-world emissions reflective of **India-specific ambient conditions**
3. Compliance should be ensured through in-use **monitoring and inspection**, over **full useful life**

PARTICULATE CONTROL

1. **Apply PN_{10} limit (6×10^{11} #/km) to all vehicles**
 - All passenger cars (GDI = PFI = Diesel) AND 2-wheelers
2. **Revise test conditions for maximum health benefit**
 - Include particles down to 10nm in the PN count
 - Set test conditions to capture high/low temperatures across major populated regions (5 °C – 45 °C)
 - Measure emissions under wide range of real-world driving conditions

GAS EMISSION CONTROL

Tailpipe Emissions

1. **Lower NOx Limits for Heavy-Duty Trucks**
 - Improve real-world testing, including at low loads
2. **Tighten CO, NOx & HC standards, improve RDE testing**
 - 45 – 60% reduction in limits, tighten in-use compliance
 - Add limit for aldehydes given increasing ethanol content

Evaporative Emissions for Petrol & Blended Vehicles

1. **Revise test conditions to Indian conditions**
 - Shift diurnal test from 20°C – 35°C to 25°C – 40 °C
2. **Align with Euro 7 proposed standard**
 - 48-hour, 1.5 g/test @ WLTP
3. **Adopt a Refueling Standard**
 - Test procedures already exist in U.S., Brazil and China

Quantifying Emissions from Various Transport Sources

Emissions Inventory Modeling covering Delhi NCR & National region

Calculate criteria pollutant emissions from the on-road transport sector in India at the national and Delhi NCR region, to identify major pollutant contributors & inform policies


National



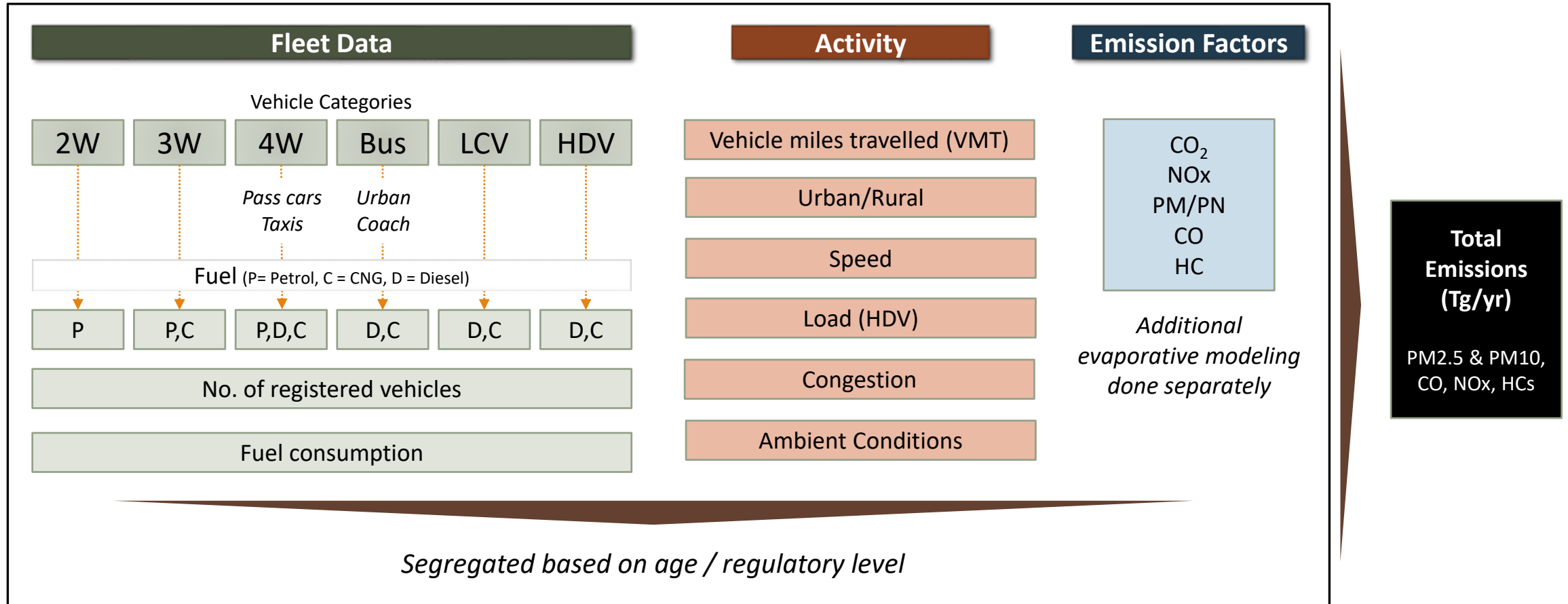

DELHI NCR



Vehicle Type		Variants		Dominant fuels	
2-Wheelers	Mopeds		Bikes		Petrol
3-Wheelers	Passenger		Goods vehicle		Petrol, CNG, Diesel
4-wheelers	Passenger, Taxis		Light goods vehicle		Petrol, Diesel, CNG, Bi-fuel
Buses	Urban, School-bus		Inter-city		Diesel, CNG
Heavy-duty	Pickup / Delivery trucks		Heavy goods vehicle		Diesel

