

LISBOA 2010
MAY 25/28
16th World Meeting

Exhaust Emission Legislation Consequences for the Profession

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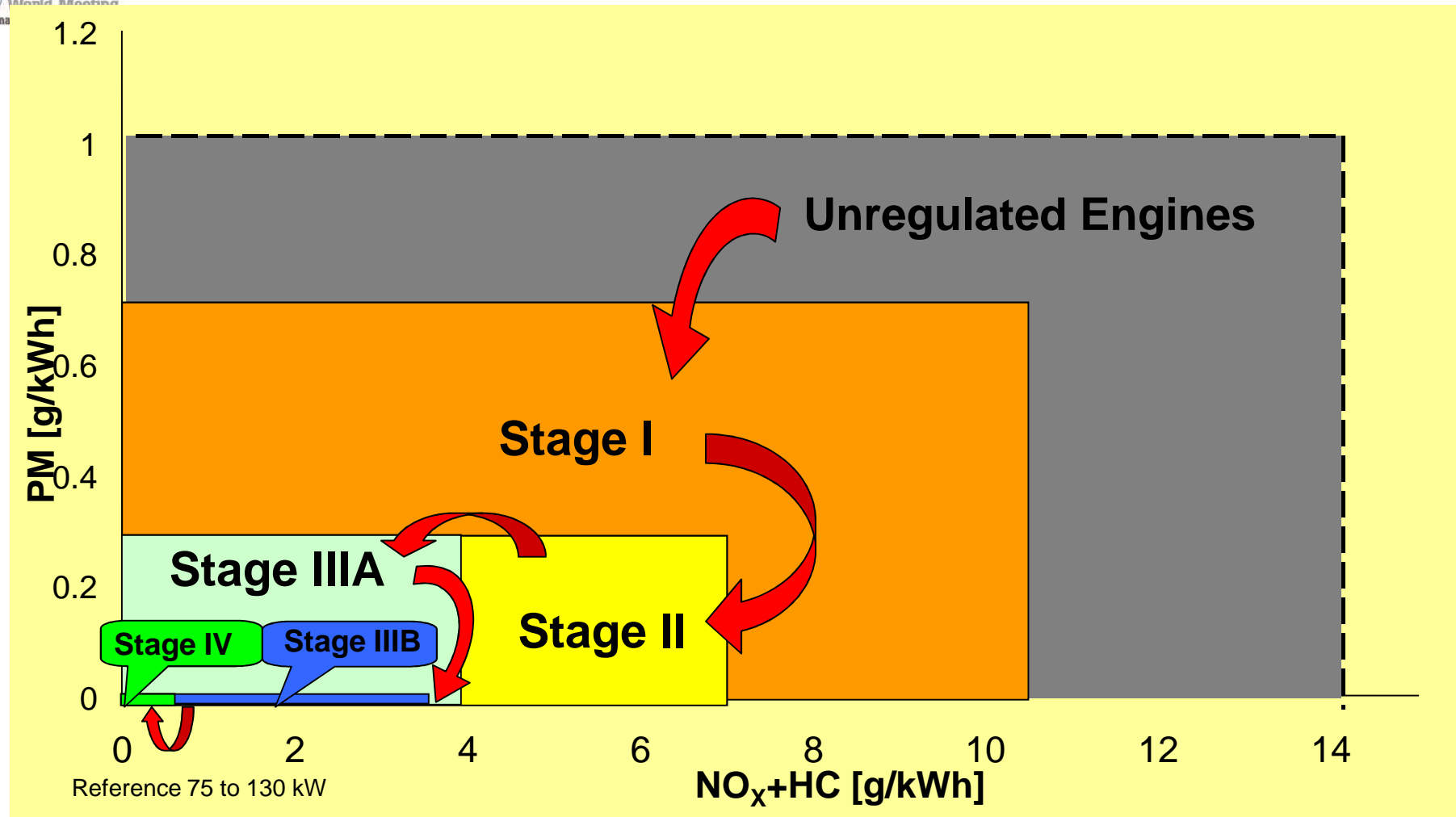


