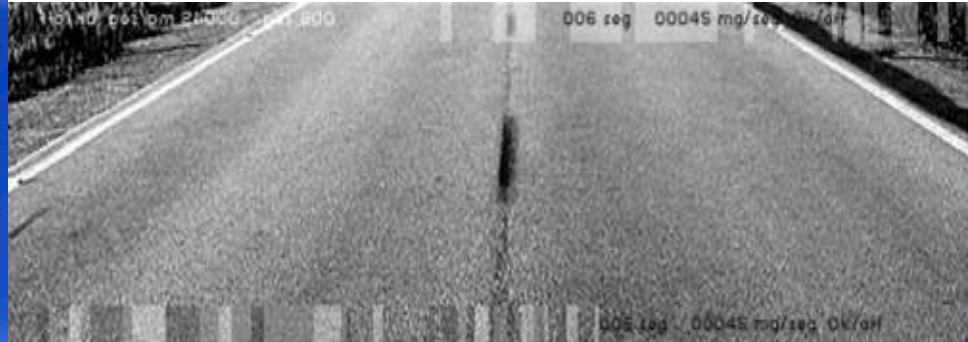




RSLab

Remote Sensing Lab.




Remote Sensing of Traffic Emissions



FIA Foundation
London, 8th of June 2016

How does remote sensing function?

