AIR QUALITY ASIA:

PANEL DISCUSSION ON A TRANSITION TO A CLEAN AIR TRANSPORTATION SYSTEM

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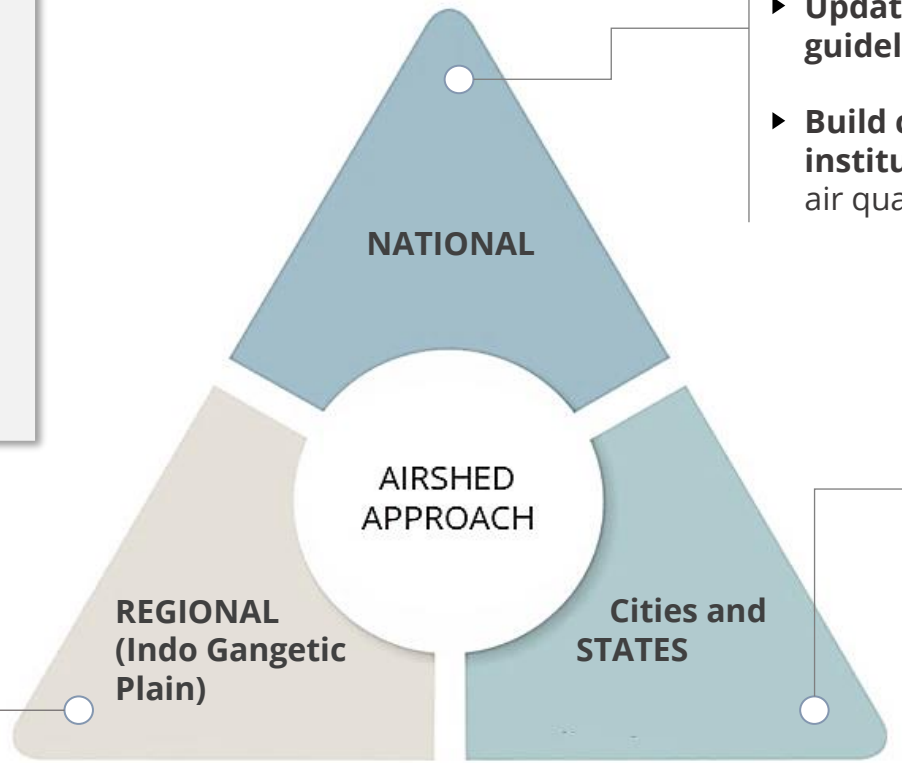
WORLD BANK has a strong program supporting NCAP IMPLEMENTATION & SCALE-UP OF IMPACT through an **airshed approach**

Key Outcomes of the multi-year TA:

1. **Multi-sector AQM plans/strategies underpin by a scientific and evidence base** (modeling), integrating greenhouse gas benefits, and consolidating national and international experiences
2. **Regional action plan/strategy for the IGP**
3. **National Guidelines updated** on different elements of air quality management planning.



- **Build capacities and deepen knowledge** for airshed management
- **Updated AQM planning guidelines**
- **Build consensus on policy and institutional reforms** for better air quality outcomes

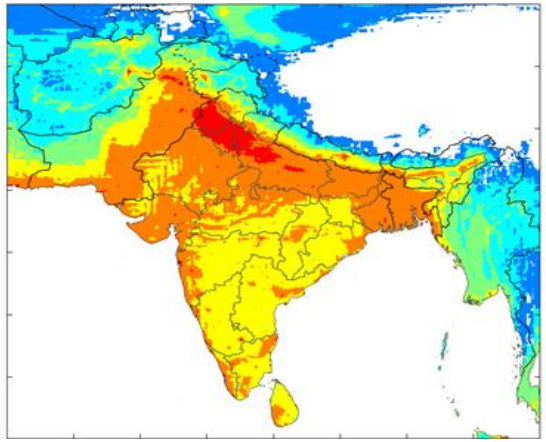
- Develop **state level action and investment plans**
- **Implementation support** for NCAP
- Development of the **foundational AQM infrastructure**

- **IGP AQM model** for regional action plan
- **National Knowledge Network (NKN)**

Inform and leverage innovative financing mechanisms, including World Bank DPO and PforR instruments for implementation of investment plans – Includes making Sector Investments in Transport AQM focused

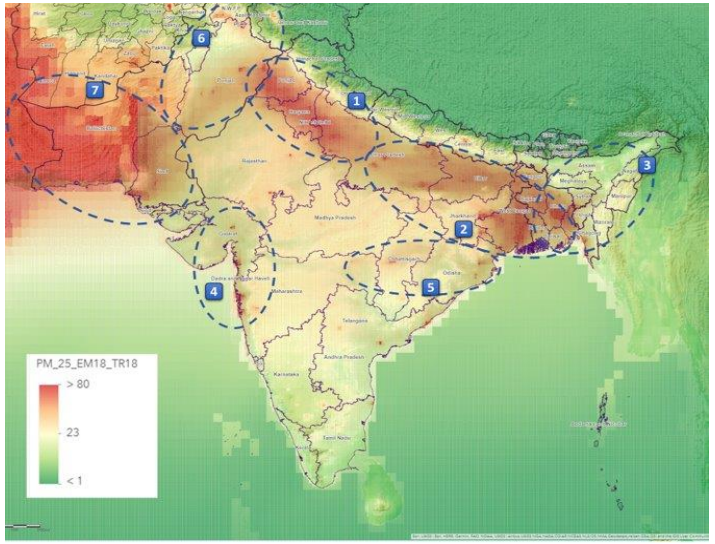
Why is the airshed management approach is important for tackling emissions from Transport?