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One Directive For All Engines

- Exhaust emission legislation is reality since the 70's for road vehicles
- EU legislation on non-road mobile machinery engines: Directive 97/68/EC
- Non-road mobile machinery: all machines with an engine which are not road vehicles
- The same engine may be installed in totally different kinds of NRMM

Emissions Reduction





A Global Market

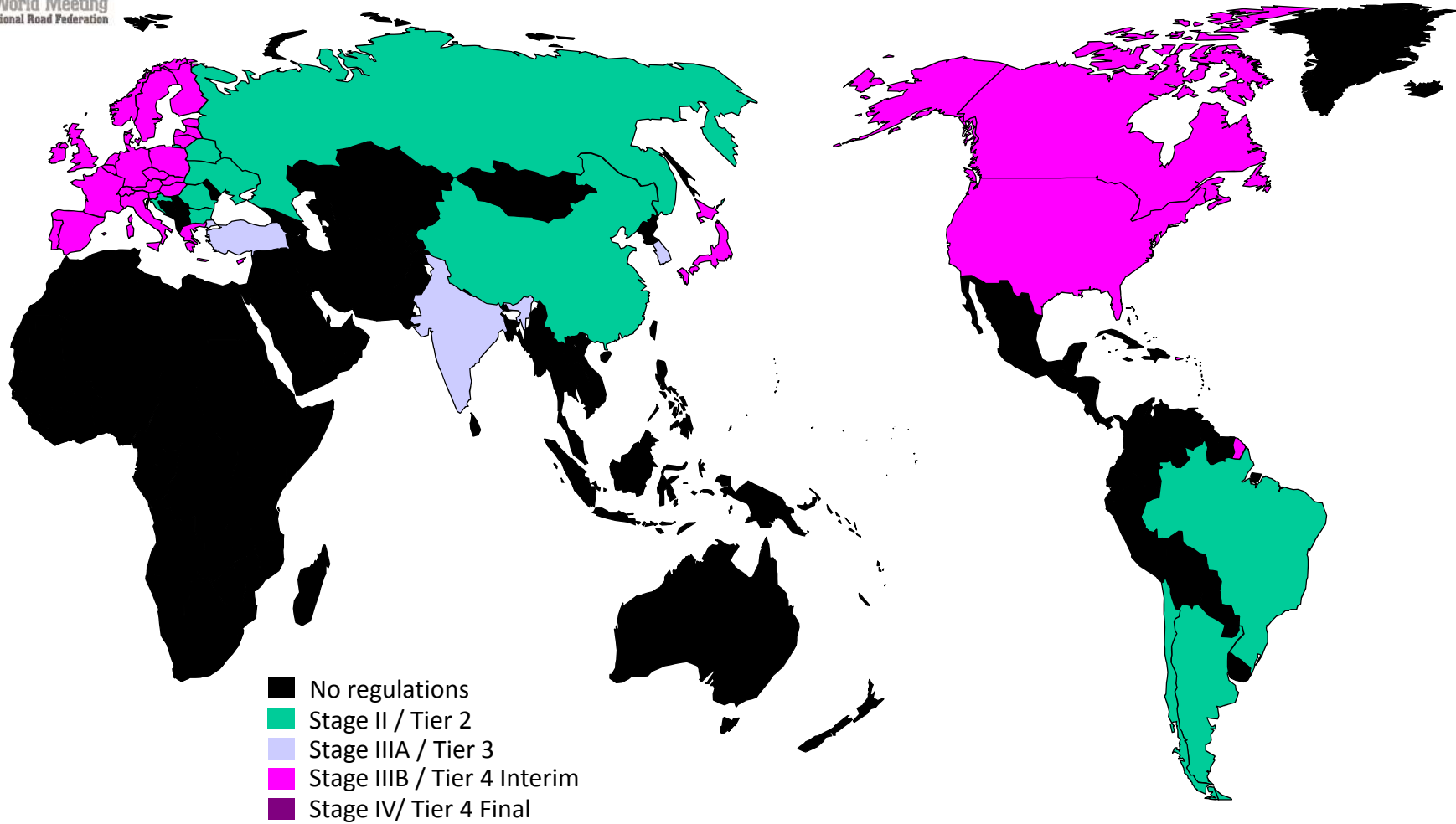
- The world NRMM market is too small to justify different models for each region.
- A globally harmonised legislation is necessary to produce one product for the world market
- Exhaust legislation harmonisation is a reality in the leading countries
- More nations join the club