Emissions Inventory Modeling Framework

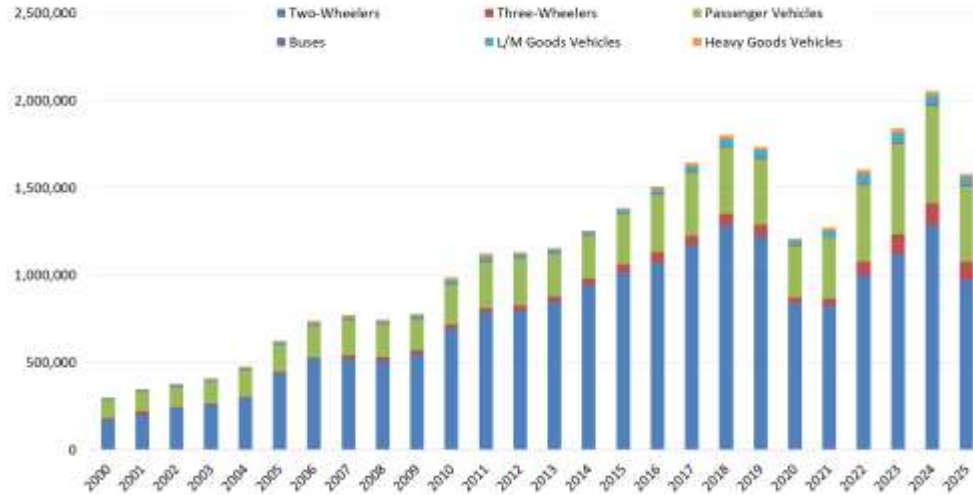
COPERT tool used



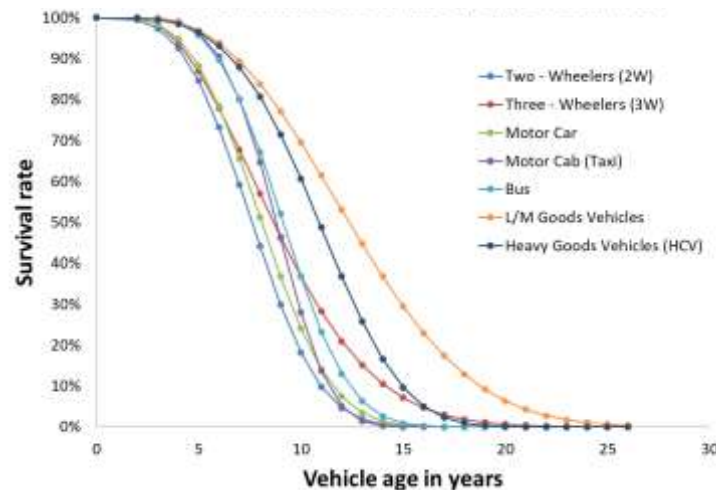
Vehicle stock analysis for Delhi NCR

Registration data combined with survival functions to calculate current fleet

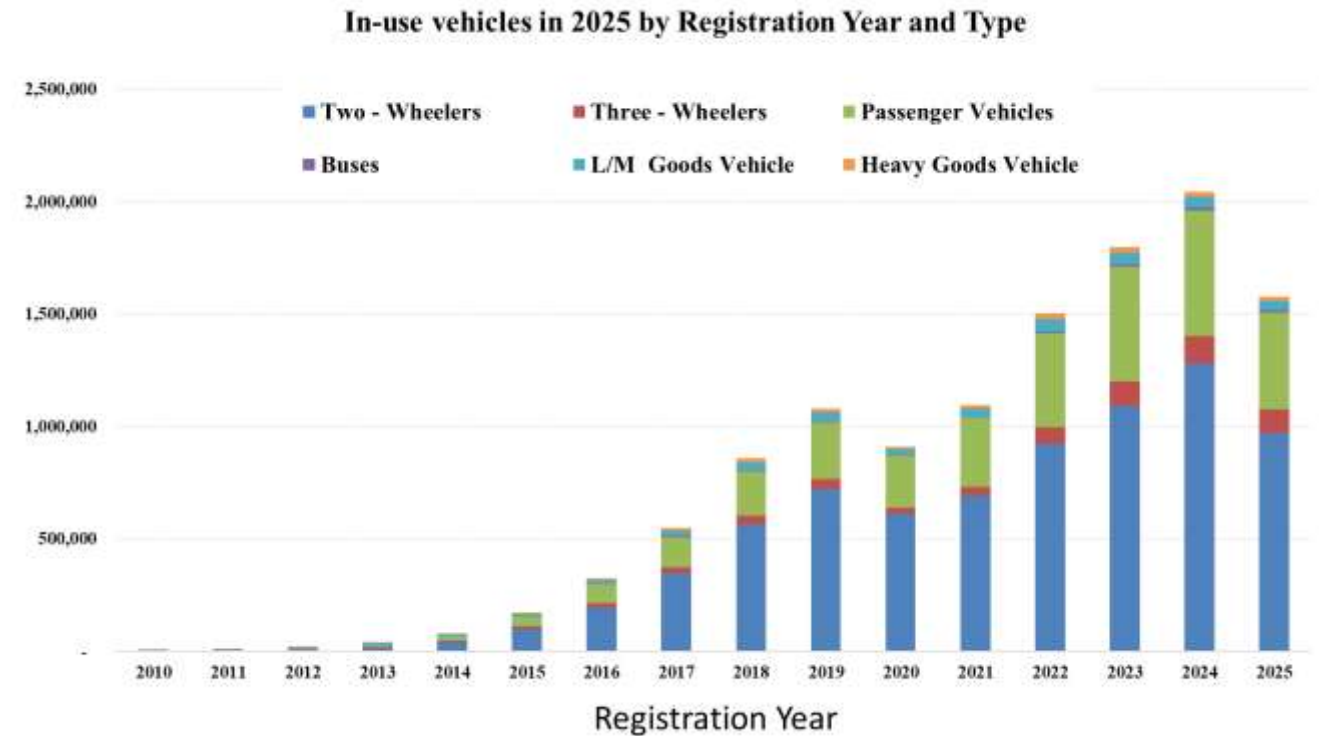
Vehicle Registration



Survival functions



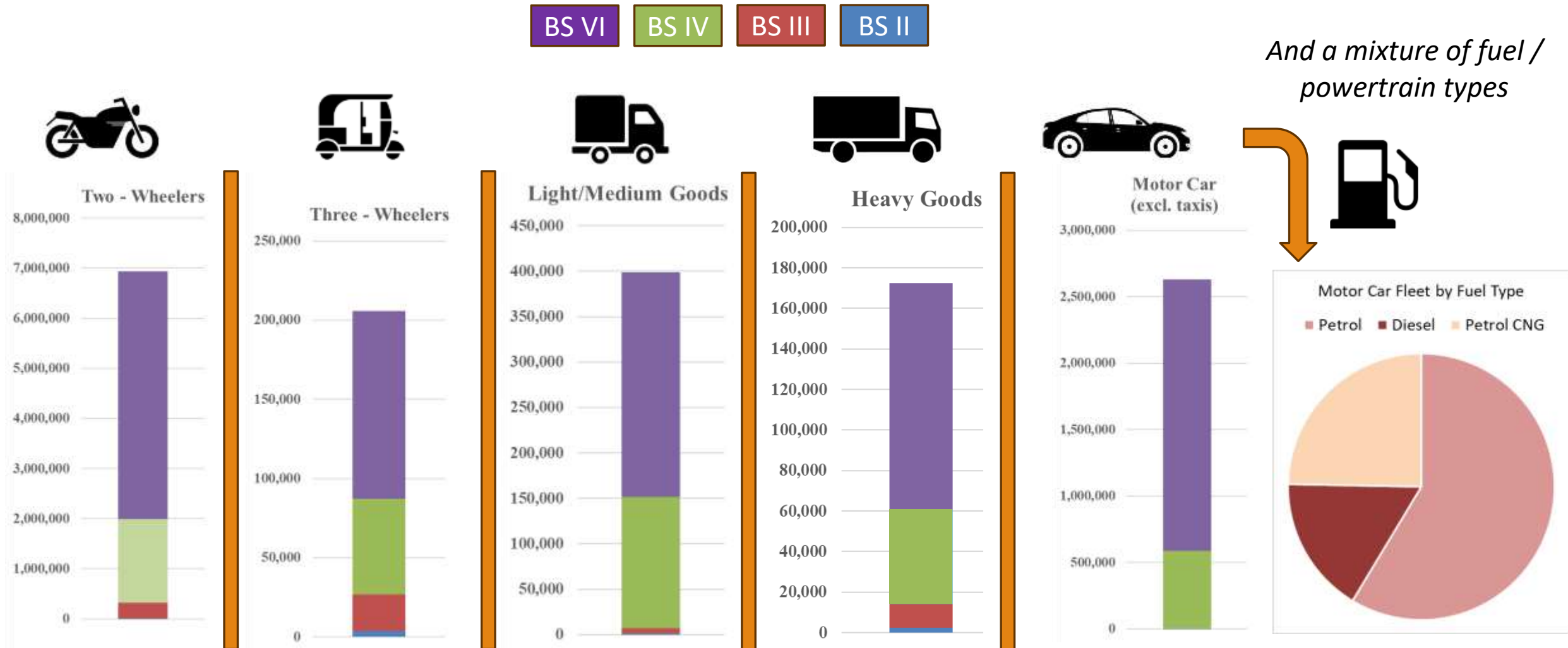
In-use vehicles in 2025 by Registration Year and Vehicle Type



*Vehicles included up to August 2025

On-road fleet (2025) – Delhi NCR

~ 65 – 70% vehicles are BS VI, others are mostly BS IV | 2Ws and cars dominate fleet



Delhi NCR : Vehicle Activity Data

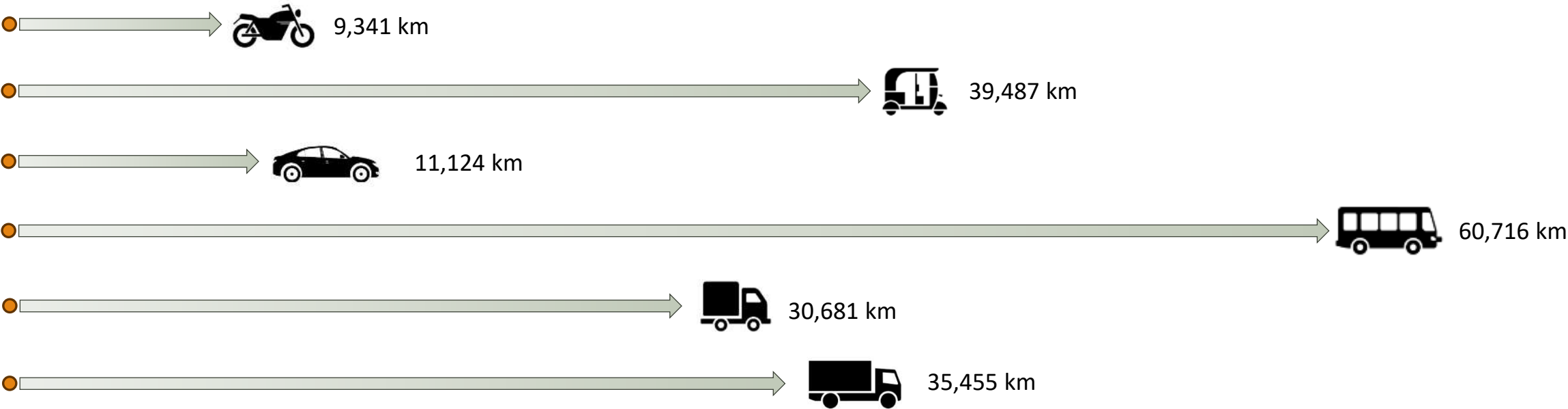
Vehicle Category	VKT	% VKT Peak traffic	% VKT Off- peak traffic	% VKT Highways
2W	9,341 +/- 3,055	59	23	18
3W	39,487 +/- 8,351	33	30	37
Cars	11,124 +/- 14,867	40	25	35
Buses	60,716 +/- 1,141	35	23	42
LCV	30,681 +/- 967	40	25	35
HCV	35,455 +/- 10,114	35	23	42

