EVALUATION OF THE EMISSIONS POTENTIAL OF SOME CANDIDATE COMMERCIAL FUELS FOR 2005 AND 2008 IN BRAZIL

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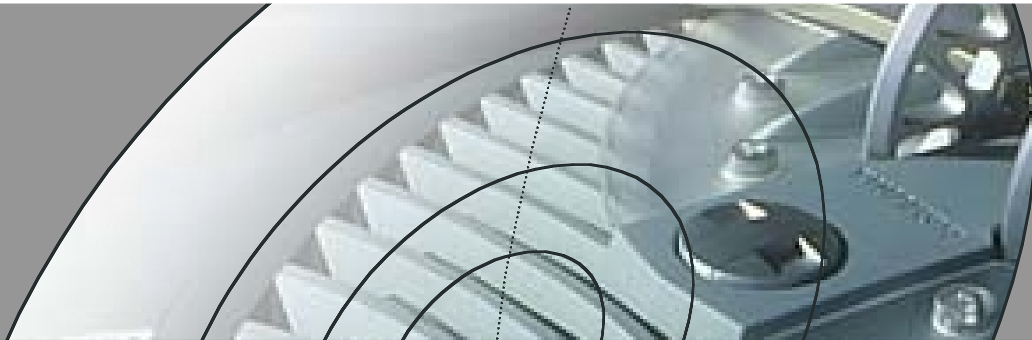
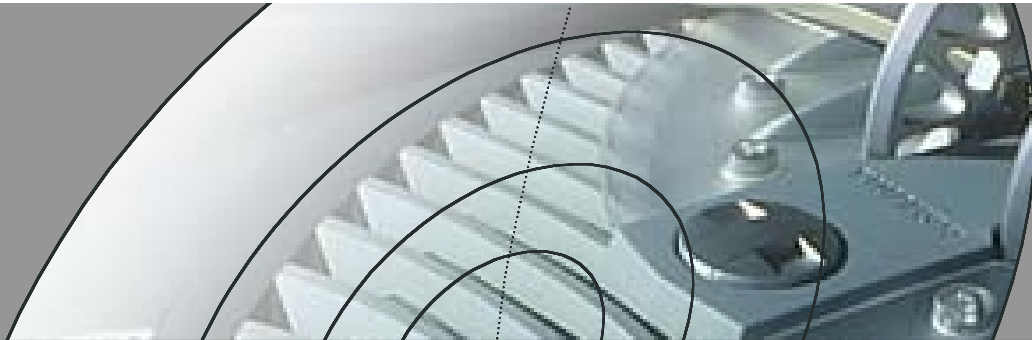


Objective

• To evaluate the emissions potential of some fuels, that are being considered as candidate fuels (8 gasolines and 8 diesel-fuels) in the framework of future Brazilian emissions regulation (two steps : 2005 ? and 2008 ?)



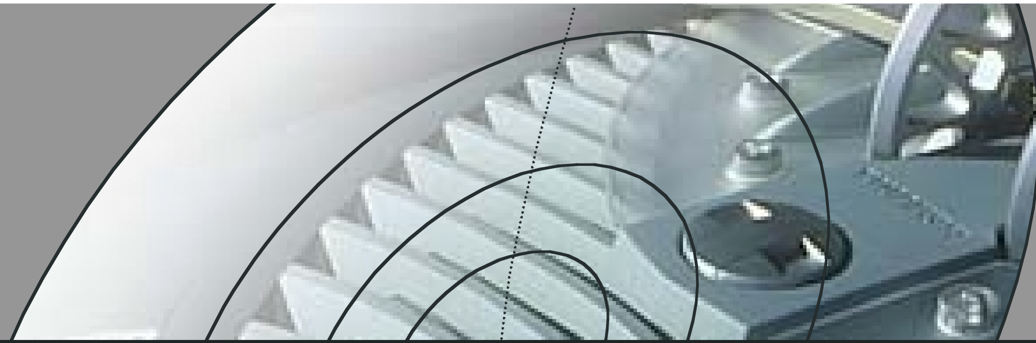
Methodology

- To use emissions models developed during the European Auto/Oil I (gasoline powered PC, diesel light vehicles and diesel heavy-duty vehicles)