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Worldwide Overview 2011

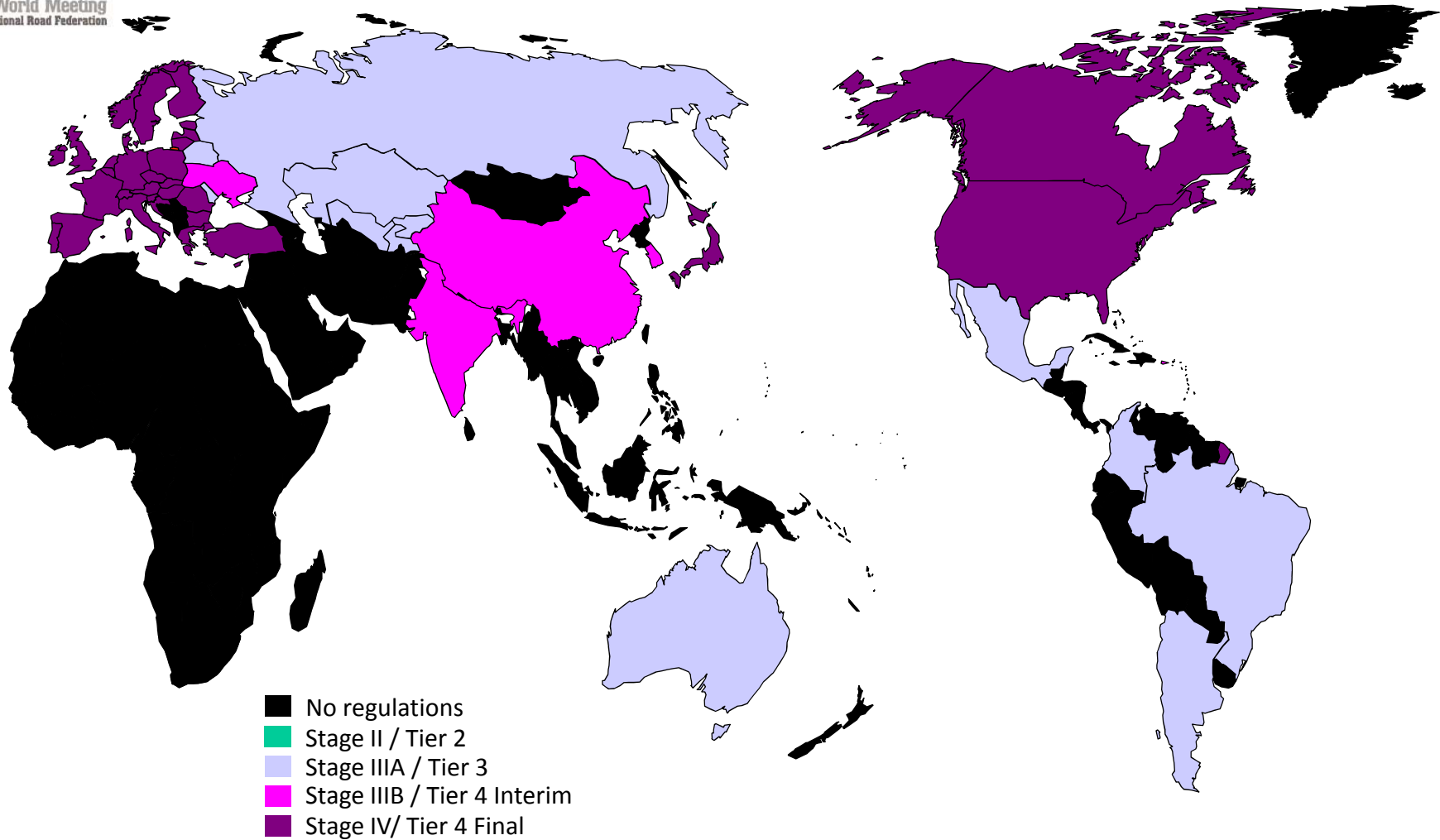




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Worldwide Overview 2016



EU USA Alignment

Comparison of 97/68/EC and 2004/26/EC vs EPA TIER IV

Limits: HC ¹+NOx/PT or HC/NOx/PT [g/kWh] versus years ²

Power [kW]	2002	03	04	05	06	07	08	09	10	11	12	13	14	15	
130 ÷ 560	1.0/6.0/0.2			4.0/0.2			0.19/2.0/0.025			0.19/0.4/0.025			EU		
	6.4/0.2			4.0/0.2			0.19/2.0/0.02			0.19/0.4/0.02			US 1		
	6.4/0.2 (2003 130÷225 NOx 6.6)			4.0/0.2			4.0/0.02			0.19/0.4/0.02			US 2		
75 ÷ 130	1.0/6.0/0.3			4.0/0.3			0.19/3.3/0.025			0.19/0.4/0.02 ₅			EU		
	6.6/0.3			4.0/0.3			0.19/3.4/0.02			0.19/0.4/0.02			US 1		
	6.6/0.3			4.0/0.3			4.0/0.02			0.19/0.4/0.02			US 2		
56 ÷ 75	1.3/7.0/0.4			4.7/0.4			0.19/3.3/0.025			0.19/0.4/0.02 ₅			EU		
	7.5/0.4			4.7/0.4			0.19/3.4/0.02			0.19/0.4/0.02			US 1		
	7.5/0.4			4.7/0.4			4.7/0.02			0.19/0.4/0.02			US 2		
37 ÷ 56	1.3/7.0/0.4			4.7/0.4			4.7/0.025			EU					