Avg. Speed (km/h)



Vehicle Category	Urban peak	Urban Off-peak	Highway
All	10	23	45

Annual Vehicle Kilometers
Travelled (VKT)

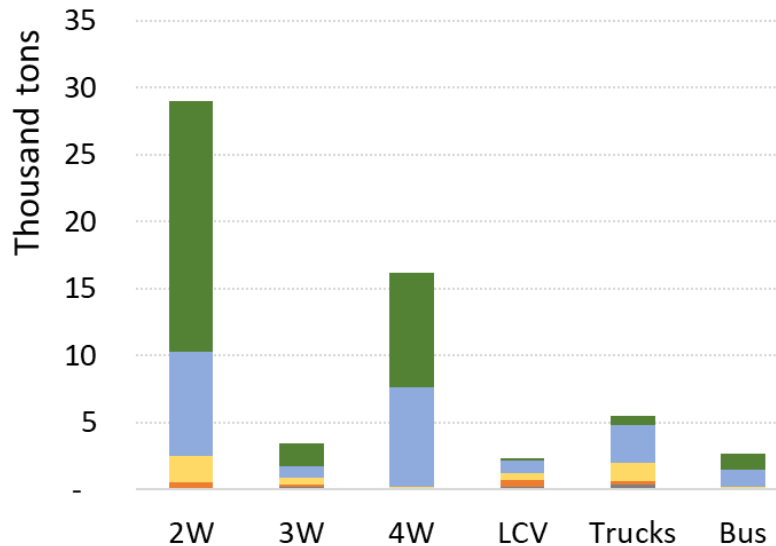


Results

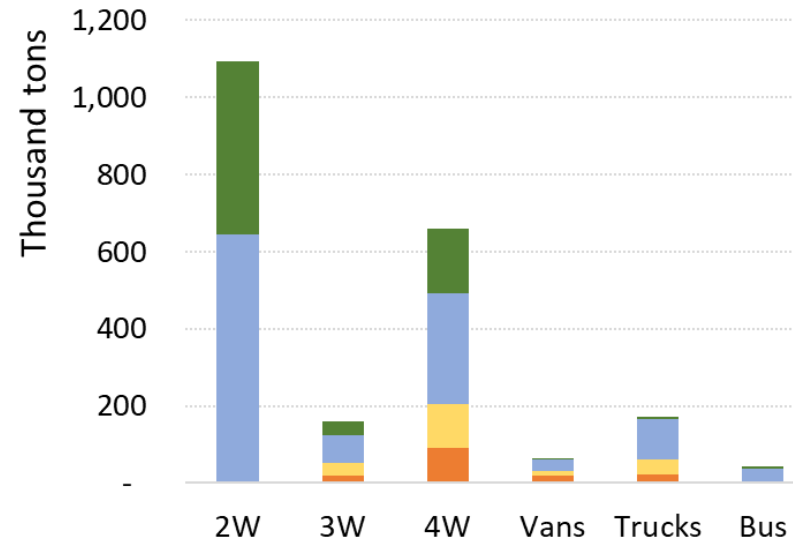
CO Emissions

■ BS 1 ■ BS 2 ■ BS 3 ■ BS 4 ■ BS 6

Delhi NCR



India National



Observations

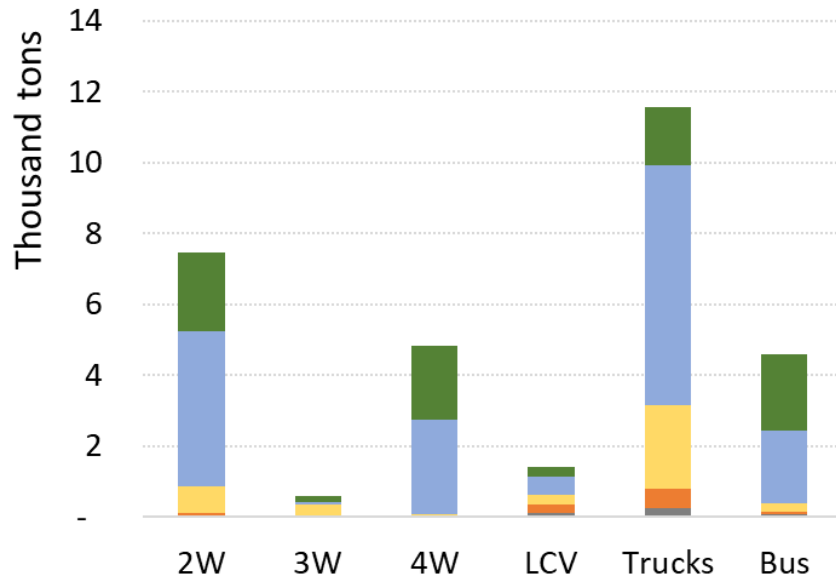
- CO emissions from 2-wheelers are ~ 2X that from passenger cars
 - › Much higher when considering remote sensing measurements (not shown here)
- Passenger cars : Large number of BS 6 vehicles (even though cleaner) lead to similar emissions as BS 4 certs.

Results

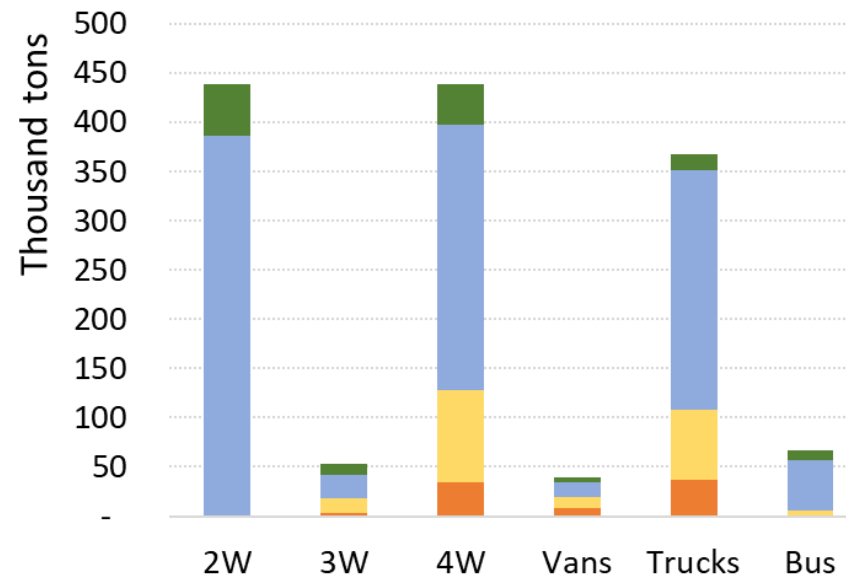
NOx Emissions

■ BS 1 ■ BS 2 ■ BS 3 ■ BS 4 ■ BS 6

Delhi NCR



India National

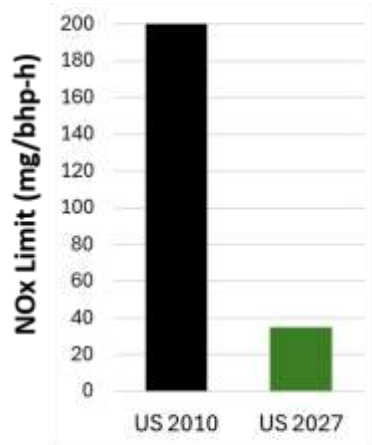


Observations

- Trucks are high emitters : this is a well-studied problem in Europe and NA (likely low speed and overloaded emissions)
- 2Ws and cars are also high contributors. High emissions from diesel cars outweigh fewer vehicle count vs. 2Ws
- Remote sensing measurements (not included here) show especially worse in-use emissions for BS IV cars – especially high for diesels

