Workshop B1

Al Bustan Rotana Hotel, Harayer & Salsabeel

Priorities for New Testing Procedures – Testing Emission Systems

Chaired by Lothar Geilen

Member of CITA Bureau Permanent

Workshop B1

Presentation 1

Sustainable Emission Test (SET)

Introduction of the Results of the Recent CITA Study – SET Project

Gerhard Müller

Policy Expert on Environmental Protection Systems, CITA

SET Study - Aims

Field tests with diesel and petrol vehicles in different Member States as well as laboratory tests

Aims of the SET study:

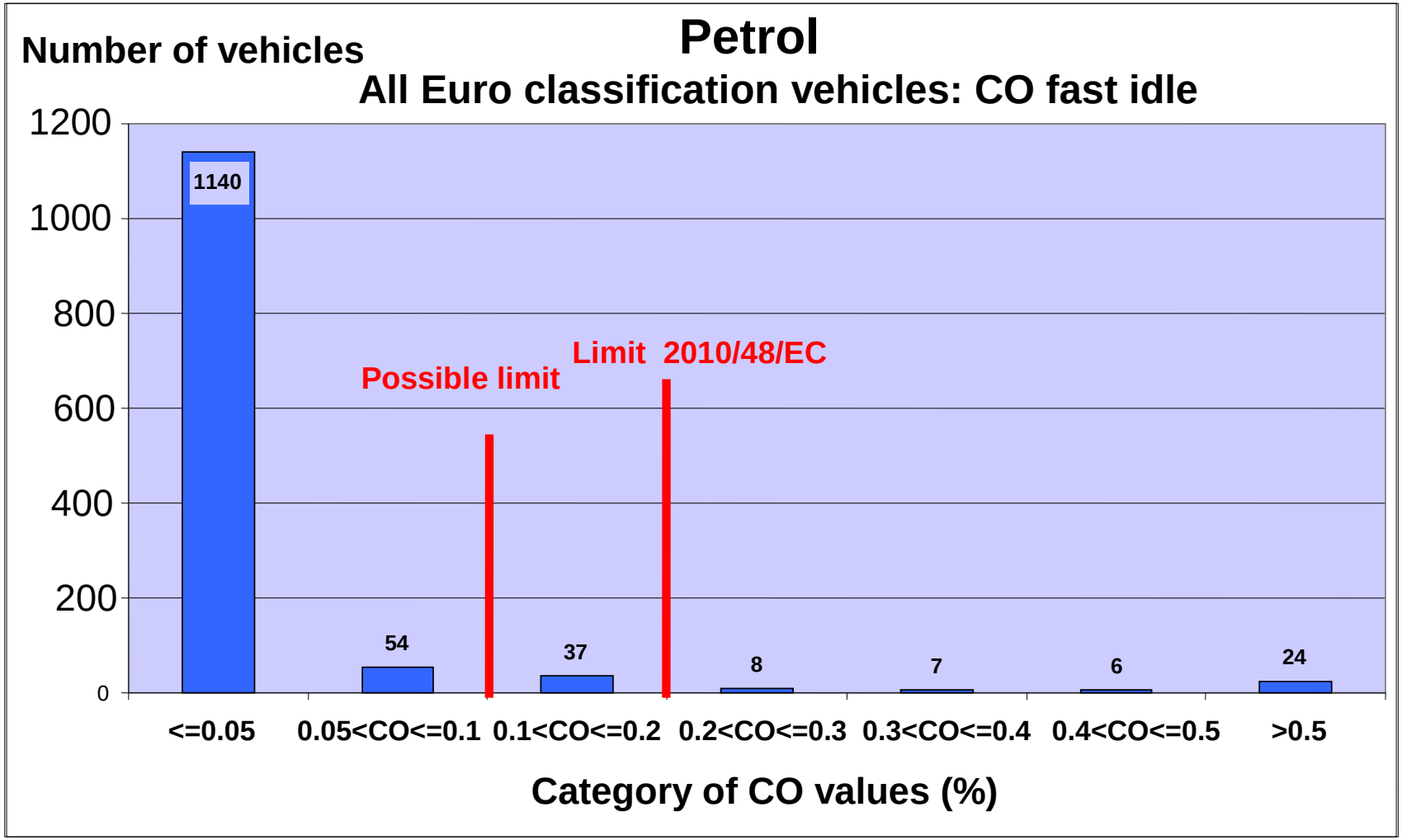
1. Definition of suitable thresholds for PM-measurement and CO-measurement
2. Comparison of reading out OBD versus tailpipe emission test
3. Compiling a precise recommendation including a cost/benefit analysis for the European Commission to adjust the PTI directive

1. General information

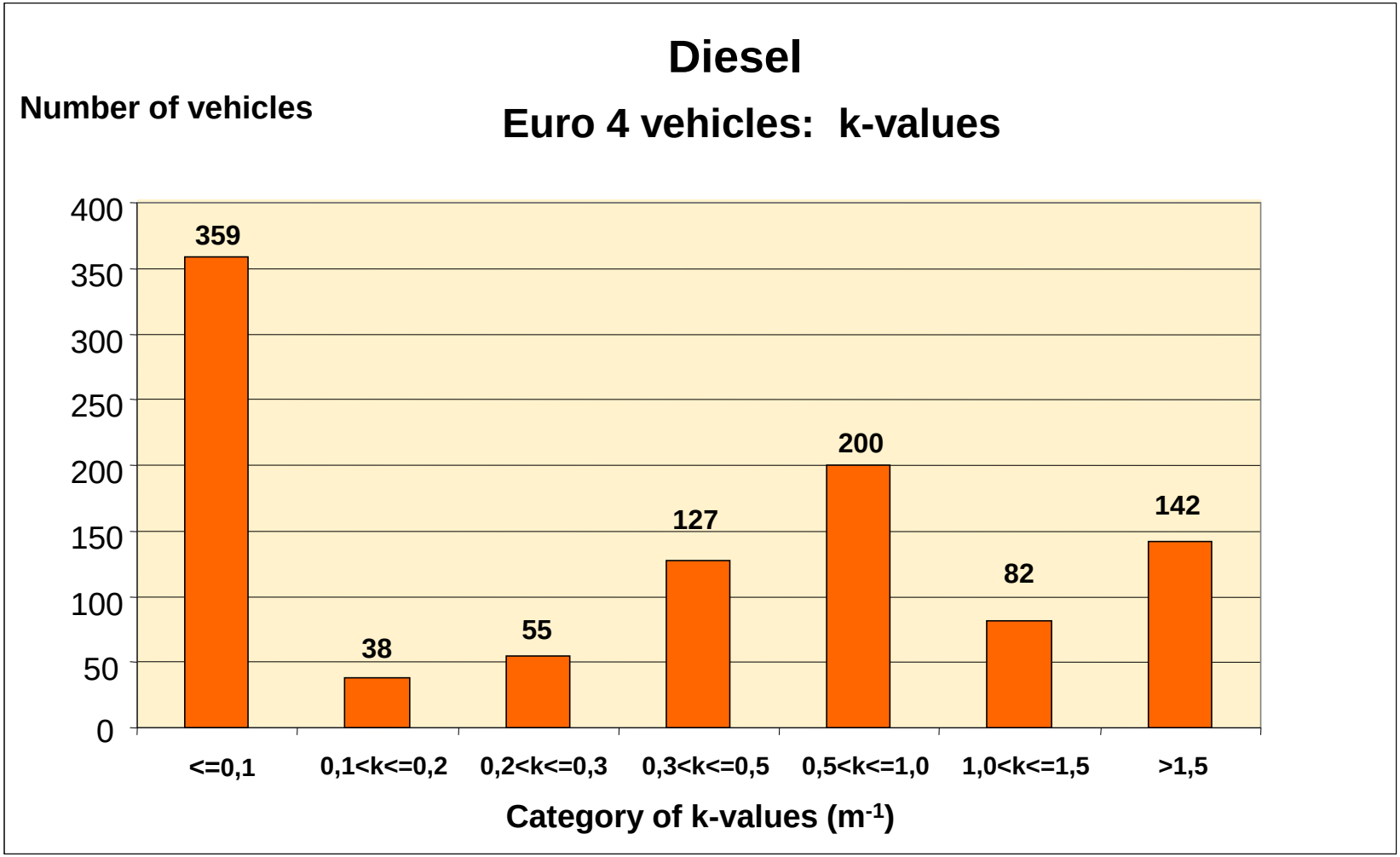
	Diesel	Petrol	Total	
Test centre	With all necessary information	With all necessary information	Delivered data set	With all necessary measure values
GOCA	412	350	763	**762**
DEKRA France	26	22	57	**48**
TUEV SUED	100	96	202	**196**
TUEV Nord	69	172	247	**241**
RDW	29	151	205	**180**
Applus	36	10	74	**46**
Certio	27	17	48	**44**
Itvasa	244	104	358	**348**
Syc	517	125	644	**642**
Itevelesa	109	99	210	**208**
Bilprovningen	44	21	65	**65**
Opus Bilprovning	85	228	316	**313**
Total	**1698**	**1395**	**3189**	**3093**

