

INTERNATIONAL CENTER FOR AUTOMOTIVE TECHNOLOGY



PRESENTATION
ON
**REMOTE SENSING FOR IN USE VEHICLE EMISSIONS
SCREENING**

CENTRE FOR SCIENCE AND ENVIRONMENT
05TH MARCH 2020

Deepak Agarwal
International Centre for Automotive Technology

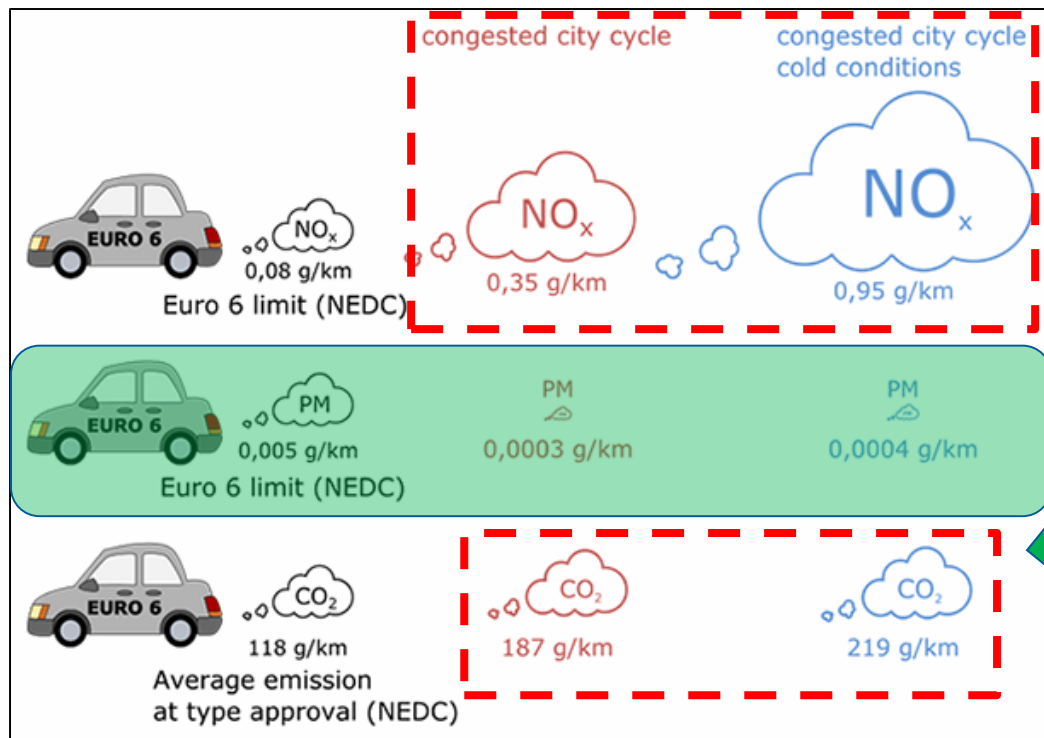
CONTENT

- ❑ Importance of in-use vehicle emission screening
- ❑ About Remote Sensing
- ❑ Remote sensing program
- ❑ ICAT Remote Sensing Study
- ❑ ICAT Remote Sensing Results
- ❑ Regulations at a glance
- ❑ Technology route

- ☐ Importance of in-use vehicle emission screening
- ☐ About Remote Sensing
- ☐ Remote sensing program
- ☐ ICAT Remote Sensing Study
- ☐ ICAT Remote Sensing Results
- ☐ Regulations at a glance
- ☐ Technology route

IMPORTANCE OF IN-USE EMISSION SCREENING

DIFFERENT EMISSIONS IN REAL WORLD



<http://nordicroads.com/new-diesel-buses-pollute-less-than-new-diesel-cars/>

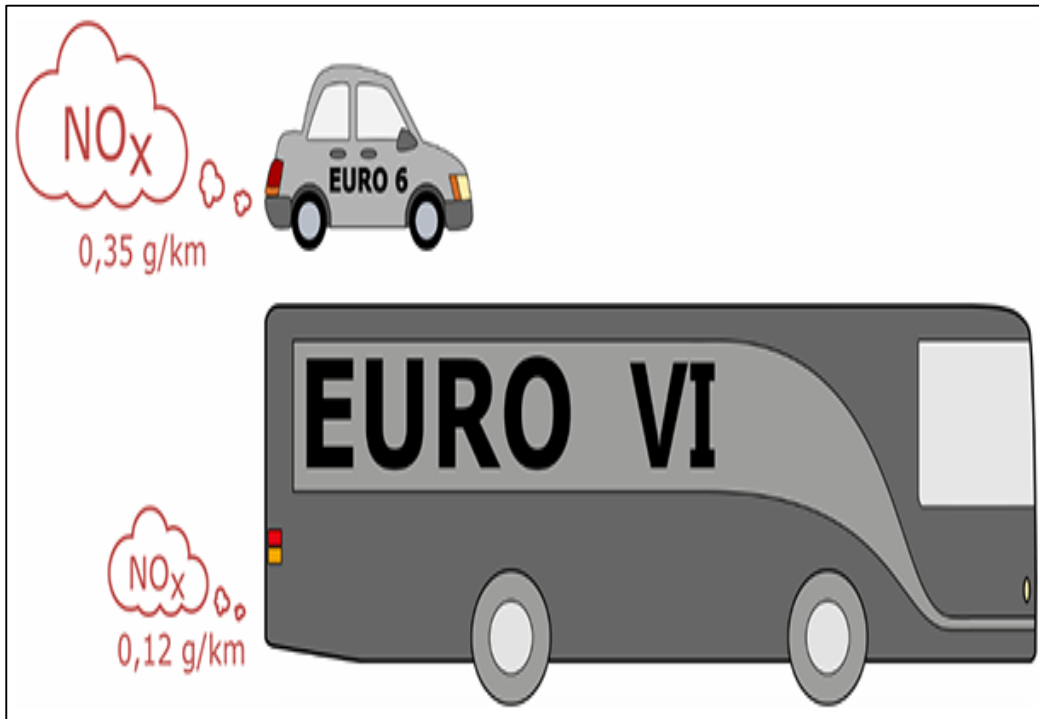
- Comparison between limit values from EUs type approval regulations (black clouds) to emissions in “real life” city traffic from the average Euro 6 diesel passenger car.
- NO_x, PM and CO₂ emission when using the Helsinki city cycle. Measured at +23 °C (red clouds) and -7 °C (blue clouds).
- The size of the red and blue clouds indicate the difference in emission from the emission in the type approval test (NEDC).

