

Emissions Benefits of Gasoline Additives and Oxygenates

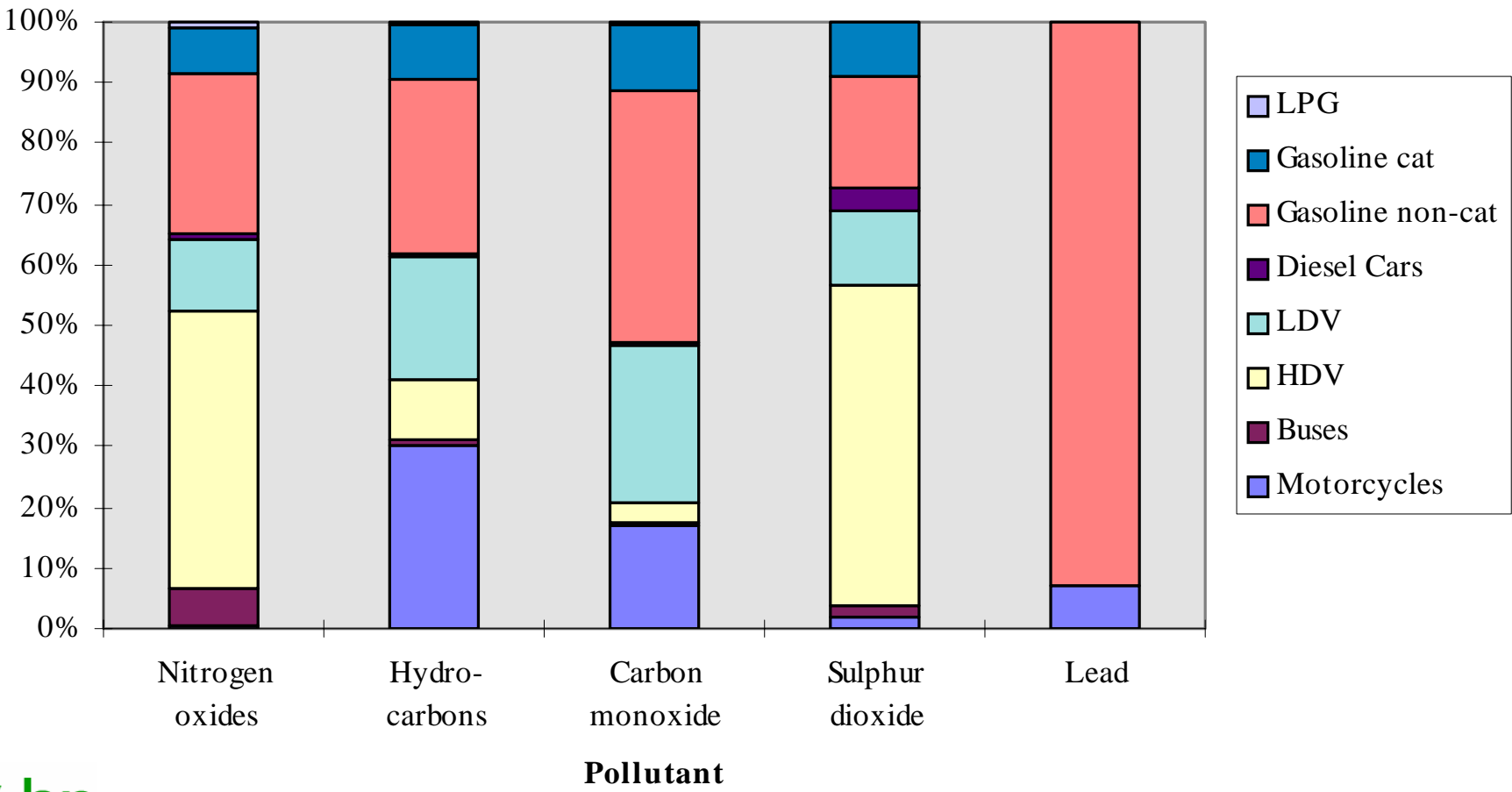
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bp

Contribution (%) of various Motor Vehicle Categories to total Road Transport Emissions (Greece)