2. Thresholds

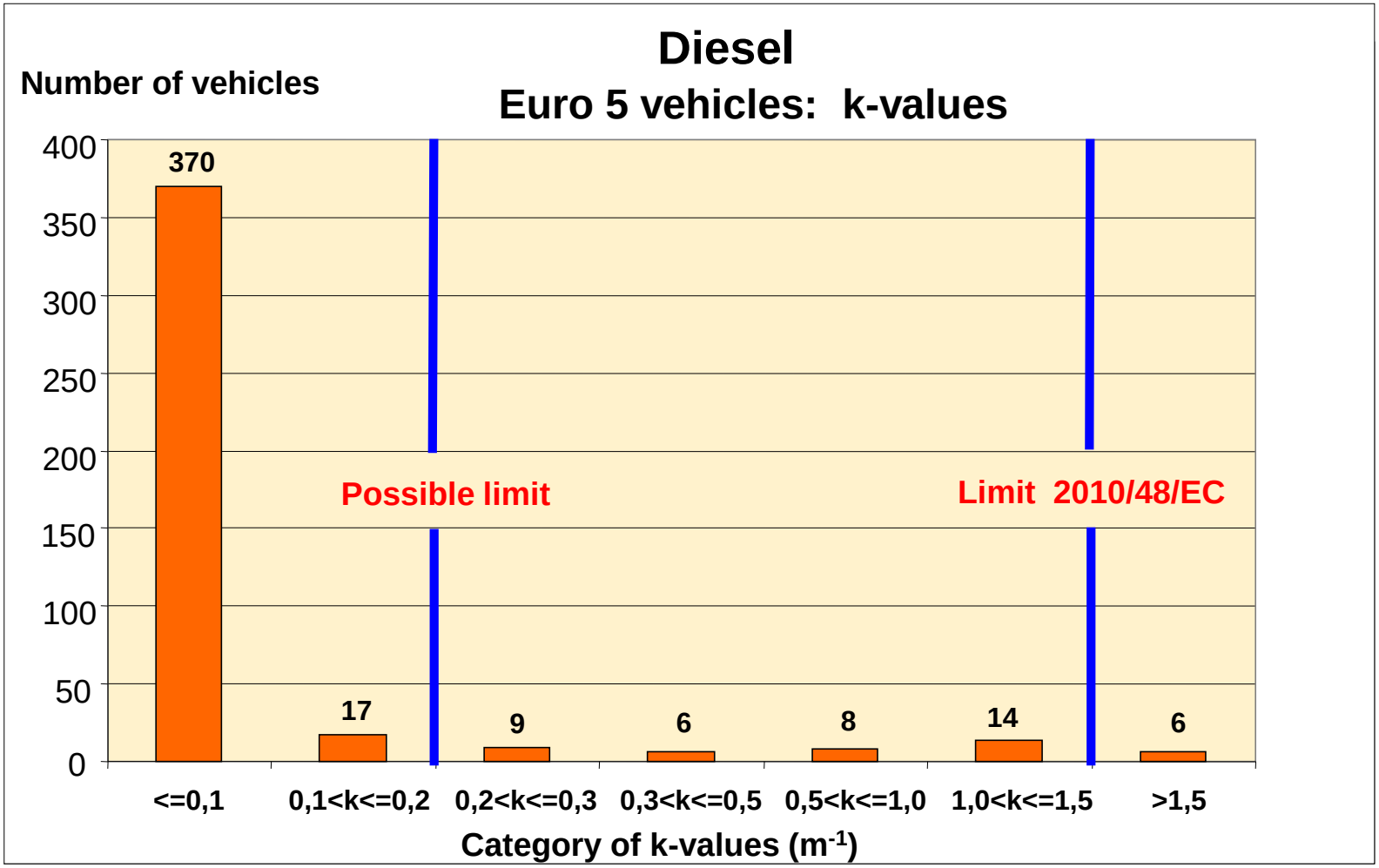
2.1 CO Thresholds



1.2 PM THRESHOLDS

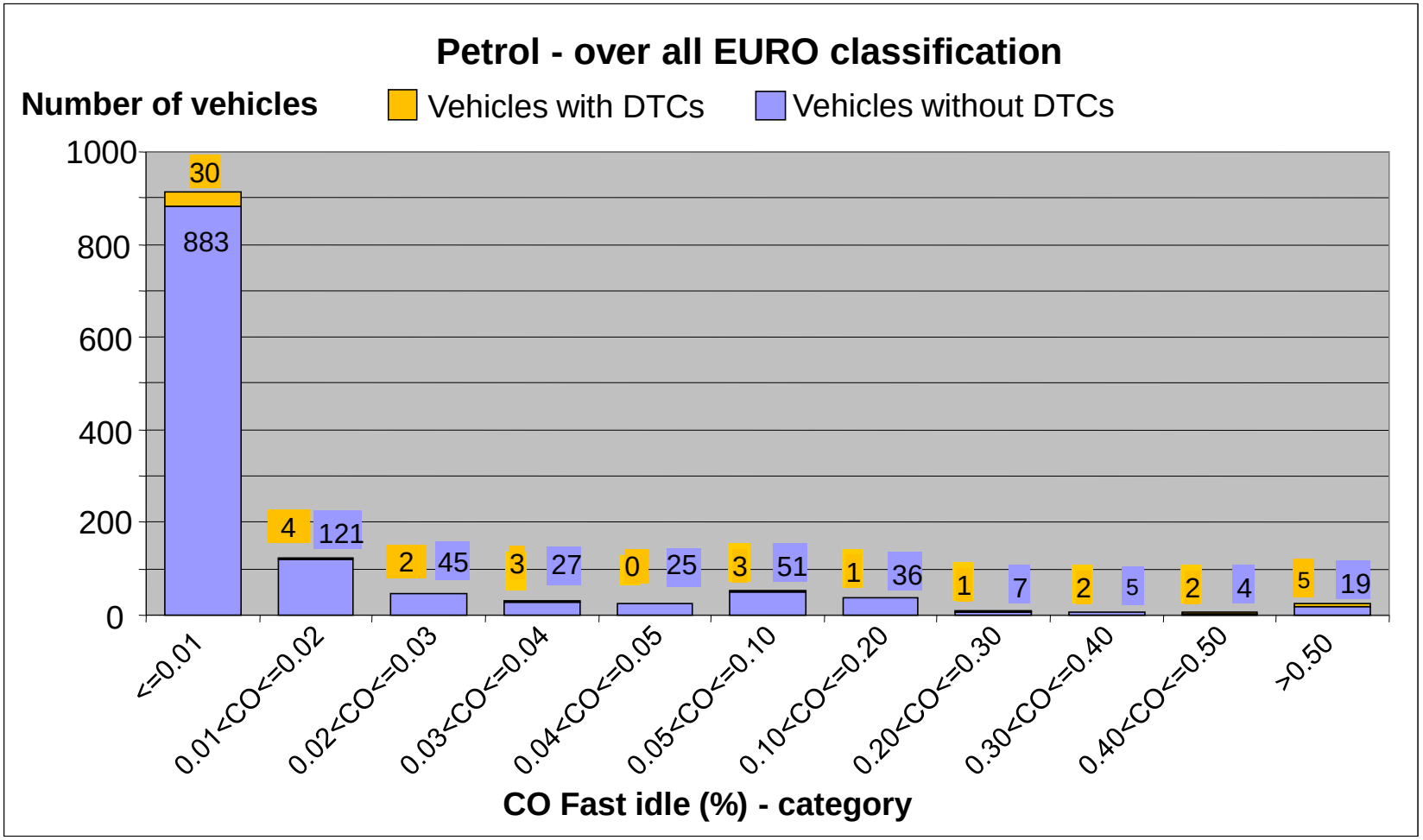


1.3 PM THRESHOLDS

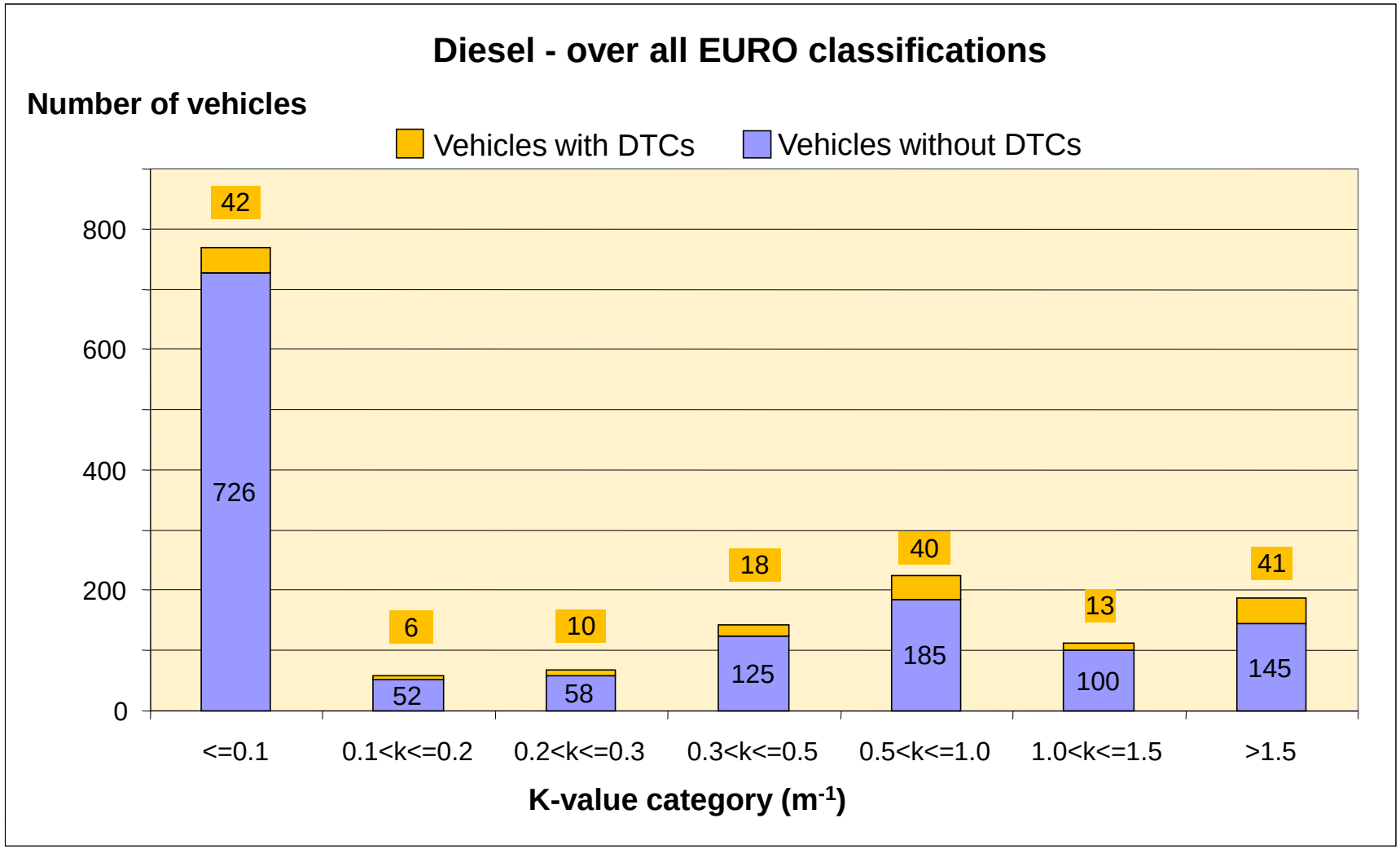


2. Comparison OBD – Tailpipe Test

2.1 CO measurement



2.2 PM MEASUREMENT



3. Implications of a new emission test

	Total tested vehicles	State of threshold	Threshold	Share of failed vehicles (%) only by exhaust emission testing	share of failed vehicles (%) only by OBD testing	Share of failed vehicles (%)
All petrol – CO high idle (%)	**1374**	old	>0.2	3,7	4,6	7,4
	1374	proposed	>0.1	**6,4**	**4,6**	**10,0**
Diesel EURO 5 - k-value (m-1)	**464**	old	>1.5	1,3	3,0	4,3
	464	proposed	>0.2	**9,3**	**3,0**	**11,4**

4. Conclusion

The SET study results clearly demonstrate, that emission controls for modern vehicles are maximally effective when:

- Both methods – **OBD and tailpipe testing** – are combined
- The **thresholds are adjusted** to the modern vehicle technology
  - PM: K-value for Diesel vehicle as of Euro 5: 0,2 m^{-1}
  - CO: Vol. % for Petrol vehicles as of Euro 4: 0,1 Vol. % high idle
- For customers **hardly any additional costs** arise
- The **benefit for the environment and health** is significantly.

SET STUDY

Thank you for your attention.

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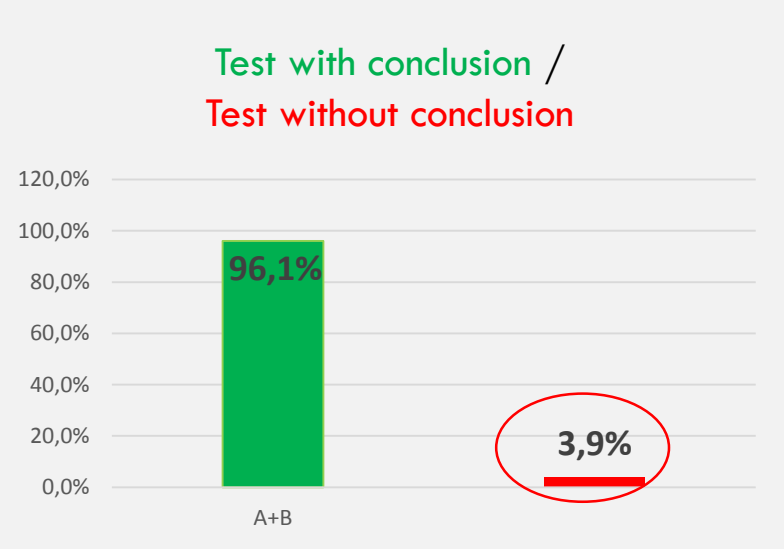
NOx measurement for Diesel Euro 4/5/6 engine

NOx functional test: 1st Field test campaign

- A functional test, based on NOx levels at **IDLE** and **FAST IDLE,** has been performed over **233 vehicles.**
- Vehicles are flagged because of faulty behaviour of recycling system
- (EGR valves…)



EU DIRECTIVE position about NOx :

"Possibilities for improving test cycles to match on-road conditions should be closely examined in order to develop future solutions, including the establishment of test methods for the measurement of NOx levels and of limit values for NOx emissio… "

Because IDLE values are not reliable enough due to non homogenous vehicle's manufacturer strategies
Valid test results cannot be considered in 4% of the use case.

NOx functional test: 2st Lab. Test campaign (Q1 2015)

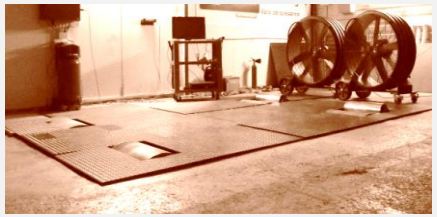
UTAC OTC
GROUPE UTAC CERAM

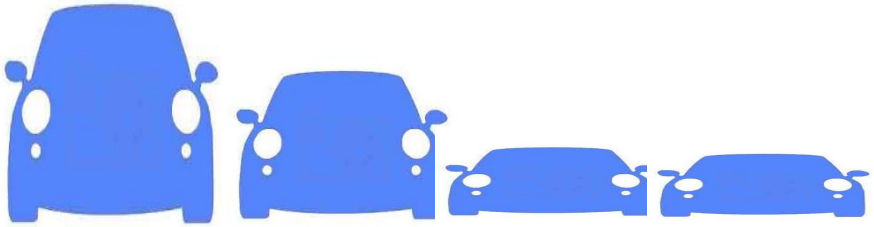
Correlation between:

- **Homologation test**
- **New PTI procedure functional test** including **Fast Idle** & **High RPM sequences** based on tail pipe measurement (NOx) & EOBD dynamic values

Valid PTI procedure allows to flag faulty vehicle behavior of their anti NOx mechanism

Homologation cycle





Euro 4 **Euro 5** **Euro 6** **Euro 6 +SCR**

Zero default
EGR valve blocked open
EGR valve blocked at 60 % closed
EGR valve blocked at 80 % closed
EGR valve blocked at 100 % closed

Fast Idle + High RPM

SET STUDY

Thank you for your attention.