Mobile source concentrations in India



Transport emissions are largest and need the most attention across the Indo-Gangetic Plain State/UTs

Airsheds are areas where typography, meteorology and climate limit the dispersion of air pollution outside the area



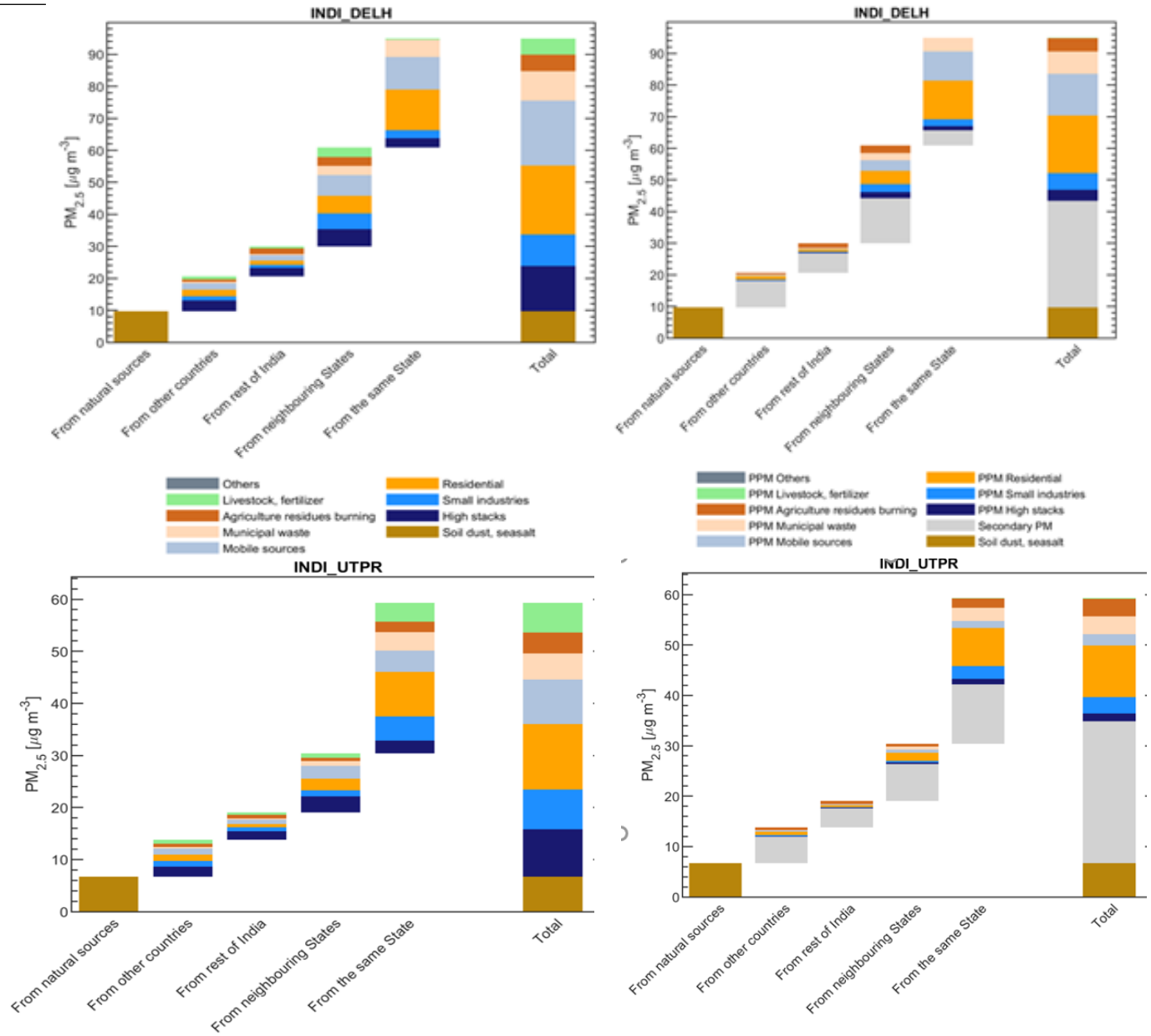
Transport emissions contribute to BOTH:

- Primary Pollutants that impact the near and most vulnerable/directly exposed people (often poor); IEA estimates 7% of combustion related $PM_{2.5}$ come from transport
- And secondary PM 2.5 when NOx mixes with other gases. Secondary PM2.5 travels with wide impact all people and corners of India! IEA estimates 40% of NOx come from transport oil combustion.

There can be a double gain from a transition to cleaner transport systems especially when considering airshed level impacts