Real world emission are meeting the PM emission in all conditions.

Mainly: NO_x & CO₂ are out

IMPORTANCE OF IN-USE EMISSION SCREENING

EMISSIONS COMPARISON BETWEEN PC AND HD IN REAL WORLD



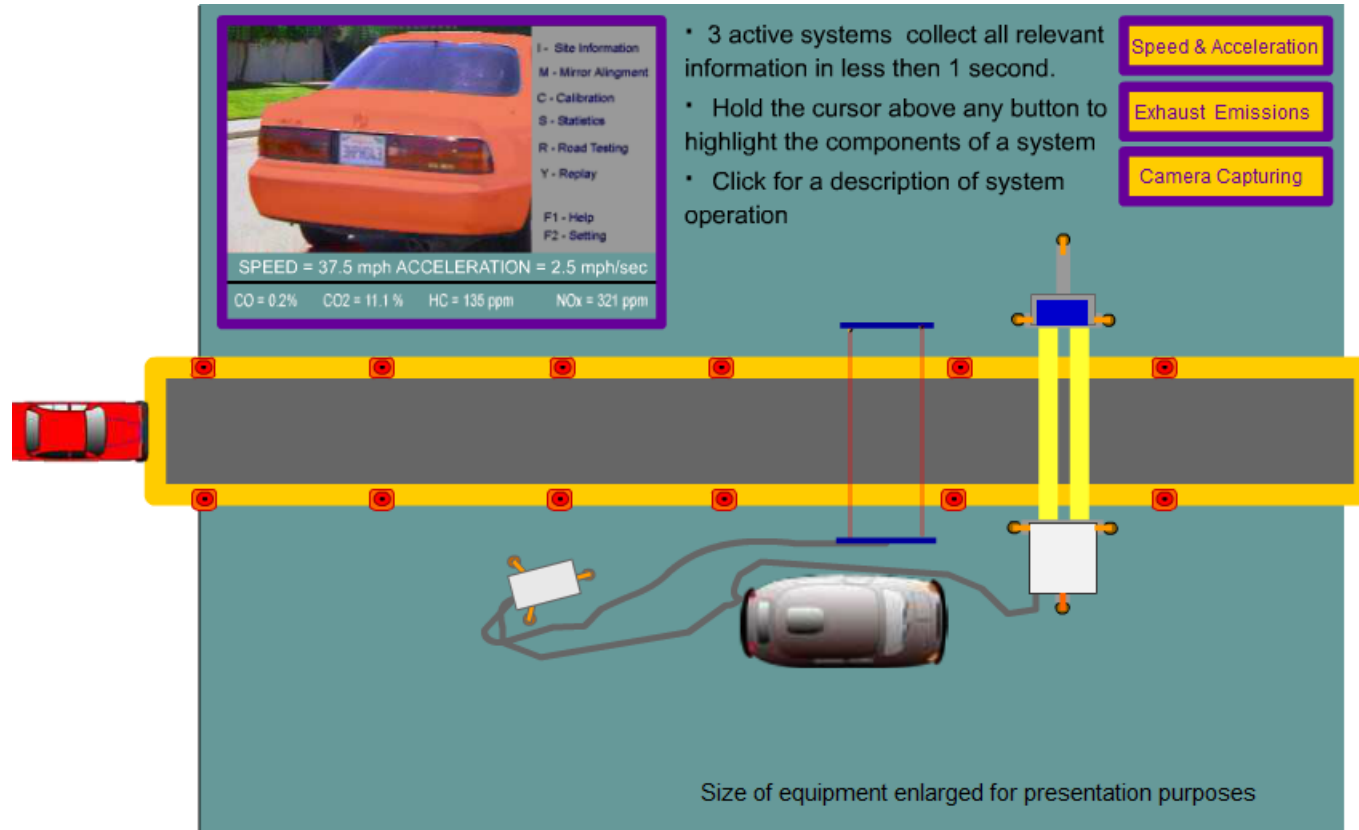
- New heavy vehicles with Euro VI approved diesel engines have very low emission of all types of local emissions.
- NOx emission from new passenger cars with Euro 6 diesel engines under demanding city driving conditions is still a challenge for urban air quality.
- The emissions shown are typical for demanding city-driving for passenger cars and city-buses, respectively.

Heavy duty emission cycle is more representative of real world emissions as compared to passenger car emission cycle.