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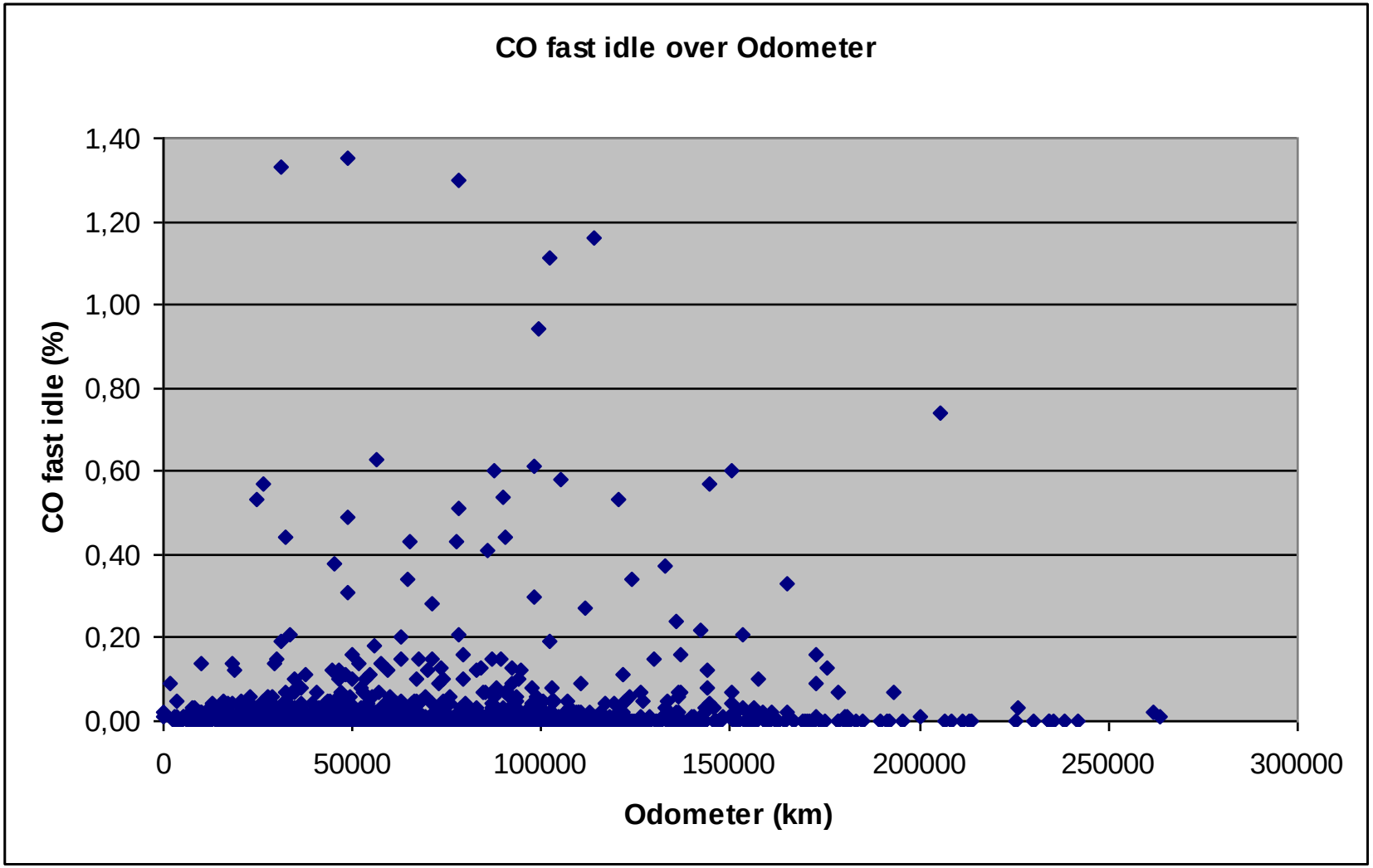
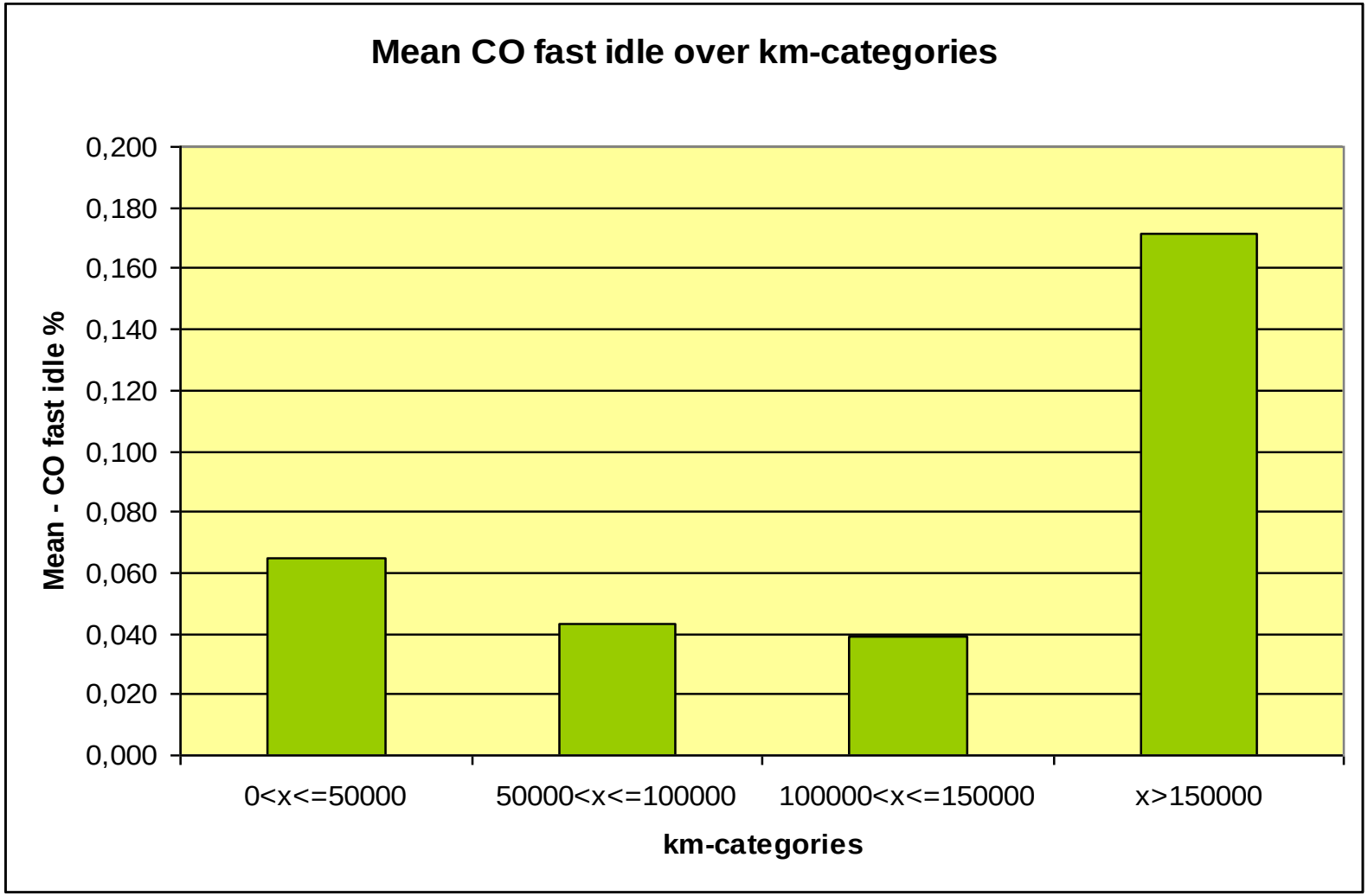
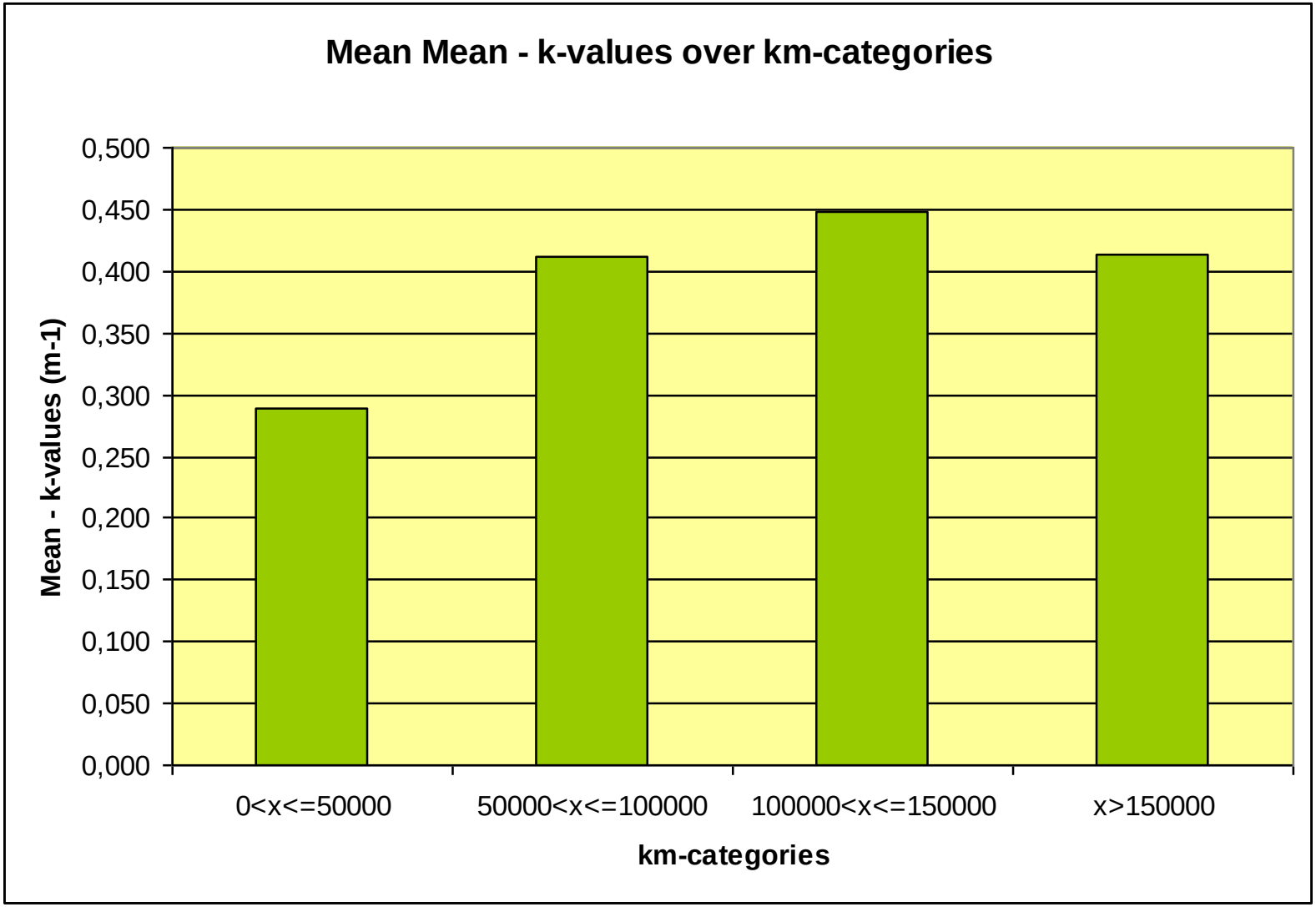
Back up for discussion


CO fast idle over Odometer
CO fast idle (%)
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
0
50000
100000
150000
200000
250000
300000
Odometer (km)

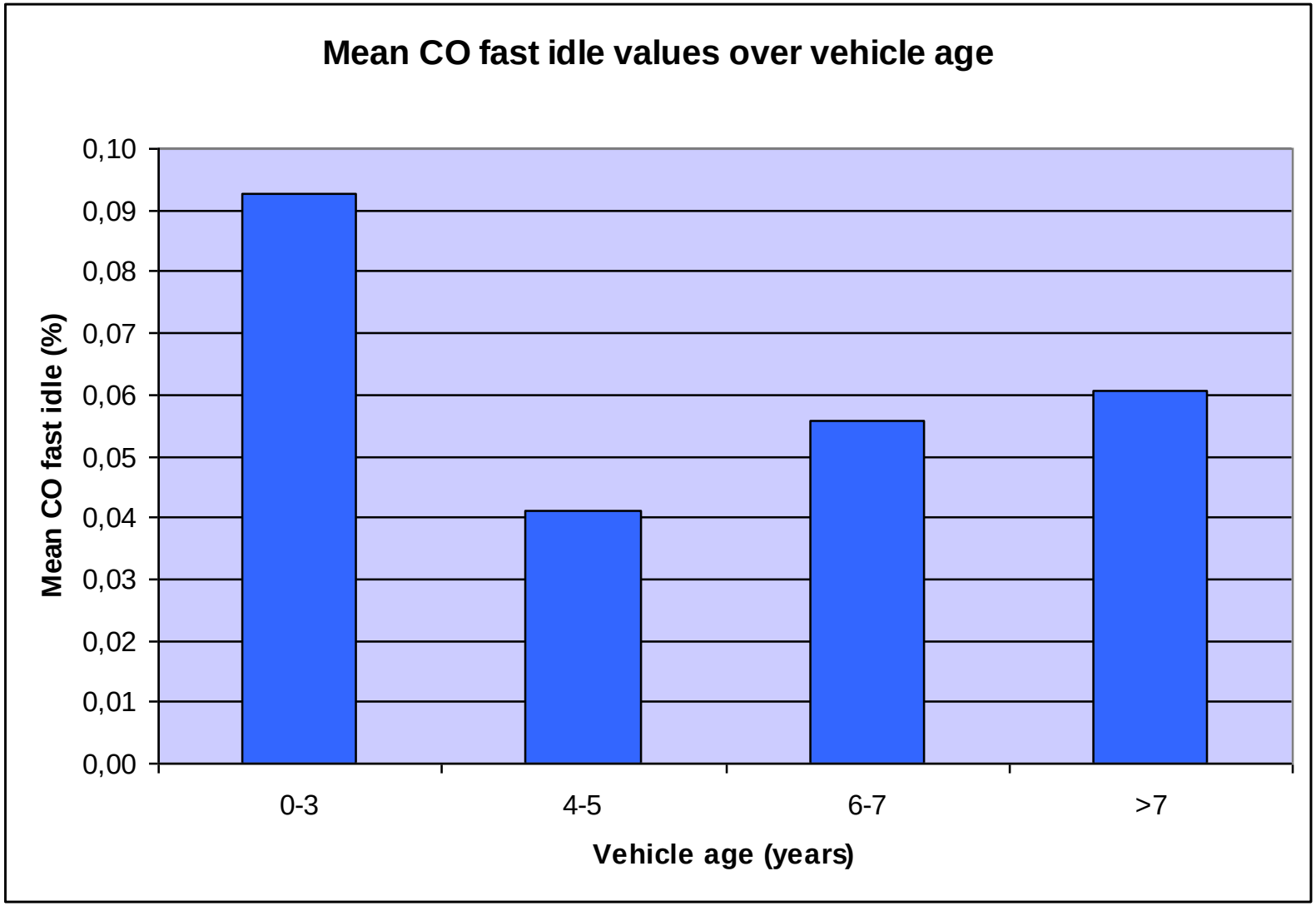
Mean CO fast idle over Odometer



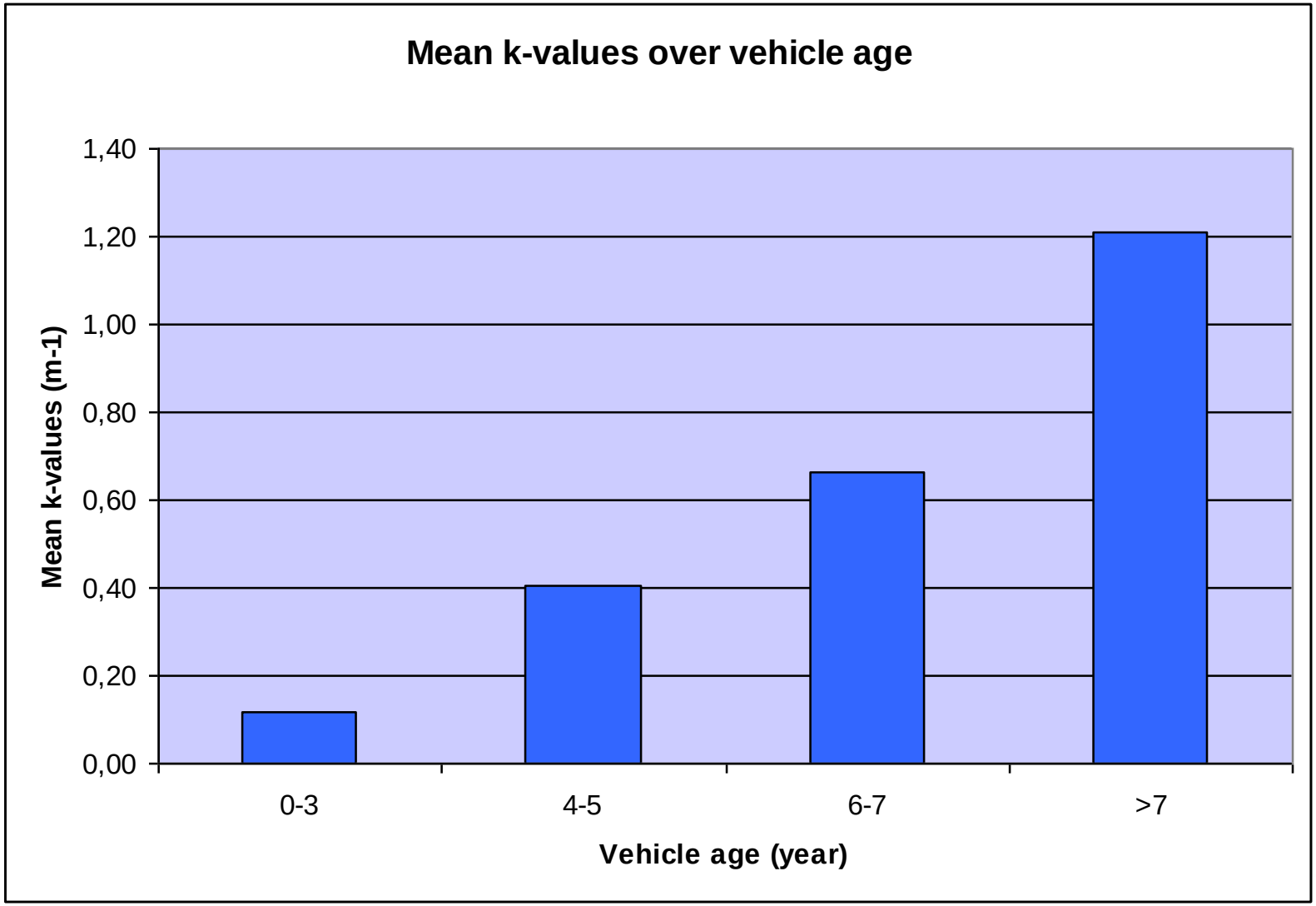
Mean k-value over Odometer



Mean CO fast idle over vehicle age



Mean k-values over vehicle age



Workshop B1

Presentation 2

Performance of OBD Euro 6/VI

Antonio Multari

Technical Expert Emissions at CITA and Vice Chairman of WG Diagnostics & Emissions at ASA and Sales Director Export, MAHA, Germany