The Significance of Transport for AQM in India

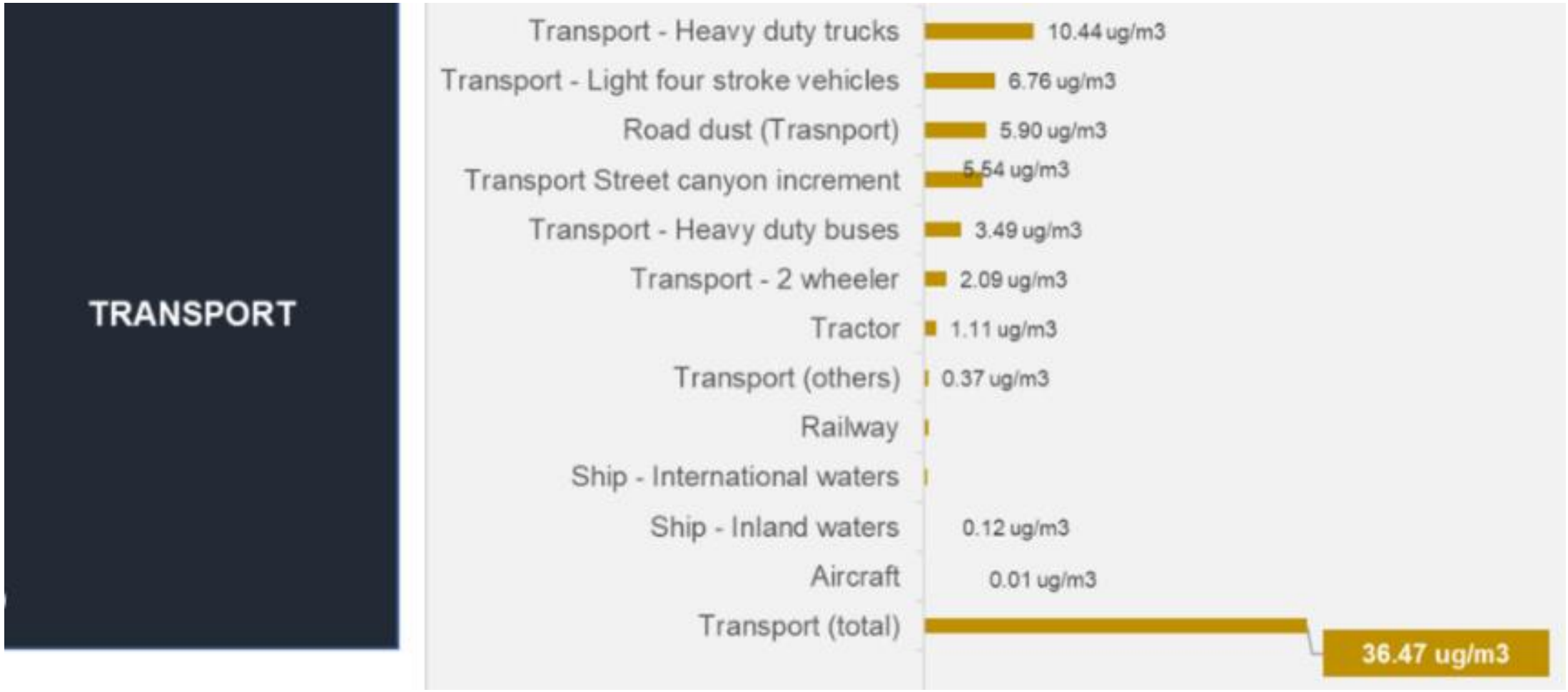
Transport emissions show appear BOTH as light blue (primary) and as grey in the right graph (secondary) emissions



From a city perspective the transport share is typically high (Delhi at 27% among the highest)

From the state and airshed perspective, the transport share is lower **but** contributes more to secondary PM2.5

Contribution to PM2.5 from transportation, a combination of different sources: (Example from the National Capital Region)



Heavy Duty Trucks **alone** contribute to Delhi NCR exceeding WHO standards!!

Understanding the ASI Framework for Climate/AQ co-benefits for passengers

Avoid

Reduce motorized demand

- Planning (TOD/compact)
- Regulatory and tech (occupancy, telework/study)
- Travel demand management
- Pricing (carbon)

Shift

Shift to more efficient modes

- From personal vehicle to shared mobility, walking, cycling, e-2wheeler
- From road to rail/river transport
- From air to rapid rail/ intercity buses