- ❑ Importance of in-use vehicle emission screening
- ❑ **About Remote Sensing**
- ❑ Remote sensing program
- ❑ ICAT Remote Sensing Study
- ❑ ICAT Remote Sensing Results
- ❑ Regulations at a glance
- ❑ Technology route

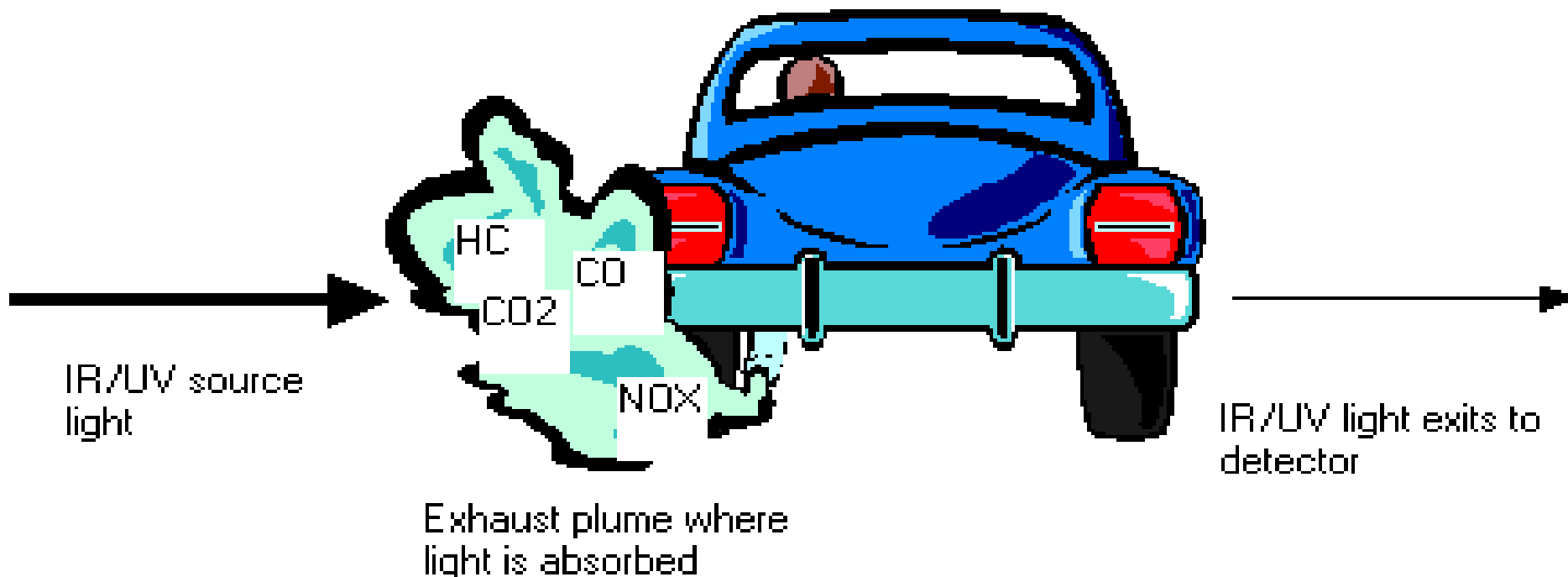
ABOUT REMOTE SENSING

HOW REMOTE SENSING EQUIPMENT WORKS



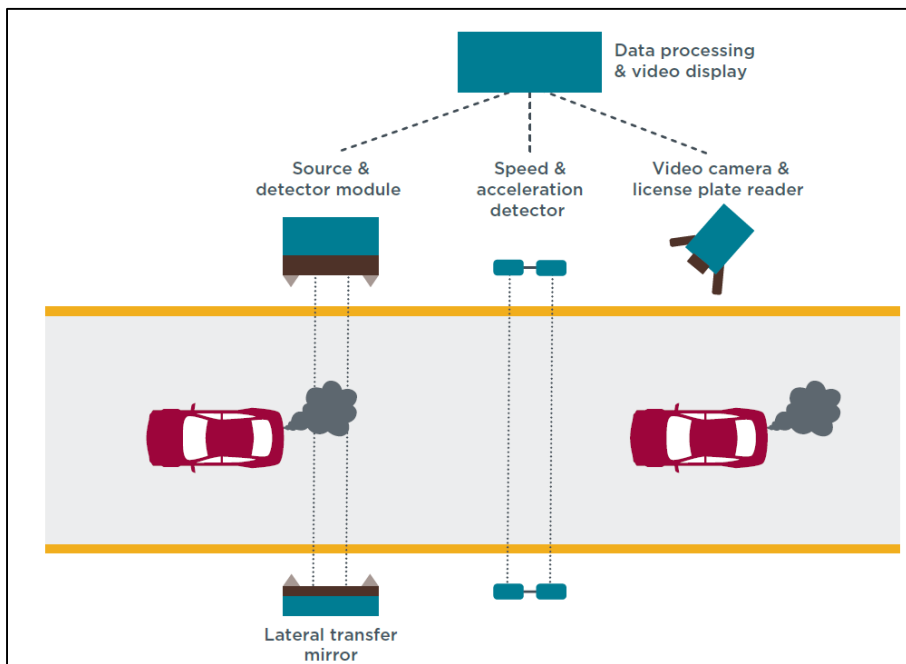
ABOUT REMOTE SENSING

REMOTE SENSING PRINCIPLE

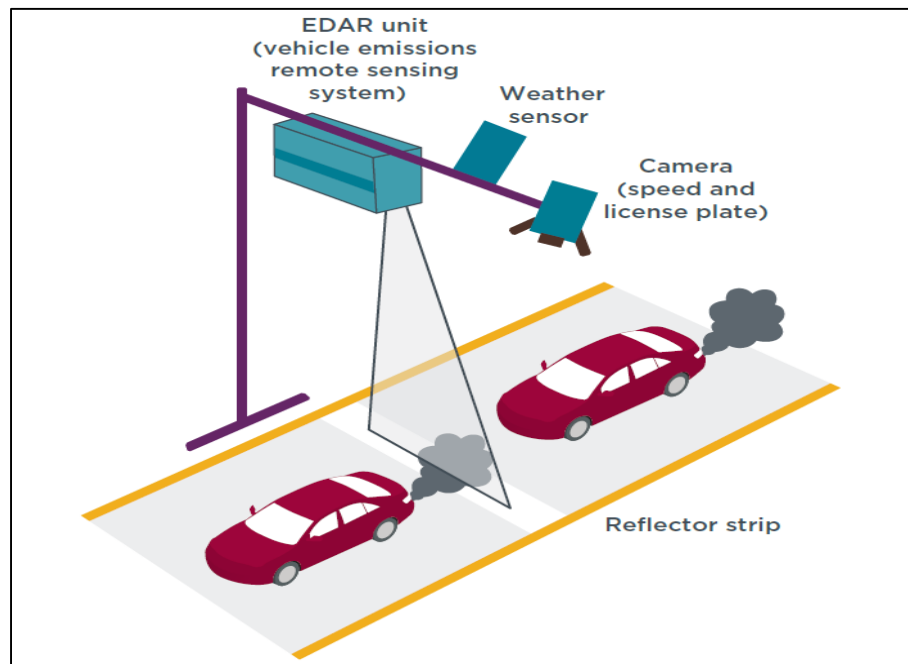


