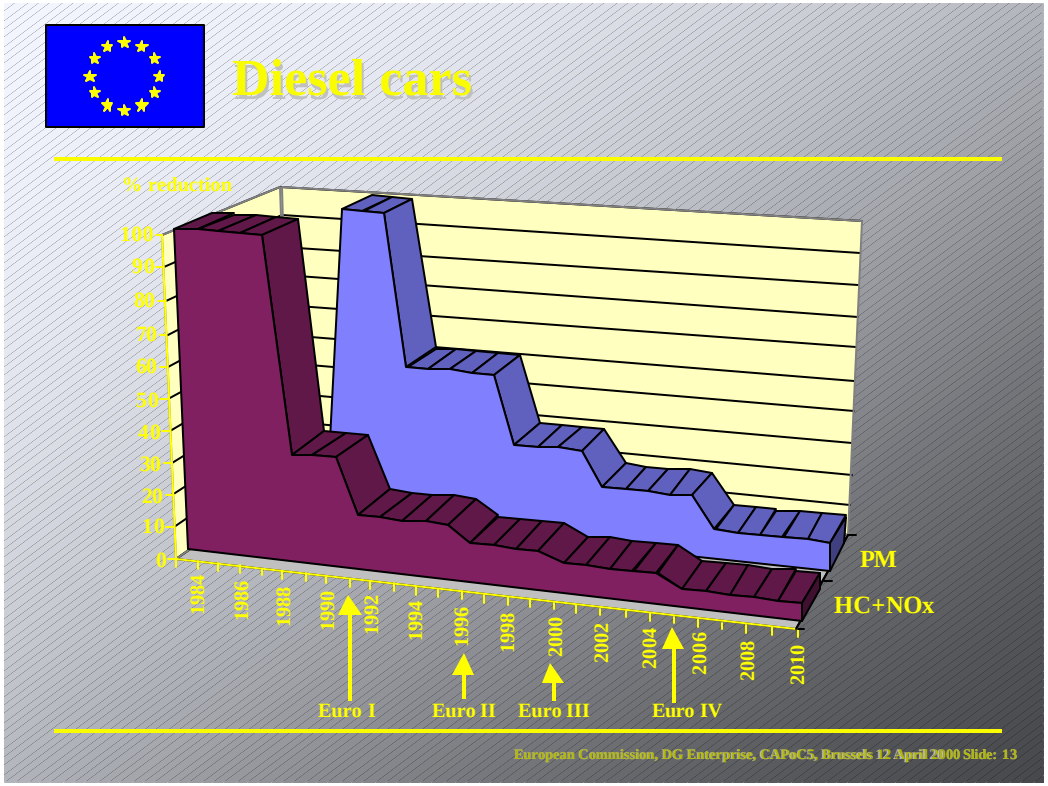
Perspective on the Future Development of Diesel Emission Standards in Europe -



Euro 5 for LDV, amendment of EURO 5 for HDV

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Directive 98/69/EC on Passenger Cars (Article 3):

The Commission shall submit proposals after December 31, 1999 on regulations to be effective after 2005, i.a. taking account of recent research in health effects of particulates:

- Particulate emissions of GDI engines
- Availability of aftertreatment systems, i.e. traps
- Improvement of measurement procedures for fine particulates

Common Position of the Council regarding Directive 99/96/EC on HDV Engines (Article 7):

"The Commission shall submit proposals no later than 12 months after entry into force, i.a. taking account of:

- Development of emission control technology and aftertreatment technology
- Improvements of measurement procedures for very low PM levels
- Development of a world wide harmonized test cycle (WHDC)"

Environment Council on 18 and 19 December 2000
Council conclusions on "Auto-Oil II"

In line with the conclusions of the Commission's report, and in order to give clear and early guidance to all stakeholders, the Council invites the Commission to:……

Make continued efforts to significantly reduce nano-particulate emissions, and in particular devise a new measuring procedure for private cars, light duty vehicles and heavy duty vehicles taking into account the results of recent studies into the health effects of nano-particulate emissions.

The Council invites the Commission to give consideration to the need to bring the provisions on limit values for diesel engines – for example, on emissions of nitrogen oxides – closer to the provisions for petrol engines.

……..

