

Taming on-road emissions in the real world: Setting the agenda for action



Anumita Roychowdhury
Centre for Science and Environment

CSE Webinar: Road to cleaner emissions: New generation and advanced strategies to monitor emissions from on-road vehicles

August 5, 2021



New vehicle technology changing rapidly in India



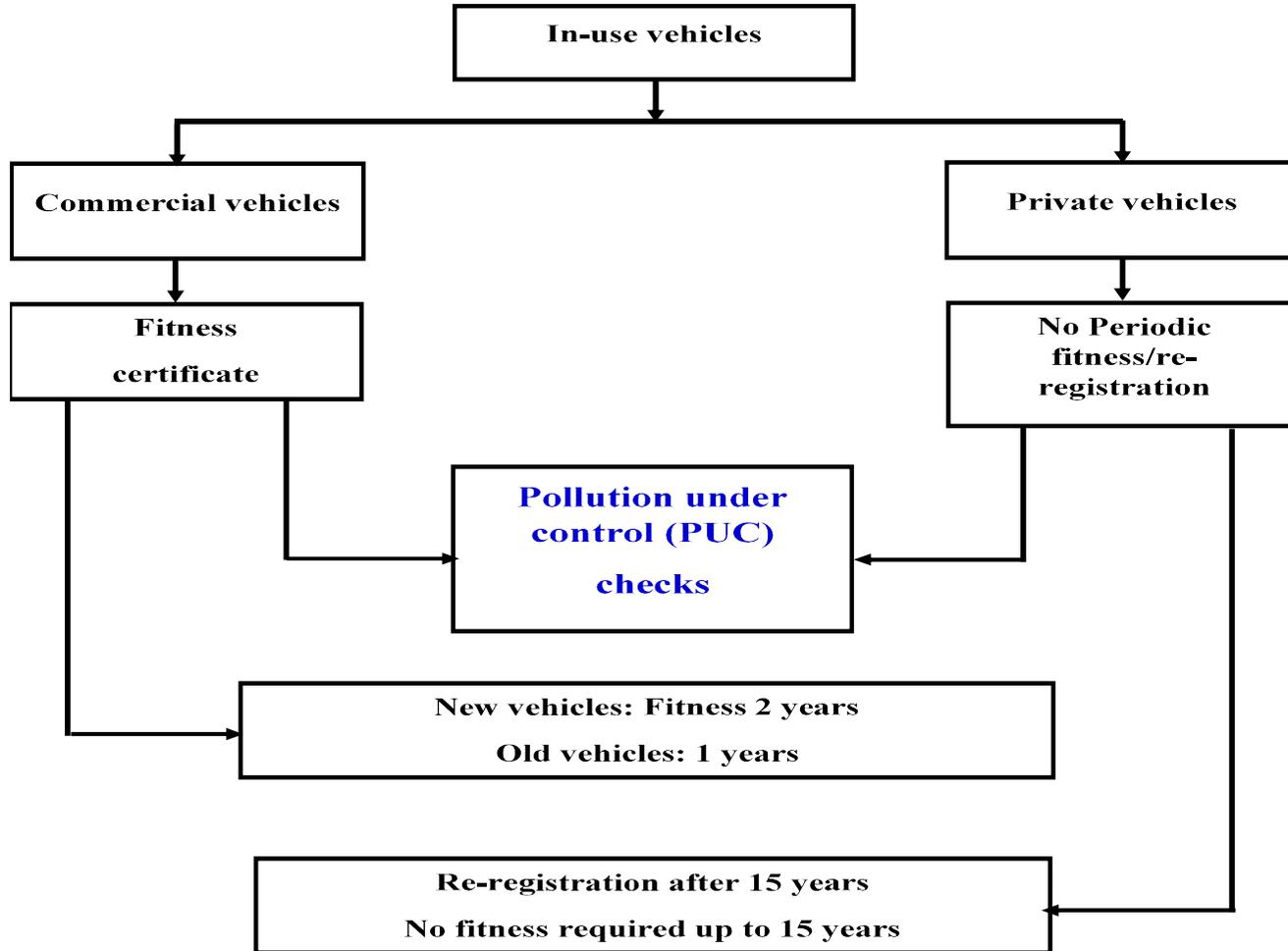
India leapfrogs to BSVI emissions standards