2015 CITA Conference, 14-16th April 2015, Dubai, UAE

Performance of OBD Euro 6VI

Workshop B1 - Priorities for new testing procedures – Testing Emission Systems

By Antonio Multari, Technical Expert Emissions at CITA
and Vice Chairman of WG Diagnostic & Emissions at ASA
and Sales Director Export at MAHA

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Performance of Euro 6 / VI
Agenda

- Legal Background
- Types of Monitor
- Circuit Continuity Checks
- Rationality Checks
- System Checks
- OBD Tampering and DPF Removal
- Summary

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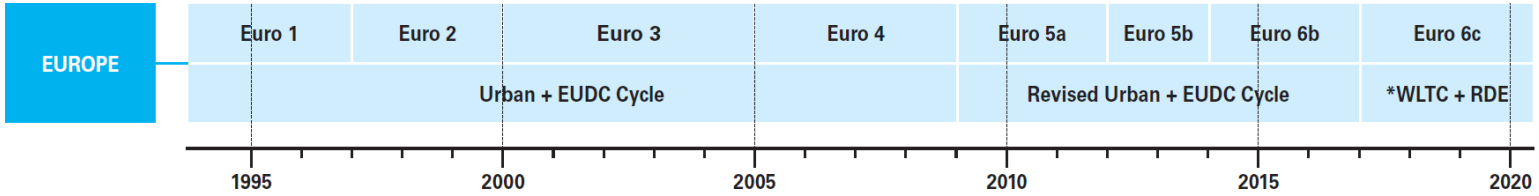
Performance of Euro 6 / VI Introduction



EURO 5-6 SPARK IGNITION EMISSION LIMITS

Emissions	Unit	PC M [1], LDT N1 CL 1				LDT N1 CL 2				LDT N1 CL 3, N2			
		Euro 5a	Euro 5b/b+	Euro 6b	Euro 6c	Euro 5a	Euro 5b/b+	Euro 6b	Euro 6c	Euro 5a	Euro 5b/b+	Euro 6b	Euro 6c
THC	mg/km	100	100	100	100	130	130	130	130	160	160	160	160
NMHC	mg/km	68	68	68	68	90	90	90	90	108	108	108	108
NOx	mg/km	60	60	60	60	75	75	75	75	82	82	82	82
CO	mg/km	1.000	1.000	1.000	1.000	1.810	1.810	1.810	1.810	2.270	2.270	2.270	2.270
PM [2] [3]	mg/km	5,0	4,5	4,5 [2]	4,5 [2]	5,0	4,5	4,5	4,5	5,0	4,5	4,5	4,5
PN # [3]	Nb/km	-	-	6,0 * E11 [4]	6,0 * E11	-	-	6,0 * E11 [4]	6,0 * E11	-	-	6,0 * E11 [4]	6,0 * E11

[1] No exemption for gasoline Passenger Car [2] Applicable to gasoline DI engines only [3] Test procedure defined in UN Reg 83 Suppl 7
[4] Until 3 years after the dates for type approval / 1st registration particle emission limit of 6,0 x E12 may be applied to Euro 6 spark ignition DI vehicles upon request of manufacturer

EURO 5-6 COMPRESSION IGNITION EMISSION LIMITS

Emissions	Unit	PC M [1], LDT N1 CL 1			LDT N1 CL 2			LDT N1 CL 3, N2		
		Euro 5a	Euro 5b/b+	Euro 6b / 6c	Euro 5a	Euro 5b/b+	Euro 6b / 6c	Euro 5a	Euro 5b/b+	Euro 6b/6c
NOx	mg/km	180	180	80	235	235	105	280	280	125
HC+NOx	mg/km	230	230	170	295	295	195	350	350	215
CO	mg/km	500	500	500	630	630	630	740	740	740
PM [2]	mg/km	5,0	4,5	4,5	5,0	5,0	4,5	5,0	5,0	4,5
PN #	Nb/km	-	6,0 * E11	6,0 * E11	-	6,0 * E11	6,0 * E11	-	6,0 * E11	6,0 * E11

[1] Exempted M1 vehicles have to comply with N1Cl3 test I emissions limits - No more exemption for passenger cars from Euro 6 [2] Test procedure defined in UN Reg 83 Suppl 7

Source: DELPHI

Performance of Euro 6 / VI Implementation Dates

EURO 5-6 IMPLEMENTATION ROADMAP

Vehicle Class		2012	2013	2014	2015	2016	2017	2018	2019	2020
M, N1 Cl I	TA	Euro 5b OR Euro 5b+ 01 Sep 2011			Euro 6b 01 Sep 2014			Euro 6c 01 Sep 2017		
	FR	Euro 5a	Euro 5b	Euro 5b+		Euro 6b 01 Sep 2015			Euro 6c 01 Sep 2018	
N1 Cl II, III, N2	TA	Euro 5b OR Euro 5b+ 01 Sep 2011				Euro 6b 01 Sep 2015			Euro 6c 01 Sep 2018	
	FR	Euro 5a	Euro 5b	Euro 5b+			Euro 6b 01 Sep 2016			Euro 6c 01 Sep 2019

Durability Requirements starting Euro 5: 160.000 km

Assigned Euro 5 DFs: PI: CO: 1,5; THC and NMHC: 1,3; NOx: 1,6; PM: 1,0
CI: CO: 1,5; NOx and THC+NOx: 1,1; PM/PN: 1,0

Alternatives: Calculated DFs based on Standard Road Cycle (SRC)
Test ageing bench: PI based on Standard Bench Cycle (SBC)
CI based on Standard Diesel Bench Cycle (SDBC)

Assigned Euro 6 DFs: PI: no change
CI: TBD

Or certification with aged (or rapid aged) exhaust system mandatory (t.b.c.)

In-Service Conformity

Up to 100.000 km or 5 years

Low Temperature Test (-7°C)

No change on positive igniton vehicles.

Compression ignition: Demonstration at TA of

- Performance of NOx aftertreatment device reaching sufficiently high temperature for efficient operation within 400 sec after a cold start (-7°C)
- Operation strategy of the EGR including its functioning at low temperature
- Potential introduction of NOx limitation (Gasoline & Diesel) with Euro 6c (t.b.c.)
- A reduction of HC and CO limits with Euro 6c (t.b.c.)

Evaporative emissions (see page 83)

Source: DELPHI

Performance of Euro 6 / VI
Euro 5 & 6 Regulation

EURO 5 & 6 REGULATION

Main additional requirements - Compression Ignition Engines

	Euro 5a	Euro 5b	Euro 5b+	Euro 6-1	Euro 6-2
Used cycle	NEDC			NEDC	NEDC & RDE
Exempted M vehicles	M1 Vehicles with Ref. Mass > 2000kg to carry at least 7 occupants			No more exemption	
	Special purpose M1 vehicles (ambulance, motor caravan, ..) with Ref.				
	M1 Vehicles with Ref. Mass > 1760kg built specifically to accommodate wheelchair use inside the vehicle				
Emissions	HC+NOx=230mg/km; NOx=180mg/km; CO=500mg/km			HC+NOx=170mg/km; NOx=80mg/km; CO=500mg/km	
	PM=5mg/km	PM=4,5mg/km (Revised method)		PM=4,5mg/km	
	No PN thresholds	PN=6*10 E 11 Nb/km		PN=6*10 E 11 Nb/km	
	DFs: CO=1,5; NOx=1,1; NOx+THC=1,1; PM=1; PN=1			DFs: under discussion	
	CO=1750mg/km; NMHC=290mg/km; NOx=180mg/km			CO=1750mg/km;	CO=1750mg/km;
OBD thresholds	PM=50mg/km except for vehicles with RM>1760kg (80mg/km)	PM=50mg/km		NMHC=290mg/km; NOx=180mg/km; PM=25mg/km	NMHC=290mg/km; NOx=140mg/km; PM=12mg/km
OBD - IUP (In Use Performance Ratio)	Not required		IUPR ≥ 0,1	IUPR ≥ 0,1 to be confirmed	IUPR ≥ 0,336 to be confirmed

For the moment, European Commission does not work on Euro 7 regulations. No official and validated information are available yet.
Note that only main subjects are listed - some other differences exist between the different emissions targets.

Source: DELPHI

Performance of Euro 6 / VI
EOBD Thresholds

EOBD Thresholds Euro 6-1 (mg/km)		CO		NMHC		NOx		PM	
Category	Class	PI	CI	PI	CI	PI	CI	PI	CI
M	-	1900	1750	170	290	15	180	25	25
N_1	I	1900	1750	170	290	150	180	25	25
	II	3400	2200	225	320	190	220	25	25
	III	4300	2500	270	350	210	280	30	30
N_2	-	4300	2500	270	350	210	280	30	30

Additional requirement starting Euro 5+:
In Use Performance Ratio Monitoring (IUPR)

IUPR indicates how often a specific monitor is operating relative to vehicle operation.

$$IUPR = \frac{Numerator_M}{Denominator_M}$$

$Numerator_M$ measures number of times a monitoring function has run and a malfunction could have been detected.
$Denominator_M$ measures the number of vehicle driving events taking into account special conditions.

Euro 5+: IUPR ≥ 0,1 for all monitors
Euro 6- plus IUPR: IUPR ≥ 0,1 for all monitors
Euro 6: IUPR ≥ 0,260 for secondary air system monitors and other cold starts related monitors
≥ 0,1 for DeNOx aftertreatment device using reagent and dosing systems (Euro 6-2 only)
≥ 0,520 for evaporative purge control monitor
≥ 0,336 for all other monitors
Monitoring of total failure or removal for Diesel particulate filter and Doc

Separate IUPR reporting for:
- Catalysts - Exhaust gas sensors - Particulate filter - VVT system - Evap system
- EGR system - Secondary air system - NOx aftertreatment - Boost pressure control system

EOBD Thresholds	Implementation Dates		CO		NMHC		NOx		PM	
Euro 6-2	TA	FR	PI	CI	PI	CI	PI	CI	PI	CI
M, LDT N1 CL1	01 Sep 2017	01 Sep 2018	1.900	1.750	170	290	90	140	12	12
LDT N1 CL 2	01 Sep 2018	01 Sep 2019	3.400	2.200	225	320	110	180	12	12
LDT N1 CL 3, N2	01 Sep 2018	01 Sep 2019	4.300	2.500	270	350	120	220	12	12

Source: DELPHI

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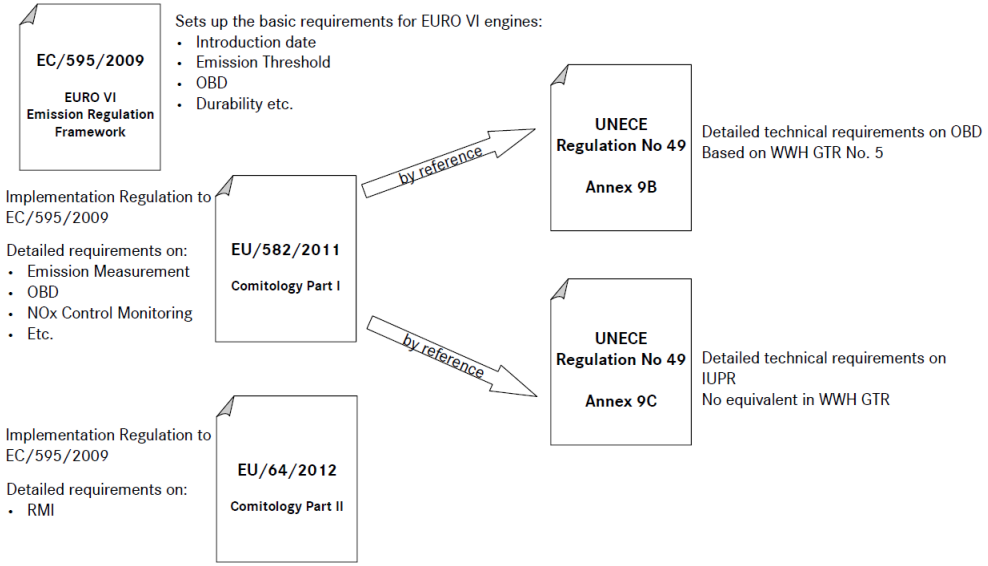
Performance of Euro 6 / VI
Euro VI OBD Legal Background

EURO VI Introduction Dates:

- Date for type approval of new types of vehicles or engines: 31.12.2012
- Date for registration of new vehicles: 31.12.2013

References:



Source: Daimler AG
WWH-OBD: World Wide Harmonized On-Board-Diagnostic

Performance of Euro 6 / VI WWH-OBD Systems

EUROPEAN UNION

EURO IV - Dir 88/77/EC as amended by Dir 1999/96/EC, Dir 2005/55/EC Dir 2005/78/EC and Dir 2006/51/EC

- Diesel engines are tested on ESC, ELR and ETC cycles if required (see pages 14-15)
- Gas engine are tested on ETC cycle

Emissions TA: Oct05 - FR: Oct06	Unit	Euro IV		Euro IV - EEV	
		ESC/ELR Diesel only	ETC Diesel & Gas	ESC/ELR Diesel only	ETC Diesel & Gas
CO	g/kWh	1,5	4,0	1,5	3,0
HC		0,46	-	0,25	-
NMHC		-	0,55	-	0,40
CH_4 [1]		-	1,1	-	0,65
NOx		3,5	3,5	2,0	2,0
PM		0,02	0,03 [2]	0,02	0,02 [2]
Smoke	m^{-1}	0,5	-	0,15	-