SETUP OF REMOTE SENSING DEVICE

DIFFERENT SETUP CONFIGURATION



Setup for cross-road remote sensing



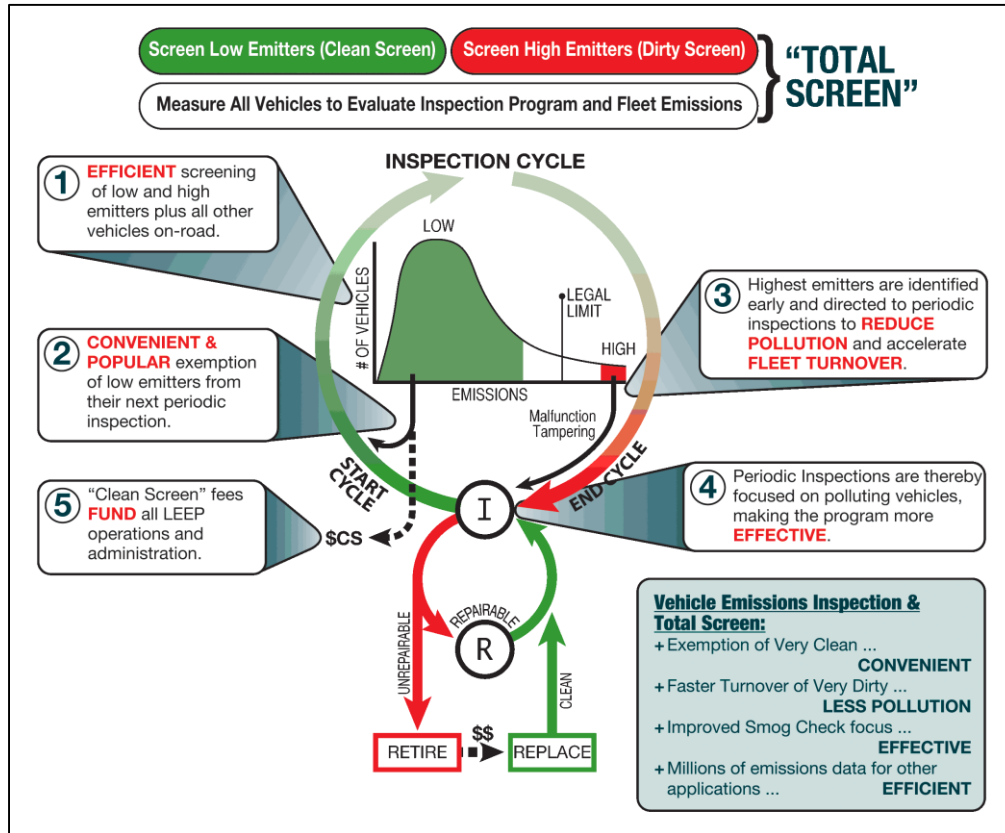
Setup for top-down remote sensing system

CONTENT

- ❑ Importance of in-use vehicle emission screening
- ❑ About Remote Sensing
- ❑ **Remote sensing program**
- ❑ ICAT Remote Sensing Study
- ❑ ICAT Remote Sensing Results
- ❑ Regulations at a glance
- ❑ Technology route

WHAT IS REMOTE SENSING PROGRAM?