Exhaust Emissions from Road Transport



BP Emissions Model

Fuel type:		Base Case/Year 2000	BP City Gasoline	%Change in Emission
Fuel properties	Units	Data	Data	
RVP	mbar	564	589	Carbondioxide = -2%
E70	% vol.	21	30	Hydrocarbon = -6%
E100	% vol.	47	54	Carbonmonoxide = -4%
E150	% vol.	85	91	Oxides of Nitrogen = -3%
Aromatics	% vol.	38	26	
Olefins	% vol.	15	6	Formaldehyde = -11%
Sulphur	mg/kg	150	17	Acetaldehyde = -11%
Oxygen	% mass	0	0	1,3-Butadiene = -16%
Benzene	% mass	1	1	Benzene = -26%
MTBE	% vol.	0	0	Total Toxics = -28%
ETBE	% vol.	0	0	
Ethanol	% vol.	0	0	Chosen market = GB



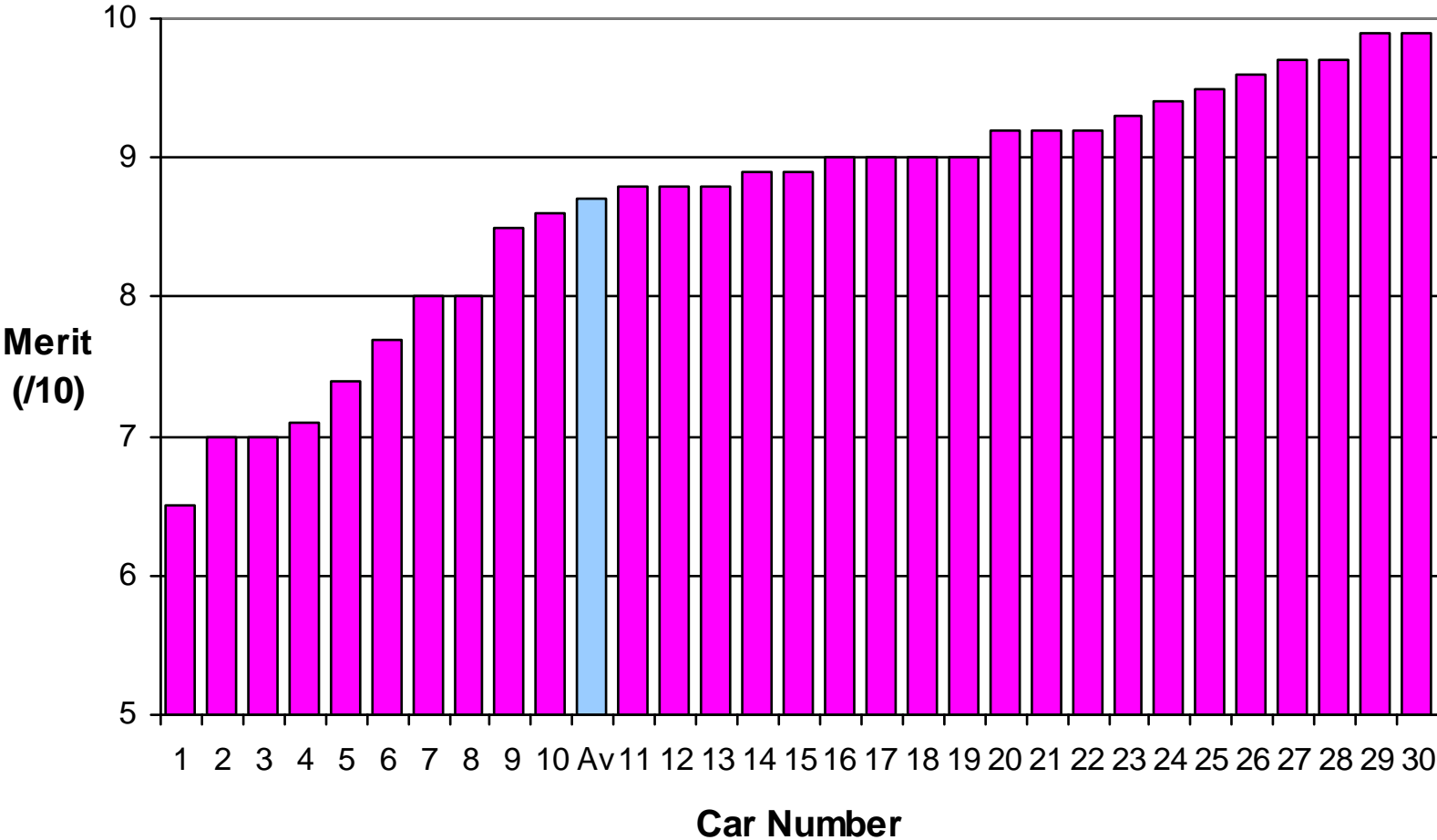
Exhaust Emission Benefits from Non-Catalyst Vehicles using Improved Gasoline