- To evaluate the emissions potential of each one of the fuels, comparing them to a base-fuel (today’s commercial gasoline and diesel-fuel)

- To compare the performance of different PROCONVE candidate fuels and to identify the best and the worst ones

- Two advanced fuels, one gasoline (California Phase 2) and one diesel-fuel (Swedish Class 1) were included for comparison purposes



Auto/Oil I equations for predicting emissions from gasoline passenger cars

HC (g/km) =

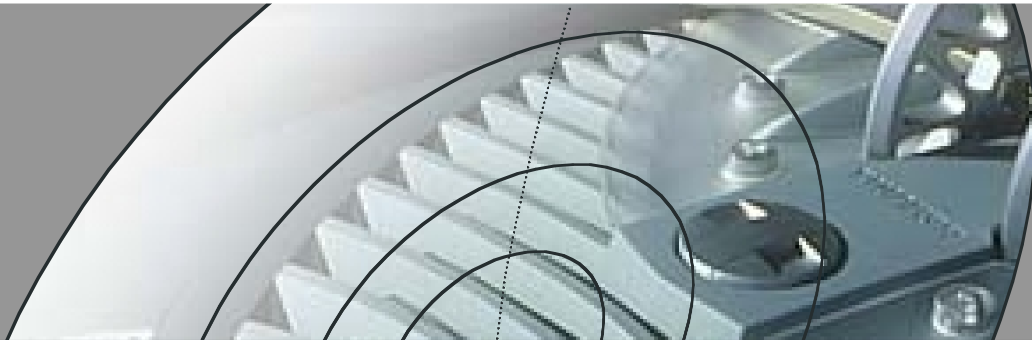
$$= [0.3147 + 0.0005489 * ARO + 25.7 * ARO*e^{-0.2648*E100} - 0.0000406 *(97 - SULPHUR)] *[1 - 0.004 * (OLEF - 4.970] * [1 - 0.022 * (OXYG - 1.75)] * [1 - 0.01 * (E150 - 90.2)]$$

CO (g/km) =

$$= [2.459 - 0.05513 * E100 + 0.0005343 * E100^{2} + 0.009226 * ARO - 0.0003101 * (97 - SULPHUR)] * [1 - 0.037 * (OXYG - 1.75)] * (1 - 0.008 * (E150 - 90.2)]$$

NOx (g/km) =

$$= [0.1884 - 0.001438 * ARO + 0.00001959 * E100 * ARO - 0.00005302 * (97- SULPHUR)] *[1 + 0.004 * (OLEF - 4.97)] * [1+ 0.001 * (OXYG - 1.75)] * [1 + 0.008 * (E150 - 90.2)]$$



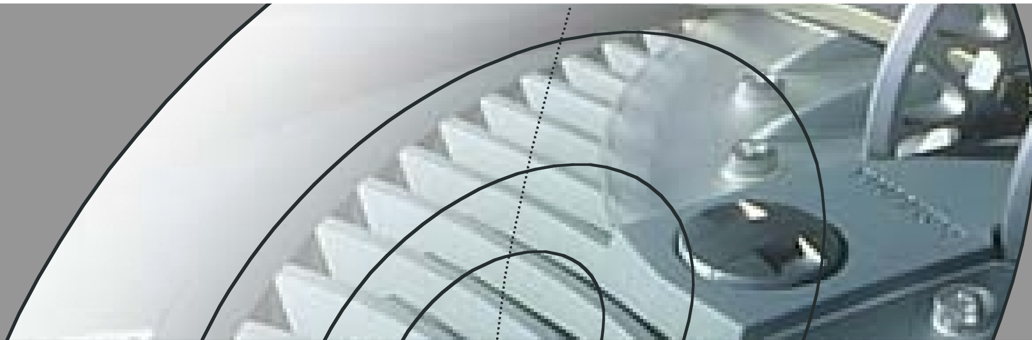
Auto/Oil I equations for predicting emissions from light diesel vehicles