	7.5/0.4			4.7/0.3 ³			4.7/0.03			US					
19 ÷ 37	(18÷37) 1.5/8.0/0.8			7.5/0.6			EU								
	9.5/0.8		7.5/0.6		7.5/0.3		4.7/0.03		US						
8 ÷ 19	9.5/0.8		7.5/0.8		7.5/0.4			US							
< 8	10.5/1.0		7.5/0.8		7.5/0.4			US							
	7.5/0.8 ⁴		7.5/0.6 ⁴			US									
Years	02	03	04	05	06	07	08	09	10	11	12	13	14	15	

Stage I Tier I
Stage II Tier II
Stage IIIA Tier III
Stage IIIB Interim Tier IV
Stage IV Tier IV

US 1 1039.102d(2)
 US 2 Phase in/ Phase out

Remarks: ¹ Total HC in EU, NMHC in US ² Placing on the market for EU and MY for EPA ³ manufacturer's choice
⁴ Optional limits applicable only to air cooled hand startable DI engines GMB 2009.09.01
 The Federal Register classifies as Interim Tier IV all MY after Tier III up to 2014 even though the limits are the same.
 It is chosen, when Interim Tier IV is not characterised by specific limits, to show the passage just by a red line between 2014 and 2015.



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Which Stage My Engine Meets?