Pollutant	RVP kPa	E70 %vol	E100 %vol	E150 %vol	Aromatics %vol	Olefins %vol	MTBE	Sulphur ppm	Lead g/l	Overall %
Fuel Property Change Leaded Super 96 vs Improved Fuel	62 60	30 40	49 58	82 90	29 30	22 14	0 7	300 150	0.15 0.00 3	
Lead									-98	-98%
Sulphur Dioxide SO ₂								-50		-50%
Nitrogen Oxides NOx	-	-	0	+2.4	+0.4	-9.6	0			-6.8%
Carbon Monoxide CO	-	-	0	-2.4	+0.6	0	-9.1			-10.9%
Total Hydrocarbons THC	-4 (eva p)		-6.0	-8.0	-	+9.6 (exh) -1.6 (evap)	-2.8			-6.8%*

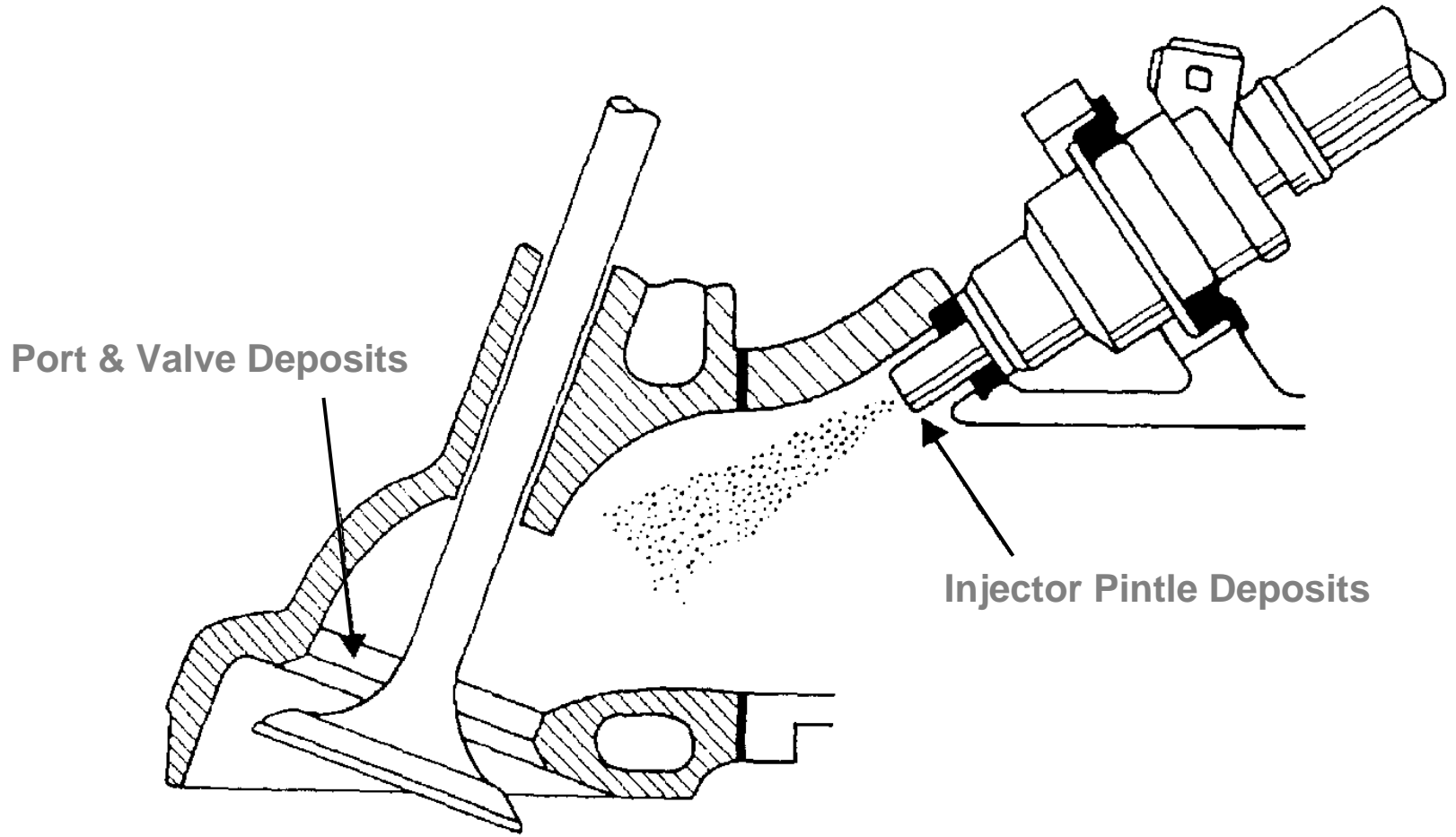
*based on the total leaded gasoline fleet and the relationship between evaporative and exhaust emissions for non catalyst vehicles.