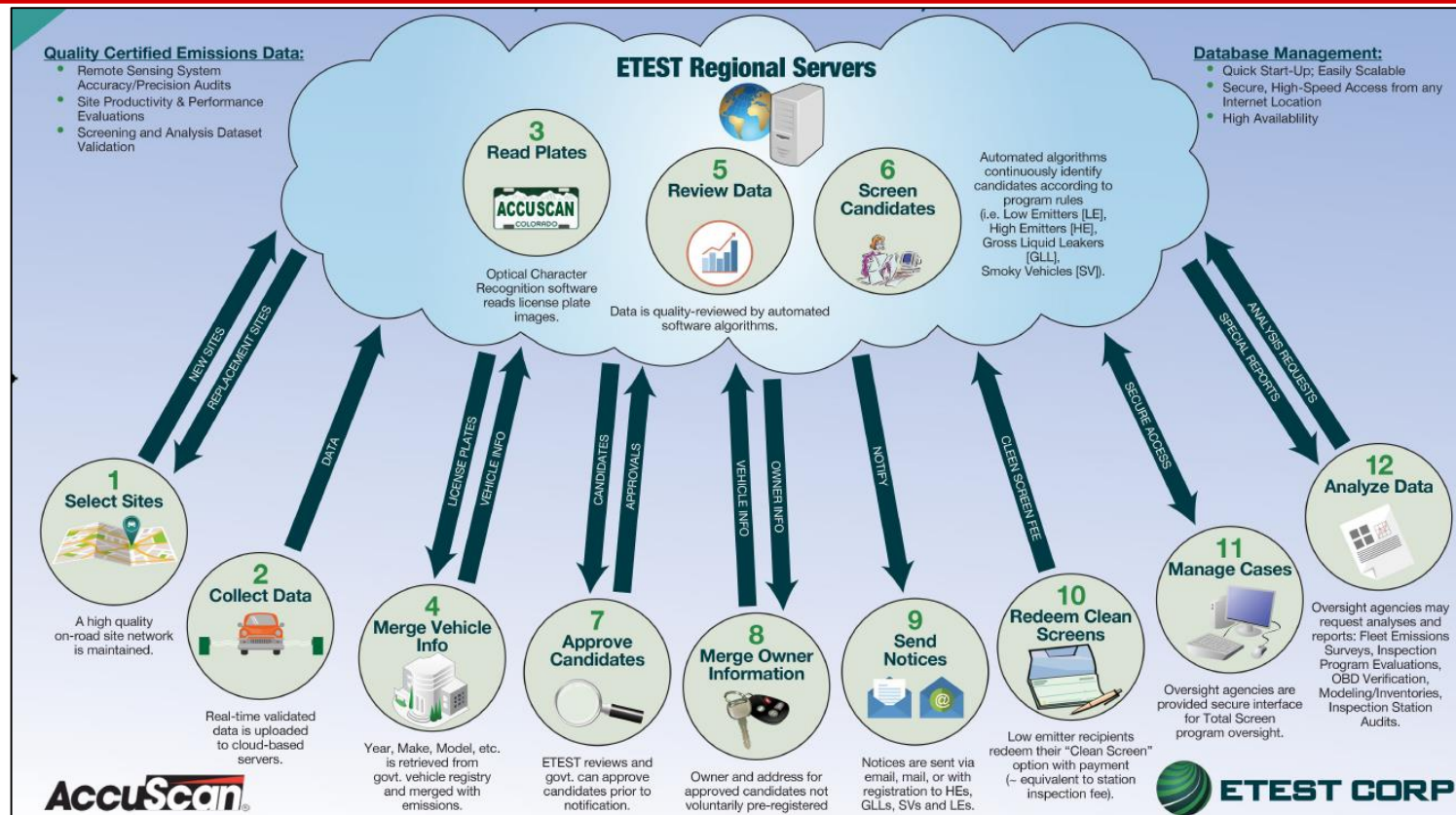
PROGRAM OBJECTIVES



- All vehicles are inspected on a periodic cycle.
- Clean vehicles continue to ply the roads.
- Dirty vehicles are sent for repair after inspection.
- If the vehicles are beyond repair, they are retired from the fleet.

Source: Etest Turnkey service brochure

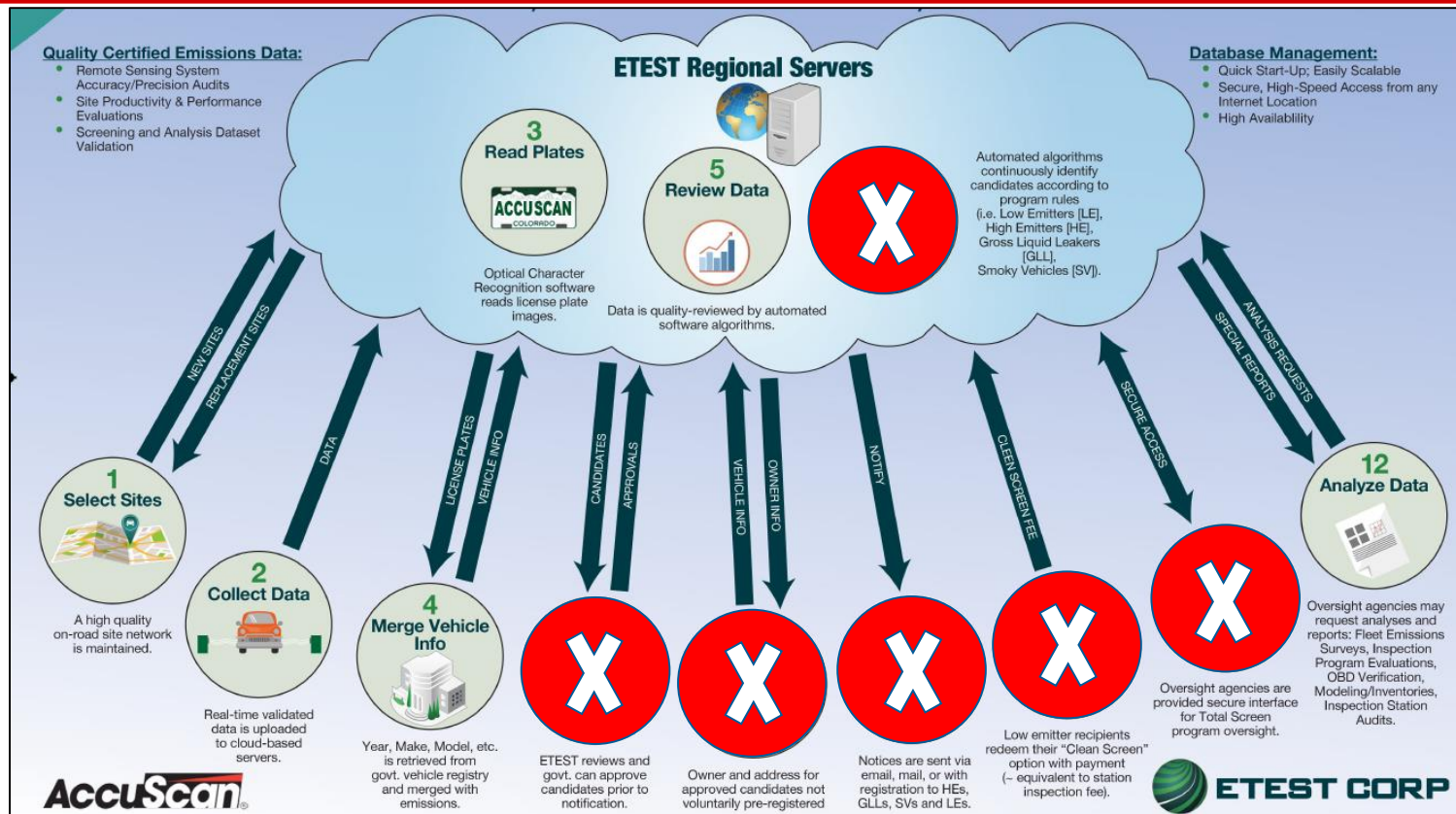
HOW REMOTE SENSING PROGRAM WORKS?