EURO V - Dir 2005/55/EC + Dir 2005/78/EC amended by Dir 2006/51/EC + Dir 2008/74/EC

For TA and for EEV's, ETC and ESC/ELR tests are applicable (see pages 14-15)

Emissions TA: 01Oct08 - FR: 01Oct09	Unit	Euro V		Euro V - EEV	
		ESC/ELR Diesel Only	ETC Diesel & gas	ESC/ELR Diesel Only	ETC Diesel & gas
CO	g/kWh	1,5	4,0	1,5	3,0
HC		0,46	-	0,25	-
NMHC		-	0,55	-	0,40
CH_4 [1]		-	1,1	-	0,65
NOx		2,0	2,0	2,0	2,0
PM		0,02	0,03 [2]	0,02	0,02 [2]
Smoke	m^{-1}	0,5	-	0,15	-

[1] For natural gas engines only

[2] Not applicable for gas fuelled engines - Euro IV Stage

Source: DELPHI

Performance of Euro 6 / VI WWH-OBD Systems

EURO VI (Reg EC No: 595/2009 and implementing regulations (EU) No 582/2011 and 64/2012)

Scope: M1, M2, N1, N2 with RM > 2.610 kg
Application dates: TA 31DEC12 - FR 31DEC13

	CO	THC	NMHC	CH4	NOx [1]	NH_3	PM Mass	PM [2] Number
	mg/kWh					ppm	mg/kWh	#/kWh
WHSC (C.I.)	1.500	130			400	10	10	$8{,}0 \times 10^{11}$
WHTC (C.I.)	4.000	160			460	10	10	$6{,}0 \times 10^{11}$
WHTC (P.I.)	4.000		160	500	460	10	10	[3]

C.I. Compression Ignition
P.I. Positive Ignition
WHSC, WHTC (see pages 2-3)

1) Admissible level of NO_2 may be defined later
2) Measurement procedure to be introduced at a later date
3) Particle number limit and date of implementation not confirmed yet

Regulation covers:
- Only world harmonized driving cycles (WHTC, WHSC) are applicable as defined in ECE Regulation Annex 4B.
- Reference fuel specifications for Diesel (B7); Ethanol (ED95) (see pages 58)
- Access to vehicle OBD and vehicle repair and maintenance information.
- Off-cycle laboratory testing and vehicle testing of engines at type approval.

Source: DELPHI

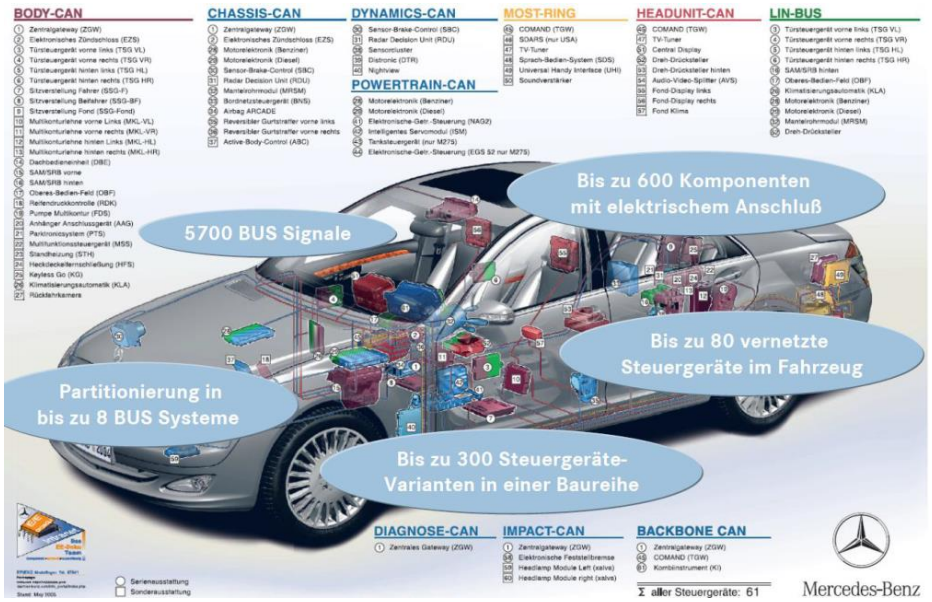
Performance of Euro 6 / VI
Types of Monitors

OBD Monitors can roughly be classified into three different groups

Circuit Continuity Checks
- Strictly component related
- Detection of electrical short cut and open load

Rationality Checks
- Component related
- Detection of sensor signal drifts and false actuator response

System Checks
- System related
- Monitoring of performance of (sub-)systems



Source: Daimler AG

Performance of Euro 6 / VI
Circuit Continuity Checks

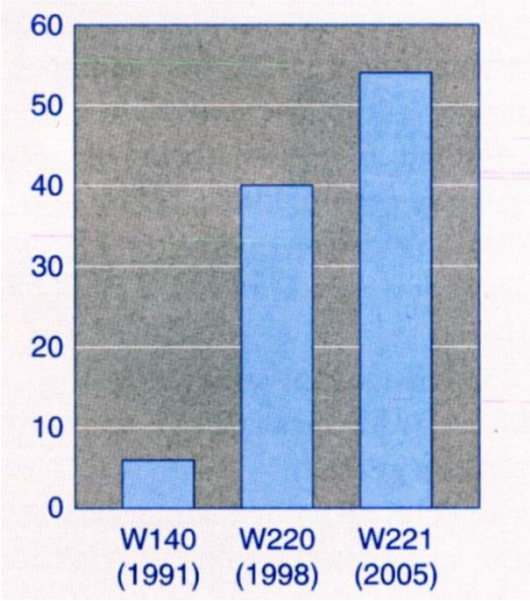
Scope of Circuit Continuity Checks is the detection of electrical failures (short cut to ground / to battery and broken wire).

- For most sensors and actuators signal range high / low checks are possible

Special Cases

- Smart sensors and actuators:
- Failure detection in sensor / actuator ECU → failure is communicated via CAN; ECU evaluates failure message

Increasing CAN-Systems in the S-Class



Source: Daimler AG

Performance of Euro 6 / VI
Rationality Checks

Scope of rationality checks

Sensors:

– Detection of sensor offsets or drifts. I.e. the measured signal is within the limits of the value/voltage look-up table. Detection of drifted high, drifted low, stuck in range is required

Actuators:

– Detection of in-correct response of the actuator. The check is a functional check and does not need to monitor the exact actuator behavior and is not linked with an emission threshold

Basic Principles:

– Usage of partial redundancies with other sensors
– Modelling of expected sensor values
– Modelling of expected actuator response

MU Statistics

	Circuit Continuity	Rationality	System	Σ MUs
Engine	138	40	19	197
Aftertreatment System	77	27	15	119

Source: Daimler AG

Performance of Euro 6 / VI System Checks

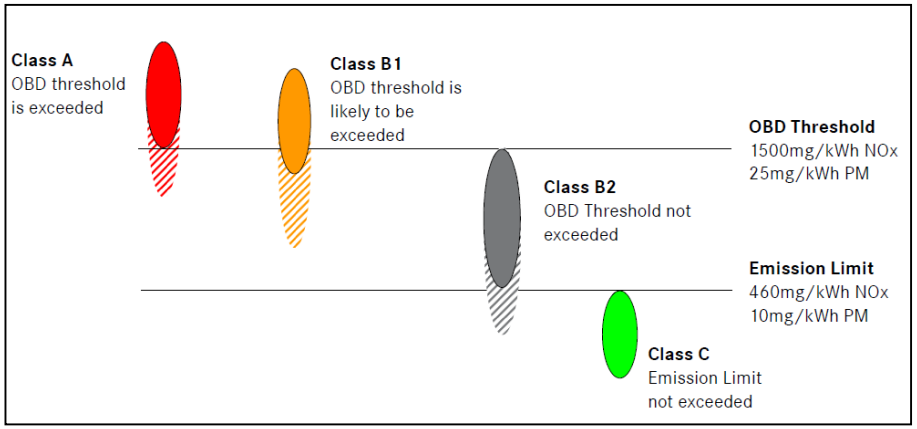
Scope of System Checks

The system checks shall monitor the overall performance of a (sub-) system.

Basic Principles:

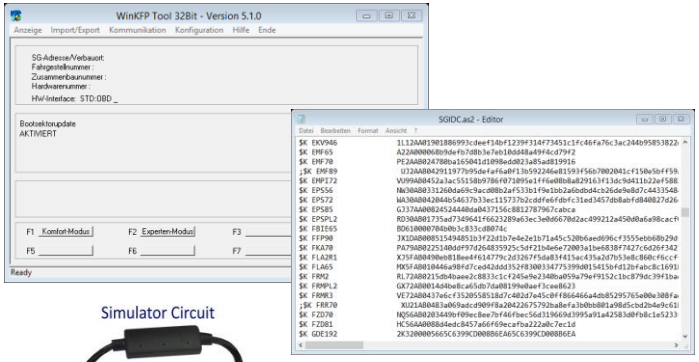
- Several system checks are linked with OBD thresholds
- Monitoring is indirect, i.e. we do not directly monitor PM or NO_x - emissions but monitor characteristic system values like temperatures, pressures etc. and correlate the deviation from the expected behavior with emissions on the test cycle.

EURO VI MI Bulb Check Failure Classification



Source: Daimler AG

Performance of Euro 6 / VI
OBD Tampering and DPF Removal



Websites for OBD/DPF Manipulation:

Cheat OBD Emissions Test
https://forum.efilive.com/showthread.php?11344-Emission-Testing-Ways-to-Cheat
http://www.chargerforums.com/forums/archive/index.php/t-186834.html

Cheat OBD Test
http://www.obdclearinghouse.com/index.php?body=get_file&id=1645

Cheat OBD Codes
http://www.cesenatico5stelle.it/wiki5st/index.php?title=Obd_2_code_cheats_download_fast_TKwS
http://www.deichcamp.de/index.php/Obd_2_cheats_download_free_fast_KYgu
http://hackaday.com/2009/05/12/obd-ii-automotive-data-logging/

Diesel Particulate Filter Removal
http://www.ecuflash.co/dpf-removal/
http://www.tdperformance.co.uk/dpf-removal/
http://www.evolutionchips.co.uk/Diesel_Particulate_Filter_Removal_DPF.html
http://www.youtube.com/watch?v=7bXxXn3nL60

Simulator Circuit

OBD Male to Vehicle

OBD Female to tester

Benefits of diesel particulate filter removal are:

- Better Performance
- Increased MPG
- Avoid Expensive Repair Costs

Source: Internet and DREW Technologies

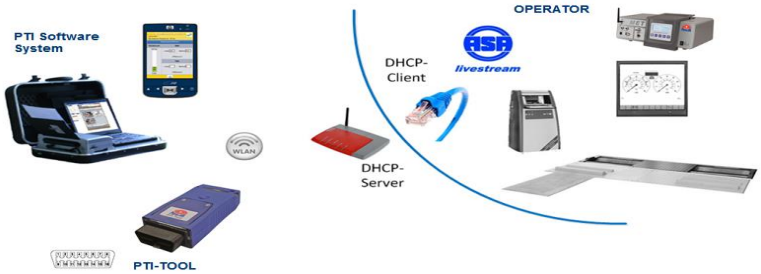
Performance of Euro 6 / VI
Summary

For an Environmental effective Diesel and Petrol Emission Test it is necessary to have a modern Mechatronic System.

OBD + Tail Pipe = is the Ultimate Diesel and Petrol Emission Test System for an 100% PTI or garage test for
Diesel and Petrol Emissions.

Especially for modern diesel-powered vehicles equipped with a emission after treatment system such as a diesel particulate filter, SRC, SRCT,…, only this combination of tests ensure the effectiveness of the emission test during PTI.

The above mentioned measuring instruments are available today.



Thank you for your attention!

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Member of MAHA-Group

Antonio Multari
Director Project Management &
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Workshop B1

Presentation 3

PTI For EURO 5 and 6 Vehicles

Klaus Schulte

AVL DiTEST, Austria

PTI FOR EURO 5/V AND EURO 6/VI VEHICLES

Klaus Schulte

PTI FOR EURO 5/V AND EURO 6/VI VEHICLES

- New communication protocols
- Very low emission values
- Engines that do not reach the real cut of speed at free acceleration test.
- …

These were only a few particularities of Euro 5/V and Euro 6/VI vehicles.

How to deal with these vehicles during PTI?

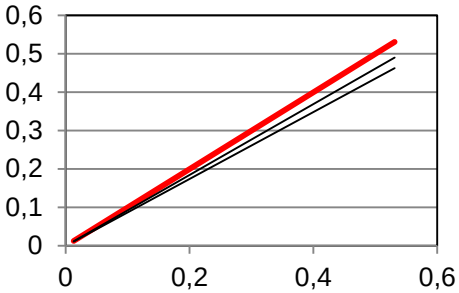
PTI FOR EURO 5/V AND EURO 6/VI VEHICLES

- Europe: Since the European Direction 2010/48 the value of the manufacturers plate has to be taken as reference.
- Plate values of 0,1 or 0,2 for modern Diesel engines are no rarity.
- The max. calibration tolerance for approving / calibrating opacimeter is higher than the reference value

PTI FOR EURO 5/V AND EURO 6/VI VEHICLES

AVL DITEST

Physikalisch Technische Bundesanstalt



- Independent PTB study states that actual opacimeter are able to measure k-values of 0,05
- Tolerance for calibration error has to be reduced
- No expensive refurbishing of test equipment necessary

Smoke meters are able to deal with EURO 5/V & EURO 6/VI vehicles

Klaus Schulte

PTI FOR EURO 5/V AND EURO 6/VI VEHICLES

- New OBD standard, called WWH-OBD, for EURO VI trucks
- WWH-OBD includes ISO protocols as well as SAE J1939 Protocol.
- New communication protocols and new kind of plug.

Klaus Schulte

PTI FOR EURO 5/V AND EURO 6/VI VEHICLES

Software Update

- Professional OBD scan tools are able to deal with these new requirements.
- Only a software update of existing tools is required.
- Adapter (plug) already available

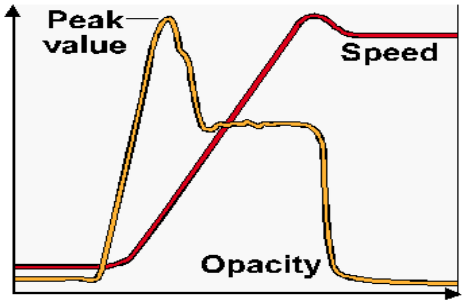
WWH-OBD is no problem for professional scan tools

PTI FOR EURO 5/V AND EURO 6/VI VEHICLES

- EURO 5/V and EURO 6/VI engines do not reach the full cut off speed during free acceleration test.
- “Low” cut off speed means less exhaust
- Actual limits values were not sufficient for these kind of vehicles!