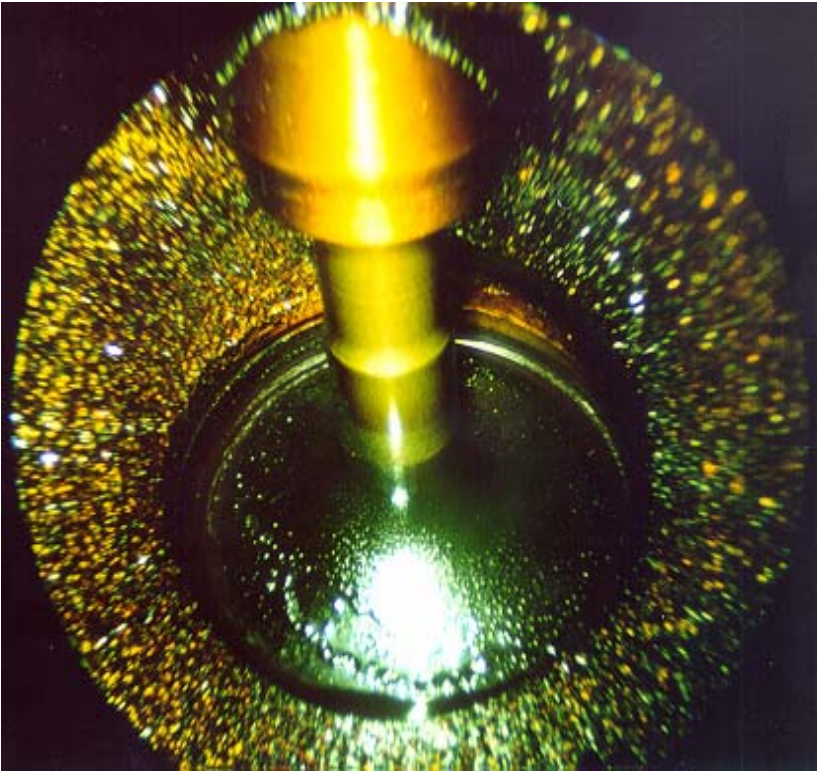
Vehicle fleet inlet valve cleanliness merit ratings