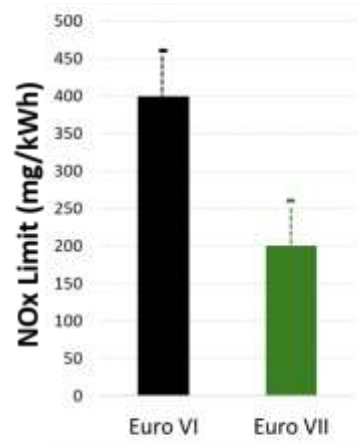
Advanced engines and emission controls already introduced in the US and Europe for meeting Low NOx Standards

 US EPA Low NOx Rule



PM Limit reduced by 50%

 Euro VII



PN Limit reduced to 9×10^{11} #/km on RDE
And includes particles down to 10 nm

OEM/Platform	 International S13	 Cummins X15	 Detroit DD13/15	 Volvo/Mack D13
				
Displacement/Configuration	12.7 L, 6-cylinder	14.9 L, 6-cylinder	12.8 L (DD13) / 14.8 L (DD15), 6-cylinder	12.8 L, 6-cylinder
Key Ratings (hp/lb-ft)	515 hp/1,850 lb-ft	605 hp/2050 lb-ft	525 hp/1850 lb-ft (DD13) 505 hp/1900 lb-ft (DD15)	500 hp/1850 lb-ft
Combustion Architecture	<ul style="list-style-type: none"> 1800 bar fuel injection system 23:1 CR 	<ul style="list-style-type: none"> 2400 bar fuel injection system Redesigned high CR piston bowl Optimized NOx-soot tradeoff 	<ul style="list-style-type: none"> 2500 bar fuel injection system Redesigned asymmetric intake port with increased swirl Optimized injector + smaller piston bowl (higher geom, CR) 	<ul style="list-style-type: none"> 2400 bar fuel injection system 20:1 CR 14-wave piston
Air System/Valvetrain	<ul style="list-style-type: none"> No external cEGR Fixed geometry turbo DOHC-VVT 	<ul style="list-style-type: none"> External cEGR VGT DOHC 	<ul style="list-style-type: none"> External cEGR Updated asymmetric turbo + eWG Miller camshaft 	<ul style="list-style-type: none"> External cEGR VGT + pre-turbine throttle
Aftertreatment Architecture	<ul style="list-style-type: none"> LO-SCR + DPF + SCR Dual DEF dosing No EH/DOC 	<ul style="list-style-type: none"> EH+DOC/DPF+EH+SCR Single DEF dosing Two 48V, 5kW Ehs 48V alternator 	<ul style="list-style-type: none"> LO-SCR+DOC+DPF+SCR VGT Dual DEF dosing ETV 	<ul style="list-style-type: none"> Dual EHs + dual SCR 48V alternator
Key Technology Highlights	<ul style="list-style-type: none"> ≥5% better vehicle FE in International's TMC Type IV competitive test with higher DEF consumption as a tradeoff Incased Electrically decoupled ATS + balanced engine-out NOx 	<ul style="list-style-type: none"> Up to ~4% better FE vs. 2024 X15 ~7% with fully optimized powertrain Reduced friction 44% lower ATS back pressure 	<ul style="list-style-type: none"> ~3% projected real-world FE improvement Millerization + increased swirl Closed-coupled SCR 	<ul style="list-style-type: none"> Improved FE Increased CR + 14-wave piston E-heated ATS with dual SCR

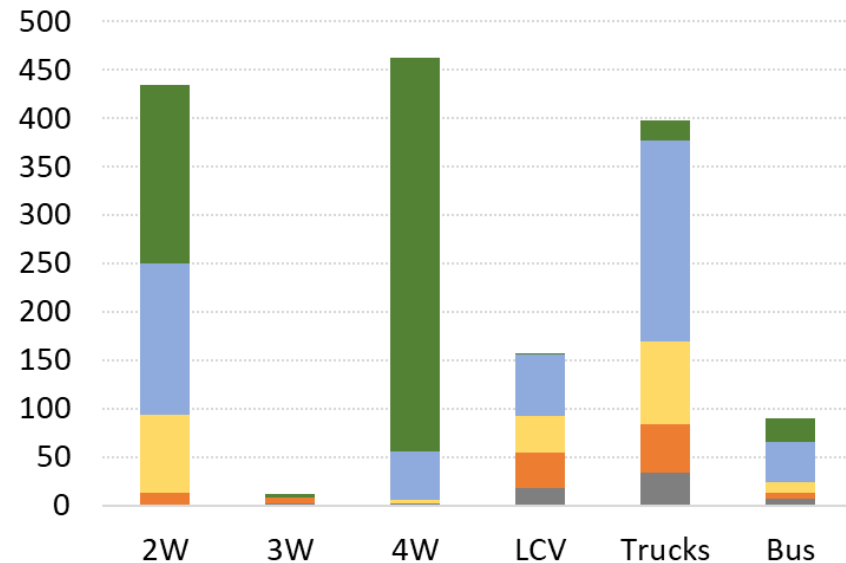
Results

Exhaust Particulate Emissions

■ BS 1 ■ BS 2 ■ BS 3 ■ BS 4 ■ BS 6

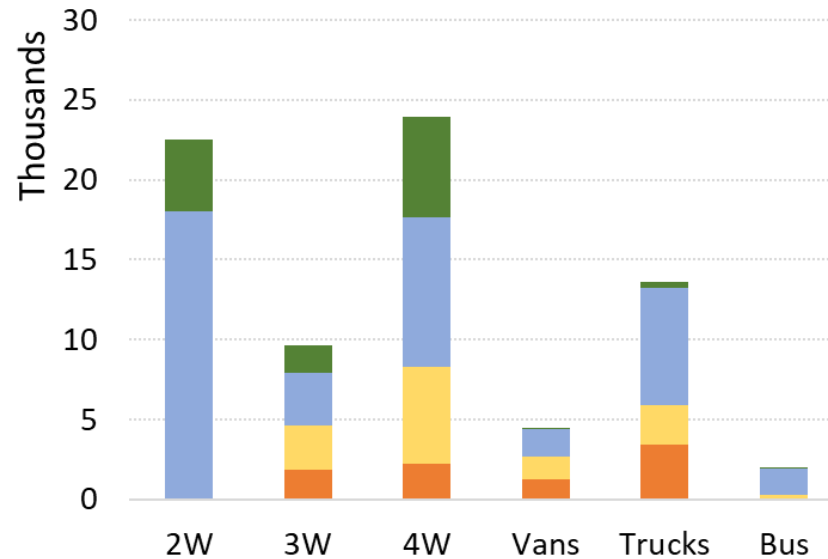
Delhi NCR

PM, tons



India National

Thousands



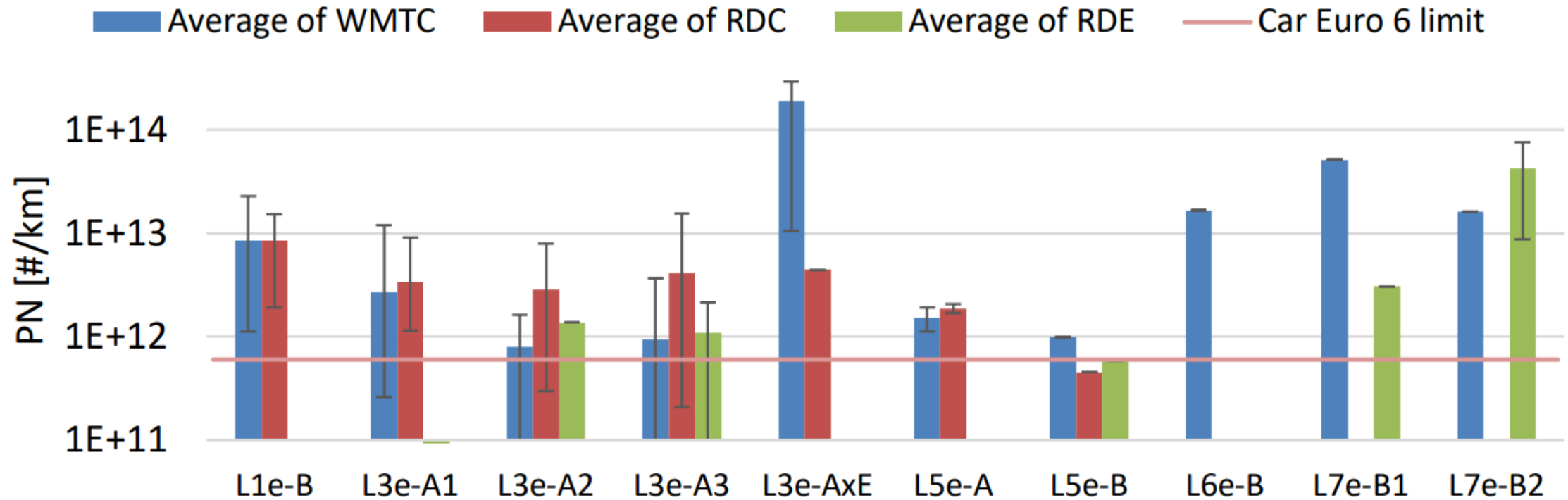
Observations

- PM from 2W, 4W and trucks are equal offenders
- BS VI emissions mostly from vehicles without filters
- Trucks: High emitting BS-4 will be phased out
- **PN limit on all pass cars and 2-wheelers, enforcing filters, should reduce these emissions drastically**