Klaus Schulte

PTI FOR EURO 5/V AND EURO 6/VI VEHICLES



k = 0,2 m^{-1}

- No change on the emission procedure required.
- No change in measurement technology required.
- Reducing the limit value for vehicles with cut of speed limitation to 0,2m^{-1}.

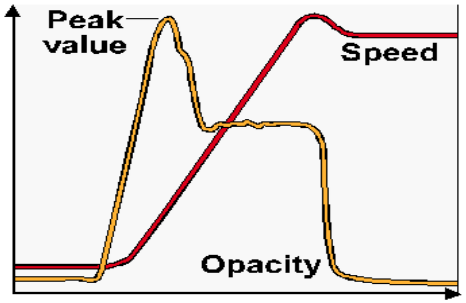
Vehicles with reduced cut off speed can be measured

PTI FOR EURO 5/V AND EURO 6/VI VEHICLES

- Particulate filters generally reduce the power of engines and may get blocked, especially in urban regions.
- Cost for changing the particulate filter > 1500 Euros
- Rising market for removing the particulate filter (cost < 300 Euros)

Klaus Schulte

PTI FOR EURO 5/V AND EURO 6/VI VEHICLES



- Detecting a removed particulate filters is possible using the emission test.
- Test procedure „Free Acceleration“
- Reduced Limit Value

$k = 0{,}2\ m^{-1}$

Manipulated particulate filter can be detected

PTI FOR EURO 5/V AND EURO 6/VI VEHICLES

- NEW EURO 6 trucks have new types of exhaust pipes
- No possibility to enter the exhaust probe!

Actually no solution for measuring exhaust on EURO 6 trucks

PTI FOR EURO 5/V AND EURO 6/VI VEHICLES

Summary:

- Actual available measuring instrument were able to deal with EURO 5/6 vehicles.
- Only small changes regarding limit values necessary
- Tailpipe test is the only possibility to detect DPF manipulation

Klaus Schulte

Workshop B1

Presentation 4

The Move from Tailpipe to OBD Testing

Darrin Greene

CEO Applus+ Technologies, USA

OBDII Inspections in the U.S. & Advantages of OBDII

Presented by:

Darrin Greene
Applus Technologies, Inc.

April 2015

OBD Overview

Applus Technologies

- OBD was developed in 1989 by the California Air Resources Board as a way to inform motorists of problems with emissions control system components in their vehicles.
- Problems are indicated visually when the vehicle's "Check Engine" light is illuminated.
- Education about the Check Engine light is the single best emissions control program:
  - By servicing your vehicle immediately, you save on expensive repairs and fuel costs, AND prevent or reduce excessive emissions.
  - The Check Engine light only illuminates when emissions are approximately 1.5 times higher than the certification level. It is <u>not</u> a maintenance indicator (for oil changes, etc.).
  - If the light is on and the vehicle is within the warranty period, the manufacturer <u>must</u> perform any repairs necessary to make the light go out at no charge to the vehicle owner.

OBD in the U.S.

Applus Technologies

- There are approximately 35 vehicle inspection programs in the U.S.
- All U.S. inspection programs (except CA and CO) are exclusively performing OBDII inspections on 1996 an newer vehicles.
- More than half are only performing OBDII inspections (and no other inspection types) due to the following:
  - The cost of the testing equipment is low.
  - Significantly less time is required to perform the OBDII inspection.
  - The vast majority of vehicles on the road today that require an inspection are OBD compliant.
  - The overall cost to perform the test is lower.
  - The test can be performed anywhere, wirelessly.

OBDII Background

Applus Technologies

- In the U.S., OBD is present on:
  - 1996 and newer light-duty gasoline-powered vehicles
  - 1997 and newer light-duty diesel-powered vehicles
  - 2008 and newer medium-duty diesel-powered vehicles
  - 2014 and newer heavy-duty diesel-powered vehicles
- Starting in 2014, all on-road vehicles introduced in the U.S. were required to be OBDII equipped.
- OBDII is a standardized way to inspect vehicles:
  - Standardized connector, usually under the dash
  - Standardized "generic" communications
- The OBDII testing system indicates when the OBD device has checked that the emissions control system of the vehicle is ready for inspection.
- Failures reports provide "diagnostic trouble code(s)" which aid in determining the repairs needed by the motorist.

OBDII Background

Applus Technologies

- The OBDII inspection is “digital” so there is an electronic “fingerprint” which is used to detect fraud.
- The fingerprint of most U.S. vehicles is known.
- 2005 and newer vehicles even transmit their VIN.
- The OBDII test is NOT subjective; computers decide when the vehicle passes or fails, and when repairs are effective.
- OBDII not only measures hot running tailpipe emissions, but also start and evaporative emissions; therefore studies have shown that emissions reductions achieved by OBDII testing are greater than with tailpipe tests.
- New technology vehicles are so clean that tailpipe tests cannot measure the emissions the newer vehicles.
- OBDII lets motorists know if a component is about to fail.

OBDII Equipment

Applus Technologies

- "Analyzer" is now simple and cost effective:
  - Tablet, with blue tooth, a camera and Wi-Fi
  - OBD scan tool - wired or wireless
  - Inspection report printer
  - Bar code reader - if the tablet camera is not used
  - Cart
- OBDII is a great solution for testing diesels. Opacity measurements are only good for public perception (they reduce visible smoke); however studies show that smoke repairs cause increases in small (more lethal) particles. Repairs of diesels which fail the OBDII test do not have this problem.

OBDII Test Process

Applus Technologies

- Performing the OBDII test takes less than five minutes!
- The test procedure includes determining that the Check Engine light on the dashboard works properly.
  - Key On Engine Off ("KOEO"): The light does not illuminate when the engine is off/not running.
  - Key On Engine Running ("KOER"): The light illuminates briefly when the engine is turned on, then goes off.
- Locate the Diagnostic Link Connector ("DLC").
  - There are photographs to assist with locating the DLC.
- Plug the OBD device into the DLC.

OBDII Test Process

Applus Technologies

OBDII Test Process

Applus Technologies

- The inspector initiates the test from the OBD testing system, causing the OBD device to communicate with the vehicle's on-board computer.
- The OBD device inquires to determine whether the vehicle is ready to be tested.
- Then the ODB device checks the vehicle's emissions control system to determine if all components are working properly.
- After the inquires, the OBD testing system prompts the inspector to disconnect the OBD device from the vehicle's DLC.

Advantages to OBDII & Future Improvements

Applus Technologies

- OBDII inspection systems can be automated to detect and block fraudulent testing.
- Minimal skill is required of the inspector in order to perform the OBDII test.
- Future OBD technology may be even more motorist friendly:
  - Remote OBDII
    - Can be installed on in-use vehicles as an option. Many new vehicles are already equipped for monitoring by the manufacturer.
  - Self-service OBDII inspection kiosks
    - Can be accessible 24 hours a day, every day
  - Data logging OBDII
    - Plug in, drive for a week and return
    - Can be done in parallel with insurance monitoring

Workshop B1

Presentation 5

Introduction to Monitoring and Enforcement of Light-Duty and Heavy-Duty Vehicle Exhaust Emissions with remote Sensing Devices

Jim Sands

Opus Inspection, USA

ETEST CORP

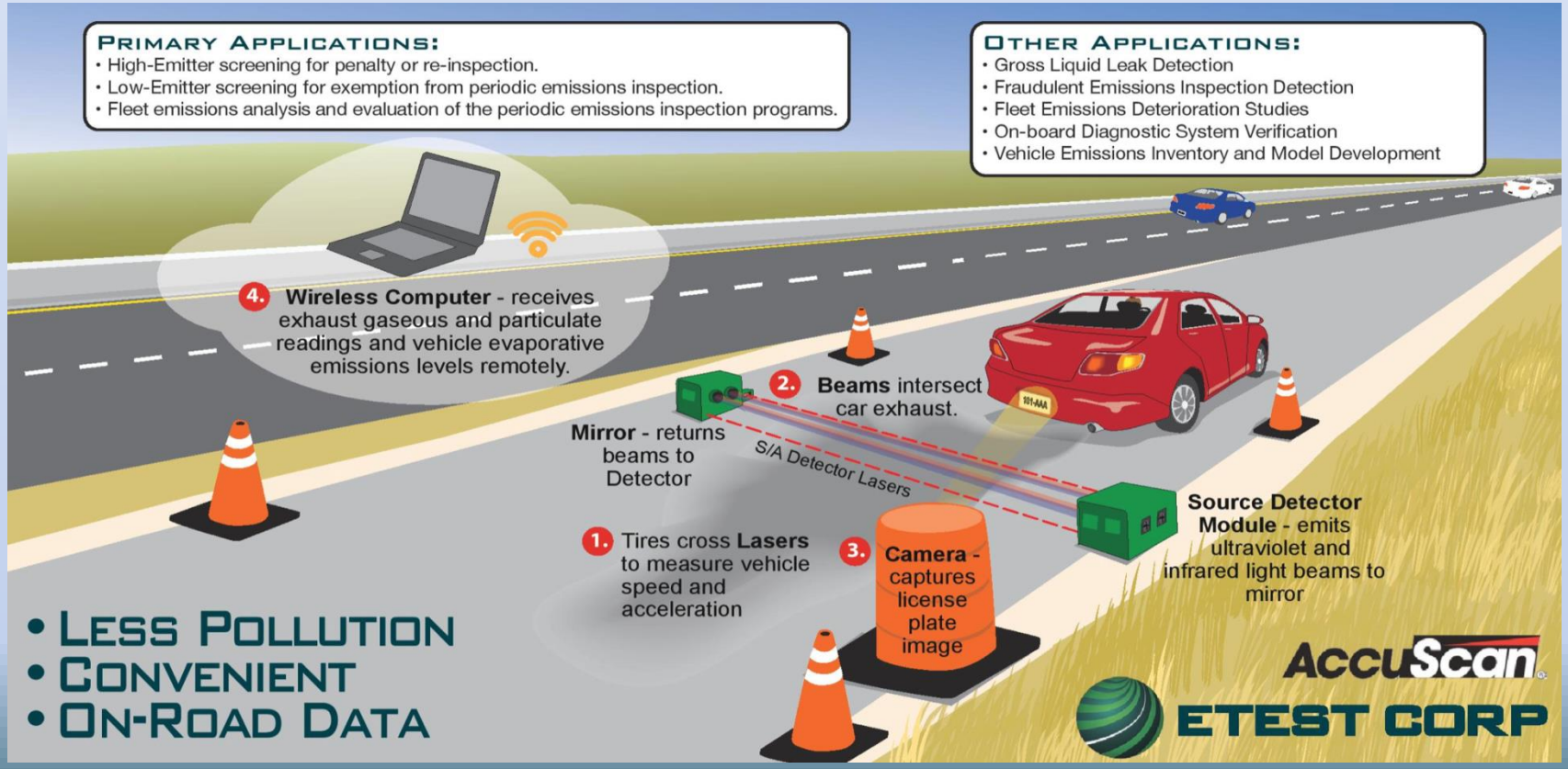
Introduction to Monitoring and Enforcement of Light-Duty and Heavy-Duty Vehicle Exhaust Emissions with Remote Sensing Services

CITA General Assembly – Dubai 2015

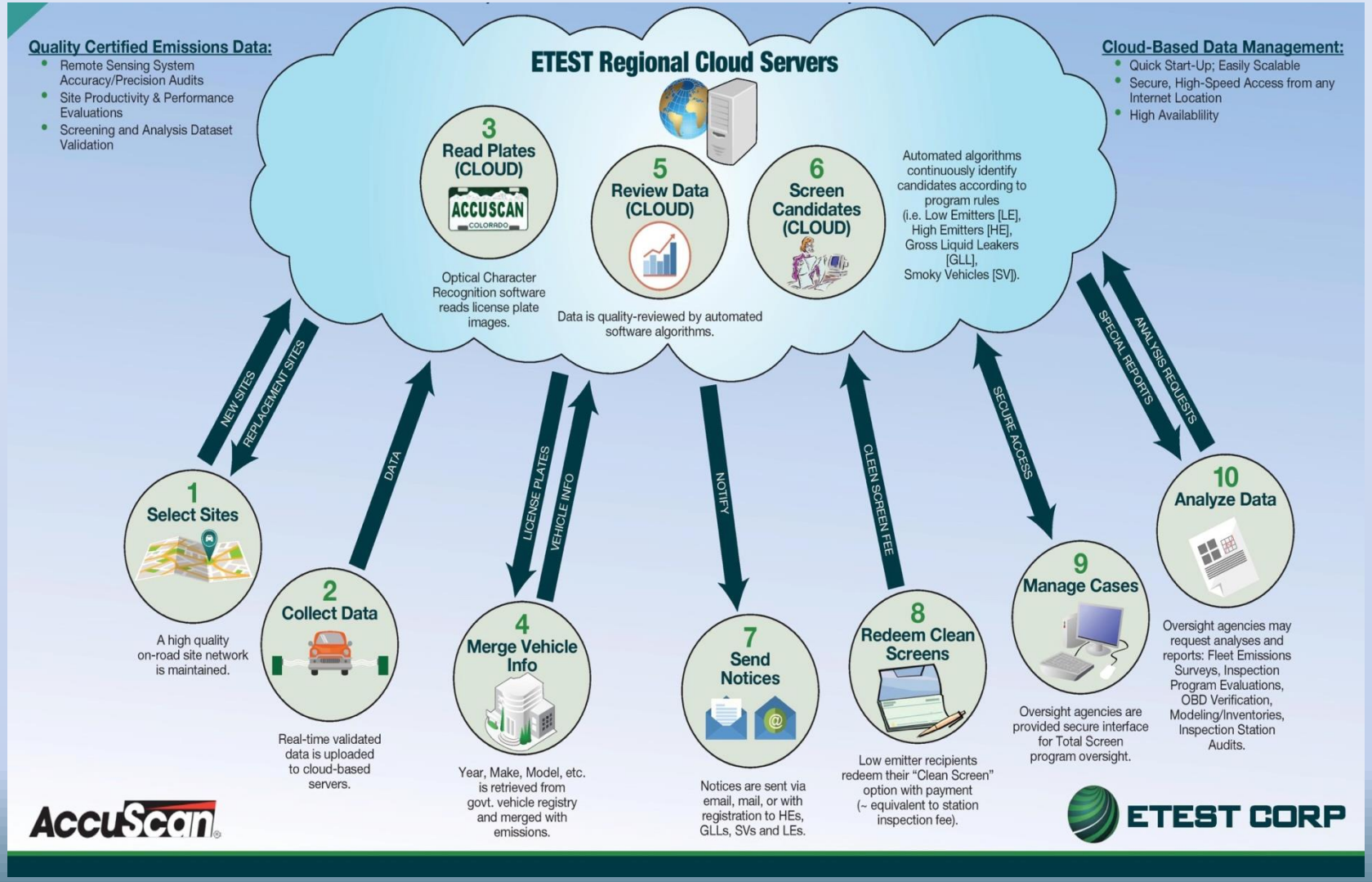
Jim Sands, Opus Inspection

ETEST CORP

How does Remote Sensing Services (RSS) Operate?