- Emissions gap between petrol and diesel cars reduced but not eliminated
- Particle number count standard introduced; Paradigm shift in diesel emissions control systems
- Two wheeler standards significantly more stringent: (NO_x and hydrocarbon regulated separately; evaporative standards; OBD etc)
- Real world Driving Emissions (RDE) regulations -- for certification and in-use testing for compliance
- In-service compliance regulations - Adoption of confirmatory factor
- To move towards more exacting test cycles WLTP
- And more Awaiting full alignment with reform packages in Europe in 2023

What about emissions from on-road vehicles in the real world?



The current system of scrutiny



Pollution Under Control Certificate: The basic scrutiny



Idle emissions testing

Petrol/LPG/CNG vehicles: Idle speed testing; Measure carbon monoxide (CO), and hydrocarbon (HC) concentration in exhaust

Diesel vehicles: Free acceleration mode or smoke opacity test for diesel vehicles.

Repair and retest if vehicles fail

Test data from PUC centres linked with central server and centralized vehicles data base (VAHAN) of the Ministry of Road Transport and Highways to prevent manual interference

Challenging to make it work...



Lessons from states: Audit of PUC system in multiple states:

Poor compliance – not all vehicles go for physical test

Improper testing and manual data reporting

Non-functioning equipment

Updated calibration certificates not available

Lack of knowledge of proper testing procedures

Lack of qualified and skilled PUC operators

Problem of quality control and assurance

Oversight of numerous PUC centres challenging

PUC: Challenges



- Poor data recording and reporting
- Poor failure rate – nearly all vehicle pass
- Smoke density test for diesel vehicles ineffectual
- PUC results do not correlate well with vehicle certification data;
- Not reliable for BS IV and beyond vehicles with more advanced emissions control systems as under BSVI regime.
- Monitoring framework for monitoring PUC centres weak

Observed challenges

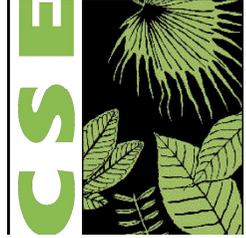


Broken non-functioning testing equipment was a common sight across Rohtak (2017 audit).

Smoke meter was not connected to the computer.

Still issued a pass certificate

Diesel vehicle testing



- Improper probe insertion
- Flushing done with probe inside the exhaust pipe
- Probe often has varied shapes

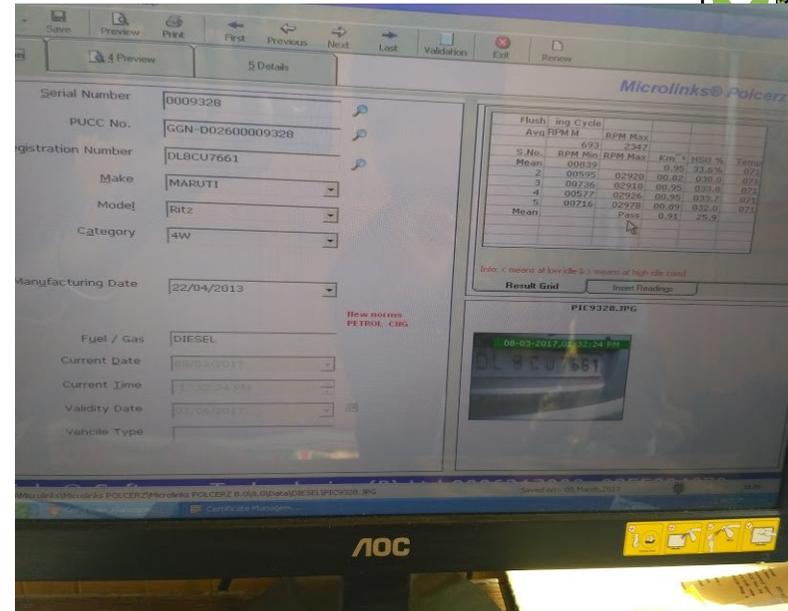
Enforcement challenges



Faridabad 2017,

This PUC centre had a **non-functioning diesel smoke meter.**

The centre still issued a pass certificate



Gurgaon 2017

Fake software called “**certificate management programme**”. -- common software found across several PUC centres