Source: Etest Turnkey service brochure

HOW REMOTE SENSING PROGRAM WORKS?

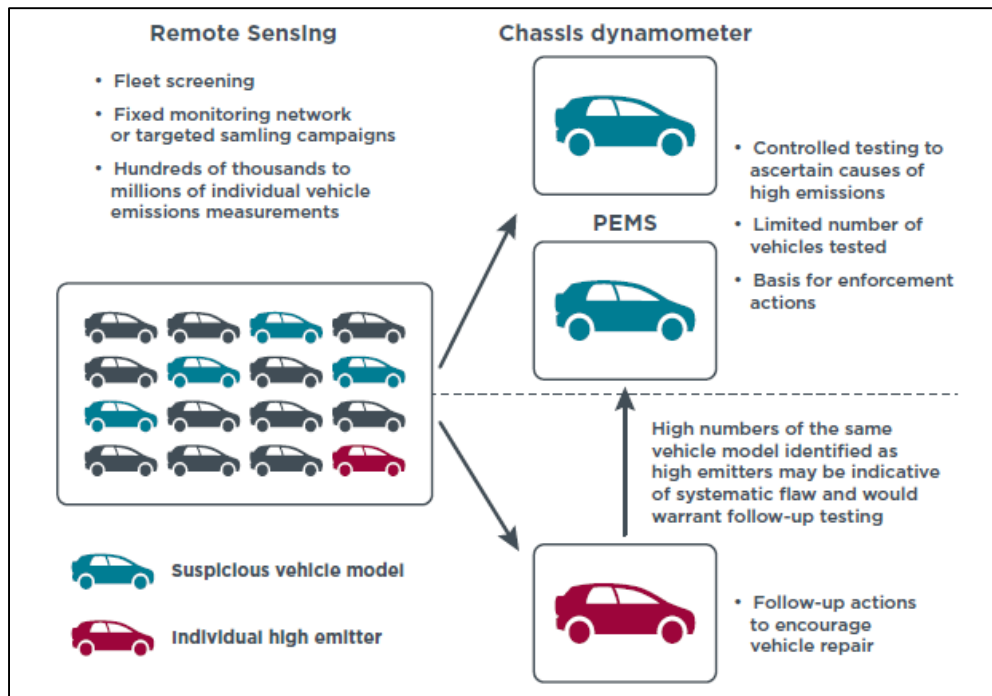
CURRENT PROJECT WORK SCOPE



Source: Etest Turnkey service brochure

ROLE OF REMOTE SENSING FOR IN-USE VEHICLE

IDENTIFICATION OF HIGH EMITTERS

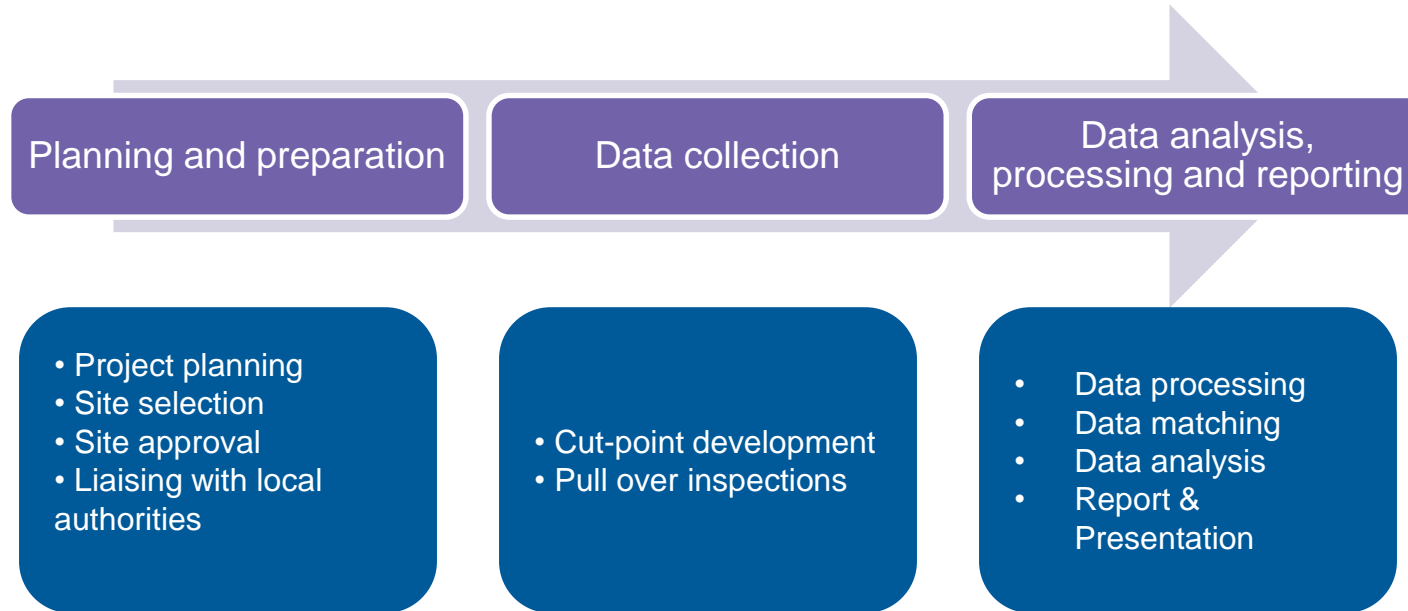


- This high sampling rate makes vehicle remote sensing very useful as a screening tool for filtering clean and dirty models in actual use.
- Over the course of a few weeks, tens to hundreds of thousands of instantaneous records can be acquired at well-chosen measurement locations.

