



INNOVHUB

STAZIONI SPERIMENTALI PER L'INDUSTRIA

Stazione Sperimentale per i Combustibili Division

Engine Laboratory

Simone Casadei, Davide Faedo, Francesco Avella

ERMES plenary meeting, Bruxelles, 27th-28th, September, 2012



Institutional aim:

super partes applied research and normative support for fuel Italian industries (oil/gas and coal)

Commercial activity: emission testing

- Biofuels and new formulation fuels - Anti-pollution dispositives and additives functionality: evaluation of regulated and unregulated emissions and consumption reduction
- Imported PC, LDV omologation (only Type 1), anti-pollution devices and dual - fuel power equipment

Main research instruments:

ELPI (FPS, Thermodenuder), Microsoot Sensor, Thermofisher FT-IR

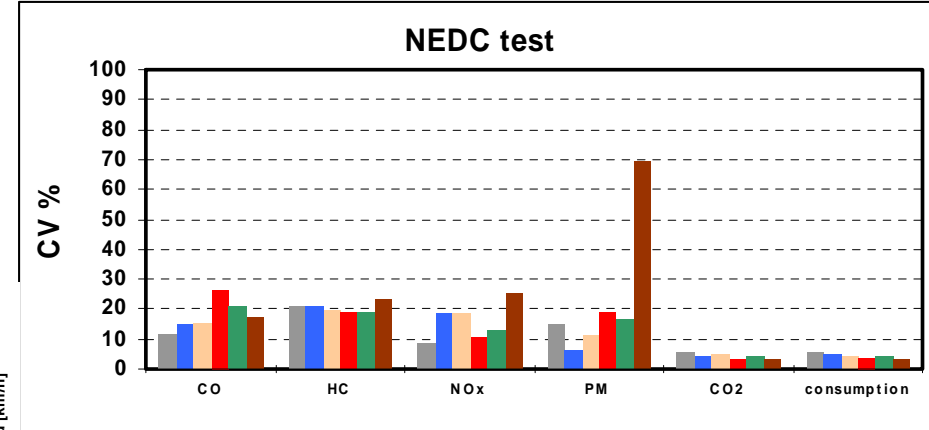
PMP compliant system for EURO 5/6 vehicles (Dekati Deed + TSI CPC)

Next: EEPS, SEM & LAICP-MS analysis (?)

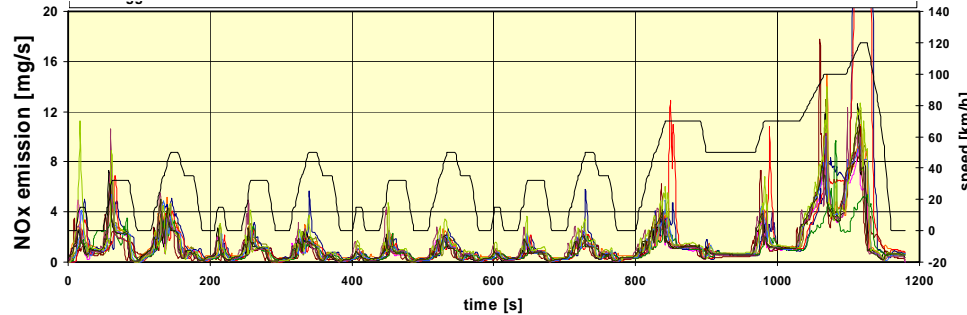


LEA: CUNA activities - Italian proficiency test

correlation 2011		Diesel passenger car: JEEP CHEROKEE 2.8 CRD DPF							
		CO	HC	CH ₄	NOx	PM	PN	CO ₂	cons
		mg/km					#*10 ⁹ /km	g/km	l/100 km
NEDC	Laboratories	18	18	8	18	18	6	18	18
	Valid data	17	18	7	17	15	4	16	16
	Outliers	1	0	1	1	3	2	2	2
	Average	322	40.5	13.1	155	0.82	10.8	206	7.8
	Std. Dev.	55.5	9.43	1.82	39.7	0.607	9.9	6.1	0.23
	CV [%]	17.3	23.3	13.9	25.6	74.4	91.7	3.0	2.9
	Repeatability r	102	20.6	1.1	15	0.4	13.9	5.0	0.2
Reproducibility R	178	31.1	257	110	2.1	11.4	19.9	0.7	



Source: CUNA



CUNA proficiency test:

since '90s management and elaboration of the Italian proficiency test data:

- one gasoline and/or diesel test vehicle every year (more or less!) and one motorcycle proficiency test in 2008
- all main Italian emission laboratories (nearly 20!)