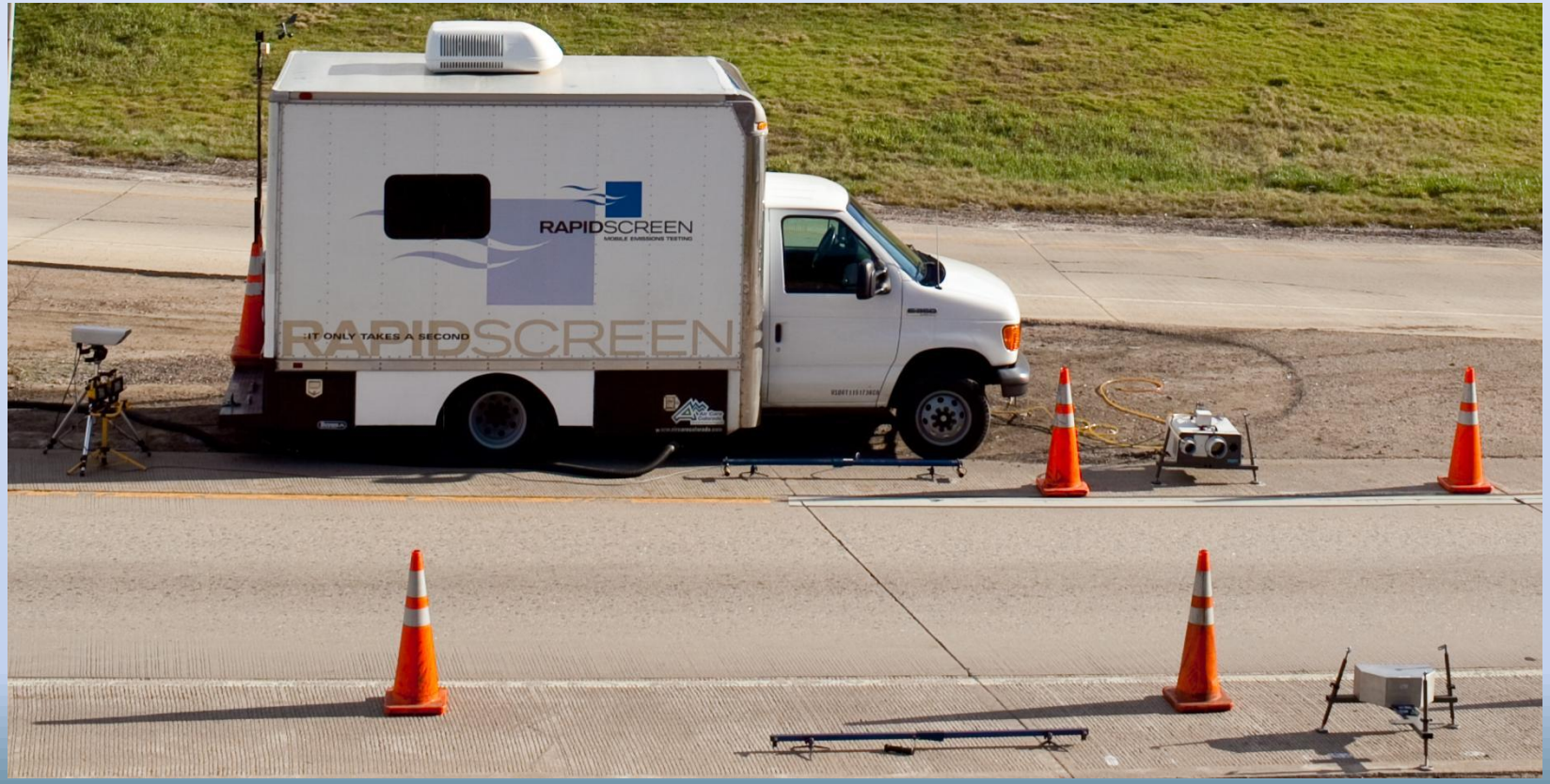
ETEST CORP


Quality Certified Emissions Data:
Remote Sensing System Accuracy/Precision Audits
Site Productivity & Performance Evaluations
Screening and Analysis Dataset Validation
ETEST Regional Cloud Servers
3 Read Plates (CLOUD)
ACCUSCAN COLORADO
Optical Character Recognition software reads license plate images.
5 Review Data (CLOUD)
Data is quality-reviewed by automated software algorithms.
6 Screen Candidates (CLOUD)
Automated algorithms continuously identify candidates according to program rules (i.e. Low Emitters [LE], High Emitters [HE], Gross Liquid Leakers [GLL], Smoky Vehicles [SV]).
Cloud-Based Data Management:
Quick Start-Up; Easily Scalable
Secure, High-Speed Access from any Internet Location
High Availability
NEW SITES
REPLACEMENT SITES
DATA
LICENSE PLATES
VEHICLE INFO
NOTIFY
CLEEN SCREEN FEE
SECURE ACCESS
SPECIAL REPORTS
ANALYSIS REQUESTS
1 Select Sites
A high quality on-road site network is maintained.
2 Collect Data
Real-time validated data is uploaded to cloud-based servers.
4 Merge Vehicle Info
Year, Make, Model, etc. is retrieved from govt. vehicle registry and merged with emissions.
7 Send Notices
Notices are sent via email, mail, or with registration to HEs, GLLs, SVs and LEs.
8 Redeem Clean Screens
Low emitter recipients redeem their "Clean Screen" option with payment (~ equivalent to station inspection fee).
9 Manage Cases
Oversight agencies are provided secure interface for Total Screen program oversight.
10 Analyze Data
Oversight agencies may request analyses and reports: Fleet Emissions Surveys, Inspection Program Evaluations, OBD Verification, Modeling/Inventories, Inspection Station Audits.
AccuScan
ETEST CORP

ETEST CORP

How is RSS Deployed?

Mobile Attended



ETEST CORP

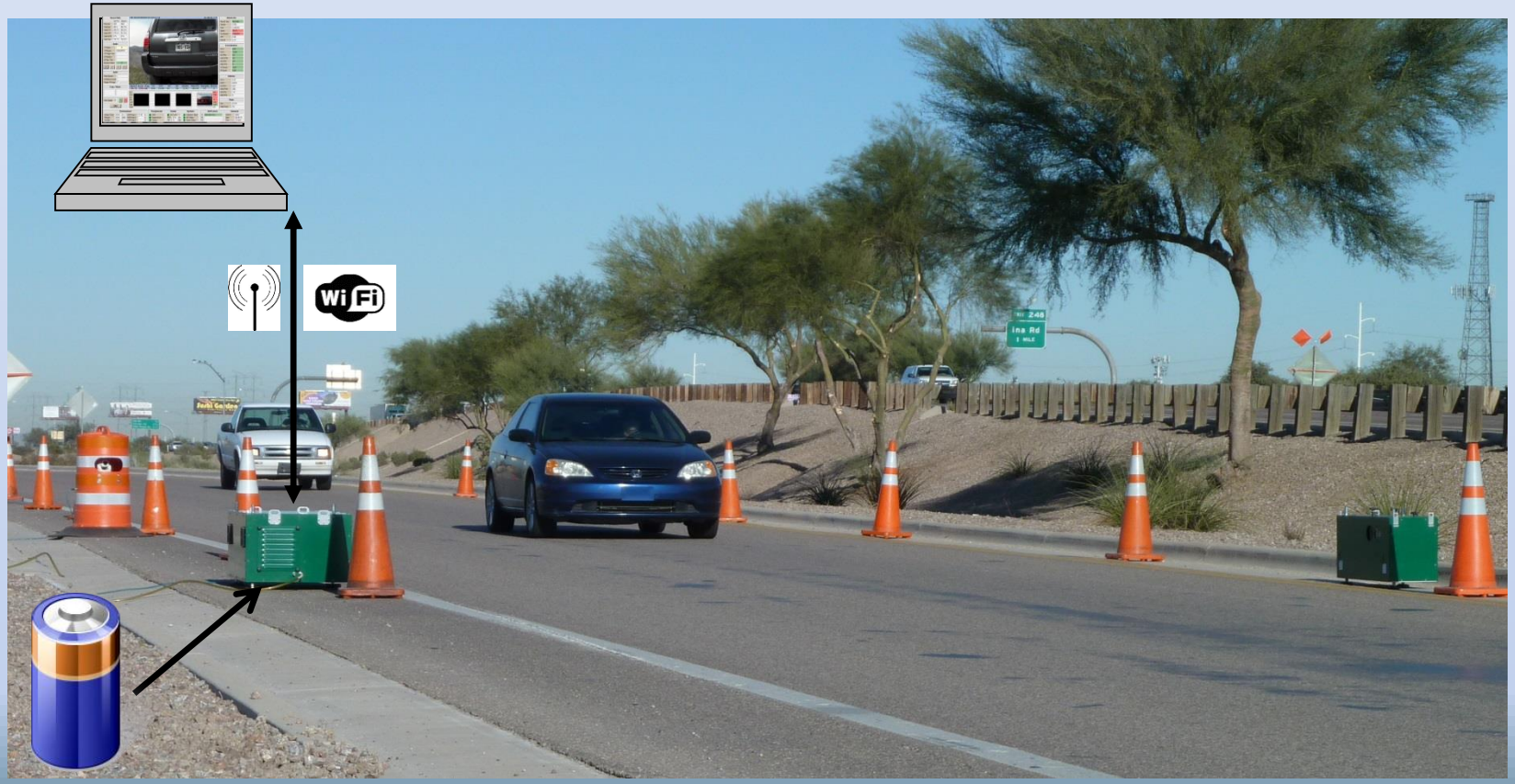
How is RSS Deployed?

Fixed Installed Unattended Deployment

ETEST CORP

How is RSS Deployed?

Mobile Unattended



ETEST CORP

Seamless compliment to existing emissions testing programs.

- **Secure, certified and accessible**
  - Data stored in cloud
  - ETEST Certified data validity
  - Remote Sensing Services Process Certified ISO 17020 (in progress)
  - Accessible to Agencies
- **Turnkey Solution**
  - Complete services leased as turnkey solutions
  - Ongoing annual projects

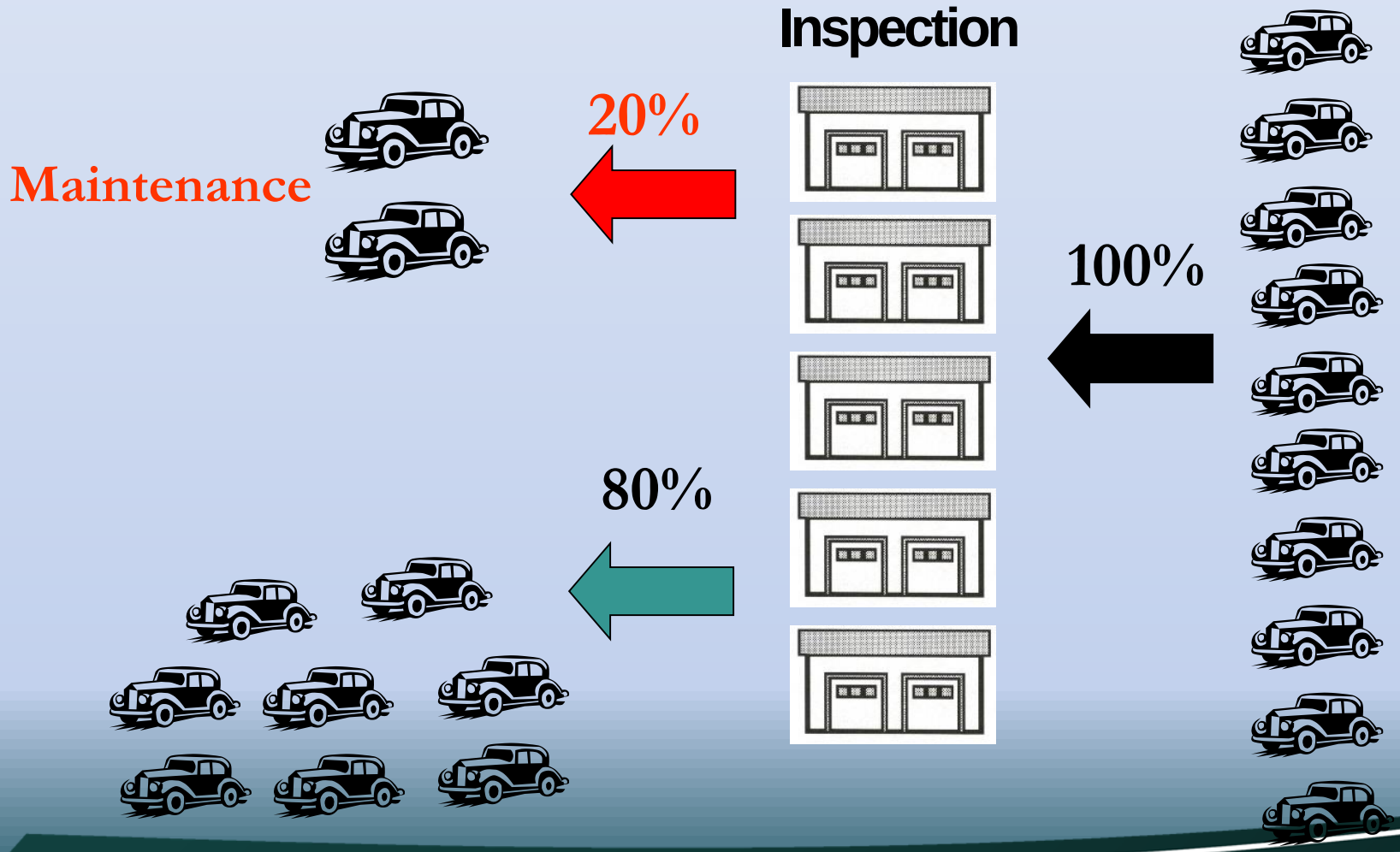
ETEST CORP

RSS Applications

- On-Road Enforcement
  - Clean Screening
  - High Emitter
  - LEZ Access
- On-Road Monitoring
  - Fleet Characterization
  - Program Evaluation