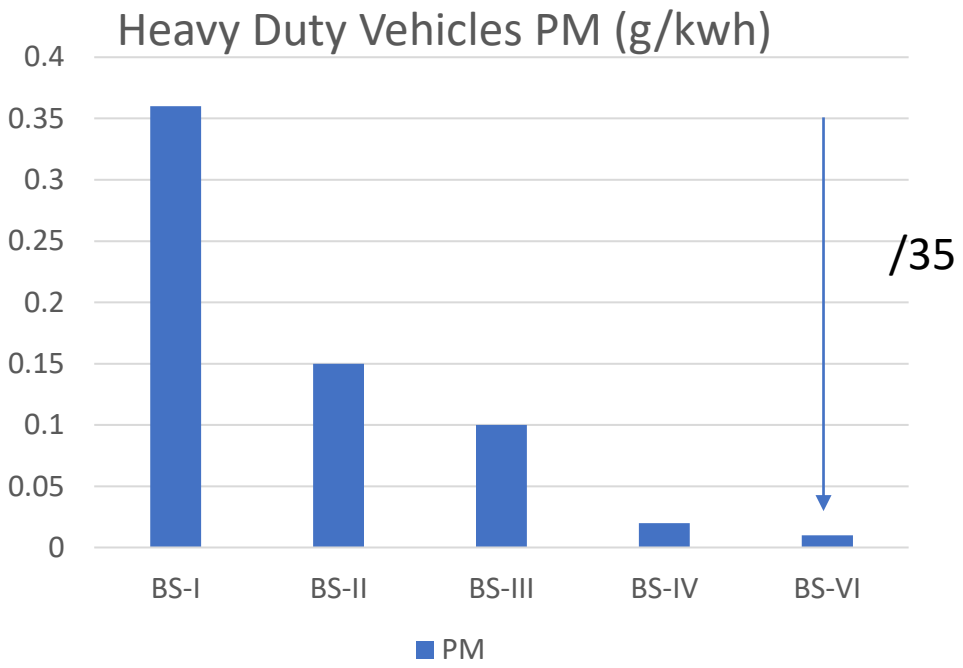
Improve

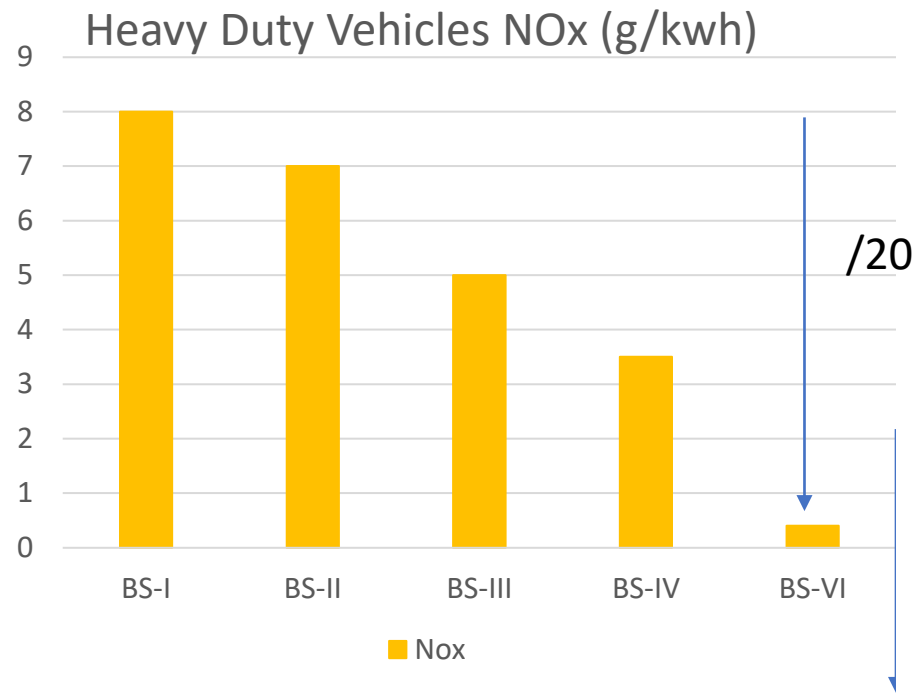
Enhance energy efficiency

- Vehicle efficiency
  - Scrapping/transition
  - Low emission zones
  - Incentives
  - Emission standards
- EV with greening power grid
- Low carbon fuels (hydrogen, biofuel…)

Through planning, regulatory, infrastructure, economic, technology, communication instruments

Improve measure: Transitioning fleet through scrapping polluting vehicles [pre-BS, BS I and II]



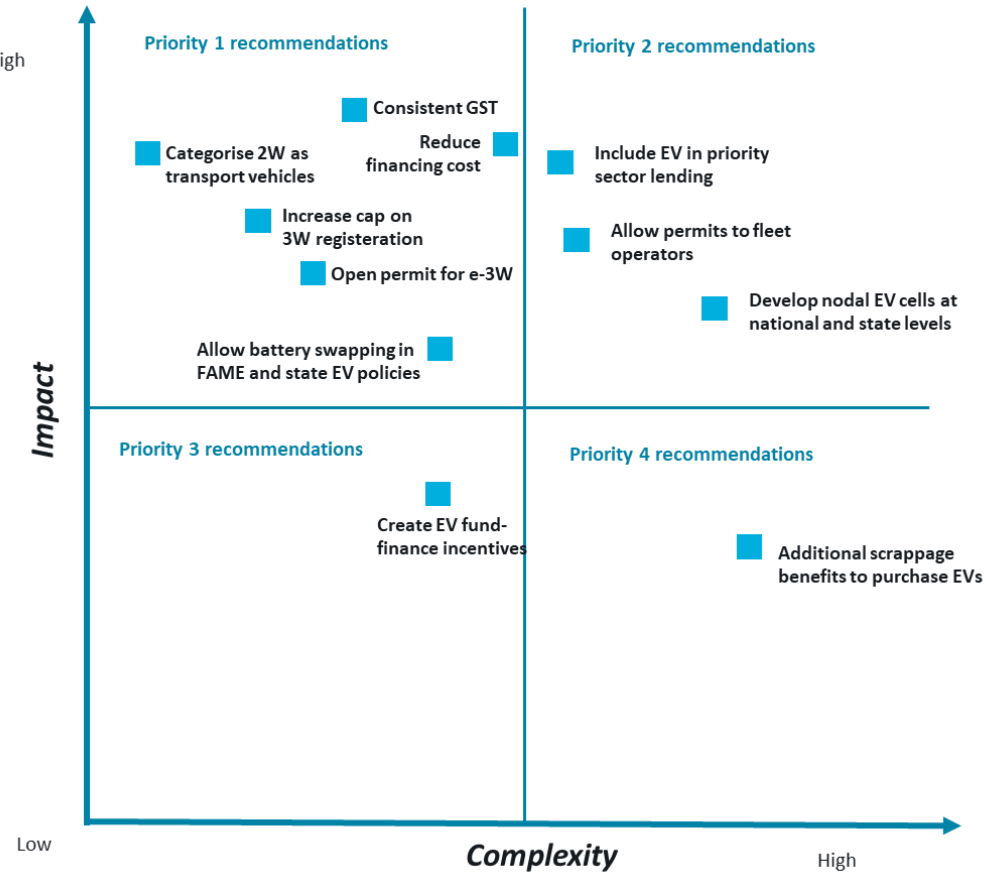


Foster switch to BS-VI and EV

Introduce Registered Vehicle Scrapping Facilities and Automated Testing Stations

https://www.transportpolicy.net/standard/india-heavy-duty-emissions/?title=india:_heavy-duty:_emissions