HC (g/km) =
= - 0.293192 + DENSITY * 0.0006759 - 0.0007306 * POLYARO - 0.0032733 * CN - 0.0000380893 *T95

CO (g/km) =
= - 1.3250726 + DENSITY * 0.003037 - 0.0025643 * POLYARO - 0.015856 * CN + 0.000170647 * T95

NOx (g/km) =
= 1.0039726 - 0.0003113 * DENSITY + 0.0027263 * POLYARO - 0.0005805 * T95 - 0.0000883933 *CN

PM (g/km) =
= (- 0.38797873 + 0.0004677 *DENSITY +0.0004488 * POLYARO + 0.0004098 * CN + 0.0000788 *T95) * [1 - 0.015 * (450 - SULPHUR) / 100]



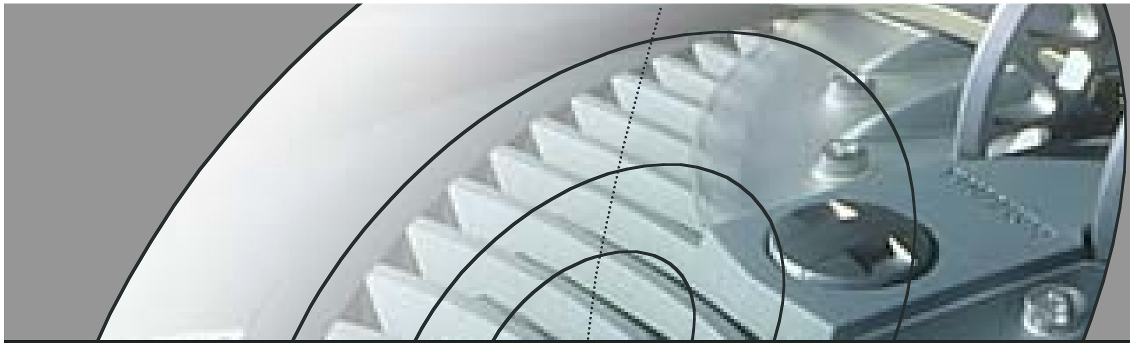
Auto/Oil I equations for predicting emissions from heavy-duty engines

HC (g/kW.h) =
= 1.61466 - 0.00123 * DENSITY + 0.00133 * POLYARO - 0.00181 * CN - 0.00068 * T95

CO (g/kW.h) =
= 2.24407 - 0.0011 * DENSITY + 0.00007 * POLYARO - 0.00768 * CN - 0.00087 * T95

NOx (g/kW.h) =
= - 1.75444 + 0.00906 * DENSITY + 0.0163 * POLYARO - 0.00493 * CN + 0.00266 * T95

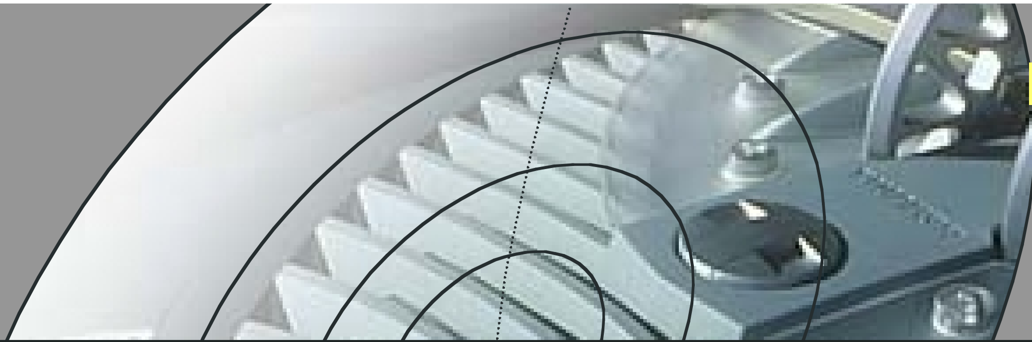
PM (g/kW.h) =
= (0.06959 + 0.00006 * DENSITY + 0.00065 * POLYARO - 0.00001 * CN) * [1 - 0.0086 * (450 - SULPHUR) / 100]