Particulate emissions from 2-wheelers can exceed passenger car limits

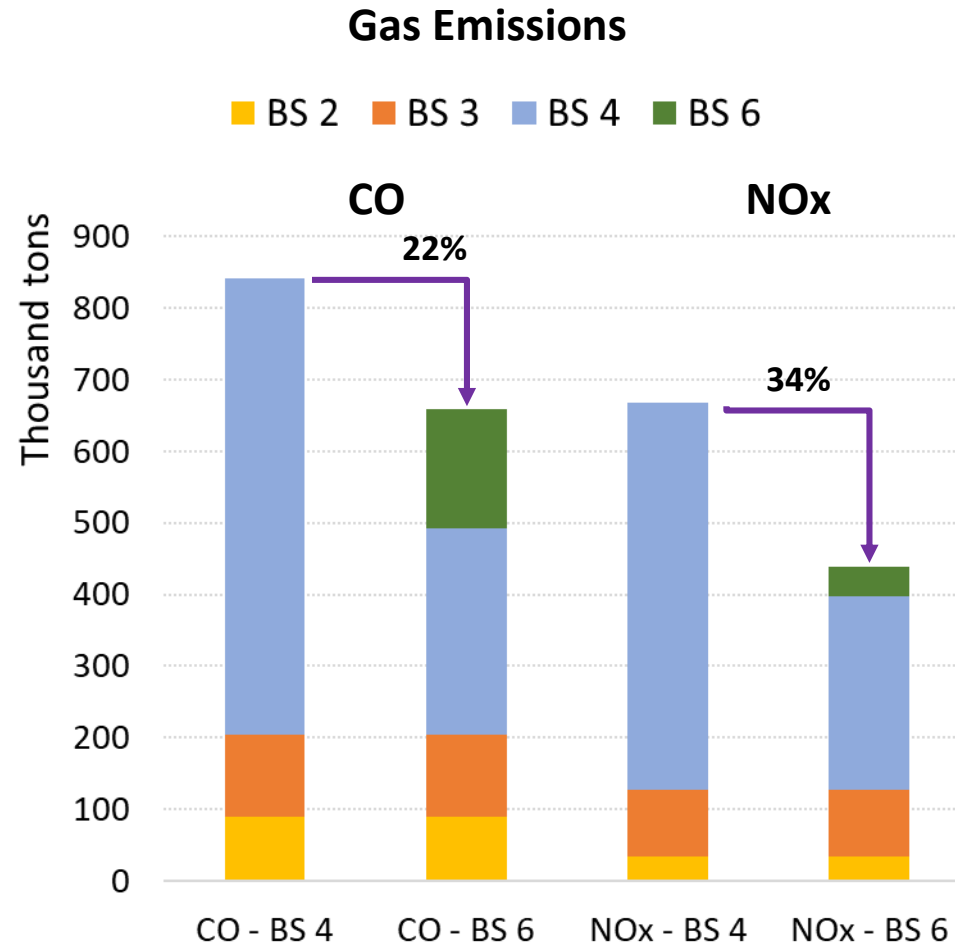
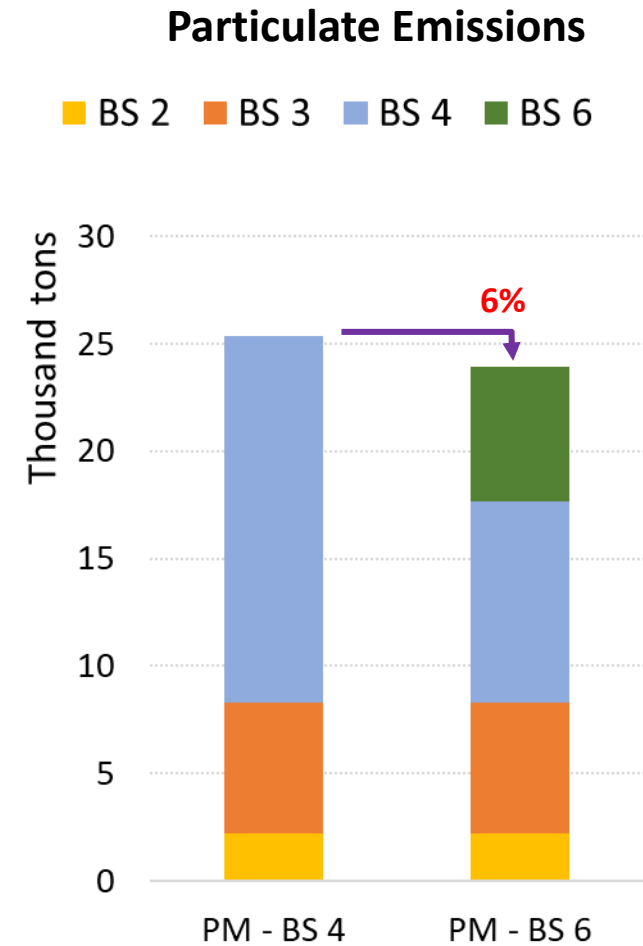
Findings from EU “LENS” Project

- Almost all 2-wheelers found to exceed PN limit for passenger cars
- Real-world cycle / on-road test can provide further insights – need to design RDE test and assess measurement capabilities in India



Why bother – did BS 6 make a difference ?

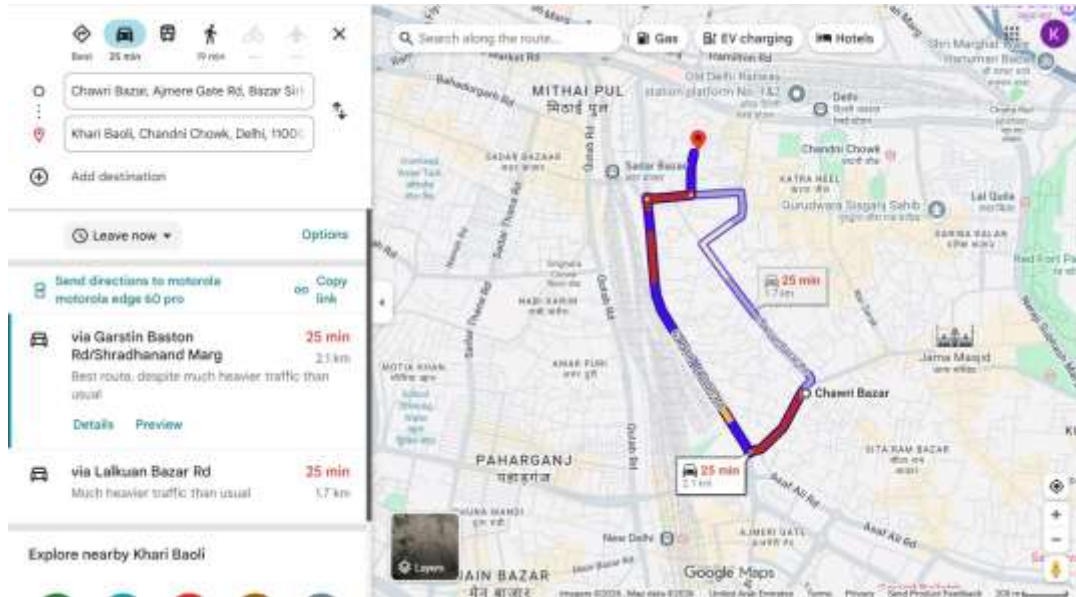
Yes it did – but impact more for gas emission reductions