Improper testing procedures



NCR

- PUC Operators often have **no working knowledge of operations**
- PUC centres still issue valid PUC pass certification using **manipulative software**

Testing of a decoy test vehicle using a petrol emission analyzer
(2017)

Fake PUC certification – fly by night business



- Along the state borders of NCR, many illegal PUC centres operate
- Use fake software

Rewari district, Haryana (2017)

Erroneous values Maximum RPM in TEST 1 lower than Idle RPM?

BS-IV vehicle reporting zero values



POLLUTION UNDER CONTROL CERTIFICATE
Issued By: MUMBAI (WEST)
Authorised by Motor Vehicles Department, Maharashtra

TEST RESULT : PASS
VALID TILL: 23/Jan/2021

DIESEL DRIVEN VEHICLES
Certified that the vehicle conforms to the standards prescribed under rule 115(2) of CMV Rules 1989

Certificate Sl. No.: MH00200190001543
Registration No.: **MH46AF9966**
Chassis No.: MA1ZN2GHKF1J72966
Engine No.: GHF1J52973
Class of Vehicle: Goods Carrier
Make: MAHINDRA & MAHINDRA LIMITED
Model: BOLERO PICK UOP FB
Vehicle Category: LIGHT GOODS VEHICLE
Date of Registration: 22/Oct/2015
Emission Norms: BHARAT STAGE IV
Fuel: DIESEL
Date of Testing: 24/Jan/2020

FUEL	Light Absorption Coefficient (Permissible Limit)	Measured Value
DIESEL	1.62	0.01

Auto Emission Testing Centre Code: MH0020019
Testing Centre Name: ANMOL MOBILE PUC CENTRE
Centre Address: C/5,SAHAYOG, RATAN NAGAR, 4BUNGLOW
Test Conducted By: CHETAN NAIK

Time of Testing: 13:35:21
Fee Charged: Rs.110.0

TEST RESULT FOR DIESEL VEHICLE

	IDLE RPM	MAX RPM	K_VALUE	OIL TEMP
TEST 1	857.0	844.0	0.01	81.0
TEST 2	840.0	987.0	0.01	83.0
TEST 3	822.0	1298.0	0.01	85.0
AVG	839.66667	1043.0	0.01	83.0

To check.

This is a computer generated certificate and does not require signature
Fuel Norms entered by PUC center MH0020019 manually, Please visit RTO and correct norms

POLLUTION UNDER CONTROL CERTIFICATE
Issued By: MUMBAI (WEST)
Authorised by Motor Vehicles Department, Maharashtra

TEST RESULT : PASS
VALID TILL: 23/Jan/2021

PETROL/CNG/LPG DRIVEN VEHICLES
Certified that the vehicle conforms to the standards prescribed under rule 115(2) of CMV Rules 1989
CO Level at Idling (% Volume) (PPM)
HC Level at Idling (RPM)

Certificate Sl. No.: MH00200170004119
Registration No.: **MH02EZ8234**
Chassis No.: MALAF51CLJM023645
Engine No.: G4HGJM971862
Class of Vehicle: Motor Car
Make: HYUNDAI MOTOR
Model: INDIA LTD
Vehicle Category: LIGHT MOTOR
Date of Registration: 16/Jan/2019
Emission Norms: BHARAT STAGE IV
Fuel: PETROL
Date of Testing: 24/Jan/2020

FUEL	Prescribed Standard CO	Measured Value	Prescribed Standard HC	Measured Value
PETROL	0.3	0.0	200.0	1.0