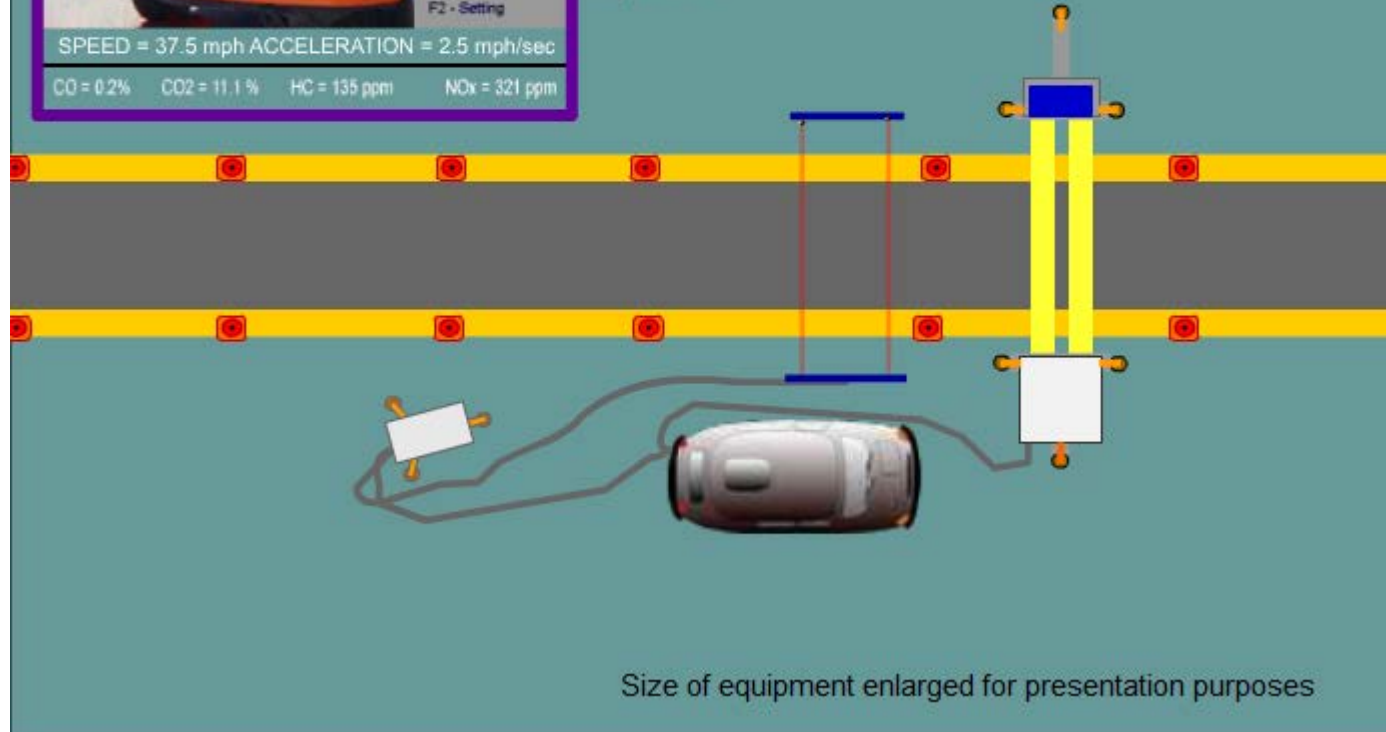


I - Site Information
M - Mirror Alignment
C - Calibration
S - Statistics
R - Road Testing
Y - Replay
F1 - Help
F2 - Setting

SPEED = 37.5 mph ACCELERATION = 2.5 mph/sec
CO = 0.2% CO2 = 11.1% HC = 135 ppm NOx = 321 ppm

- 3 active systems collect all relevant information in less than 1 second.
- Hold the cursor above any button to highlight the components of a system
- Click for a description of system operation

Speed & Acceleration
Exhaust Emissions
Camera Capturing



Size of equipment enlarged for presentation purposes

CORETRA Project

Spain developed the first remote sensing legislation and did a major project to validate the technology in the CORETRA project

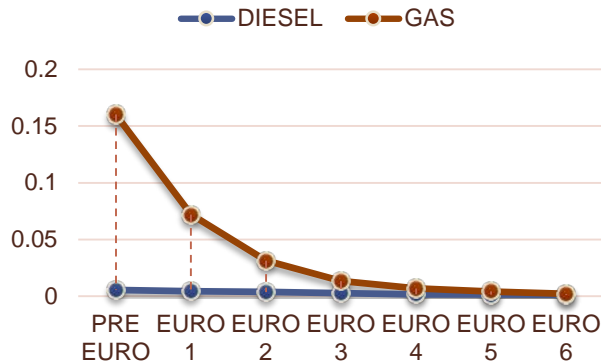


- Remote sensing project “CORETRA” commissioned by the Ministry for Environment during 2014/2015 executed with CIEMAT
 - Measurement of 200,000 vehicles (140,000 unique vehicles) in 25 locations
 - Evaluation of RSD technology AccuScan 4600
 - on road and static tests (<10% of uncertainty)
 - OBS Horiba correlation (validated)
 - Evaluation of Spanish Fleet