Improve measure: EV accelerated adoption



Expected EV Sales penetration (base scenario)

Market segment	FY20	FY21	FY25	FY30	EV share (FY30)
2W personal	152,000	143,000	1,243,000	2,375,000	11%
2W Fleet (passenger and cargo)			566,000	969,000	18%
4W Personal	3,400	6,000	121,000	365,000	6%
4W Passenger Fleet			21,000	70,000	13%
3W Passenger Fleet	90,000*	88,000	265,000	741,000	36%
3W Cargo Fleet			46,000	144,000	34%

High penetration | Medium penetration | Low penetration

Expected Sale EV penetration (Alternate Scenario) Indicative/subject to change

Market segment	FY20	FY21	FY25	FY30	EV share (FY30)
2W personal	152,000	143,000	3,100,000	6,913,000	31%
2W Fleet (passenger and cargo)			2,079,000	2,524,000	46%
4W Personal	3,400	6,000	174,000	604,000	10%
4W Passenger Fleet			30,000	115,000	21%
3W Passenger Fleet	90,000	88,000	382,000	1,072,000	52%
3W Cargo Fleet			65,000	207,000	49%

High penetration | Medium penetration | Low penetration

Market penetration depends on measures to accelerate EV Implementation in 2/3 wheelers and fleets and unlocking financing

True success requires greening the grid

World Bank Group EMMA Study with Steer (2021)/figures are illustrative and subject to changes

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Accessibility & Affordability

Affordable access to work, live, learn and play opportunities for all

Citizen Experience

Quality walking, cycling and integrated mobility, answering citizens' needs

Efficiency & System Performance

An efficient and well-performing system

Resilience

A system resilient to natural hazards and pandemic

Green Performance

Mobility with a low CO2, air and noise pollution

Safety

A safe and secure environment for all

Innovation

Data and service ecosystem for CASE

Santiago de Chile

Urban Mobility: Clean Air and Low Carbon Transition - How

Institutions

Holistic

- Urban Metropolitan Transport Authority
- State level EV Program
- State level Green Mobility Program

Finance

Leveraging

- Objective-driven allocation
- Urban Transport Fund
- Leveraging private capital
- Incentivize accelerated transition (green tax)

Service

Integrated

- Multimodal transport/ stations/Mobility as a Service
- Walk/cycle environment
- Charging facilities
- Vehicle Inspection

Unlock planning, regulatory, infrastructure, economic, technology, communication instruments

Example

Inadequate urban bus service supply

Currently, the bus sector in India is lagging behind other modes. It is not developing either in capacity or quality and is losing market share.

This is happening throughout India, indicating fundamental problems in the overall framework rather than weaknesses in individual States.

Major supply gap	**Bus provision is 1/3 to 1/5 of needs in cities**
Low quality of services	**Aging fleet with limited customer focus**
Low fleet growth	**Growing at half of competing modes**
Limited public resources for scale up	**Public operators on survival mode**

Potential Impacts in numbers

A full program that would scale up urban bus service delivery by adding 150,000 buses, would have a large impact across all sustainability metrics.

{a conservative reduction factor of 30% compared to existing average STU ridership value is applied}

Increased bus services lead to

Improved mobility

A fleet of 150,000 urban buses can deliver 86 million daily trips or 320 billion passenger kilometres per annum, at a cost lower by 63% than the alternative, **saving US$12 b** per annum.

Efficiency

Over **US$8.4 b per annum in vehicle operating cost** savings
Postponed infrastructure upgrade (better use of road space)
4,700 million fewer litres of fuel consumed per annum

Safer mobility

8,400 fewer lives lost in road accidents per annum

Greener transport

6.5 million tons of C02 emission avoided per annum
8,900 tons of PM emission avoided per annum

Private investments and employment

US$15 b in private investments in buses
Over **780,000 jobs** in the service industry

Key Required Shifts

Moving to a system that satisfies the urban mobility needs of citizens for the coming decade will require more than the mere addition of new buses. The following shifts are essential to move to sustainable service provision. Creating a contracted model for transport requires some key ingredients: a contracting model and a contracting authority; a good ITS system to make the administration and enforcement of the contract transparent; a fare setting mechanism to keep the system solvent; a mechanism to deal with the Viability Gap Funding (VGF); a dispute resolution mechanism so that contractors are not left unpaid without cause.