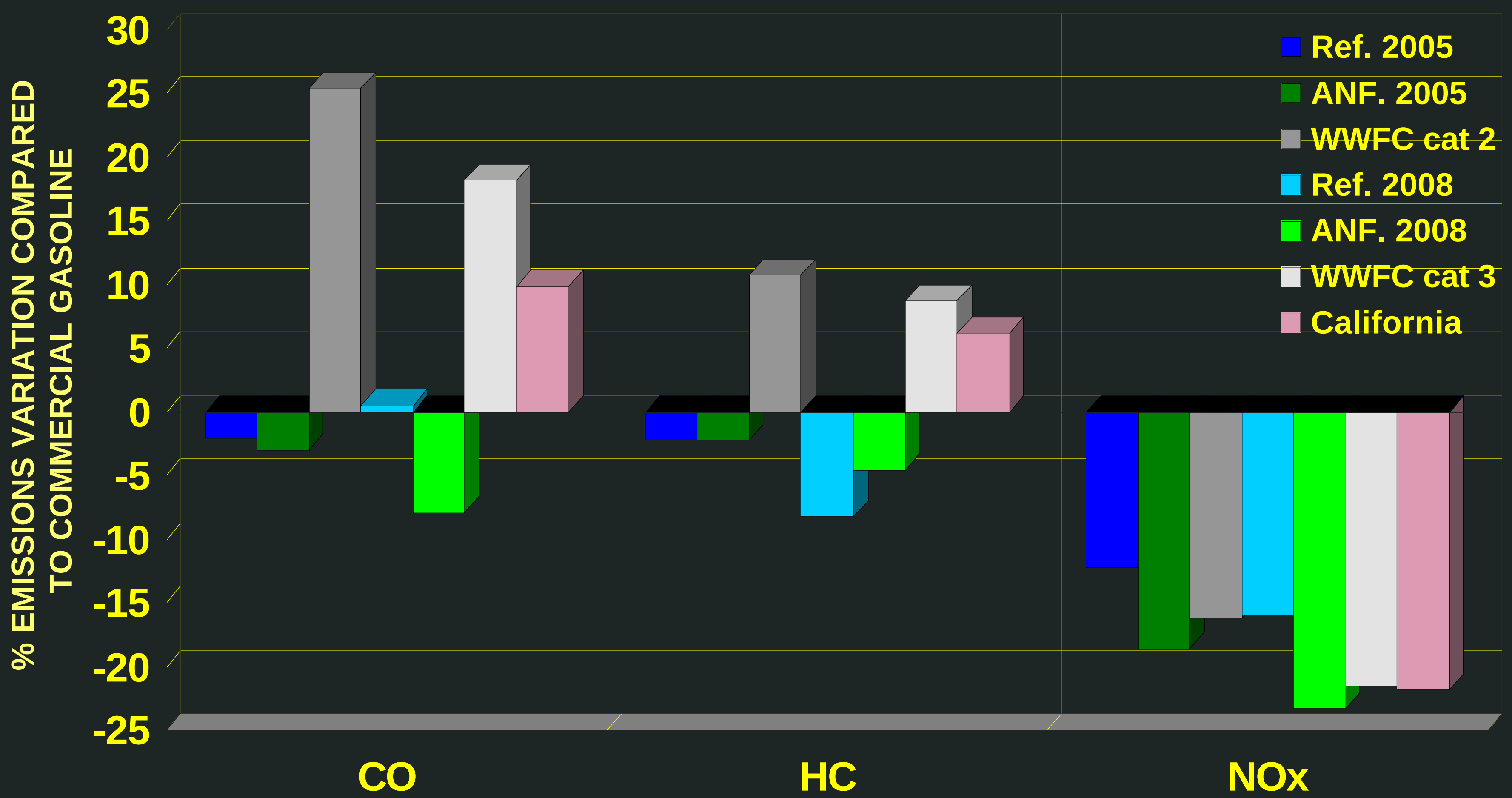


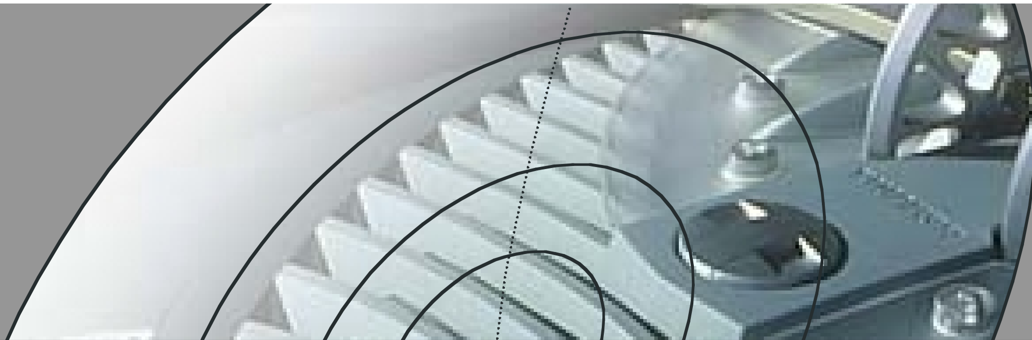
Gasoline characteristics

	Unit	Base fuel	Refiners 2005	ANF. 2005	WWFC Cat. 2	Refiners 2008	ANF. 2008	WWFC Cat. 3	Calif. Ph. 2
Oxygen	% m/m	9.1	9.1	9.1	2.2	9.1	9.1	2.2	1.6
Aromatics	% v/v	19.4	19.4	24	32	32	21	28	19
Olefins	% v/v	14.2	14.2	12	16	24	6	8	4.3
Sulfur	mg/kg	634	320	160	160	64	24	24	0
E100	% v/v	67	67	65	58	67	65	58	55
E150	% v/v	89	83	81	87	83	81	87	88