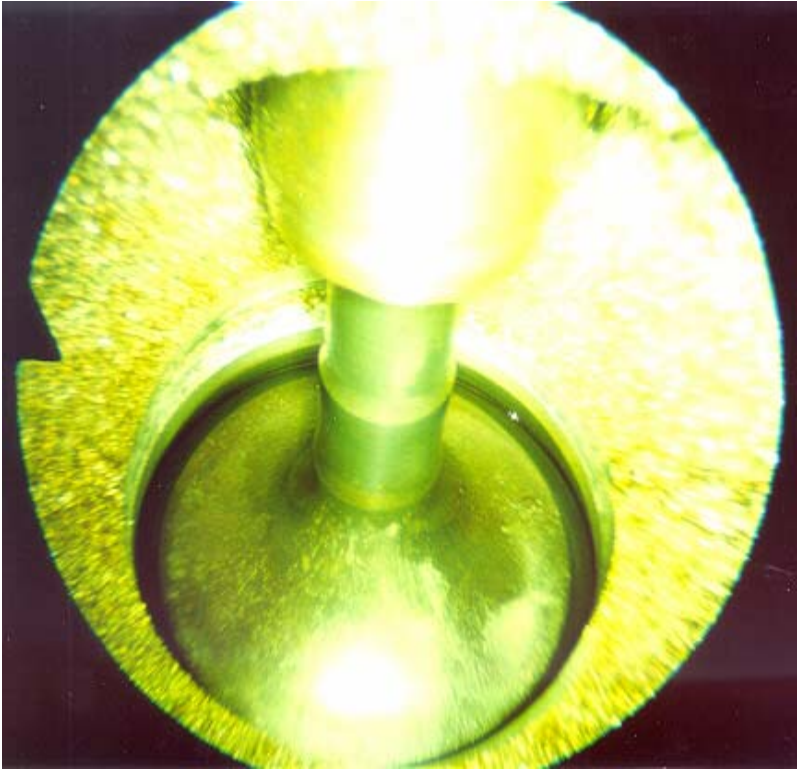
Inlet System Deposits



Valve Cleanliness



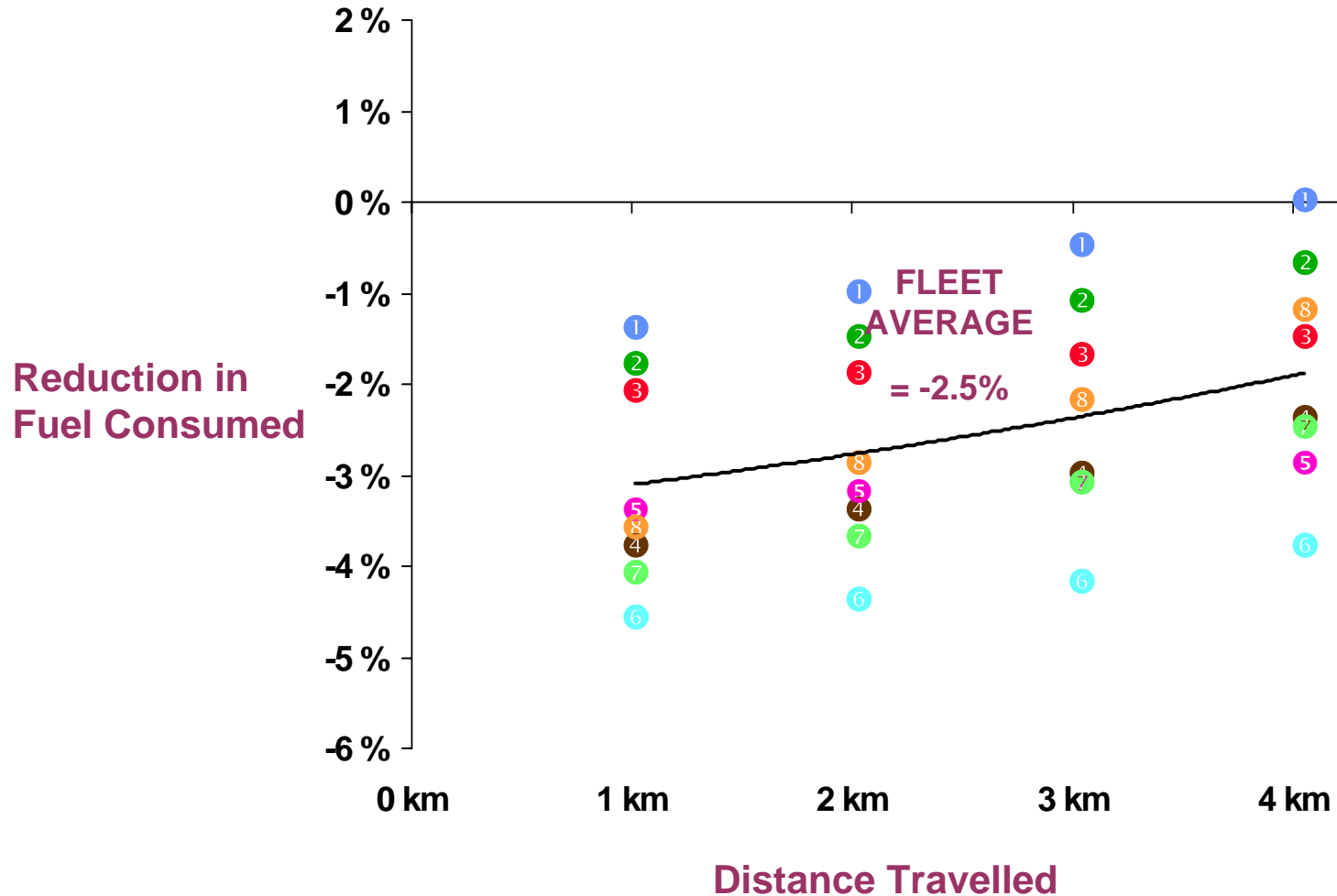