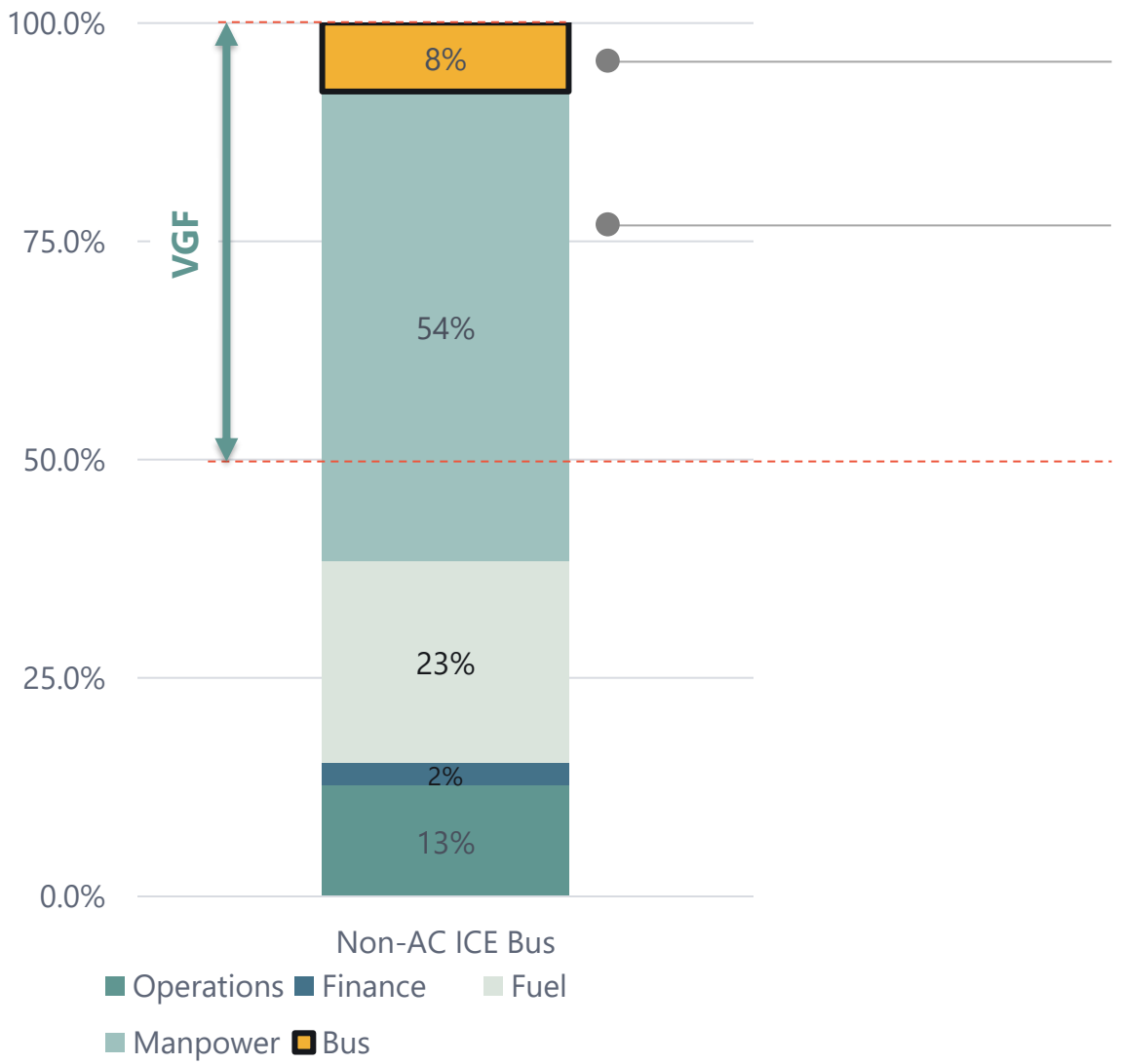
1. **Establish clarity of mandate**
2. **Develop integrated mobility vision with NMT, centered on people**
3. **Replace invest-decay-invest cycle with sustainable growth**
4. **Refocus from bus purchase to services with sustainable funding**
5. **Leverage private sector engagement for reducing cost**
6. **Ensure effective delivery through reliable contracting**
7. **Leverage ITS as the backbone for Service Design and Delivery**

Key Required Shifts

Refocus from bus purchase to bus services with sustainable funding

Historically, the dialogue of agencies and operators has focused on the need for more buses. While buses are undersupplied, buying more buses does not address the sustainability question, as bus capital costs are a small percentage of overall lifecycle costs. Sustainability requires a refocus towards bus operations and on the cost of service delivery compared to revenues.

From CAPEX to OPEX for Urban Bus Operations: Re-focus Financing for Sustainability



Bus cost is less than 10% of total operating cost over a 10 year period

Salaries for the crew account for a majority of the total cost

Average recovery of cost via ticket collection

Need for viability gap financing (VGF) to ensure buses purchased can be operated throughout life-time

Roadmap for State Urban Bus Program (SUBP)

Key questions and process to follow to design an urban bus program and determine the level of support required under a SUBP.

Focus on key requirements: customer needs, economic efficiency and sustainability.

1 **Define the vision** for the State detailing the level and design of bus service to be provided across different tiers of cities

2 Evaluate the **mode of delivering bus services** i.e. share of in-house and outsourced

3 For in-house operations, **consider efficiency measures** to increase utilization and reduce costs (conductor less - flexwork)
For outsourced services, **adopt best-in-class practices** to generate private sector interest
Develop driver availability through training to align salary increase with inflation

4 Evaluate **total viability gap funding required** based on cost of achieving vision based on model of delivery

5 **Identify current and new sources of revenue** to balance VGF requirements on a sustainable basis**. If required, iterate on vision and business model** to achieve balance and finalize **Long Term Funding Mechanism.**

6 **Announce state policy and program,** put in place fare policy, funding mechanism, State Technical Directorate, arms-length arrangements with STU; and empower cities**.**