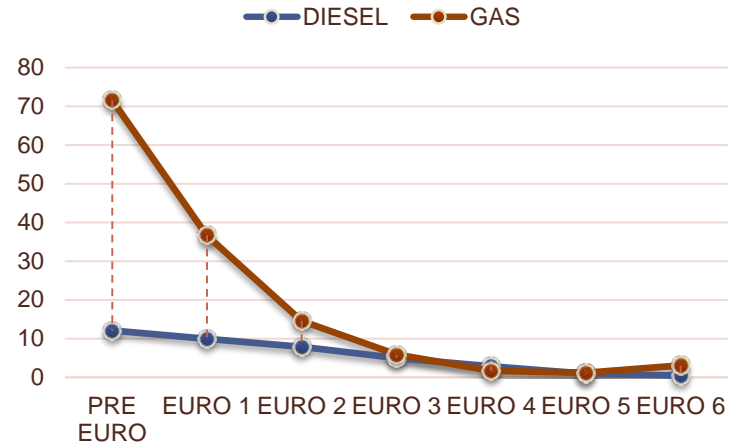
Evolution of real driving emissions

NOx of diesel vehicles wasn't significantly reduced along the Euro Standard

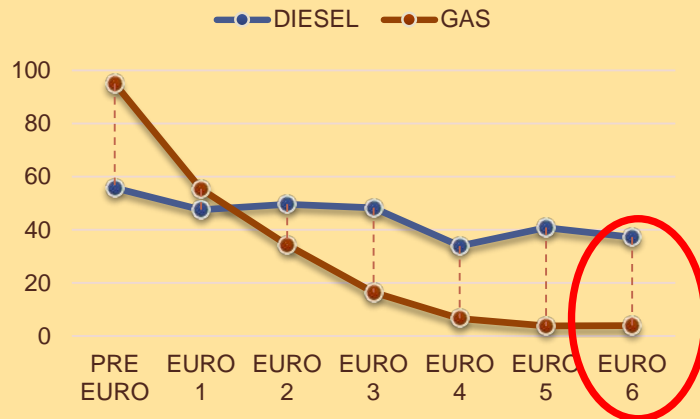
Evolution of CO/CO2



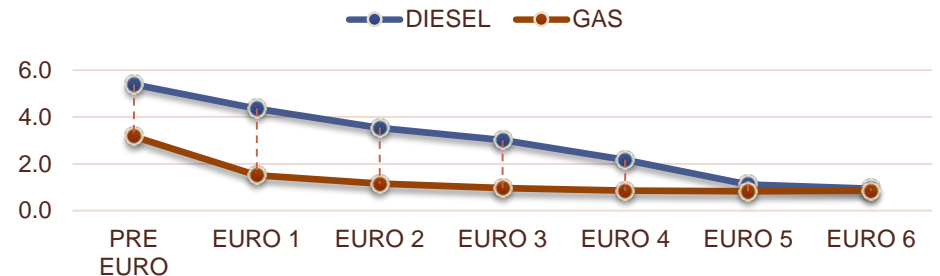
Evolution of HC/CO2



Evolution of NO/CO2



Evolution of opacity



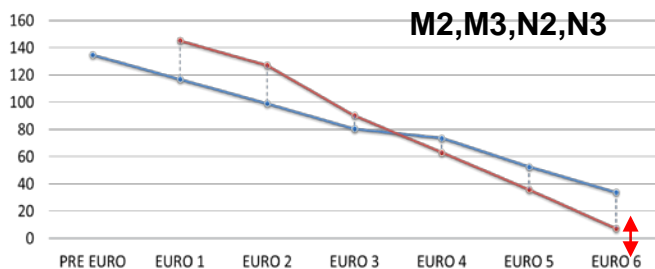
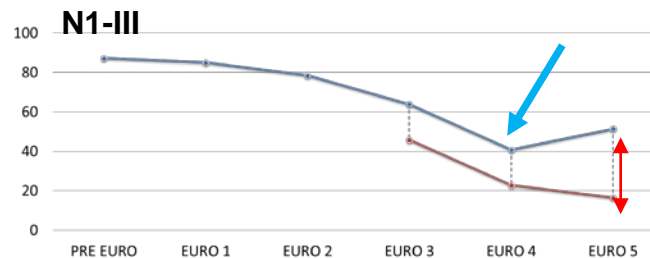
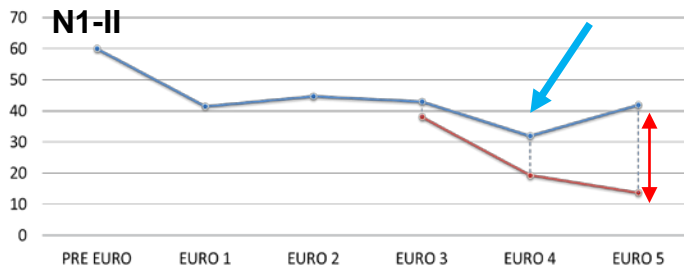
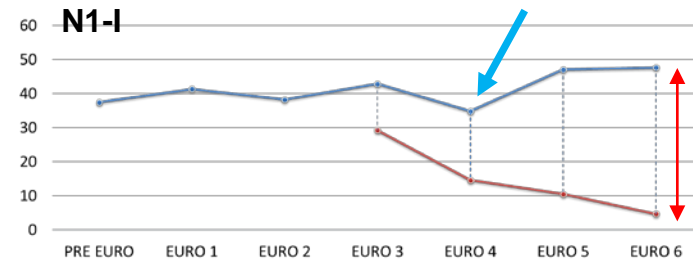
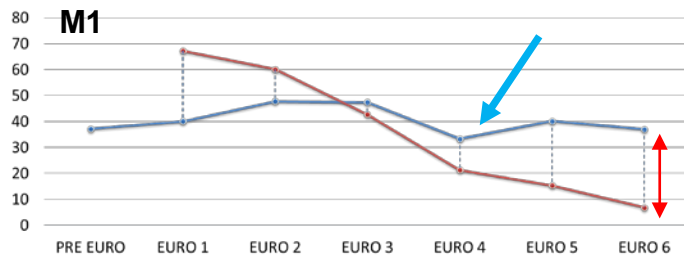
Source: Spanish Ministry for Environment (CORETRA 2015)