Dirty



Clean

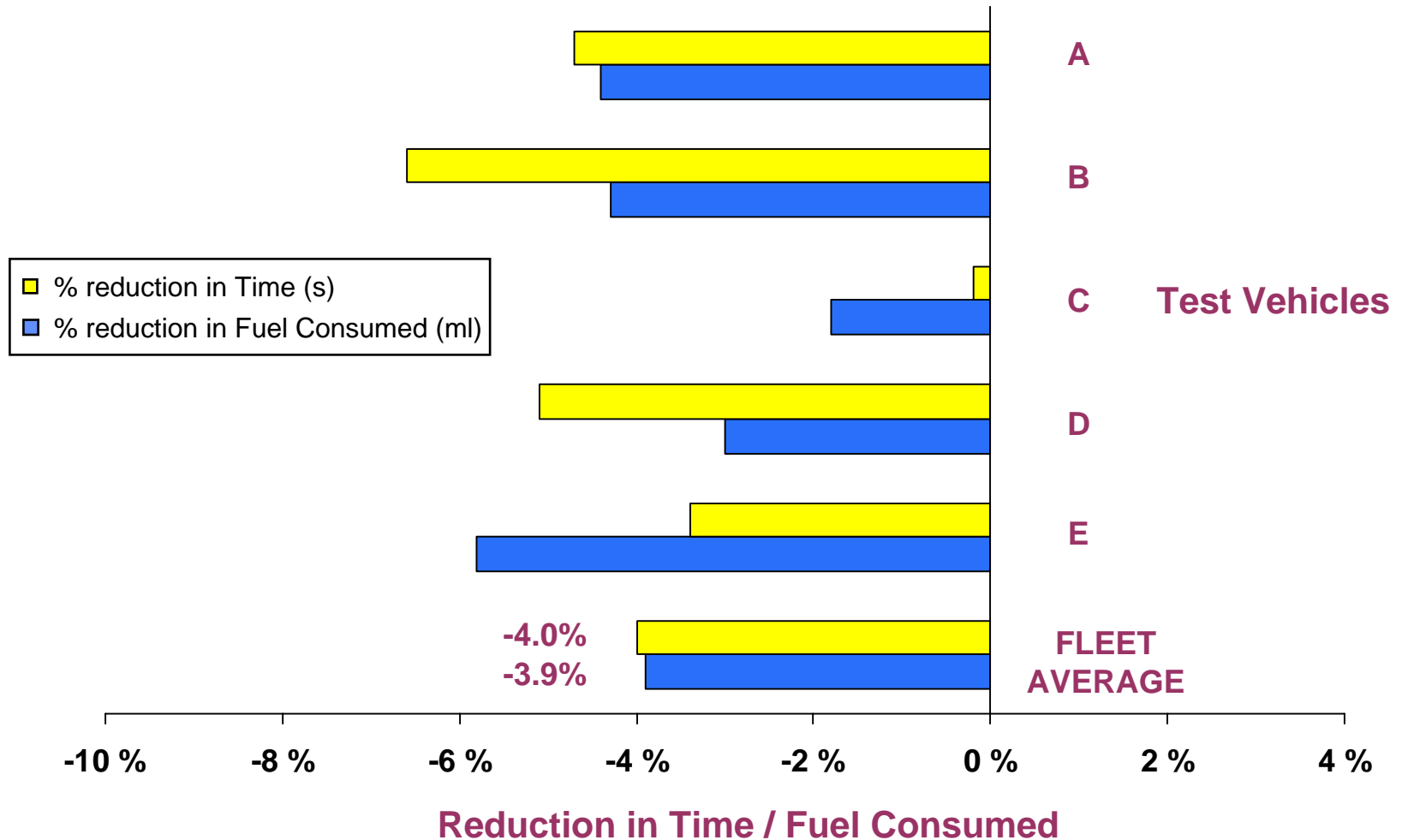
Detergent additives – fuel economy benefit