Next regulations must include PN limit for all vehicles (not only direct injected vehicles) for substantial impact

Emissions are sensitive to vehicle speed

Higher emissions at lower speeds / congestion typical of Indian urban driving



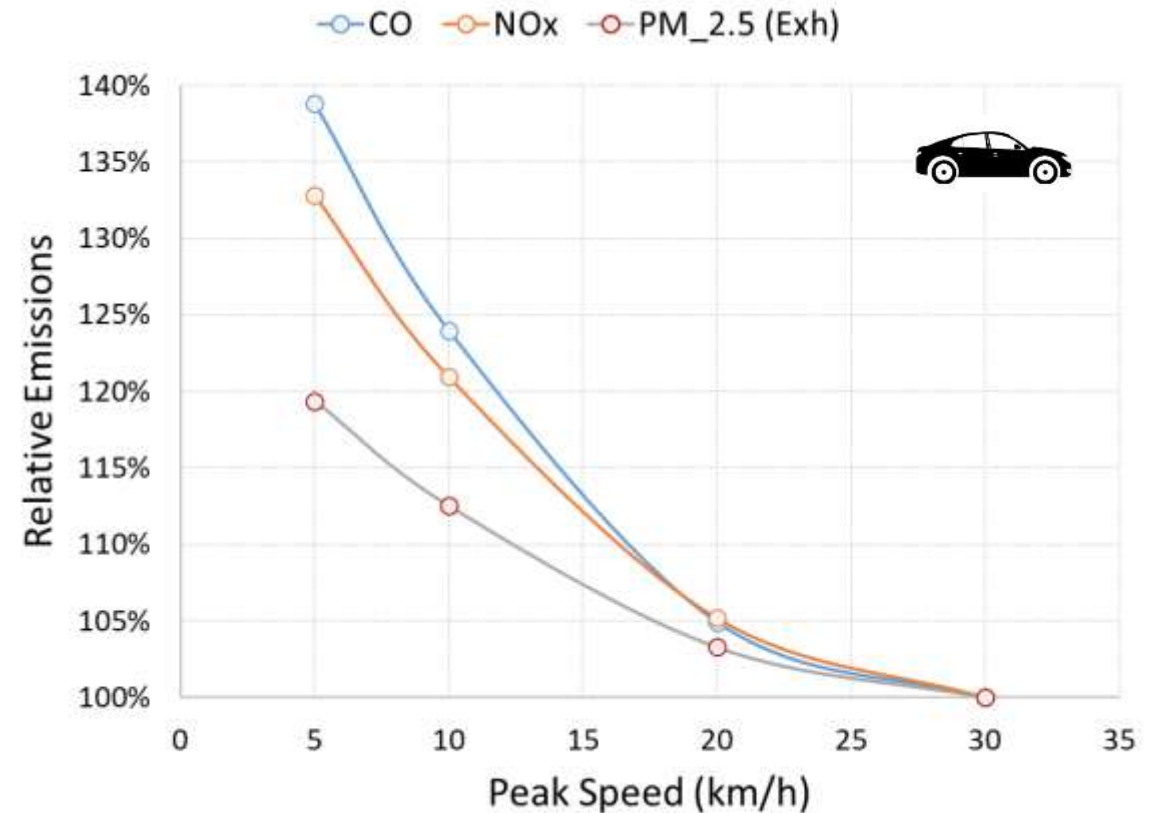
Travel time for 2.1 km Chawri Bazar–Khari Baoli, 12:30 pm Monday



Motor vehicle : 25 min, ~5 km/h



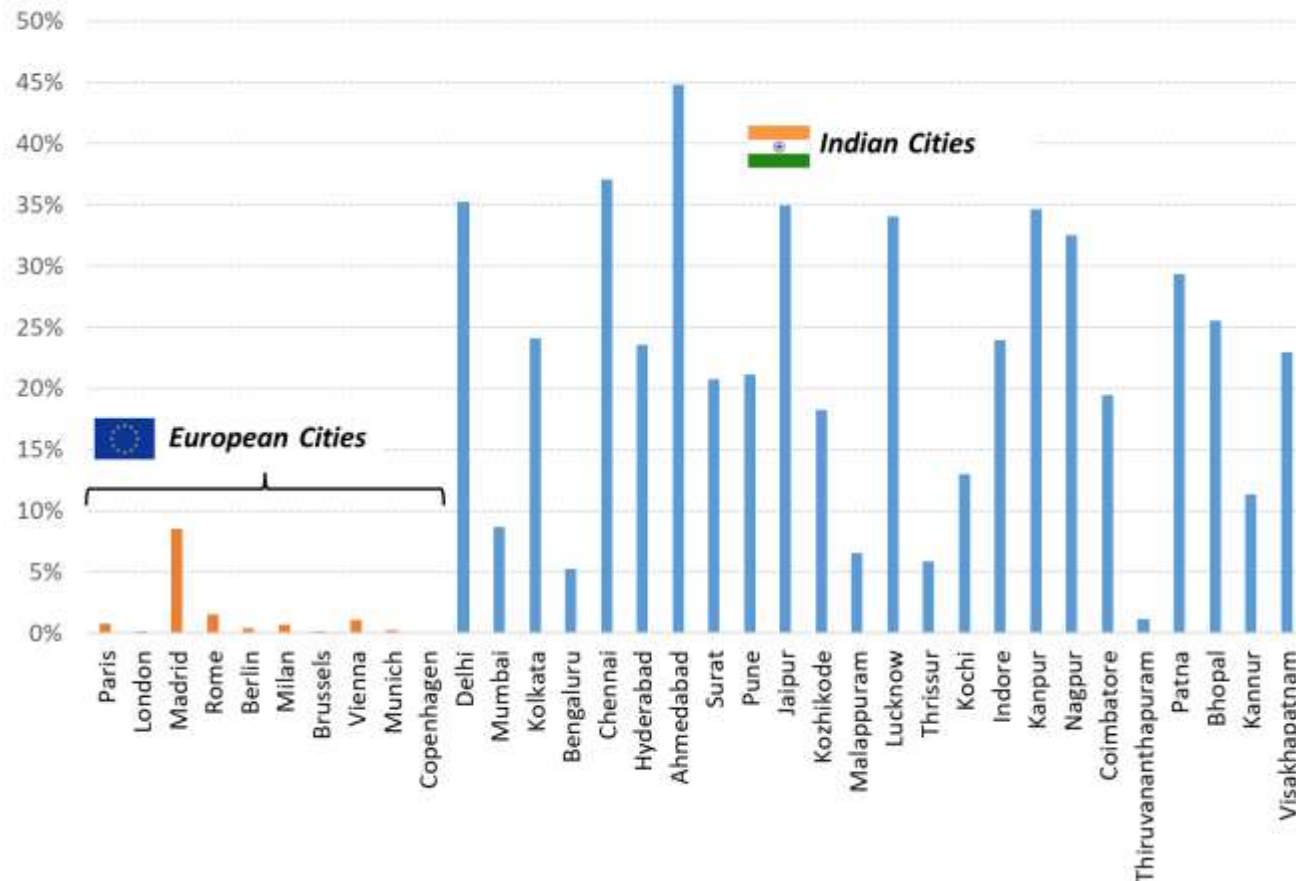
Pedestrian : 19 min



Combination of high ambient temperatures and ethanol content leads to much higher evaporative emissions in India