European Air Quality Directive 1999/30/EC:

PM_{10} limits (annual avarage)
from 2005 on: 40 µg/m^3
from 2010 on: 20 µg/m^3 (to be confirmed)

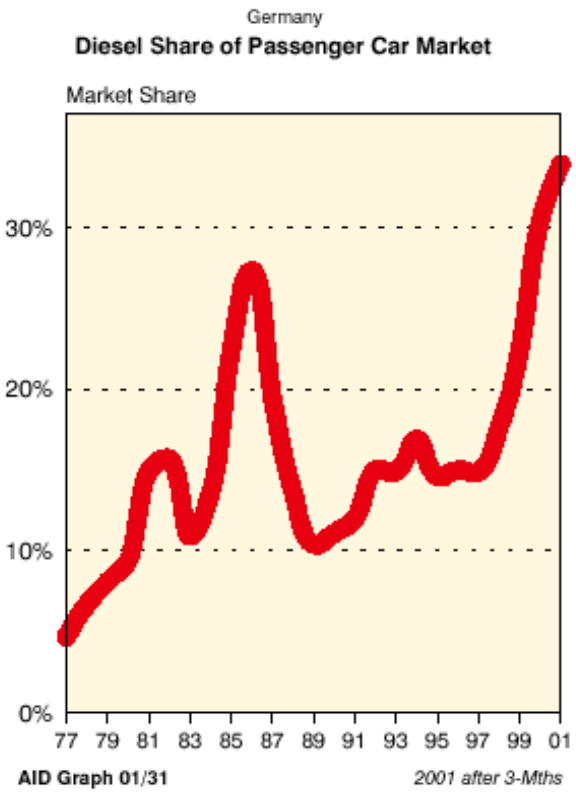
Directive 2001/81/EC on National Emission Ceilings (NEC) for Certain Atmospheric Pollutants

i.a. the national emission ceiling for Germany to be attained by 2010: NOx max. 1.051 kt p.a.
(all sources, mobile sources alone produce 500 kt p.a.)

Reducing the Cancer Risk

The national **German long term target is to reduce the additional lifetime cancer risk** for humans in congested areas **below 1:5000 until 2020.**
This requires to reduce PM immissions by more than 99 % until 2020 compared to 1998.
This means to achieve the particulate concentration of ambient air like in rural areas (**PM10 < 0,8 µg/m³**).

But: The share of diesel passenger cars in Germany is increasing > 35 % !



UNDERSTANDING THE HEALTH EFFECTS OF COMPONENTS OF THE PARTICULATE MATTER MIX: PROGRESS AND NEXT STEPS (HEI, April 2002)

„..... Epidemiologic studies over the last decade have reported associations between short-term increases in exposure to PM and increases in morbidity and mortality, particularly among those people with respiratory or cardiovascular disease. ..... Recent studies funded by HEI and other agencies have corroborated and extended the associations found in the earlier studies. The recent epidemiologic studies and studies of controlled exposure to PM in humans and other species have begun to provide information about critical issues in PM research:

[A] the size and chemical composition of particles that may cause harmful human health effects,

[B] the potential biologic mechanisms of PM effects that underlie the epidemiologic associations previously reported

[C] the groups of people that may be particularly sensitive to the effects of PM.

Nevertheless, to inform future regulatory discussions on control strategies, a systematic research effort is required to develop a better understanding of the health effects of different components of the PM mixture and the mechanisms of PM effects. .....“

Effects of Black Carbon on Climate

„Global-model calculation in which twelve identifiable **effects of aerosol-particles on climate** were accounted for were run. Results suggest that any emission reduction of fossil-fuel BC+OM will slow global warming more than will any emission reduction of CO2 or CH4 for a specific period. Calculations also suggest **diesel cars** emitting continuously under the most recent U.S. and E.U. particulate standards **warm climate per distance driven** over the next 100+ years **more than do equivalent gasoline cars**."

Mark Z. Jacobson, Department of Civil and Environmental Engineering, Stanford University: Control of fossil-fuel particulate black carbon and organic matter, possibly the most effective method of slowing global warming.
Journal of Geophysical Research, in press.
(www.stanford.edu/group/efmh/fossil/fossil.html

Proposal of EURO 5 Standards for Passenger Cars and Light Duty Vehicles

Date	Vehicle Category/Class		Reference Weight RW (kg)	CO (g/km)	HC (g/km)	NO_x (g/km)	PM- (g/km)
	Category	Class		Gasoline Diesel	Gasoline Diesel	Gasoline Diesel	GDI Diesel
01.01.2008	Pass. Cars	—	alle	1,0 EURO 4 Diesel: 0,50	0,100	0,08 EURO 4 Diesel: 0,25	0,0025 EURO 4 Diesel: 0,025
01.01.2008	Light Duty-Vehicles	I	RW £ 1305	1,0	0,100	0,08	0,0025
		II	1305 < RW £ 1760	1,0	0,100 —	0,08	0,0025
		III	1760 < RW	1,25	0,125 —	0,10	0,0032