PUMI Project (Fine particulate in the Milan urban area atmosphere) [2002]

Physical and chemical characterization of the Particulate exhaust emission from:

- 4 Diesel cars (Euro 1, 2 Euro 2, Euro 3)
- 2 Gasoline cars (Euro 1, Euro 4)

PARFIL Project (Fine atmospheric particulate in Lombardy Region) [2008]

Particulate, particle distribution, NH_3 and N_2O exhaust emissions from

- 2 Diesel cars (Euro 3, Euro 4 DPF)
- 2 Gasoline cars (Euro 3, Euro 4)

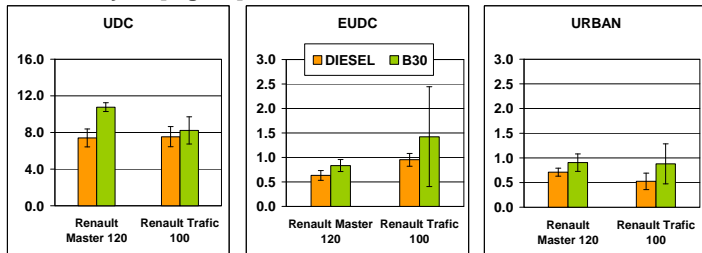


LEA research topics: Fuel Effects on exhaust emissions

Effects of 30% v/v biodiesel/diesel fuel blend on regulated and unregulated pollutant emissions from diesel engines

A. Macor, F. Avella, D. Faedo. *Applied Energy* 88 (2011) 4989–5001

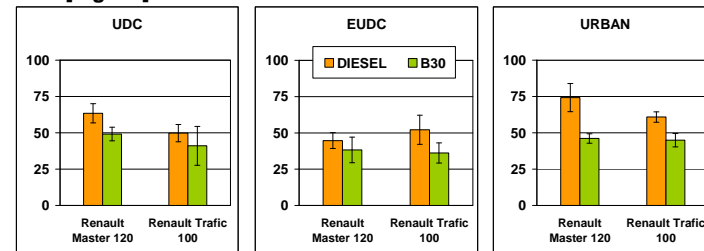
formaldehide [mg/km]



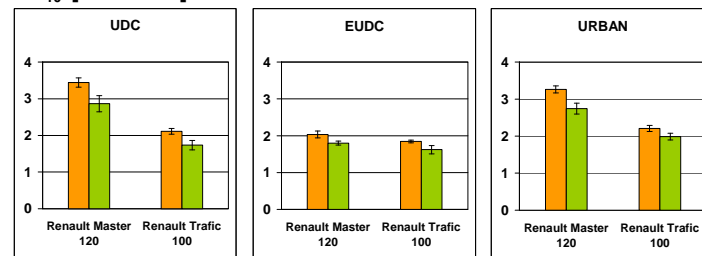
Effects of Ethanol/Gasoline Blends on Passenger Cars Performance and Unregulated Exhaust Emissions

S. Casadej, D. Faedo, F. Avella.
Proceedings of the 20th European Biomass Conference and Exhibition (2012)

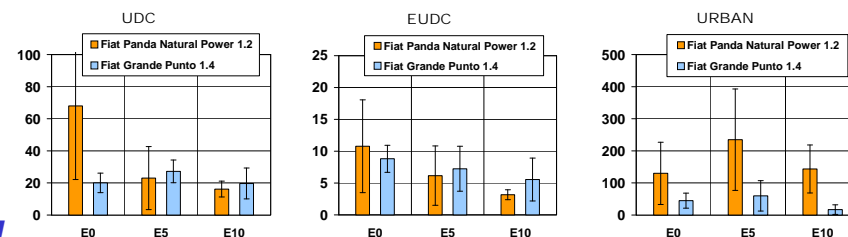
PM [mg/km]



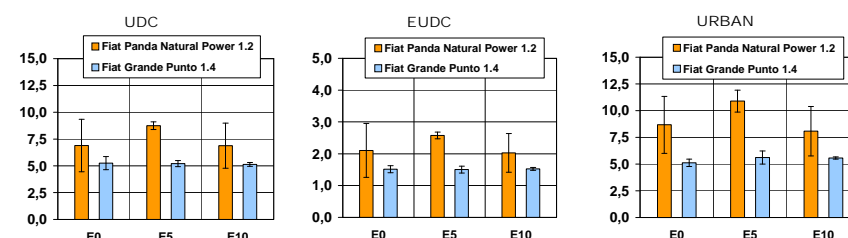
PM₁₀ [N*10¹⁴/km]



PM soot [μg/km]



PN [N*10¹²/km]