- ❑ Importance of in-use vehicle emission screening
- ❑ About Remote Sensing
- ❑ Remote sensing program
- ❑ **ICAT Remote Sensing Study**
- ❑ ICAT Remote Sensing Results
- ❑ Regulations at a glance
- ❑ Technology route

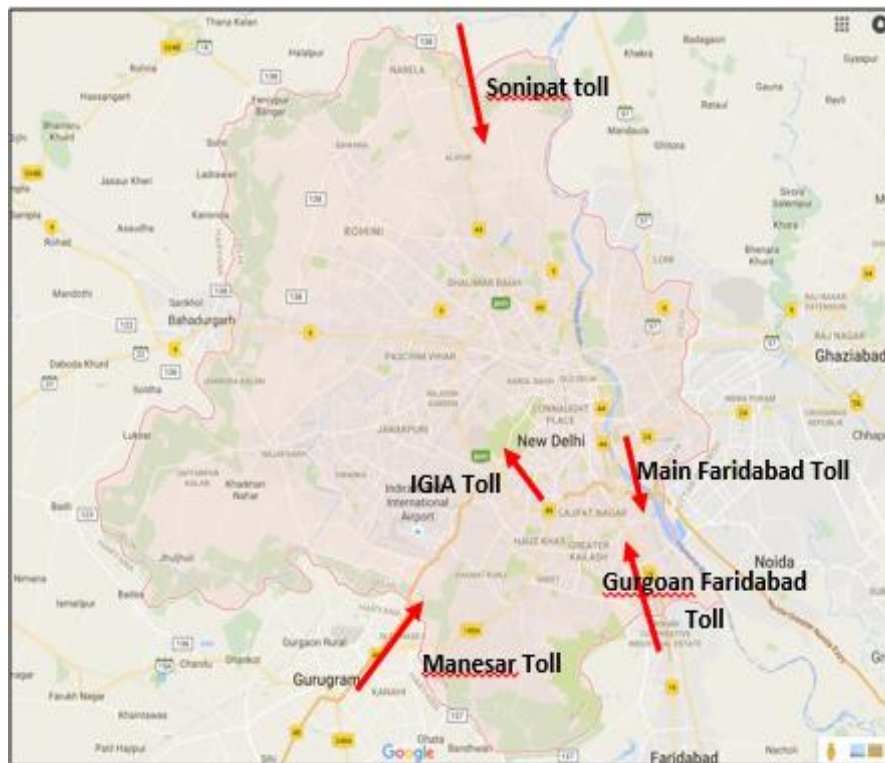
PROJECT APPROACH

The figure below shows the main activities involved in this project:



SITES LOCATION

RSD DATA COLLECTION



	Details	Vehicle count	Remarks
1	Total vehicles captured	305,371	Total vehicles those passed through RSD during the overall study
2	Total valid data	176,667	Valid data of 1,76,667 vehicles was captured during the study. Valid implies that vehicle emissions, vehicle speed & acceleration and vehicle registration number were captured for these vehicles during data collection. Vehicle details were further matched using VAHAN database.
3	Additional Data collected	16,542	This is additional number of vehicles whose emissions could be measured but speed & acceleration and vehicle registration number couldn't be captured. This data contained majority of heavy duty vehicles.

RSD EQUIPMENT SET UP

IGI TOLL BOOTH



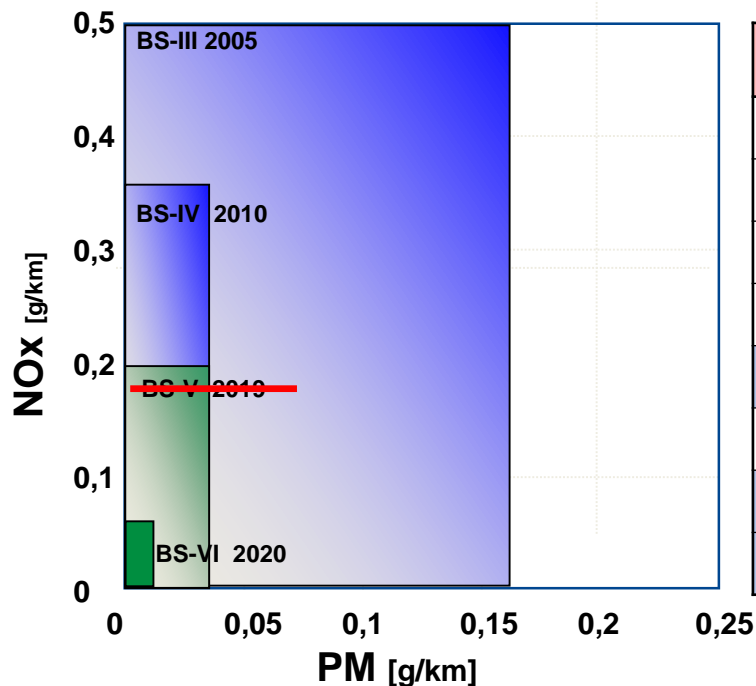
Toll sites around Delhi/NCR were selected for RSD installation and data collection.

CONTENT

- ❑ Importance of in-use vehicle emission screening
- ❑ About Remote Sensing
- ❑ Remote sensing program
- ❑ ICAT Remote Sensing Study
- ❑ ICAT Remote Sensing Results
- ❑ **Regulations at a glance**
- ❑ Technology route