Influence of fuel properties on vehicle emissions from gasoline passenger cars



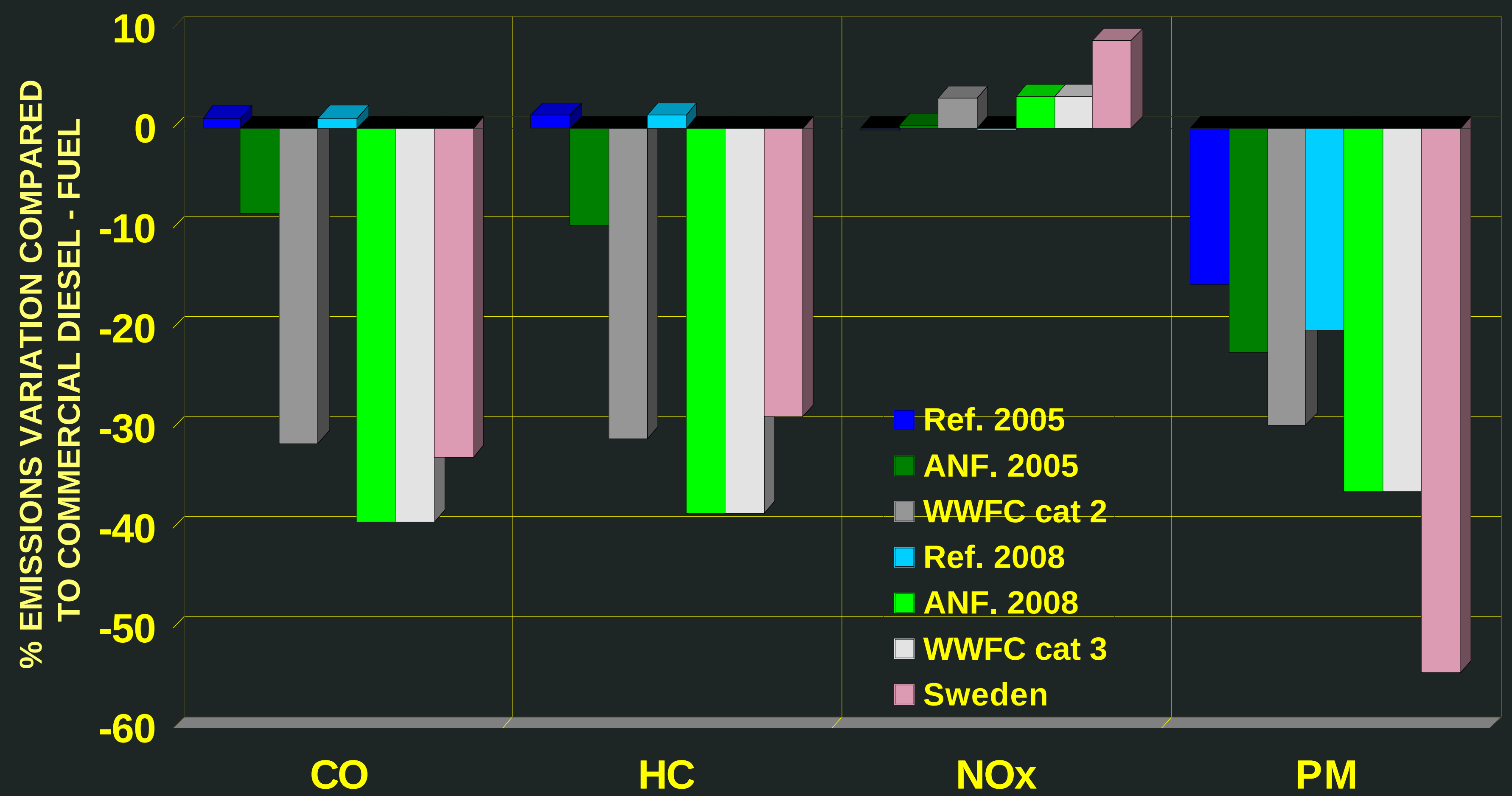


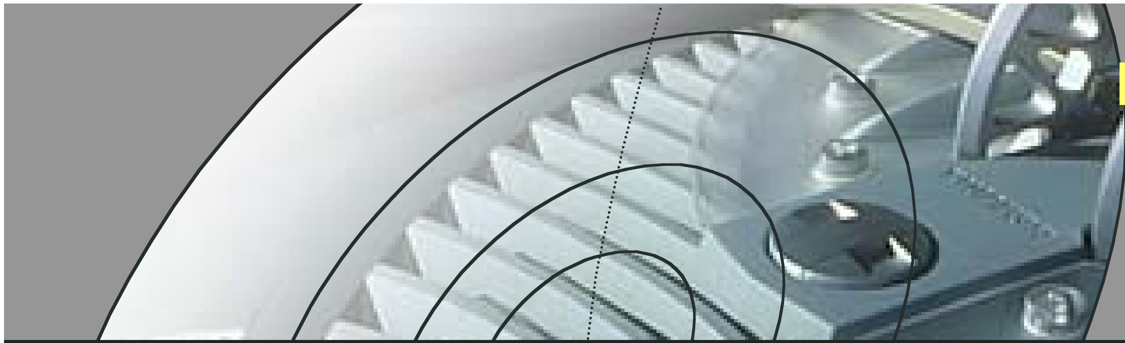


Diesel-fuel characteristics

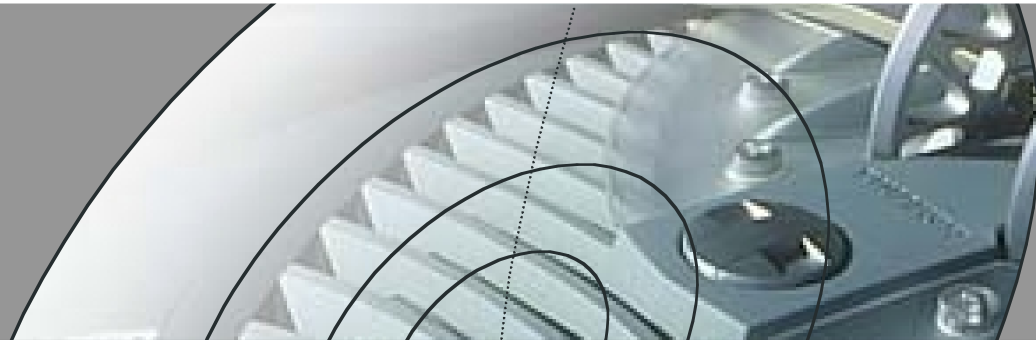
	Unit	Base fuel	Refiners 2005	ANF. 2005	WWFC Cat. 2	Refiners 2008	ANF. 2008	WWFC Cat. 3	Sweden Class 1
Density	kg/m3	850	852	840	835	852	830	830	814
CN	---	48	48	49	56	48	58	58	52.4
Sulfur	mg/kg	1742	400	400	240	40	24	24	2.6
Polyaromatics	% m/m	7.5	7.5	7.5	4	7.5	1.6	1.6	0.3
T95	deg. C	379	379	380	340	379	330	330	282