At High Idle RPM 2500±200 Measured RPM...
CO% Lambda λ (RPM-2500:)

Prescribed	Actual	Prescribed	Actual
0.2	0.0	0.97-1.03	1.0

Auto Emission Testing Centre Code: MH0020017
Testing Centre Name: ANMOL MOBILE PUC CENTRE
Centre Address: C/5, SAHYOG, RATAN NAGAR, FOUR BUNGLOW,
Test Conducted By: CHETAN NAIK

Time of Testing: 13:25:23
Fee Charged: Rs.90.0

TEST RESULT FOR PETROL/CNG/LPG VEHICLE

	MEASURED VALUE	UNIT
CO	0.0	%
CO-CORRECTED	0.0	%
HC	0.0	PPM
CO2	10.1	%
O2	0.29	%
RPM	2500.0	
OIL TEMP	0.0	DEGREE CENTIGRADE



More PUC reforms

MoRTH June 14, 2021 notification:

Uniform PUC certification format,

Linking PUC database with national register,

Concept of rejection slip introduced for the first time,

IT enabled enforcement,

QR code to be printed on the form

Provide information about the PUC centre

- Earlier directive to link PUC with annual vehicle insurance

Massive digitization: But data does not help



Even with uniform software for recording PUC data, there is no system for maintaining and analyzing back-end database

Several important fields such as year of manufacture/registration, vehicle type, fuel type or other such fields, are not recorded

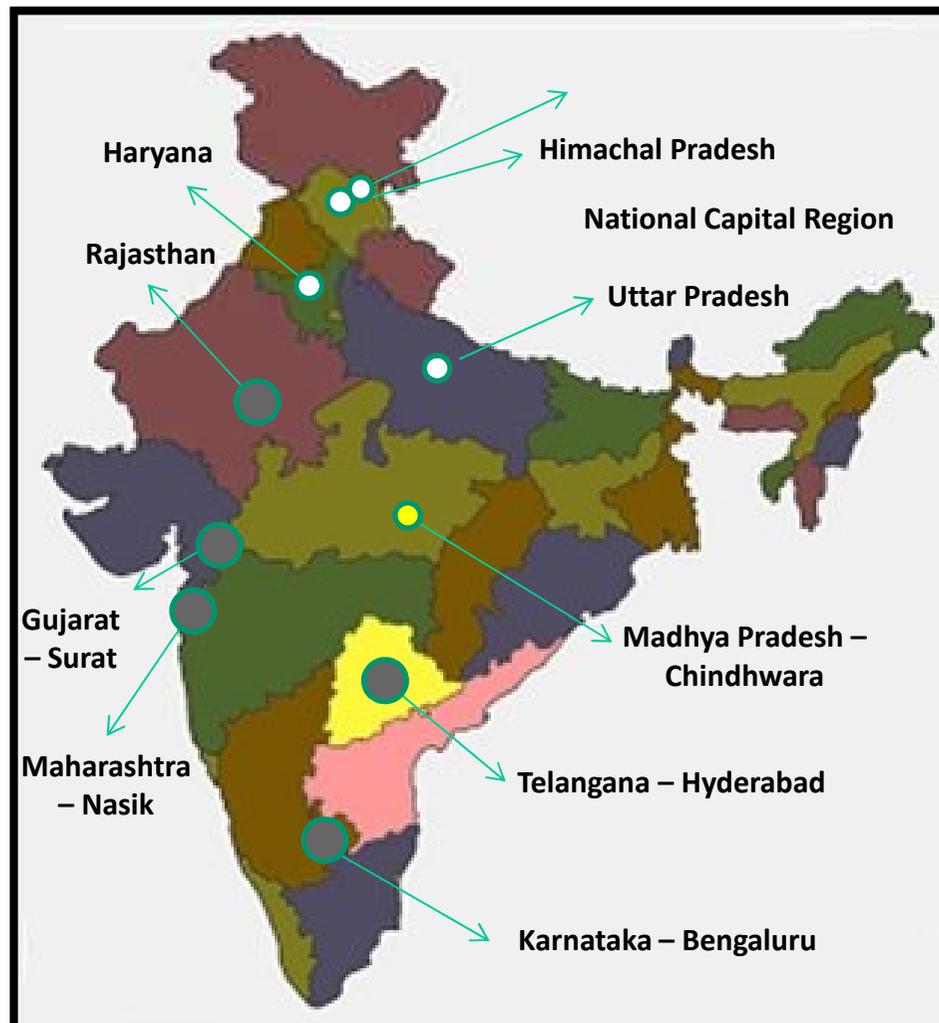
There is no system or capacity for data analytics to provide feed back to improve performance