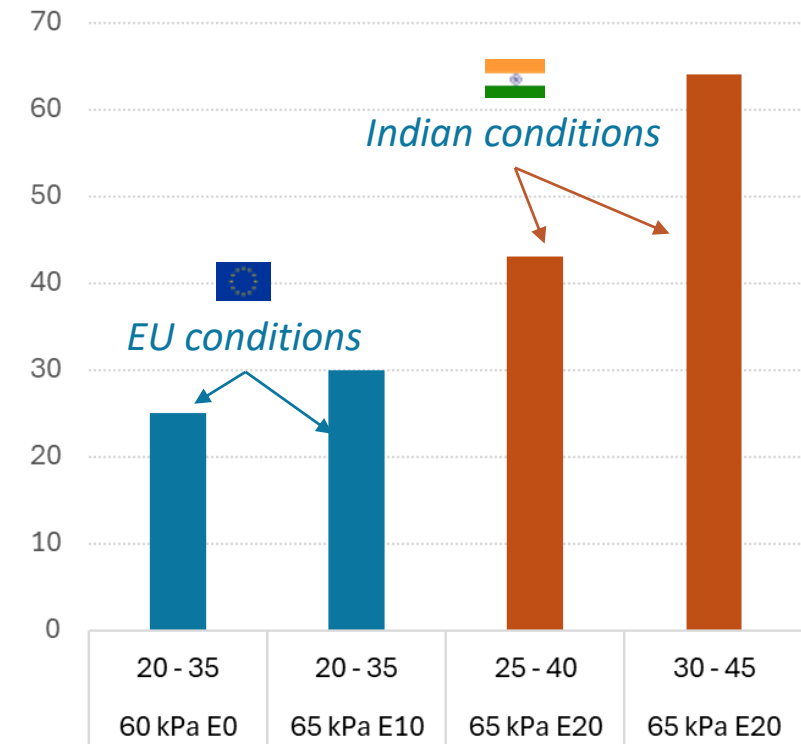
Comparison of % days > 35 C in major cities in India and Europe

% Days each year with Temperatures > 35 °C



Vapor generation depends strongly on diurnal temperature profile and fuel

Vapor generated (g/day)



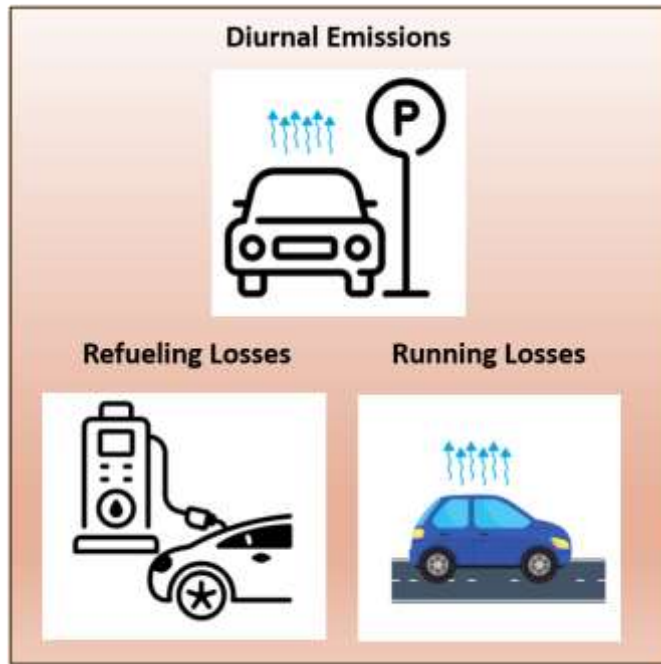
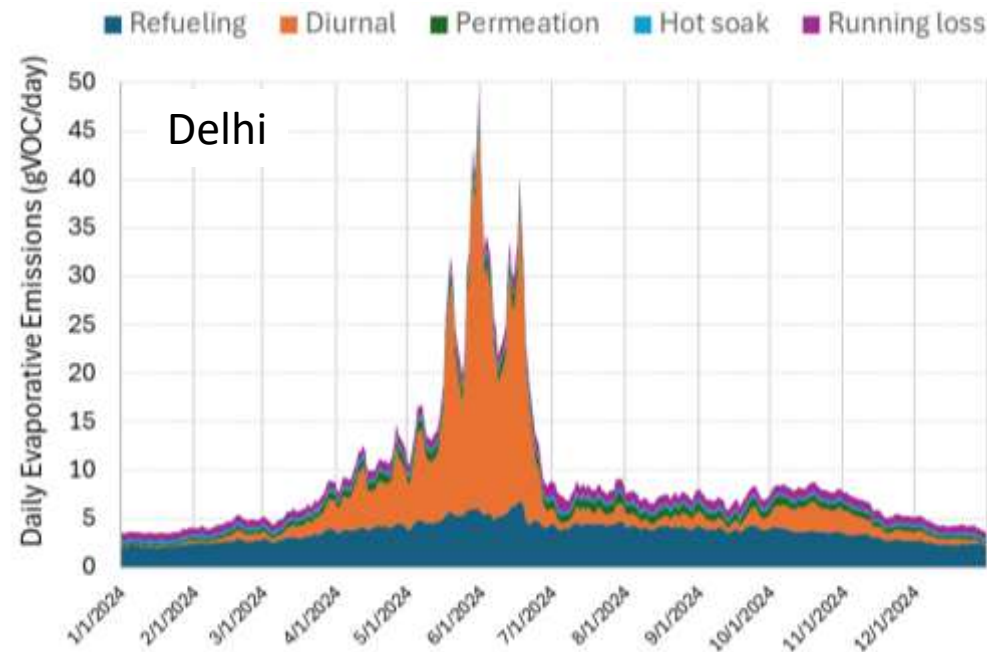
Source: ECMA [webinar](#), June 2025

Evaporative emissions now greatly exceed tailpipe

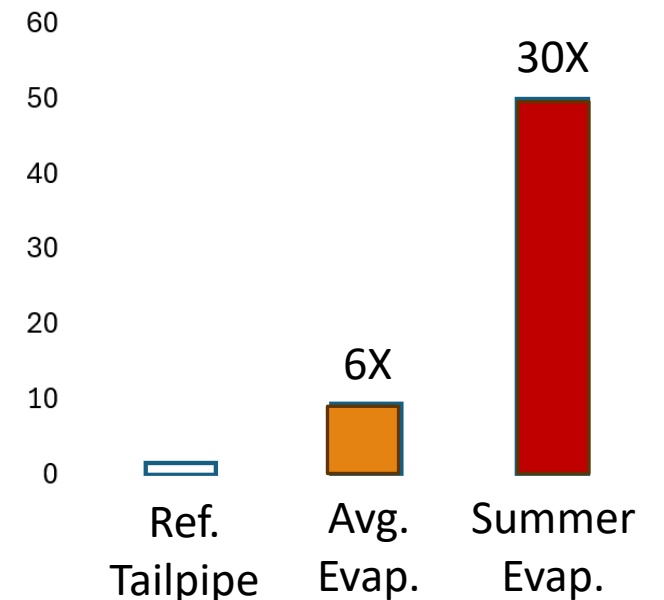
And are non-linear with temperature ... (averages don't mean much !)