HEAVY DUTY EMISSION REGULATION

DIESEL

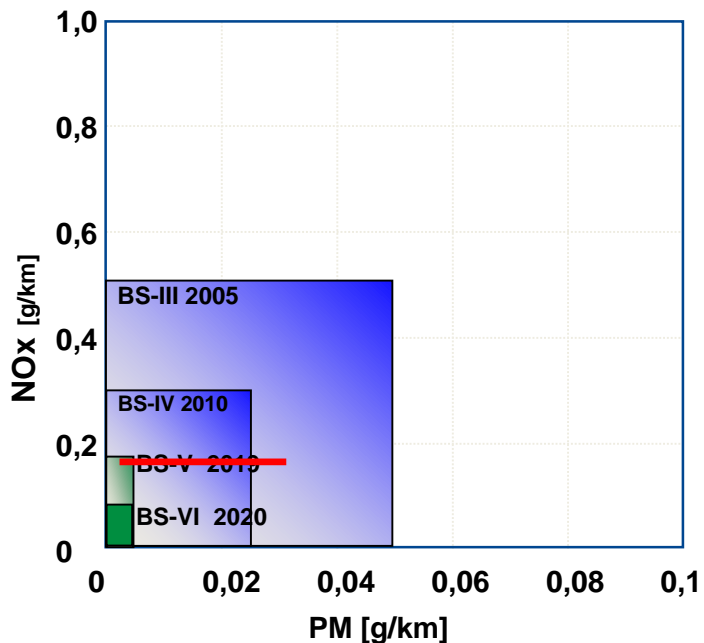


Item	Unit	BS 3	BS 4	Euro 5	BS 6
CO	g/kWh	5.45	4	4	4
NOx	g/kWh	5	3.5	2	0.46
NMHC	g/kWh	0.78	0.55	0.55	NA
Methane	g/kWh	1.6	1.1	1.1	0.5
THC *	g/kWh	NA	NA	NA	0.16
PM	g/kWh	0.16	0.03	0.03	0.01
PN	Number	NA	NA	NA	6X10 ¹¹
NH3	g/kWh	NA	NA	NA	0.01

New requirement in BS 6
(* NMHC is replaced by THC in BS 6)

PASSENGER CAR EMISSION REGULATION

DIESEL



Item	Unit	BS 3	BS 4	Euro 5	BS 6
CO	g/km	0.64	0.5	0.5	0.5
HC+NOx	g/km	0.56	0.3	0.23	0.17
NOx	g/km	0.5	0.25	0.13	0.08
PM	g/km	0.05	0.025	0.0045	0.0045
PN	Number	NA	NA	6×10^{11}	6×10^{11}



New requirement in BS 6

PASSENGER CAR EMISSION REGULATION

PETROL/CNG

Item	Unit	BS 3	BS 4	BS 5	BS 6
CO	g/km	2.3	1.0	1.0	1.0
HC	g/km	0.2	0.1	0.1	0.1
NO _x	g/km	0.15	0.08	0.06	0.06
PM *	g/km	NA	NA	NA	0.0045
PN *	Number	NA	NA	NA	6X10 ¹¹



New requirement in BS 6

*** PM and PN limits are applicable for direct injection systems**

CONTENT

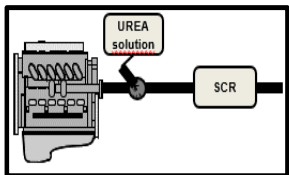
- ❑ About Remote Sensing
- ❑ Remote sensing program
- ❑ ICAT Remote Sensing Study
- ❑ ICAT Remote Sensing Results
- ❑ Regulations at a glance
- ❑ **Technology route**

HEAVY DUTY - DIESEL

PREFERRED TECHNOLOGY ROUTE COMPARISON

Route 1

SCR Route



Layout

Specs

BS4

Base Engine

Base engine

After treatment

Higher capacity

FIE

1300-1600

Intake Air

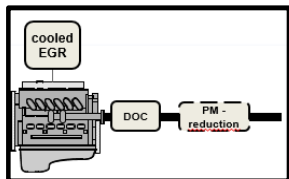
FGT/WGT

EGR Rate

No EGR

Route 2

EGR Route



Base Engine

Modified

After treatment

DOC/DPF

FIE

1600-1900

Intake Air

VGT

EGR

Yes

Layout

Hardware

BS6

Base Engine

Modified

After treatment

DOC+DPF+SCR

FIE

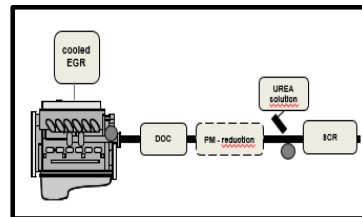
Modified

Intake Air

VGT

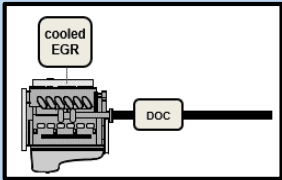
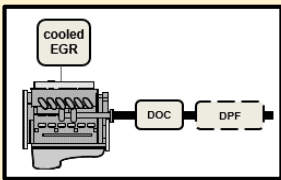
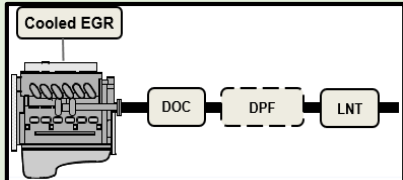
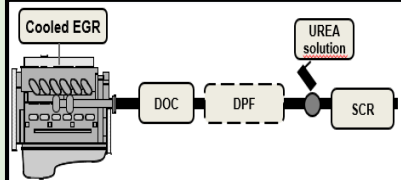
EGR

Yes



PASSENGER CAR - DIESEL

PREFERRED TECHNOLOGY ROUTE COMPARISON

Specs	BS-IV	BS-V	BS-VI	
			Route 1 Engine Size < 2l engine	Route 2 Engine size > 2l engine
Layout				
Base Engine	Base engine	Modified	Modified	Modified
After treatment	DOC	DOC/DPF	LNT	SCR
FIE pressure (bar)	1300-1600	1600-1900	1900 - 2100	
Intake Air	FGT/WGT	VGT	VGT/Twin Turbo	
EGR type	Cooled EGR	Cooled EGR	Cooled EGR	

THANKS

**International Centre for Automotive Technology
Division of NATRiP Implementation Society (NATIS), Govt. of India,
Plot No. 26, Sector - 3, IMT Manesar, Gurgaon - 122 050
www.icat.in**