<http://www.rslab.es>

NOx per vehicle type

Real NOx values are above Euro St. in all vehicle categories, the gap is growing and Euro 5 and 6 are frequently worse than Euro 4

Average Emissions
 Euro Standard



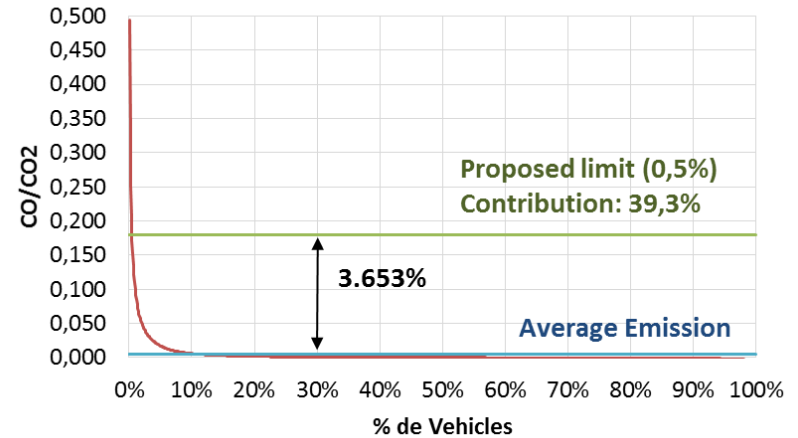
Source: Spanish Ministry for Environment (CORETRA 2015)

<http://www.rslab.es>

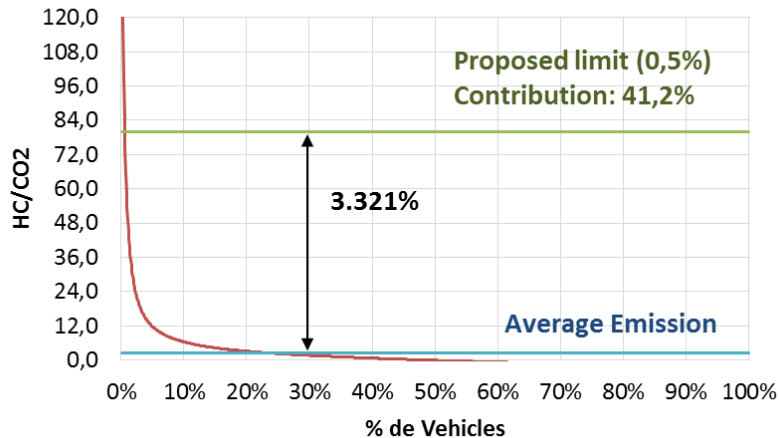
Methodology to identify high emitter

Identification of the minimum percentage of vehicles that contributes most to the total emissions: High Emitters imply emissions values up to 36 times above the fleet average.