Mismatch between basic PUC system and new generation regulatory requirements for real world emissions surveillance and control – How do we move forward?

Centralised automated vehicle inspection centres for commercial vehicles



10 Model I&C Test Centers being established..



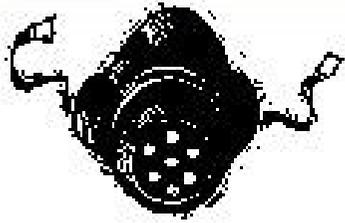
- Centers to be facilitated by ARAI
- Centers to be facilitated by iCAT
- Center to be facilitated by SIAM

Need to leverage this for advanced emissions testing

Source: ARAI



Towards next generation challenges and strategies to keep vehicles low emitting during useful life on road



Dieseldate: global alert

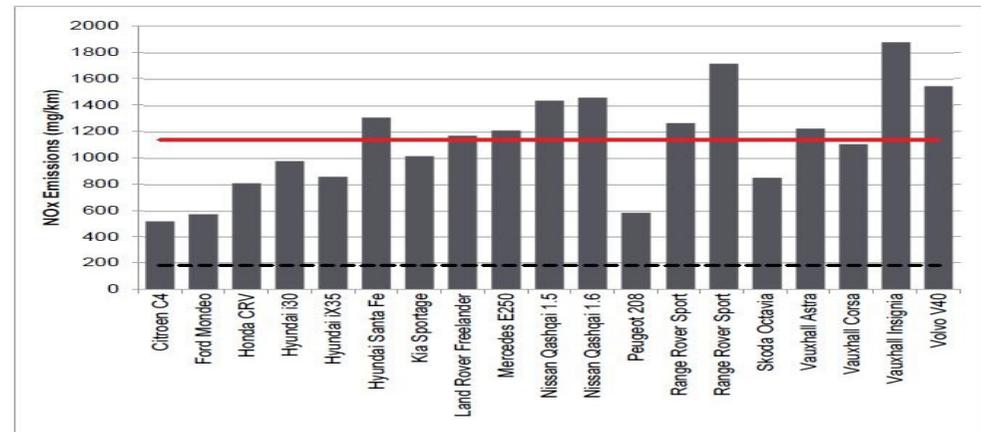
Unacceptably high emissions from diesel cars



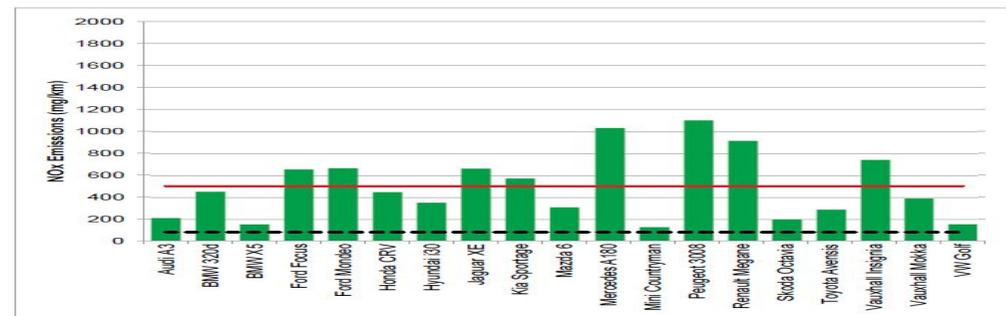
Real world NOx emissions from Euro 5 vehicles

Global response:

- Certification testing reformed
- Focus shifts to real world emissions monitoring, on board diagnostic and remote sensing measurements, remote monitoring of on-road fleet



Real world NOx emissions from Euro 6 vehicles



Source: April 2016, Vehicle Emissions Testing Programme, Secretary of State Transport, UK



What about India?