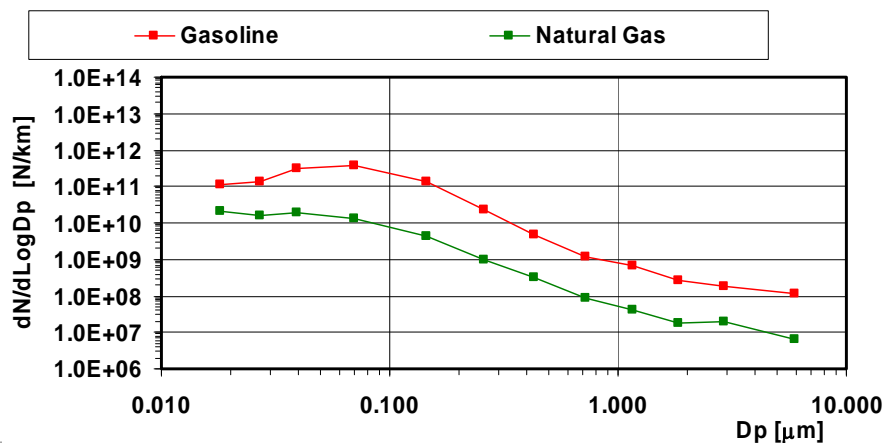
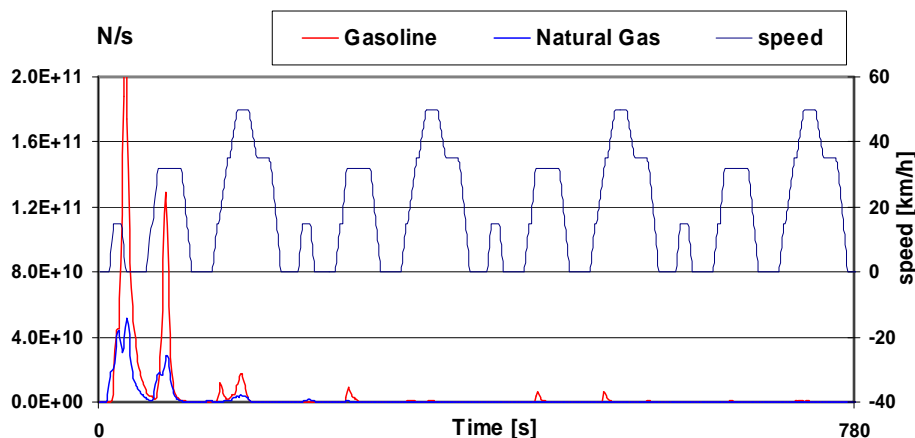


LEA work in progress research (1)

NGV project: NG vehicles particulate emissions

7 Bi-fuel vehicles (NG/ gasoline) to evaluate the differences in PN & PM emissions (total and soot fraction) and particle distribution

Modello autovettura	Fiat Marea	Fiat Doblò	Fiat Panda	VW Touran	Fiat Doblò	Fiat Multipla	Fiat Grande Punto
codice	A	B	C	D	E	F	G
Omologazione	Euro 2	Euro 3	Euro 4	Euro 4	Euro 4	Euro 4	Euro 5
anno/mese test	feb-05	ott-07	lug-10	ago-10	apr-11	apr-12	ott-11
km	97000	30500	10600	15350	15400	54058	18900
Cilindrata (cc)	1581	1596	1242	1984	1596	1596	1368
Potenza max (kW@rpm) benzina	76 @ 5750	76 @ 5750	44 @ 5000	80 @ 5400	76 @ 5750	76 @ 5750	57 @ 6000
Potenza max (kW@rpm) GN	68 @ 5750	68 @ 5750	38 @ 5000	-	68 @ 5750	68 @ 5750	51 @ 6000
Coppia max (Nm@rpm) benzina	145 @ 4000	145 @ 4000	102 @ 2500	160 @ 3500	145 @ 4000	145 @ 4000	115 @ 3000
Coppia max (Nm@rpm) GN	130 @ 4000	130 @ 4000	88 @ 3000	-	130 @ 4000	130 @ 4000	104 @ 3000
TWC S/N	S	S	S	S	S	S	S



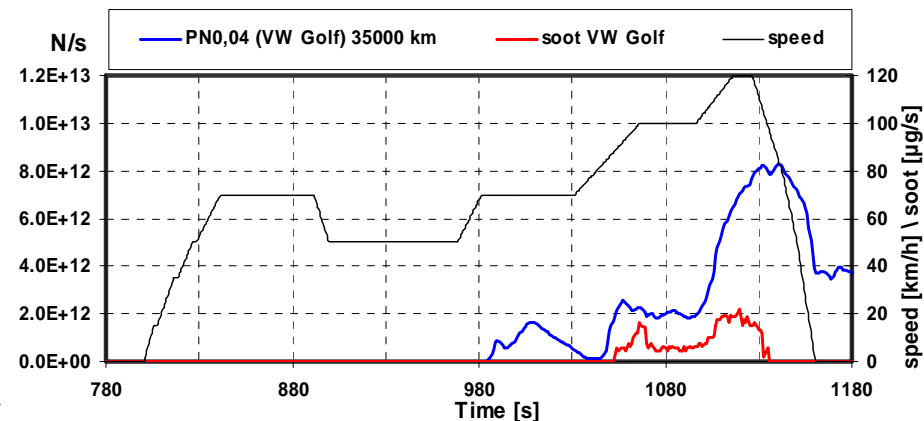
LEA work in progress research (2)