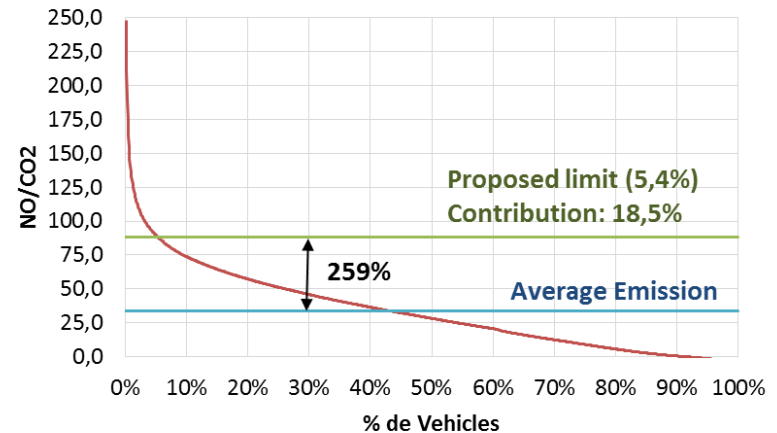
Distribution CO/CO2 - M1



Distribution HC/CO2 - M1

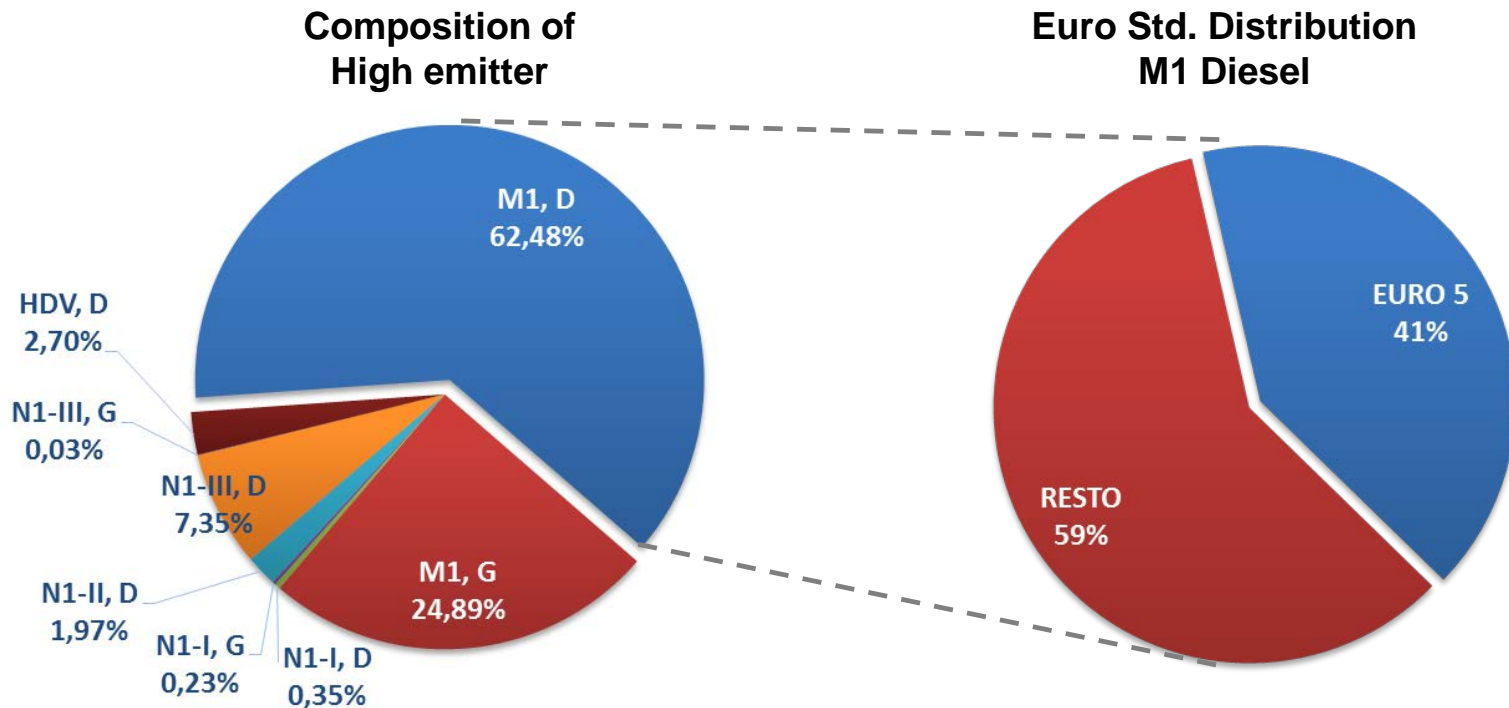


Distribución NO/CO2 - M1



Details on high emitters

Diesel passenger cars represent most high emitters.
Thereof, almost half is represented by relatively new Euro 5 vehicles



Source: Spanish Ministry for Environment (CORETRA 2015)