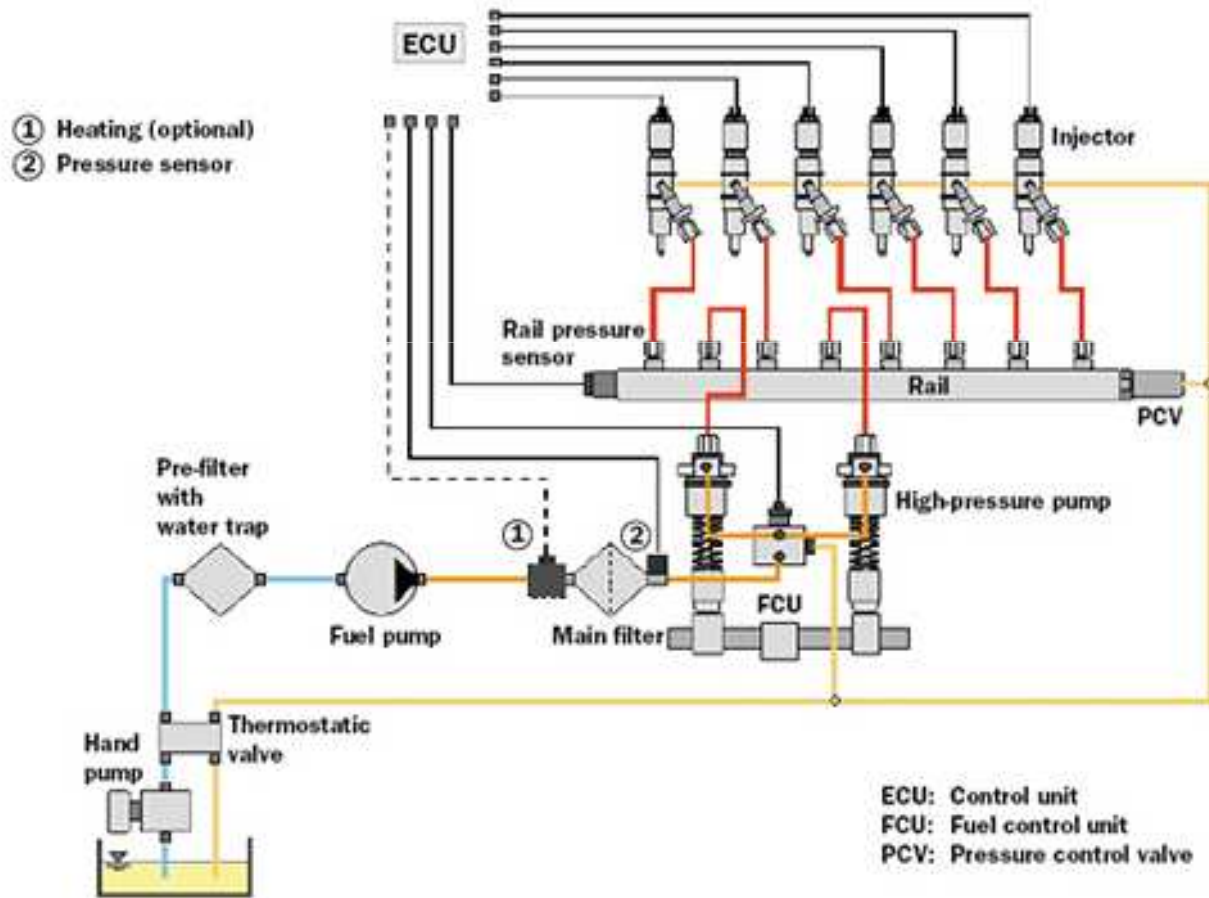
- e11*97/68JA*2004/26*0003*00

Power kW	Stage I	Stage II	Stage IIIA	Stage IIIB	Stage IV
19 - 37		D	K		
37 - 56	C	G	J	P	R
56 - 75				N	
75 - 130	B	F	I	M	
130 - 560	A	E	H	L	Q