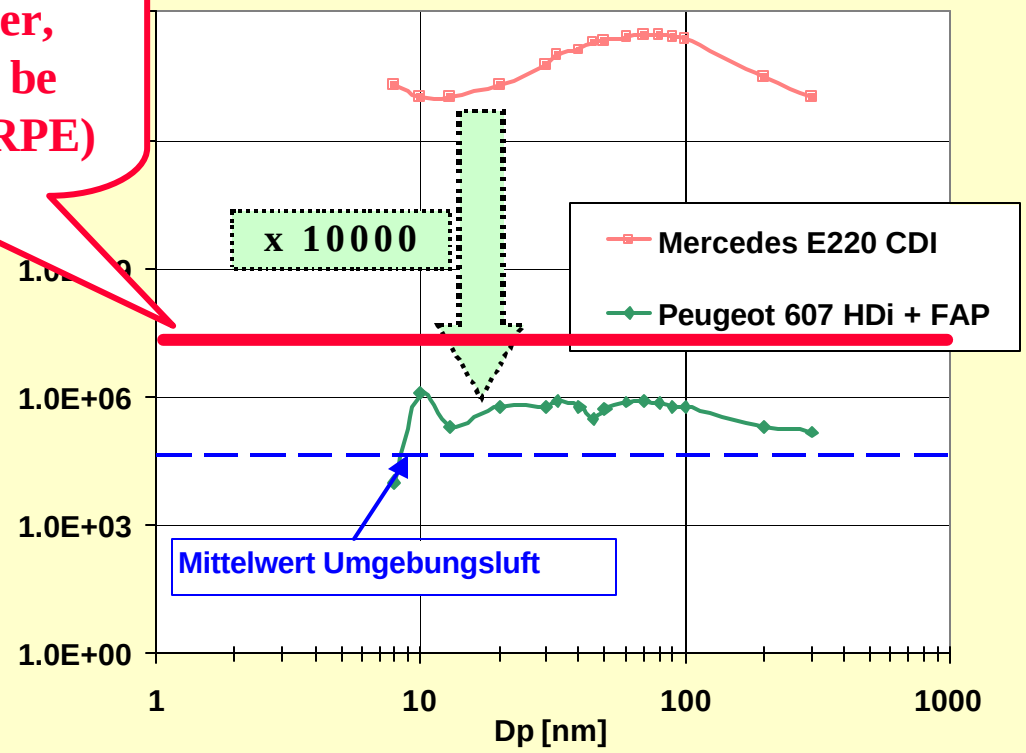
(Separate limitation of HC and NOx for Diesel like for Gasoline)

Source: UBA, July 2002

Auswirkung des Partikelfilters auf die l und das Partikelspektrum

ADAC

Example: Limitation of particulate number, test procedure to be developed (ECE-GRPE)



Messung mit SMPS bei Konstantfahrt 80 km/h (Mercedes 6.Gang, Peugeot 5. Gang)