<http://www.rslab.es>

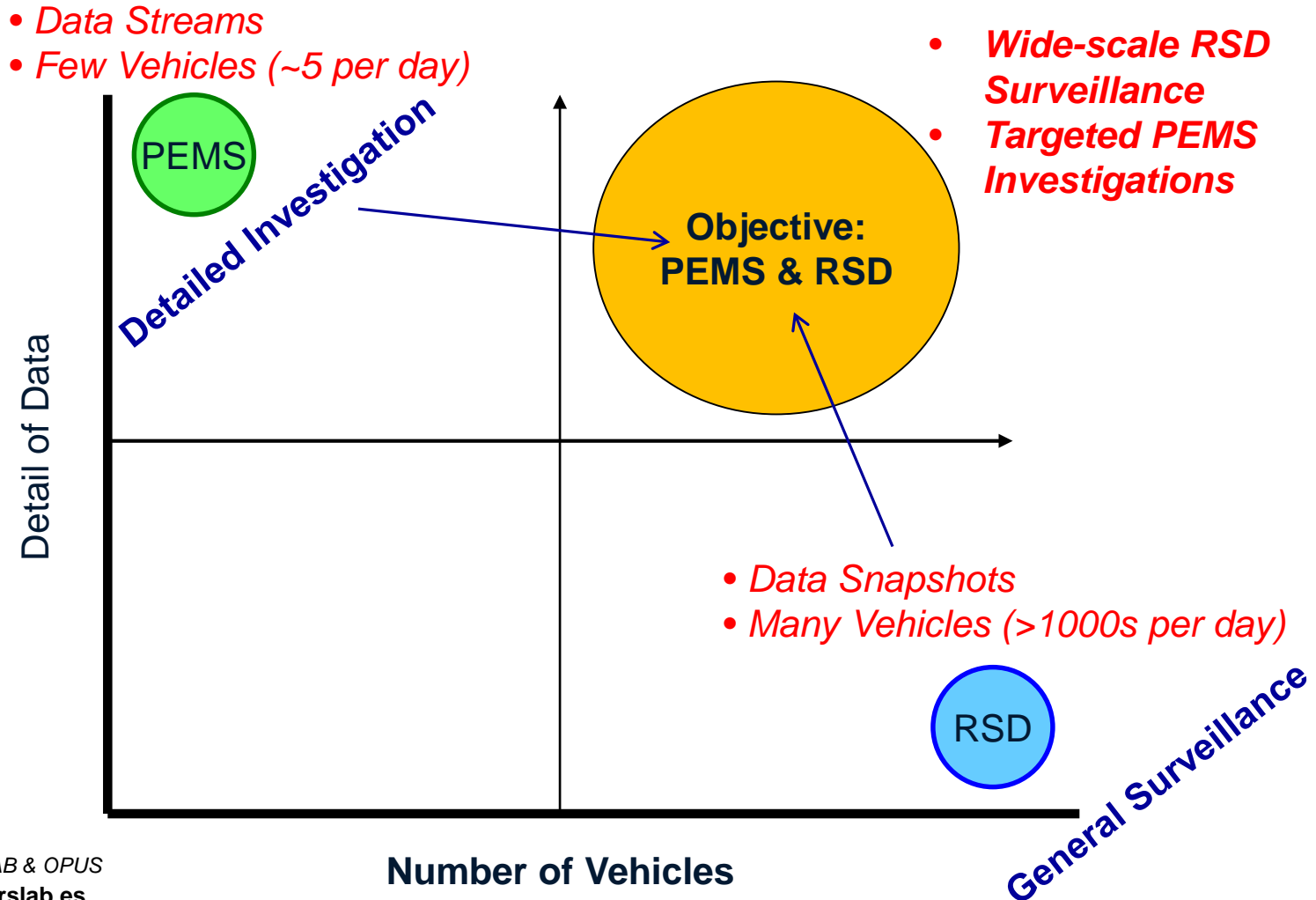
Comparison of measurement technologies

RSD most cost effective technology for massive emission measurement

	Static Test		On Board	Remote	
Tecnology	PTI	CVS	OBS-PEMS	RSD	RSD+
Scope of measurement	CO, PM	CO, PM, HC, NOx	CO, PM, HC, NOx	CO, PM, HC, NOx	CO, PM, HC, NO2
Real driving emissions	No	No	Yes	Yes	Yes
Accuracy	Low	High	High	High	High
Regulation/Standard	2009/40/EC ISO 17020	200/46/EC	CE-marking	ISO 17025	ISO 17025
Number of vehicles/hour	10	3	1	1.000	3.000
Data automation/integration	Low	Low	Limited	High	High
Deployment	Indoor	Indoor	On board	Outdoor	Outdoor
Cost/vehicle	50 €	2.000 €	1.500 €	1 €	0,5 €