Influence of fuel properties on vehicle emissions from light diesel vehicles



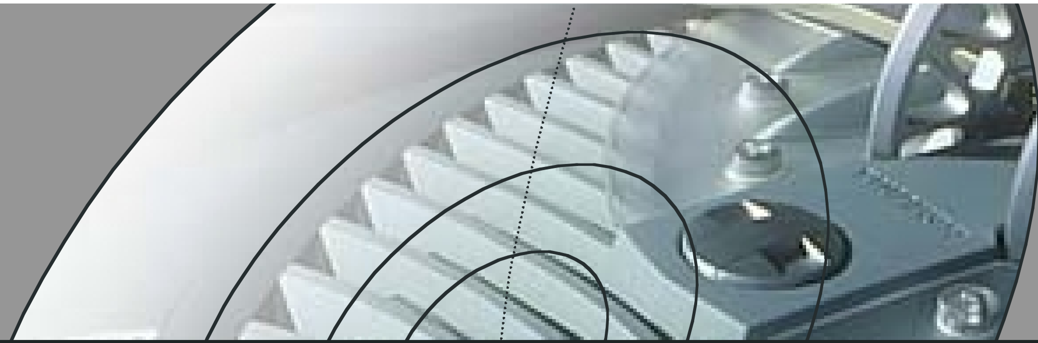


Influence of fuel properties on vehicle emissions from heavy-duty diesel engines



Conclusions on gasoline

- Best gasoline was ANFAVEA 2008
- Worst gasoline was WWFC category 2
- The presence of Oxygen in the fuel reduced emissions of all pollutants
- All seven fuels presented a reduction of NOx
- Reduction of Sulfur in the fuel reduces the emissions of all pollutants
- All fuels presented the same tendency for both, HC and CO emissions, except Refiners 2008



Conclusions on diesel-fuel for light vehicles

- Best Diesel-fuels were ANFAVEA 2008 and WWFC cat. 3 (but not in NOx)

- Worst Diesel-fuels were Refiners 2005 and 2008 (reduction only in PM)

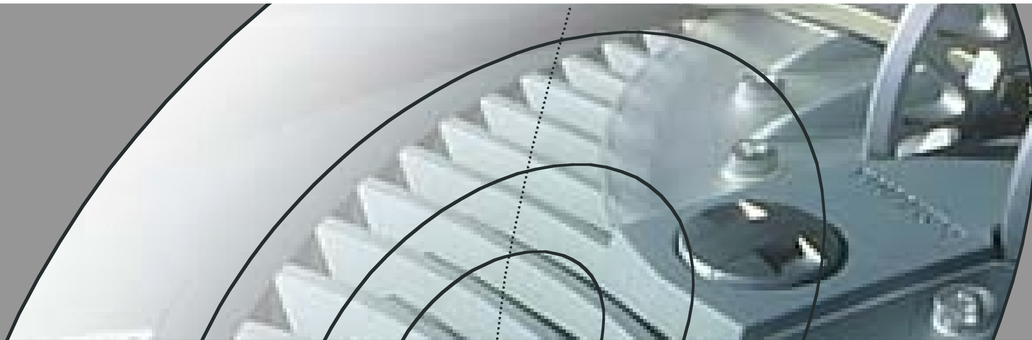
- Almost all the fuels presented an increase in NOx emissions, except Refiners 2005 and 2008

- Increases in density and T95 reduced NOx emissions

- Lowering Density reduced CO and HC emissions

- All fuels presented the same tendency for both, HC and CO emissions

- All fuels presented significant reductions in PM (influence of Sulfur)



Conclusions on diesel-fuel for heavy-duty vehicles

- Best Diesel-fuels were ANFAVEA 2008 and WWFC cat. 3 (but not in HC)
- Worst Diesel-fuel was Refiners 2005 (no effects on HC, CO and NOx and smallest reduction of PM)
- Almost all the fuels presented reductions of NOx emissions, except Refiners 2005 and 2008
- Only significant effect of Refiners 2005 and 2008 was PM reduction (same characteristics of base-fuel, except Sulfur)
- All the fuels presented significant reductions in PM (influence of Sulfur)
- Effect of all fuels on NOx and PM showed very similar tendencies, but opposed to HC