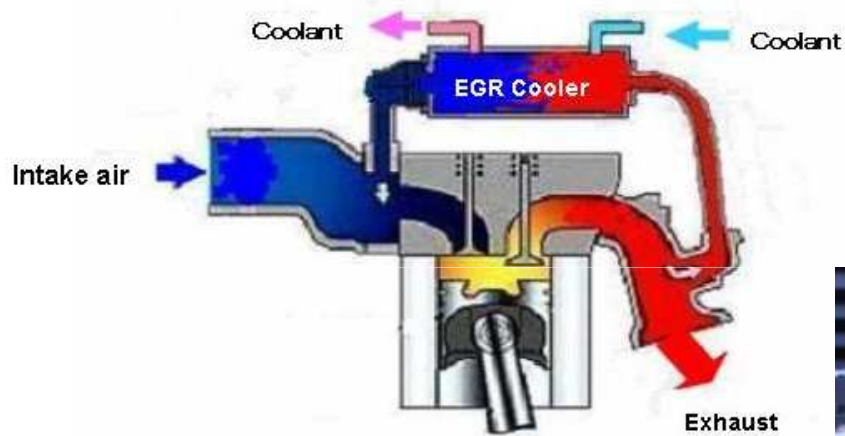
A Whole Range of Technical Solutions

- High pressure injection up to 2200 bar
- Exhaust gas recirculation
- Oxidation catalyst
- Particle filters open or closed
- Selective catalytic reactors

Common Rail System



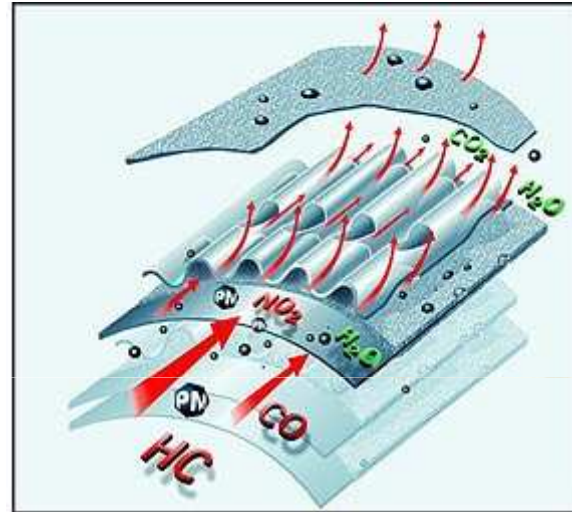
Exhaust Gas Recirculation



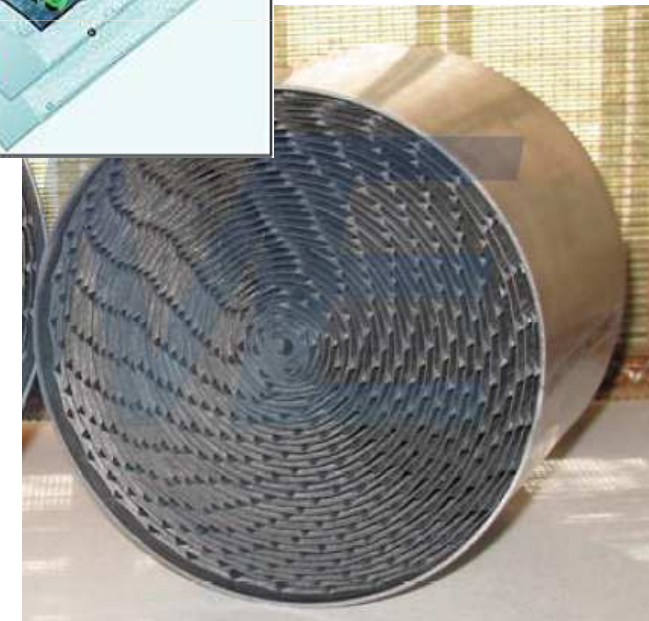
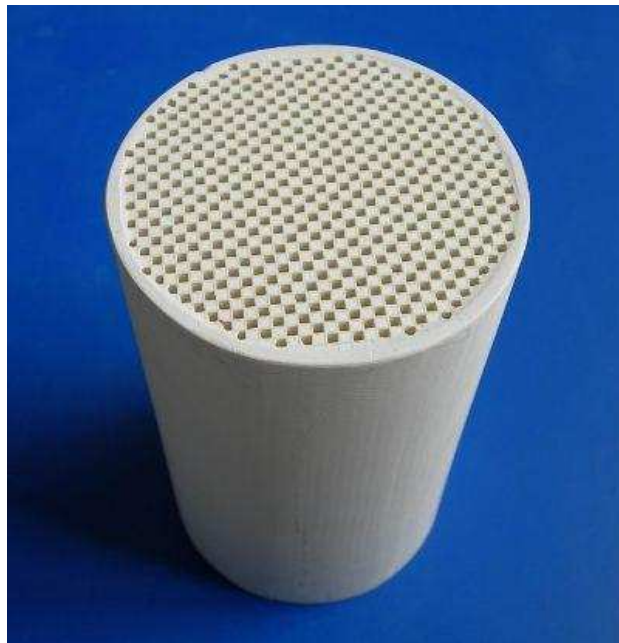
Particle Filter