PEMS and RSD are complementary tools

To advance in in service conformity, PEMS and RSD are complementary tools



In service conformity – support through RSD

Wide-scale RSD Surveillance can provide massive emission data on samples (e.g. brands, engine families) to detect abnormalities or lack of emission improvements to assure targeted PEMS investigations

Example: diesel passenger car

Peer Group	Fuel	Type	GVW	Make	Disp Liters	Model Year	VSP kW/t	N	PM g/kg	CO g/kg	HC g/kg	NO2 g/kg
DP2009	D	P		D		2009	14.43	816	0.18	6.2	1.58	10.05
DP2010	D	P		D		2010	14.39	1,099	0.20	4.9	1.65	10.51
DP2011	D	P		D		2011	13.85	996	0.15	8.4	1.62	9.83
DP2012	D	P		D		2012	14.57	1,564	0.14	6.5	1.51	9.93
DP2013	D	P		D		2013	14.61	2,148	0.15	6.2	1.67	10.18
DP2014	D	P		D		2014	14.38	774	0.14	7.1	1.62	8.77

No clear NO2 reduction over time

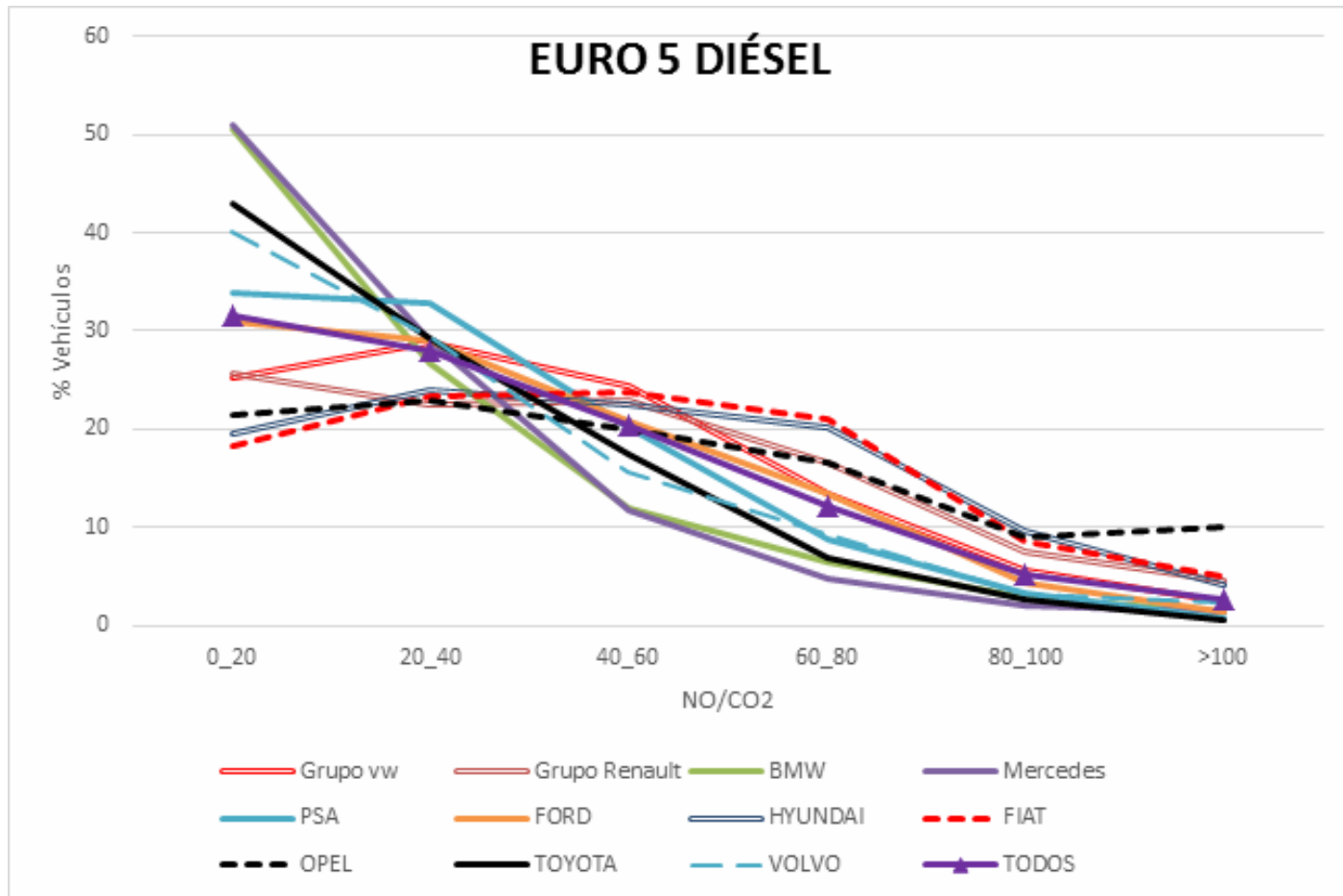
Exceeding peer group values

Example: gasoline passenger car

Peer Group	Fuel	Type	GVW	Make	Disp Liters	Model Year	VSP kW/t	N	PM g/kg	CO g/kg	HC g/kg	NO2 g/kg	% of Group	PM	CO	HC	NO
GP2008	G	P		C		2008	14.55	506	0.06	3.5	0.68	0.89	0.67%	92%	36%	73%	83%
GP2009	G	P		C		2009	14.57	588	0.06	11.7	0.63	1.35	0.98%	98%	129%	76%	140%