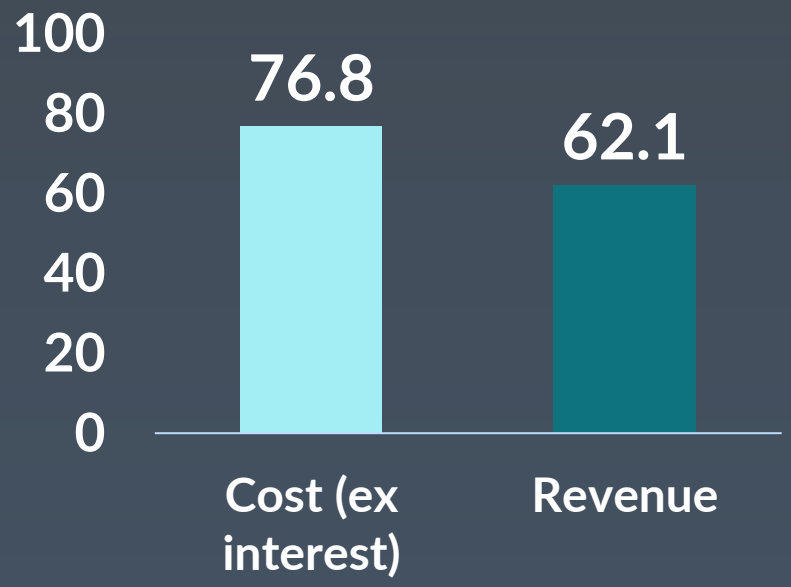
Opportunity from bus to e-bus

	Impact of adding 1000 Urban buses	Impact of adding 1000 e-buses
Improved mobility	600,000 daily trips or 2 billion passenger kilometres per annum, at a cost lower by 63% than the alternative, **>> saving users INR5600 cr** for 10 years	Similar but not impacted by future fuel price increase
Efficiency	Postponed infrastructure upgrade (better use of road space) **310 million** fewer litres of fuel consumed for 10 years	Save 600 million litres of fuel over 10 years [AC option]
Safer mobility	**560** fewer lives lost in road accidents for 10 years	Similar
Greener transport	**400,000 tons** of C02 emission reduction over 10 years **590 tons of PM** emission reduction over 10 years	**600,000 tons** of CO2 emission reduction over 10 years [including grid] [AC option]
Private investments and employment	**INR700 cr** in private investments in buses Over **5,200 jobs** in the service industry	**INR1600 cr** in private investments in buses and accelerate industry development

Challenge

Addressing the viability gap for urban buses

INR14.6 per km



Urban bus services by STU ran an average deficit of INR 14.6 per km pre COVID ex interest (CIRT 2017-2018)

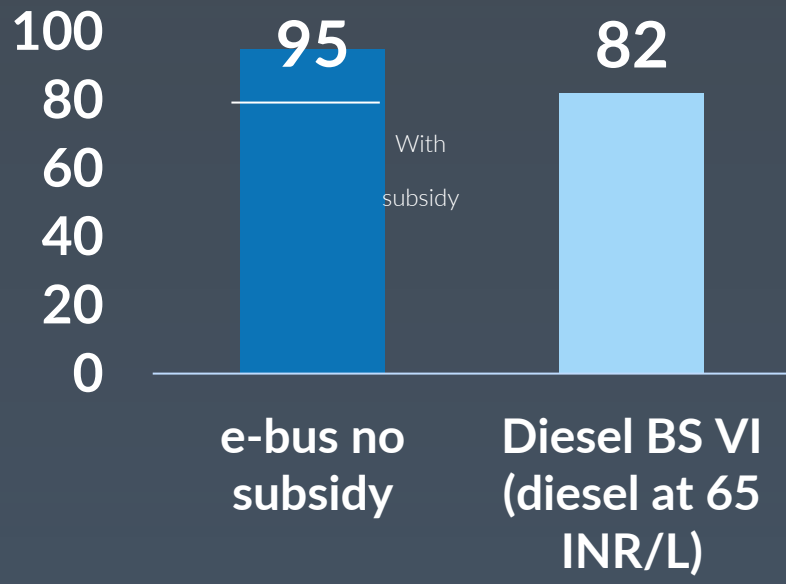
Beyond the CAPEX Support, OPEX Support is needed

Min INR1 Crore per bus (real term)

70,000 km*10 year*15INR

Addressing TCO GCC gap between electric and diesel buses

INR13 per km



Estimated GCC Cost for 70,000 km per year intracity

*Value varies (Spoctech/Steer 2021)