Improved Fuel Economy - Cold Start ECE 15.04 Cycle



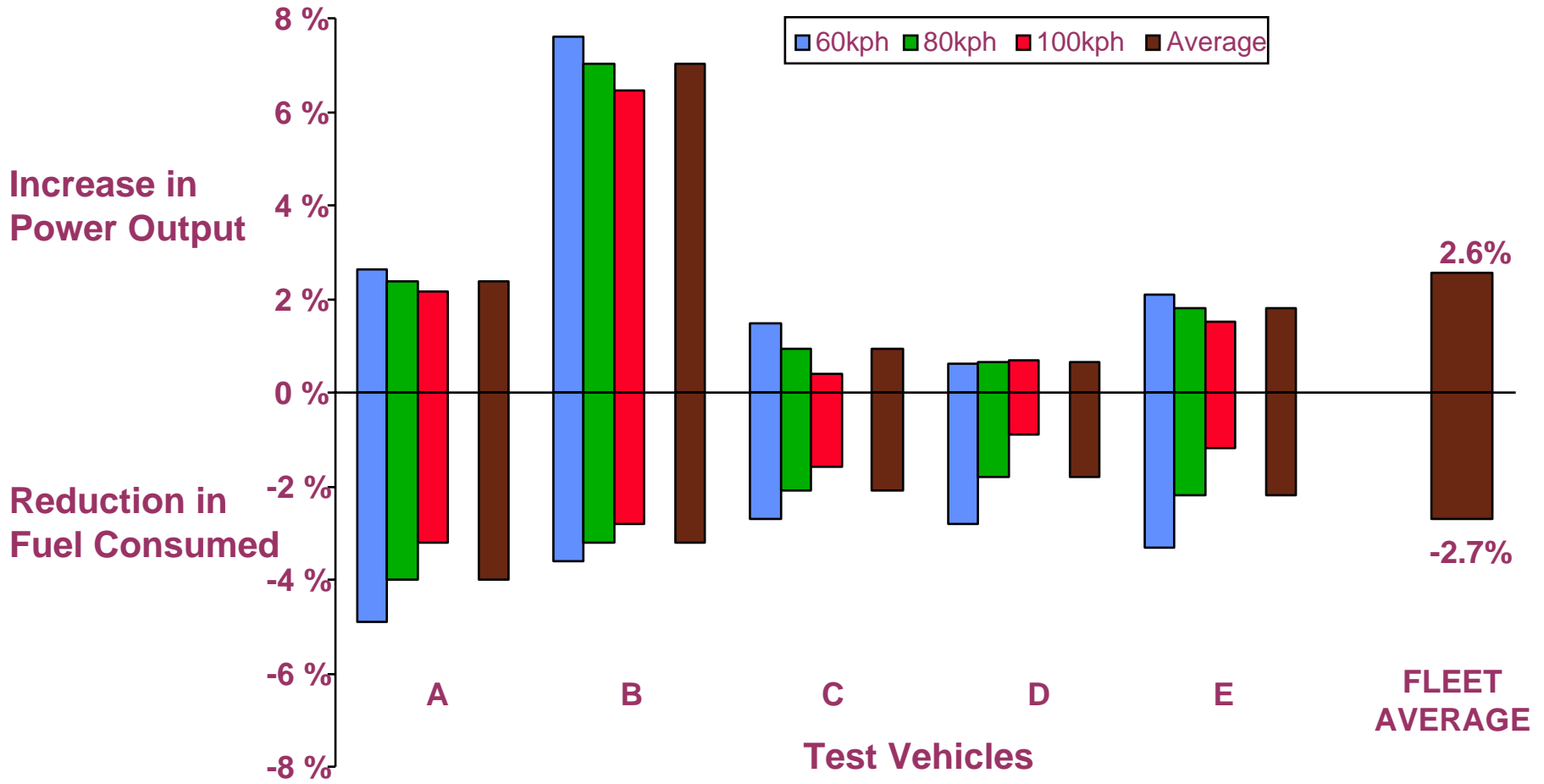
Detergent additives – performance benefits

Improved Acceleration and Fuel Economy (50 - 110kph)