Nascent steps beyond PUC in India

- **Rule on OBD:** Check MIL light: (*MORTH notification G.S.R. 881(E), 26th November, 2019*): No PUC test if the On Board Diagnostics (OBD) Malfunction Indication Lamp (MIL) of BS IV and BS VI vehicle is on -- Vehicle to be tested after repair or servicing
- **Vehicle recall:** MORTH G.S.R. 173(E) 11th March, 2021: *Defective Motor Vehicles and Recall Notice; Vehicle recall portal; Recall notice; Rectification of recall products; Imposition of fines per number of vehicles recalled*
- **Step towards remote sensing:** AIS rules in the making



Clean air action plans under NCAP provide for remote sensing

Clean air action plans of several cities include remote sensing

West Bengal: Asansol, Barrackpore, Durgapur, Haldia, Raniganj have mentioned expanding the existing pilot on remote sensing for monitoring of emissions from in-use vehicles in Kolkata to upgrade inspection of on-road vehicles.

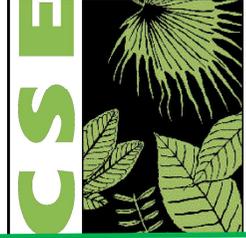
Kolkata- is already reporting action taken on RSD

Mumbai: Installation of Remote Sensor based PUC systems

Odisha- Bhubaneswar has included remote sensing in their clean air action plan

Delhi mandated by the Supreme Court to implement RSD

Remote sensing: First generation



Nascent beginning: 2004-05

- MoRTH had set up committee under ARAI to make recommendations on inspection and certification centres in India.
- Field trial of remote sensing in Delhi and Pune

Initial challenges:

- Technology not mature
- Measuring emissions from 2 and 3-wheelers challenging --devices not aligned with the tailpipes of small vehicles -- relatively smaller plumes of emissions that decay fast before a minimum number of readings can be taken. Capture rate low.
- Out of total measurements in the pilot scheme, 92% of total results for cars and 78% of total results for buses and trucks were valid. But for two wheelers, only 28% of the results were valid. (ARAI Report of the Technical Committee on Inspection and Certification System in India for MORTH)
- More innovation needed.

Second generation

Catalyst: Supreme Court directives for clean air action



- **SC Directive - May 10, 2018:** “Remote sensing screening of emissions has been found to be extremely effective in Kolkata and it would be of considerable utility in .. Delhi. take instructions in this regard for NCT of Delhi.
- **SC Directive July 8, 2019:** A report has been filed by International Centre for Automotive Technology (ICAT)..... and it is a finding of the ICAT that it is effective method to check the pollution. the technology is found to be working well in Kolkata also. EPCA to consider and submit a Report.
 - EPCA states: ‘If implemented, remote sensing can dramatically alter the way we monitor emissions from on-road vehicles and allow more efficient screening of highly polluting vehicles.’
- **SC Directive July 29, 2019:** Considered Report No.99 submitted by EPCA ..Issue notice to the Ministry of Road Transport and Highways and the Department of Transport, NCT of Delhi.