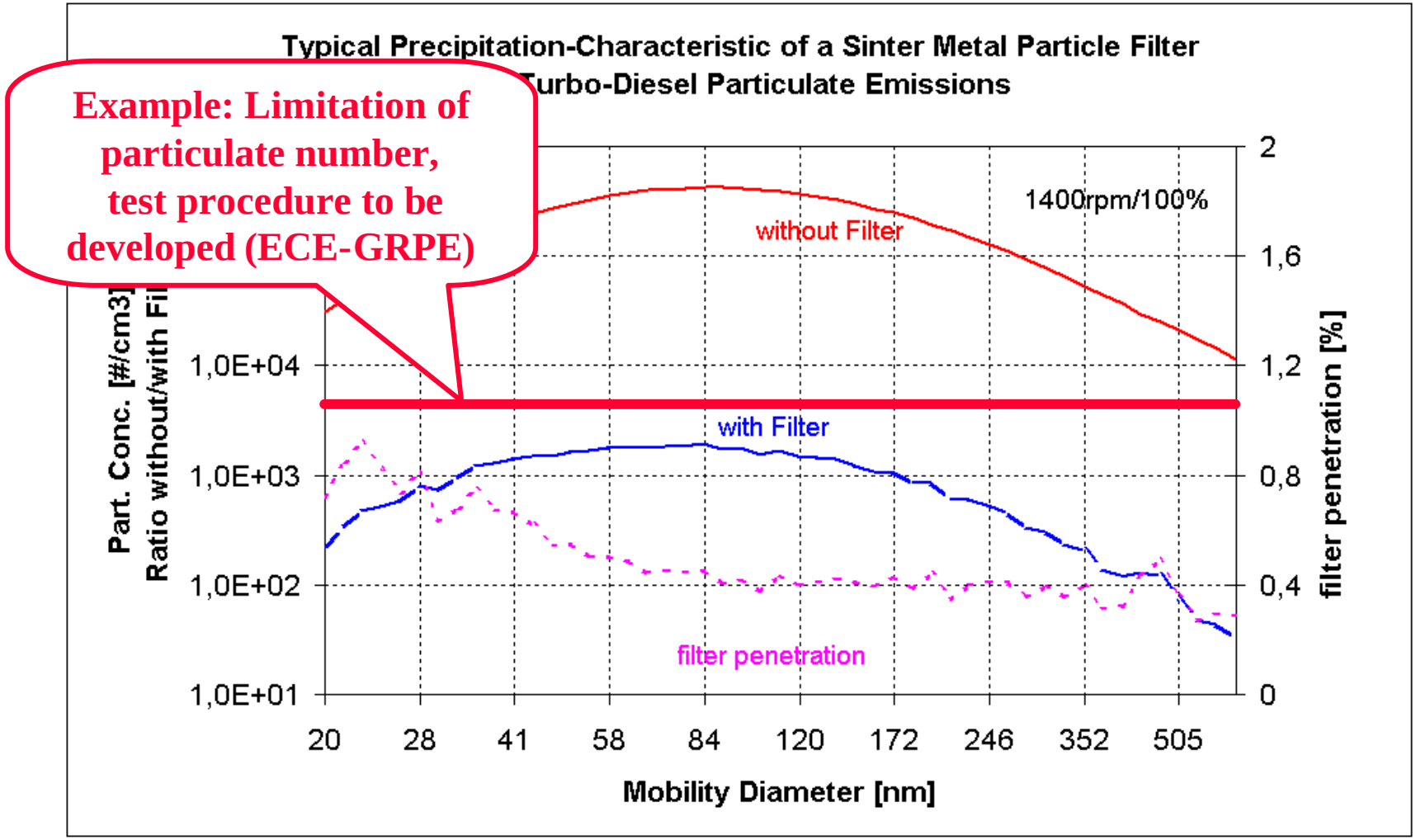
Proposal for Amending the EURO 5 Standards for HDV Engines (for Particulates)

	EURO 3		EURO 4/5	
	1999/96/EG			
	from 2000		from 2005/2006 resp. 2008/2009*)	
	ESC- and ELR-Test [1]	ETC-Test [2] [3]	ESC- and ELR-Test [1]	ETC-Test [2] [3]
g / kWh	g / kWh	g / kWh	g / kWh	g / kWh
CO	2,1	5,45	1,5	4,0
HC	0,66		0,46	—
NMHC	—	0,78		0,55
Methane	—	1,6 [4]		1,1 [4]
NO_x	5,0	5,0	3,5 / 2,0*) ?	3,5 / 2,0*) ?
PM	0,1	0,16 [5]	0,02 / ***0,002***	0,03 / ***0,003*** [5]
Smoke	0,8 m^{-1}	—	0,5 m^{-1} / ***?***	—

[1] new test procedure for all diesel engines
[2] additional transient test cycle for diesel engines with aftertreatment systems
[3] for gas engines only transient test
[4] for CNG engines only
[5] for diesel engines only
*) for EURO 5 (from 2008/09) originally only the NOx standard was reduced from 3,5 to 2,0 g/kWh

Possibly a NOx-limit < 1,0 g/kWh is necessary to fulfill NEC (2001/81/EC) requirements

Source: UBA, July 2002


Typical Precipitation-Characteristic of a Sinter Metal Particle Filter
Turbo-Diesel Particulate Emissions
Example: Limitation of particulate number, test procedure to be developed (ECE-GRPE)
1400rpm/100%
without Filter
with Filter
filter penetration
Part. Conc. [#/cm3]
Ratio without/with Fil
1,0E+04
1,0E+03
1,0E+02
1,0E+01
2
1,6
1,2
0,8
0,4
0
filter penetration [%]
20
28
41
58
84
120
172
246
352
505
Mobility Diameter [nm]

Thank You for Your Attention !