B10 project: Evaluation of the mid-long term behaviour of 2 EURO 4 DPF PC fed with 10% V/V biodiesel/diesel blend

Every 5000 km emission test: NEDC + ARTEMIS URBAN cycle. Trends by now:

- **CO, HC**: slight tendency towards an increase in all driving conditions
- **NOx**: no appreciable variation in all driving conditions
- **ALDEHYDES**: trend towards a slight increase in the emission
- **PARTICULATE**: no appreciable change
- **PARTICLE NUMBER**: slight tendency towards an increase
- **PARTICLE DISTRIBUTION**: unimodal with a peak emission at 140 nm for AR 159 and around 70 nm for VW Golf
- **FUEL CONSUMPTION**: tendency towards a decrease

Detection of DPF regeneration frequencies and emissions





LEA work in progress research (3)

BIAGIO project: Unconventional biodiesel/diesel blends: impact on mobile and fixed sources

Aim: evaluate **new emission factors of regulated and mainly unregulated species (PAH, aldehydes, nanoparticles, others?)** fuelling passenger cars with **biofuels blendings obtained by second generation biofuels** as UCO or PFAD (sustainable «double counting» biofuels to reduce the impact of GHG transport emissions and diversify energy sources)

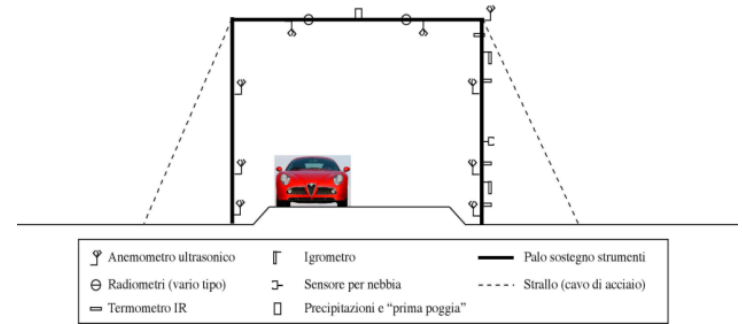
2 EURO 5 diesel passenger cars will be fuelled by:

- B7 – reference blend: 7% V/V RME/diesel blend;
 - B10 – UCO: 10% V/V UCO/diesel blend;
 - B30 – UCO: 30% V/V UCO/diesel blend;
- B10 - PFAD: 10% V/V PFAD/diesel blend;
- B30 - PFAD: 10% V/V PFAD/diesel blend.

LEA work in progress research (4)

SMELLER project: A real time single vehicle emissions monitoring system

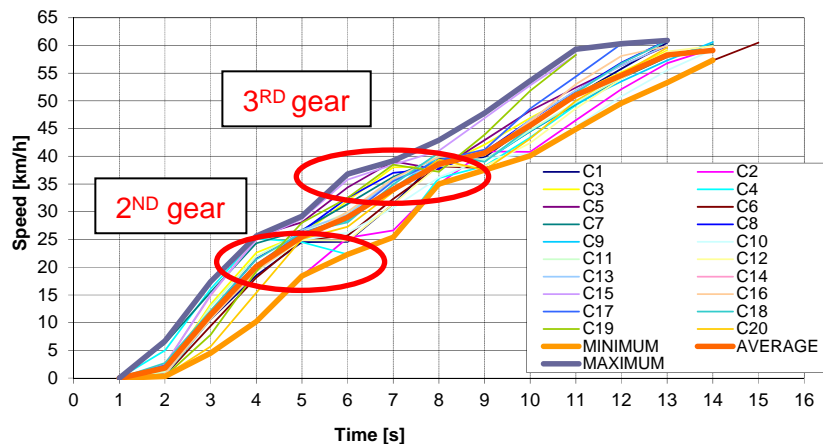
Università degli Studi di Milano - Bicocca (UNIMIB), Stazione Sperimentale per i Combustibili (SSC), Joint Research Centre ISPRA (JRC)



Aim: detect **high emitters** vehicles by **remote sensing**

Laboratory task: **validation** of the remote sensors capacity to detect pollutants emission peaks in a context of urban driving

SMELLER acceleration curves



SMELLER cycle