Closed Filter



Partial Flow Filter

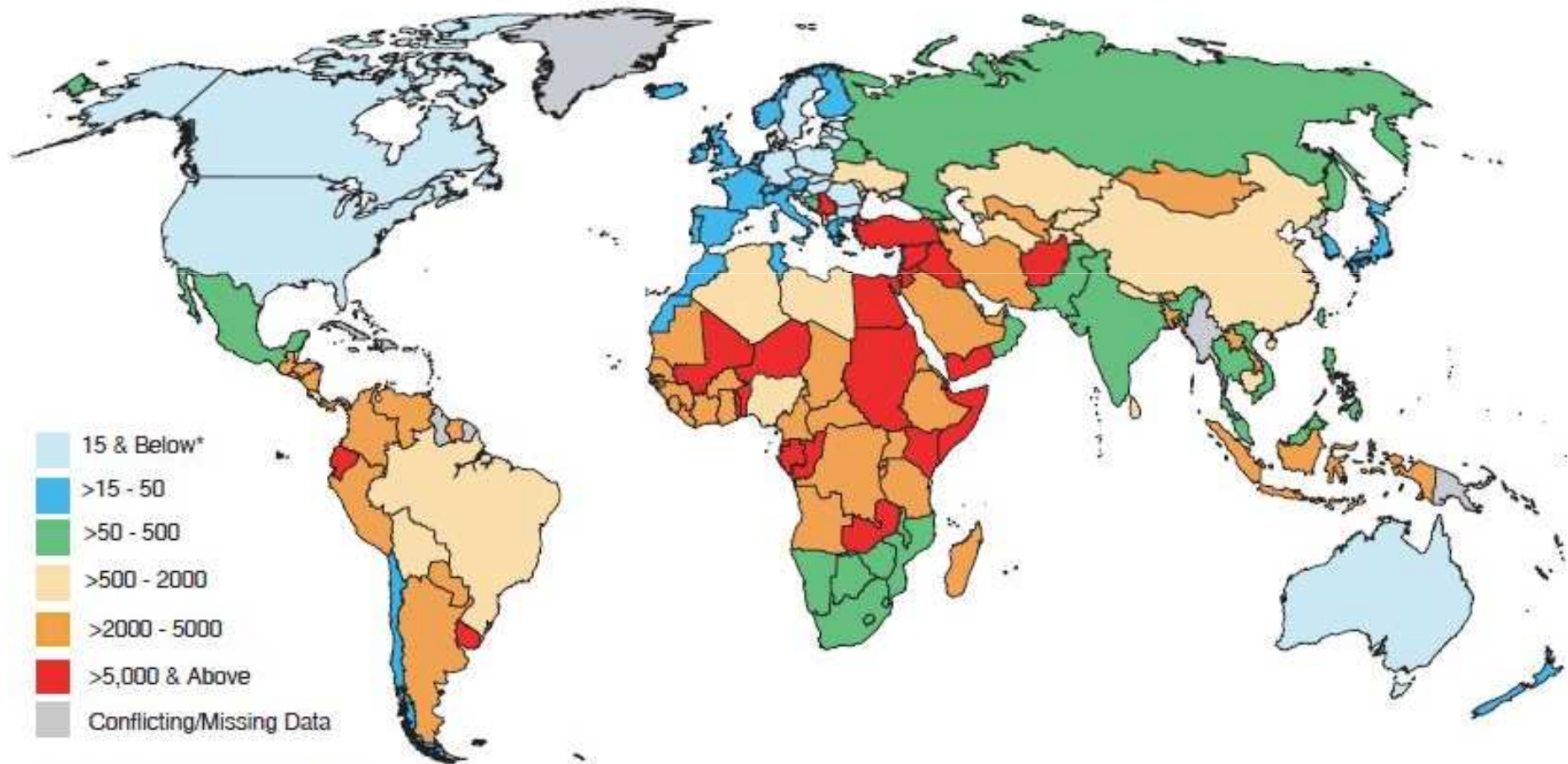


Fuel Implications

- Particulate filters are quite sensitive to fuel characteristics
- Sulphur in the fuel causes deposits in the after-treatment systems that block their correct functioning or regeneration and corrosion on some engine parts.
- Low or sulphur free fuel is generally necessary
- This will be an obstacle for a single product on the global market

Diesel Fuel Sulphur Content

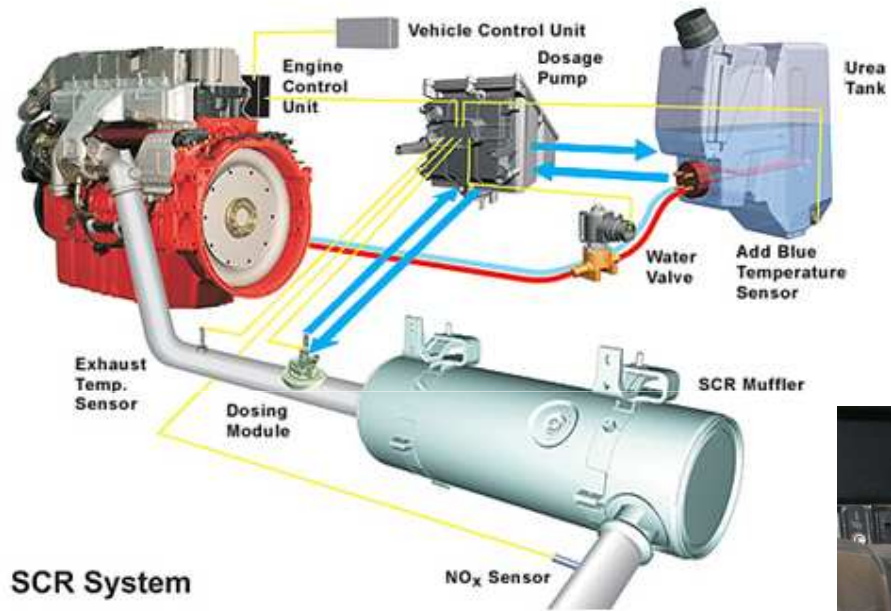
April 2010



* Information in parts per million (ppm)

Indicative information of maximum sulphur content

Selective Catalytic Reactor





Urea – Ad Blue

- A urea solution is necessary for the SCR functioning
- Now available at filling stations due to use in Euro IV trucks
- Machines dashboards shall have indication of the quantity of Ad Blue in the tank
- In future if Ad Blue is lacking or poor quality the engine power will be reduced or the machine will not be able to operate



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Grazie per l'attenzione

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