Steps outlined and taken on board



EPCA recommendations taken on board and notices issued:

Union Ministry of Road Transport and Highways (MoRTH)

- Plan for implementation of Remote Sensing -- suggested agencies and time-lines
- Frame rules under Central Motor Vehicle Act and Rules to define the scope and use of remote sensing for monitoring and enforcement
- Notify gross polluter threshold under CMVR as recommended by ICAT
- Technical guidance on designing of the programme, (equipment, networking and data sharing, site selection, O&M etc)
- Global tender for purchase of 5 machines for Delhi
- Finalisation of site and sampling plan
- Issue guidance on industry standard on remote sensing

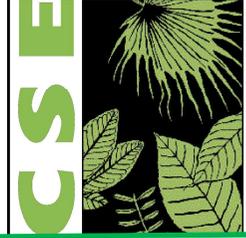
Steps outlined and taken on board



Department of Transport, NCT Delhi:

- **Issue global tender for procurement of remote sensing equipment and its operations:** Procure five
- **Availability of equipment** - capable of measuring NO, NO₂, HC, CO, CO₂, opacity at a minimum. N₂O, NH₃, SO₂, and CH₄ desired, not necessary.
- **Do a site selection and sampling plan**
- **Set up system for management of data and network**
- **Software system to automatically issue a warning to all vehicle owners whose vehicles exceed high emitter threshold even once.**
- **National Informatics Centre (NIC) may develop integrated platform necessary for this**
- **As per Open Government Data initiative, emissions data to be released** for analysis of emissions trends, identify systemic problems etc

Framing of Rules



Action at central level: MORTH drafts rules

- **Draft AIS-170/DF September /2020 FINALIZED DRAFT AUTOMOTIVE INDUSTRY STANDARD Remote Sensing Devices for on-road Emissions Monitoring – Product Specifications and Programme Guidelines**
- Requirements for the RSD
- Pollutants to be measured
- Requirements for ambient weather and site condition testing:
- To be GPS enabled
- Parameters to be recorded
- Test parameters and provision of threshold levels
- Calibration checks
- System requirements
- And more.....

To be taken forward for implementation

Kolkata takes the lead



2009: Calcutta High Court had directed a phase out of older vehicles it had also directed improvement in in-use emissions surveillance.

Source: CSE field visit



**Tap the global learning curve to
build the India programme**

Rapid advancement



- **Spotting and chasing visibly polluting vehicles to take them for compliance testing for short test on dynamometer**
- **Small volume testing on dynamometer**
- **Vehicles tested with portable emissions monitors (PEMS) as part of real world emissions monitoring – low volume**
- **Remote sensing – high volume fleet-wide screening – large volume**
- **OBD monitoring and remote OBD installation and management regulations** - Platform can monitor vehicle speed, fuel consumption, NOx emission and more parameters in real time. **–large volumes**
- **As OBD is integrated with surveillance programme**, remote sensing, PEMS etc can help to establish the reliability of OBD

A lot is possible



Europe, US, China, Hong Kong, Korea, Mexico city... and more

- Fleet emissions monitoring; identification of worst emitters for compliance testing and enforcement
- More pollutants under scrutiny – NO, NO₂, HC, CO₂, CO, opacity and PM
- More representative of real-world emissions
- Enables surveillance of emissions fraud and high real world emissions
- Assess performance of vehicle technology on road -- detects inherent technical defect, system failure, deterioration overtime
- Supports implementation of policy measures to reduce vehicular pollution - -- low-emissions zones, vehicle phase out and scrappage schemes
- More steps: standardisation of application and data analytics, siting, weather conditions, and other technical application etc

Next steps in India



- **MoRTH rules:** -- AIS rules for remote sensing in place; create technical guidance & guidelines for cities; standardise systems
- **Roadmap for implementation.** Champion cities can implement and create the infrastructure to demonstrate
- **Compliance system** -- high emitters to report for a more improved loaded test at centralized & automated testing centers. Prioritise commercial vehicles
 - Upgrade I/C centres (like Juljuli, Burari) to be equipped with simple dynamometers to measure emissions that is not possible under PUC
 - Personal vehicles can be notified for repair and retest
- **Develop penal and enforcement action**
- **Capacity and infrastructure for data analytics and feedback**– fleet profiling, clean and dirty screening, use of data to develop real-world emissions factors, improve accuracy of emissions models, forecast etc



Thank You