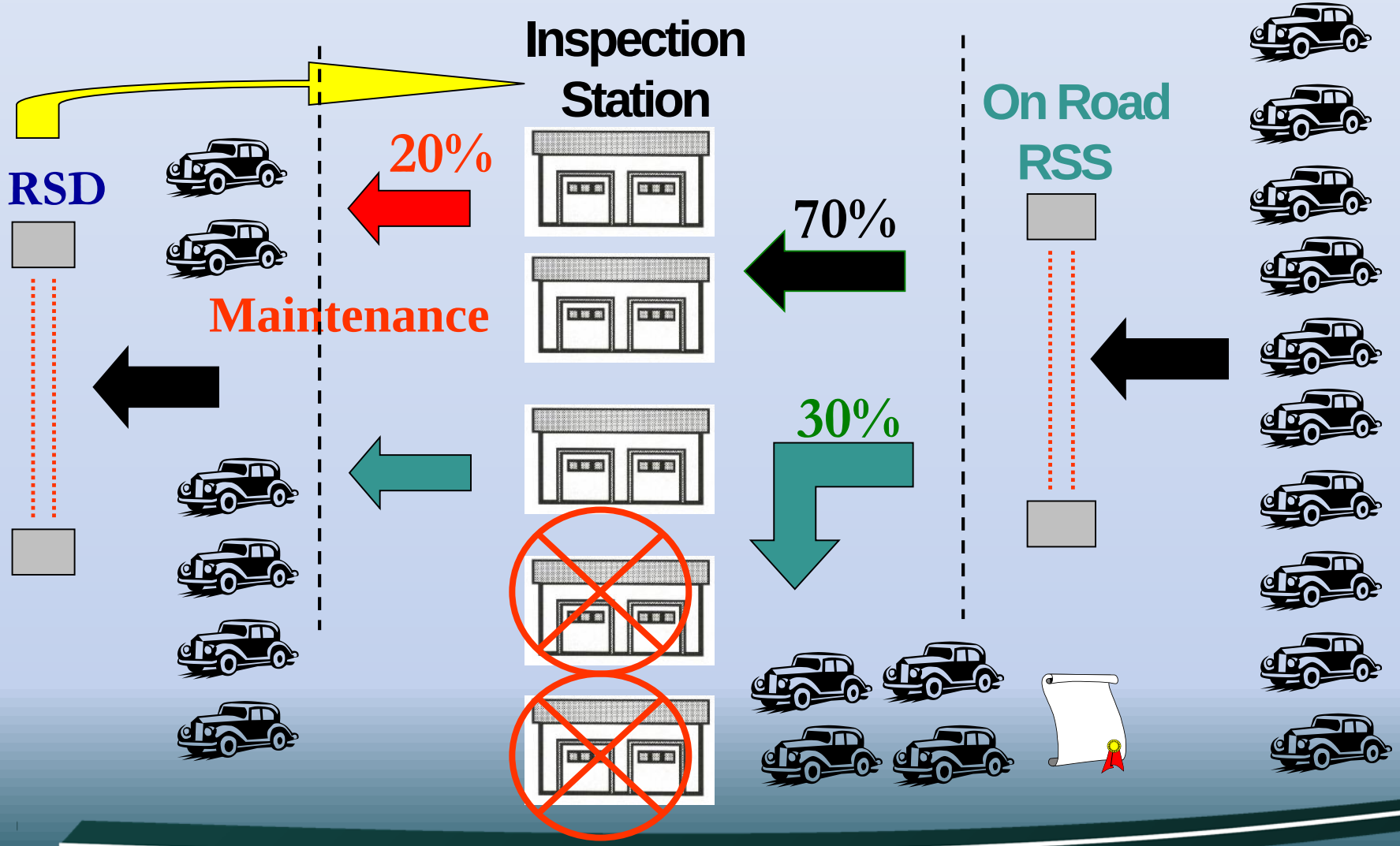
ETEST CORP

"Universal" I / M



ETEST CORP

I / M with Total Screen



ETEST CORP

Use of remote sensing services as a control tool for Low Emission Zones (LEZ)

Rapid access control by on-road emission measurement in the LEZ

Eliminates the need for traditional stickers as the remote sensing measures on-road emissions real time when vehicles are in normal operating conditions.

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Additional Value of On-Road Monitoring

- **Profile Vehicle Fleet Emissions**
  - Segment Classes & Highlight Principle Mobile Sources
  - i.e. India, Chile (Days)
- **Evaluate Emissions Program Performance**
  - Compare Tested to Untested
  - i.e. Virginia, Switzerland (Months)
- **Inventory Vehicle Fleet Emissions**
  - Compare Computer Model to Real-World
  - i.e. Colorado (8M/yr.), China (Years)

ETEST CORP

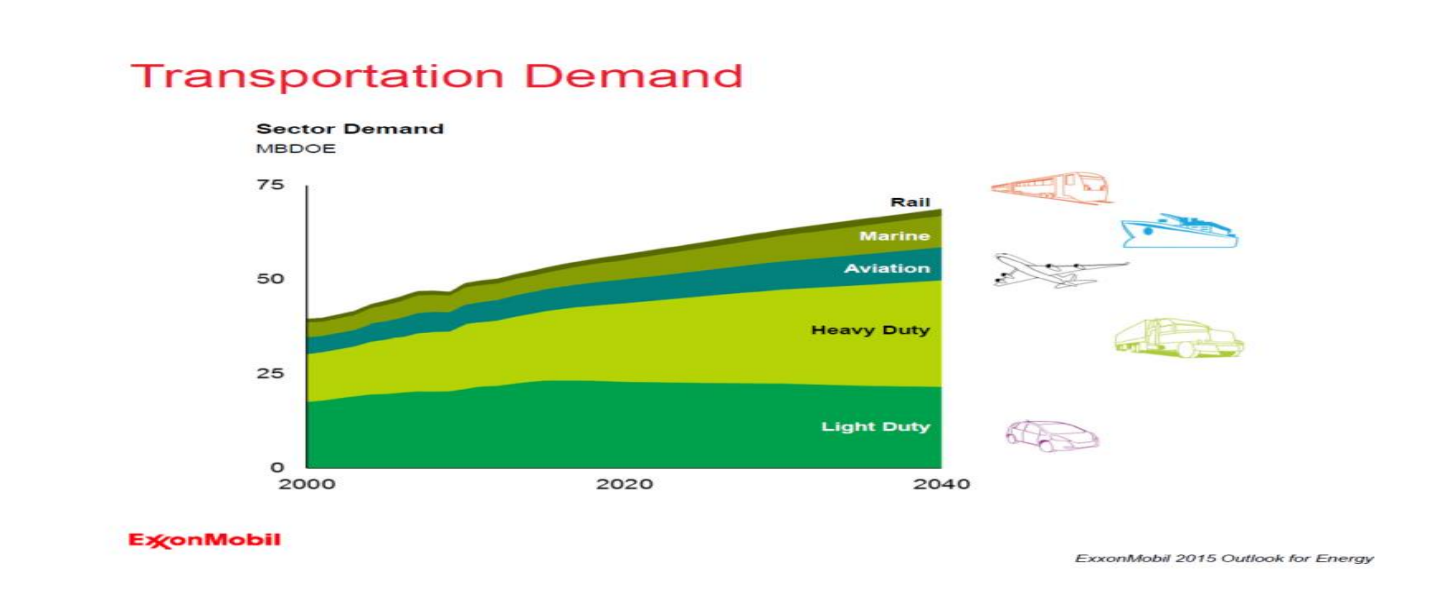
How is HD RSS Deployed?

Mobile Attended (HDV)

ETEST CORP

Why the Interest in HDV Emissions?

- Public: "What are you doing about those trucks?
- Modelers: HDV contribution is growing.



- Regulators: Major new HDV vehicle regs adopted

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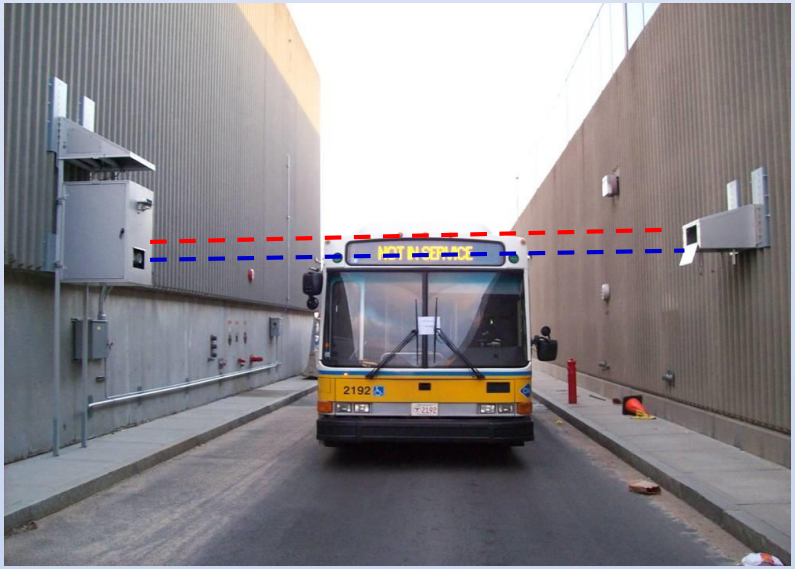
Boston Bus Inspection Program (MBTA)

6 of 8 Depots



2 of 8 Depots

1. Efficient as an In-House Testing Protocol for Buses (1000/day):
    1. **Drivers** have learned to use RSD → Consistent & Reliable RSD data.
    2. **Mechanics** used Bus Emissions Summary Reports → Repairs.
2. Value of Public Reporting Recognized:
    1. Bus I/M Report Card → Municipal Agency Website.

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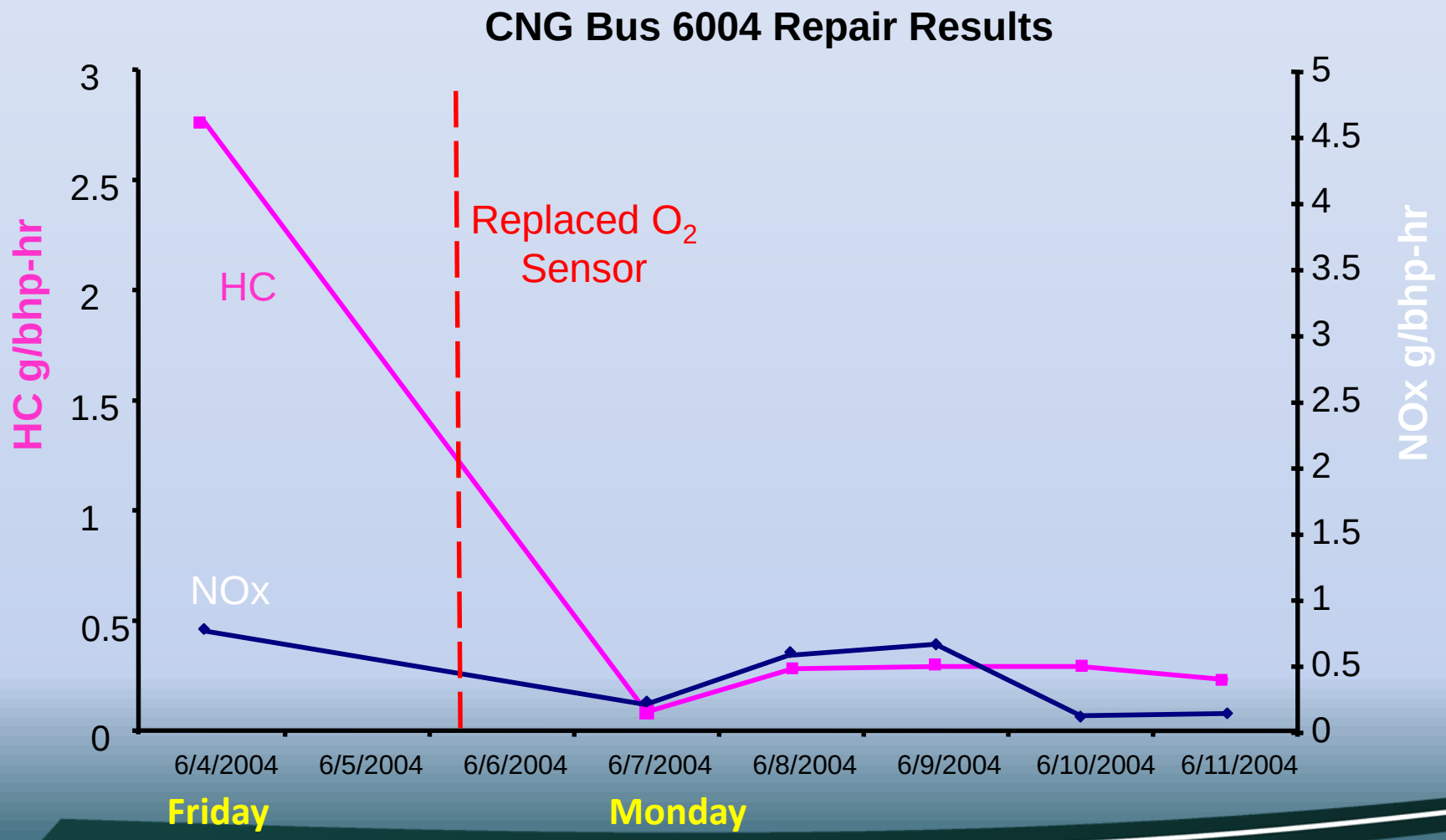
Effect of Maintenance



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Getting the Emissions Picture

N = 1,000 (Day)

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Getting the Emissions Picture

N = 10,000 (Week)

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Getting the Emissions Picture

N = 100,000 (2 Months)

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Getting the Emissions Picture

N = 1,000,000 (1 Year)

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Summary – Remote Sensing Services

- Total screen program is easy to implement, can be seamlessly added to existing programs;
- Certified results, fully controlled via cloud server, not by operator
- Pass/Fail results and additional values such as:
  - high emitter identification
  - liquid leakers
  - fleet characterization
- Easy access to data for authorized users via the internet.