GP2010	G	P		C		2010	14.68	689	0.04	6.3	0.92	1.09	1.16%	66%	71%	110%	119%
GP2011	G	P		C		2011	14.23	267	0.05	6.2	1.69	1.15	0.44%	74%	67%	198%	129%
GP2012	G	P		C		2012	14.67	1,151	0.16	11.4	1.12	0.78	1.56%	255%	126%	140%	101%
GP2013	G	P		C		2013	14.29	1,928	0.16	9.9	1.14	0.87	2.26%	248%	104%	133%	99%
GP2014	G	P		C		2014	14.38	403	0.18	12.0	1.20	0.59	0.91%	320%	132%	131%	67%

Emissions along brand (M1)

Relevant differences between vehicle brands



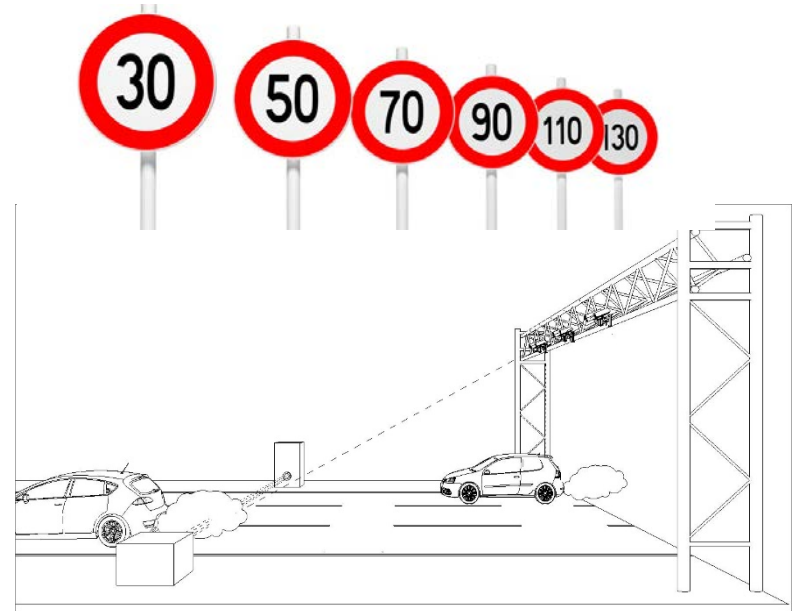
The real world emission database allows the implementation of efficient and sustainable mobility policies. Automobile clubs can assume an active role

Multiple applications (examples)

- Identification of high emitters (repair or substitution of vehicles)
- Traffic management (e.g. variable speed limits based on air quality or traffic density)
- Traffic emission inventory with real emission data (massive and continuously updated)
- Fraud detection (inspections or manufacturers)
- Incentives for clean vehicles or substitution of high emitters)
- In service conformity testing throughout the vehicle lifecycle

Results

Effective measures for reduction of emission and optimization of circulation



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