For Delhi

Avg. Evap Emissions ~ 9.5 g/day
During summer months ~ 50 g/day

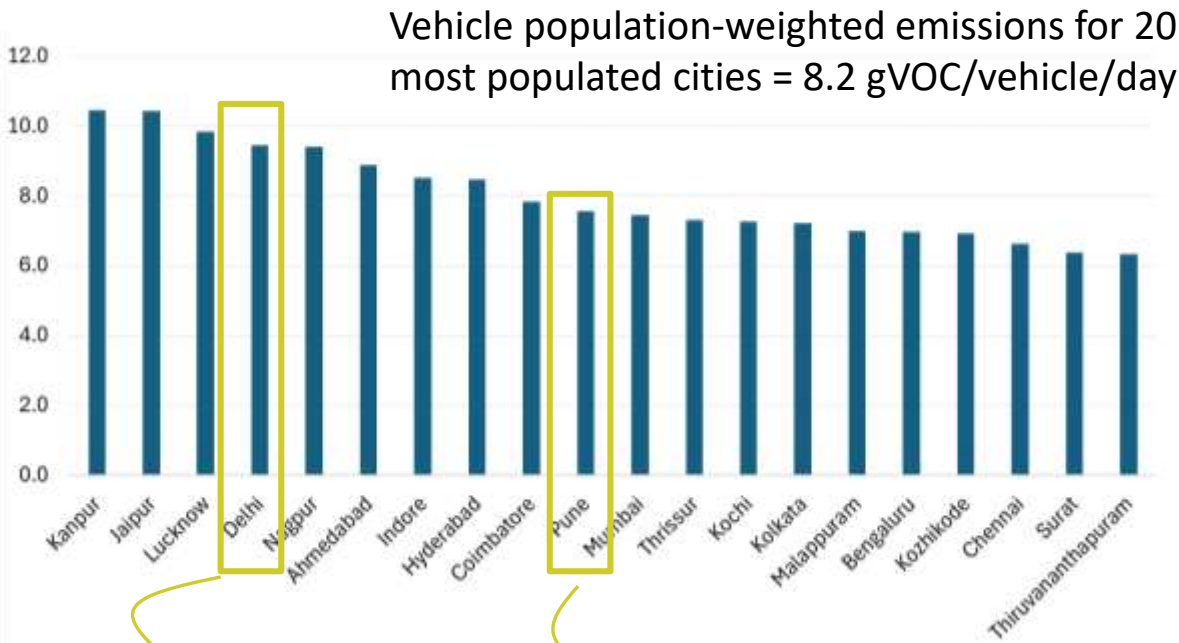
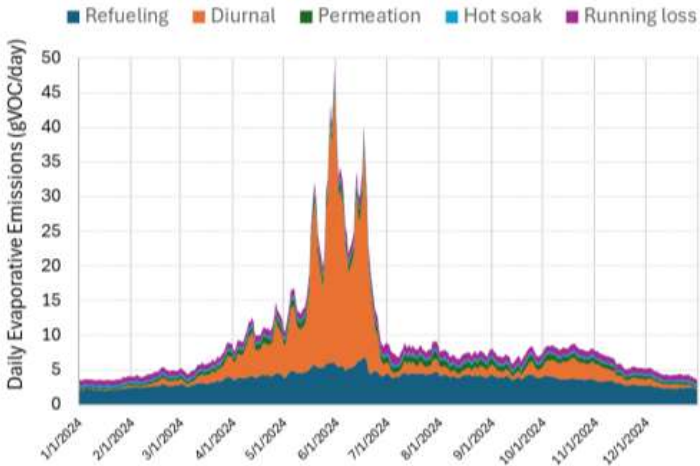
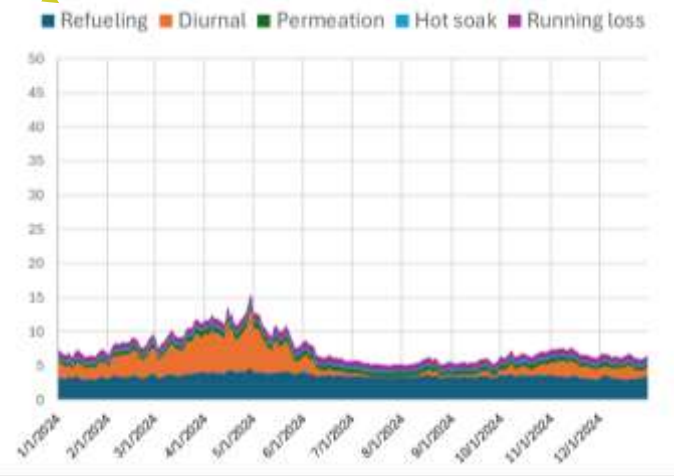


Hydrocarbon Emissions
g/Vehicle/Day



For average daily driving of 30 km:
Tailpipe HC emissions = 1.6 g/day
(assuming emitting at 75% of limit of 68 mg/km)

Evaporative Emissions of Petrol Cars for 20 Most Populated Cities



Total national evaporative emissions = 8.2 x 365 x Number of petrol cars (~ 27M) = 80,811 tons-VOC/year



Recommendations for final BS VII emission standards

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2. Test procedures should include real-world emissions reflective of **India-specific ambient conditions**
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GAS EMISSION CONTROL

Tailpipe Emissions

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3. **Adopt a Refueling Standard**
 - Test procedures already exist in U.S., Brazil and China

Acknowledgments



Overall Project Scope & Guidance
Emission Controls Manufacturers Association

Setting the Goals
Govt. Agencies



Government of India
Ministry of Road Transport and Highways



Students from IIT-D Abu Dhabi & Faculty
Bilal Rasheed, Ankit Kumar

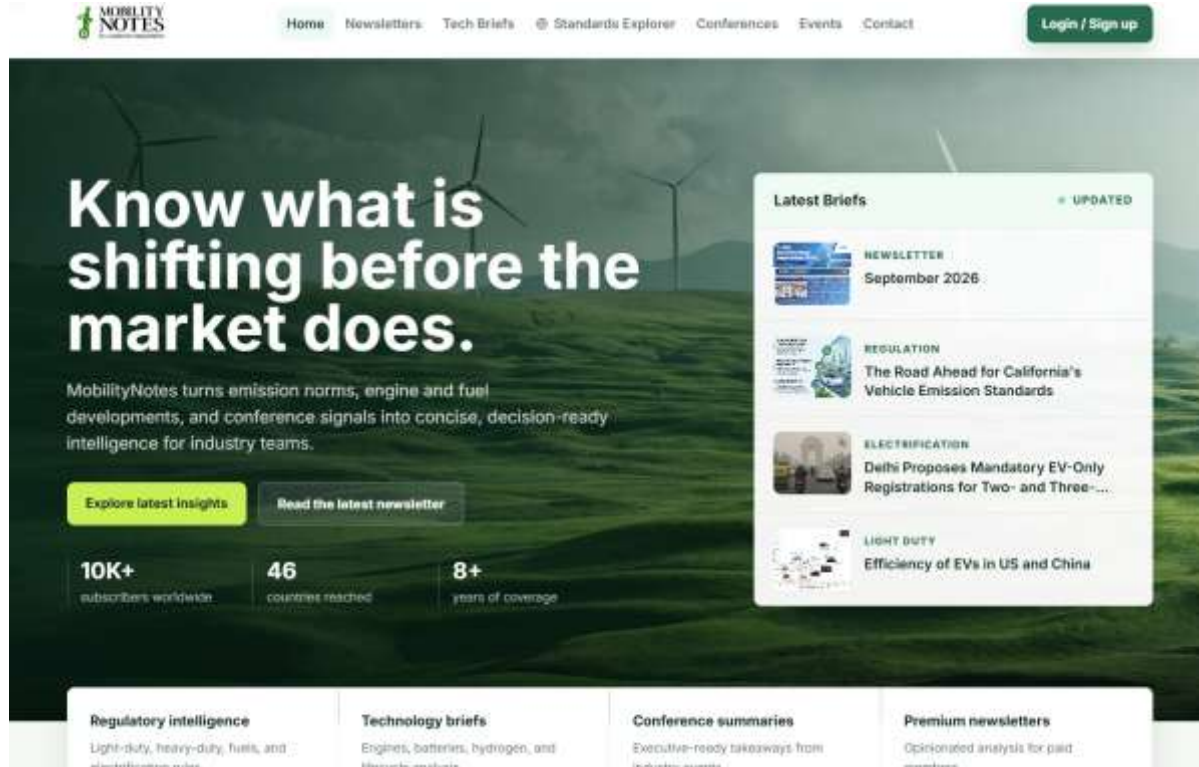


Emisia for support with COPERT
T. Karageorgiou, C. Kouridis



Discussion and pointers with previous work
Namita Singh

Check out the new MobilityNotes website, sign up for newsletters and events



The screenshot shows the MobilityNotes website homepage. The header includes the MobilityNotes logo, navigation links (Home, Newsletters, Tech Briefs, Standards Explorer, Conferences, Events, Contact), and a Login / Sign up button. The main banner features the headline "Know what is shifting before the market does." and a subtext: "MobilityNotes turns emission norms, engine and fuel developments, and conference signals into concise, decision-ready intelligence for industry teams." Below this are two buttons: "Explore latest insights" and "Read the latest newsletter". A statistics section shows "10K+ subscribers worldwide", "46 countries reached", and "8+ years of coverage". A "Latest Briefs" sidebar lists updates in Newsletter (September 2026), Regulation (The Road Ahead for California's Vehicle Emission Standards), Electrification (Delhi Proposes Mandatory EV-Only Registrations for Two- and Three-...), and Light Duty (Efficiency of EVs in US and China). The footer highlights four categories: Regulatory intelligence, Technology briefs, Conference summaries, and Premium newsletters.

 [Register](#) for an online (free) webinar for an extended review series rounding up global developments in light- and heavy-duty transport



The screenshot shows the MobilityNotes Webinar registration page for November 2026. The title is "MobilityNotes Webinar" with a date tag "NOV 2026". The description states: "Join us for an in-depth overview of recent advanced in light- and heavy-duty vehicle and off-road propulsion technologies and regulations." The page lists three speakers: Dr. Ameya Joshi (MobilityNotes CEO & Founder), Giacomo Belgioia (Durameta Automotive Italia), and Dr. Yu Zhang (Caterpillar Inc.). Each speaker has a brief bio. A "Register" button is at the bottom.

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