Unlocking E-Bus through bankable solutions

Contracting

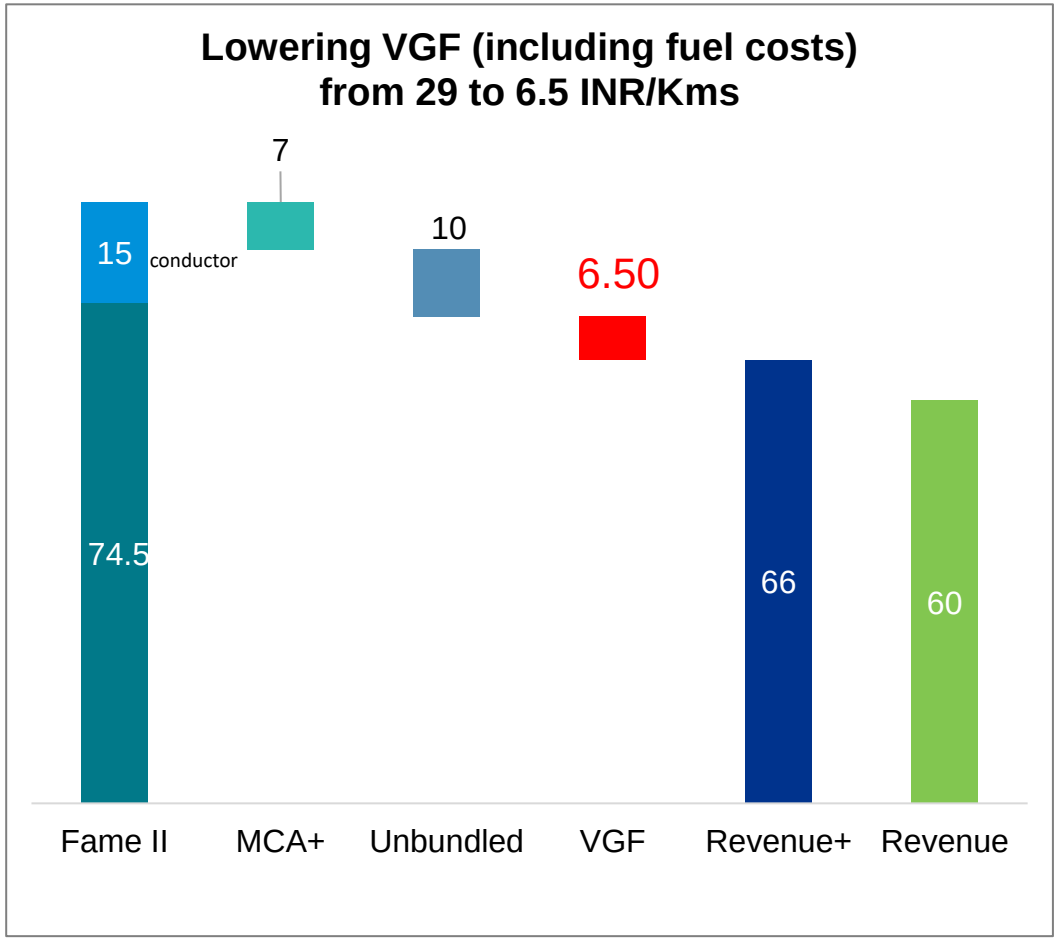
Reduce Viability Gap Funding through efficiency gains

1. **Sound contracting:** Enhance procurement/MCA: Costs **- 10%**
2. **Scale:** Purchase at scale/unbundled models: Costs **- 10%**
3. **Good planning:** better use Revenues **+ 10%**

Financing

Lower Risk to banks to reduce capex financing cost (2%)
(e.g. World Bank Group instruments)

1. **Payment Security:** Guaranteed payments (who pays? mechanism)
2. **First Loss Facility:** In case of loss on loans for buses under FAME II contracting with CESL, coverage of [20%] of Loss



Leverage the detailed work by World Bank Group and address those in up to lighthouse cities at scale prior to replication

Key Assumptions: [to be tailored for each city]
Average daily distance travelled is assumed to be 200 km per day (347 days per year)
For EVs, no road registration fee is assumed for computation of EVs
FAME-II incentive of INR 20,000 per kWh of battery capacity is taken into consideration
State Govt incentive of upto INR 10,000 per kWh of battery capacity is taken into consideration
Debt to equity ratio of 80:20 is assumed with post tax ROE of 14% and interest rate of 10%
MCA+ and Unbundled, Revenue+ based on World Bank (2021)

WBG POTENTIAL SUPPORT

FROM WHAT TO HOW TO

POLICY/ REGULATORY	Technical assistance in policy formulation and system development (vision for mobility, sector funding, effective procurement) at scale; policy lending
INSTITUTIONAL	Technical assistance for Institutional Capacity Building
FINANCIAL	Payment Guarantees Assurance to enable Private Sector Participation (especially for GCC, Leasing type of models) Support to viability gap funding contribution where Private Sector Participation, funding and contracting is in place Risk sharing facilities and guarantees to enhance commercial bank support to e-bus rollout Soft loans for infrastructure development / upgradation Support to development of Green Funds, Equity and debt financing to private sector (IFC only) Sub-sovereign lending (IFC only)
PROCUREMENT & CONTRACT	Technical assistance to set up procurement and contract management system Transaction advisory support to the Authority / State Government Pilot e-bus program using early-stage development product

In Summary

- Many types of vehicles to target in the mixes- for example Delhi importance by source: #1 Heavy vehicles; #2 4-wheel personal cars; #3 dust in street canyons; #4 Buses; #5 2-wheelers.
- *Time Frames and Market Segments: think plurality of solutions*
- *Accelerated Transition: From existing fleet to new technology*
  - Remove the most polluting vehicles off the road and prevent spill-over to other places through aggressive scrapping and incentive schemes; diesel filters
  - Accelerate EV uptake combined with power grid greening.
  - Expand compressed natural gas from biomass including for both on and off-road uses (private and public sector) and prepare for green hydrogen
- *Adapted Institutions and funding: working at airshed level scale for planning (regional/metropolitan); Multisector and objective driven; multimodal and shared mobility*
- *Key Solutions: recognize green buses as major part of solution if combined with rethought service delivery for sustainable results; reduced bus taxes and green tax can help pay for it*

Useful reference

https://thedocs.worldbank.org/en/doc/236681571411019437-0090022019/original/GreenMobilityGlobalRoadmapofAction.pdf

Volume of pollutants emitted (gram per km) for different modes

Vehicle Type/ Pollutant	CO	HC	NOX	PM	CO_2
2-wheeler	1.4	0.7	0.3	0.05	28.58
3-wheeler	2.45	0.75	0.12	0.08	77.89
Cars (incl. cabs)	1.39	0.15	0.12	0.02	139.52
Bus (incl. BRT)	3.72	0.16	6.53	0.24	787.72
Treatment Cost (Rs. /ton)	1,00,000	1,00,000	1,00,000	1,00,000	500

MoHUA Guidelines