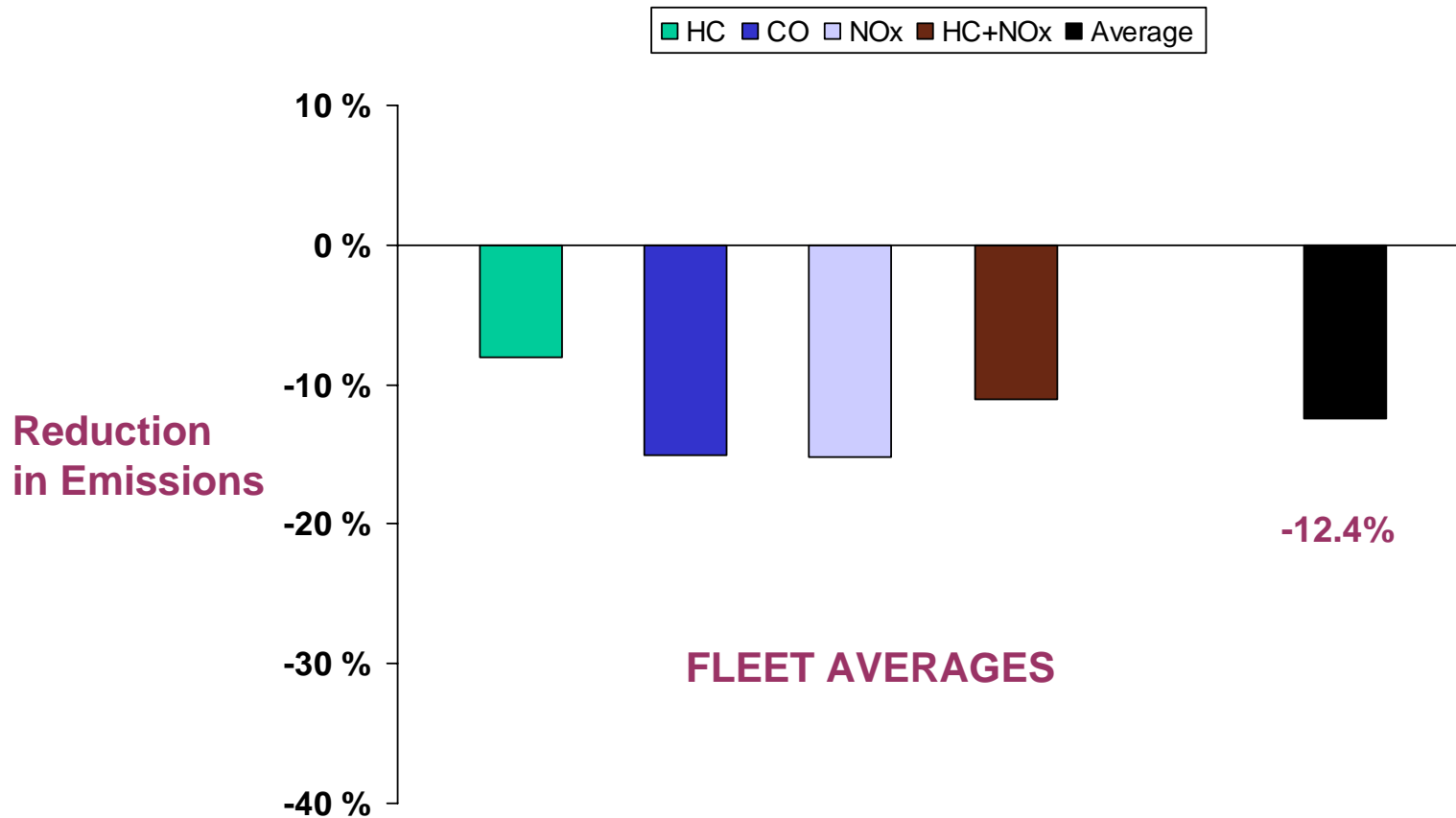
Detergent additives – combined benefits

Improved Power Output and Fuel Economy (in 5th Gear)



Detergent additives – emissions benefits

Reduced Regulated Emissions - ECE 15.04 + EUDC Cycle



Detergent additives – summary

A full-treat detergent additive package will typically;

- clean-up and keep-clean engine inlet systems
- provide up to 6% better fuel economy and hence reduced CO₂ emissions
- enable faster engine response, resulting in up to 7% better acceleration
- give up to 8% more power
- reduce exhaust emissions by up to 15%

all as a result of keeping engines close to their original condition



Oxygenates – emissions benefits

- Addition of oxygen to fuel weakens mixture in older cars, which reduces CO emissions (and HCs to a lesser extent)
- Modern vehicles with closed-loop engine management systems ($\lambda=1$) compensate and neutralise benefits
- Less energy per litre of fuel, but low % blends give imperceptibly worse fuel economy
- Alcohols increase toxic emissions, especially aldehydes/formaldehydes
- RVP restraint required to avoid increases in evaporative emissions
- Ethers help to maintain octane when aromatics caps applied to reduce regulated emissions
- Biofuels land- and energy-intensive to manufacture, but can be CO₂ benefits well-to-wheel
- Risk of infrastructure problems with materials compatibility and phase separation with water

