Global Efforts to Encourage Heavy-Duty Vehicle Fuel Economy Improvements- Germany

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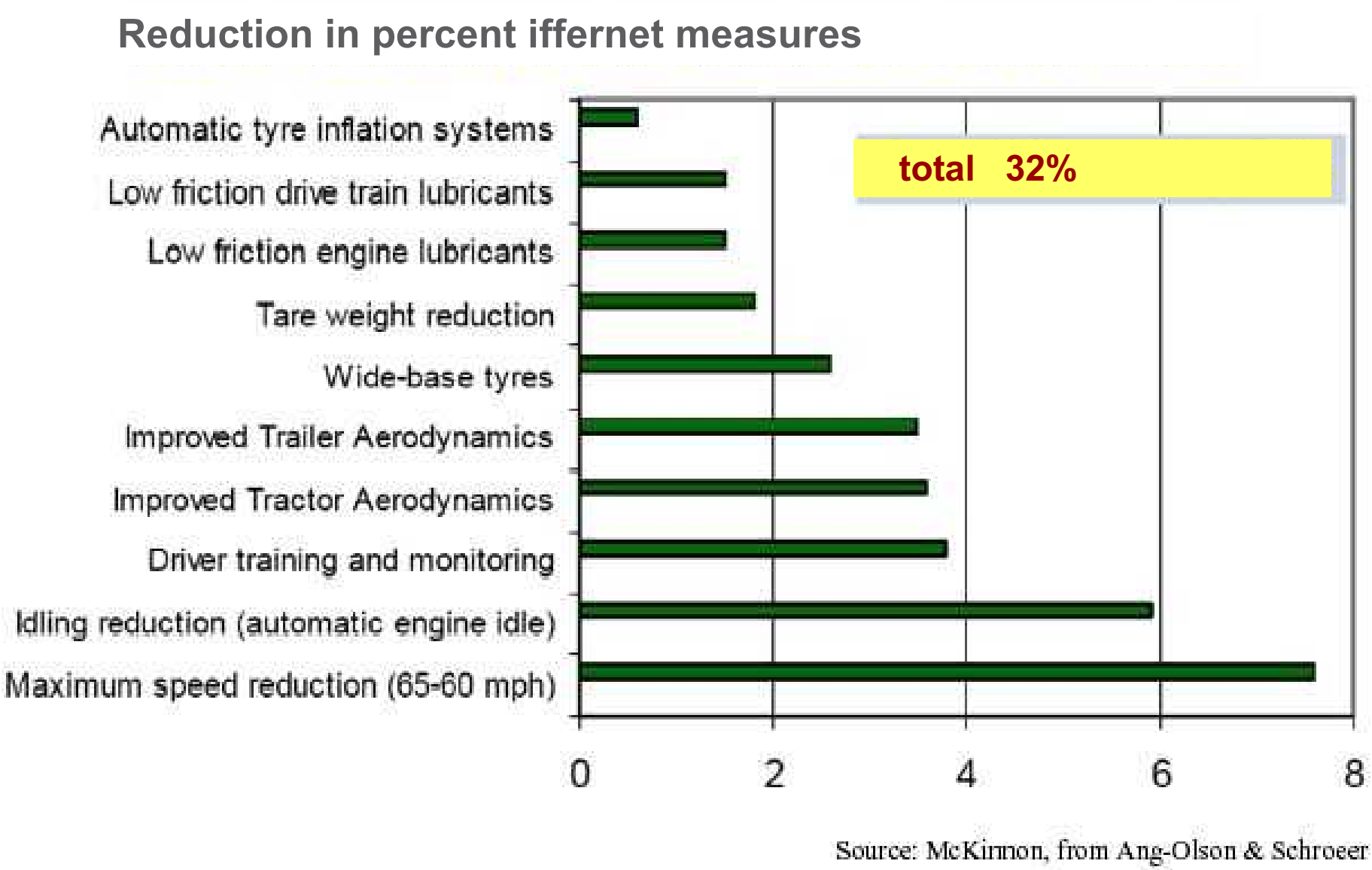
Germany

Improving the Fuel Economy of Heavy Duty Fleets II- San Diego, CA
February 20th, 2008

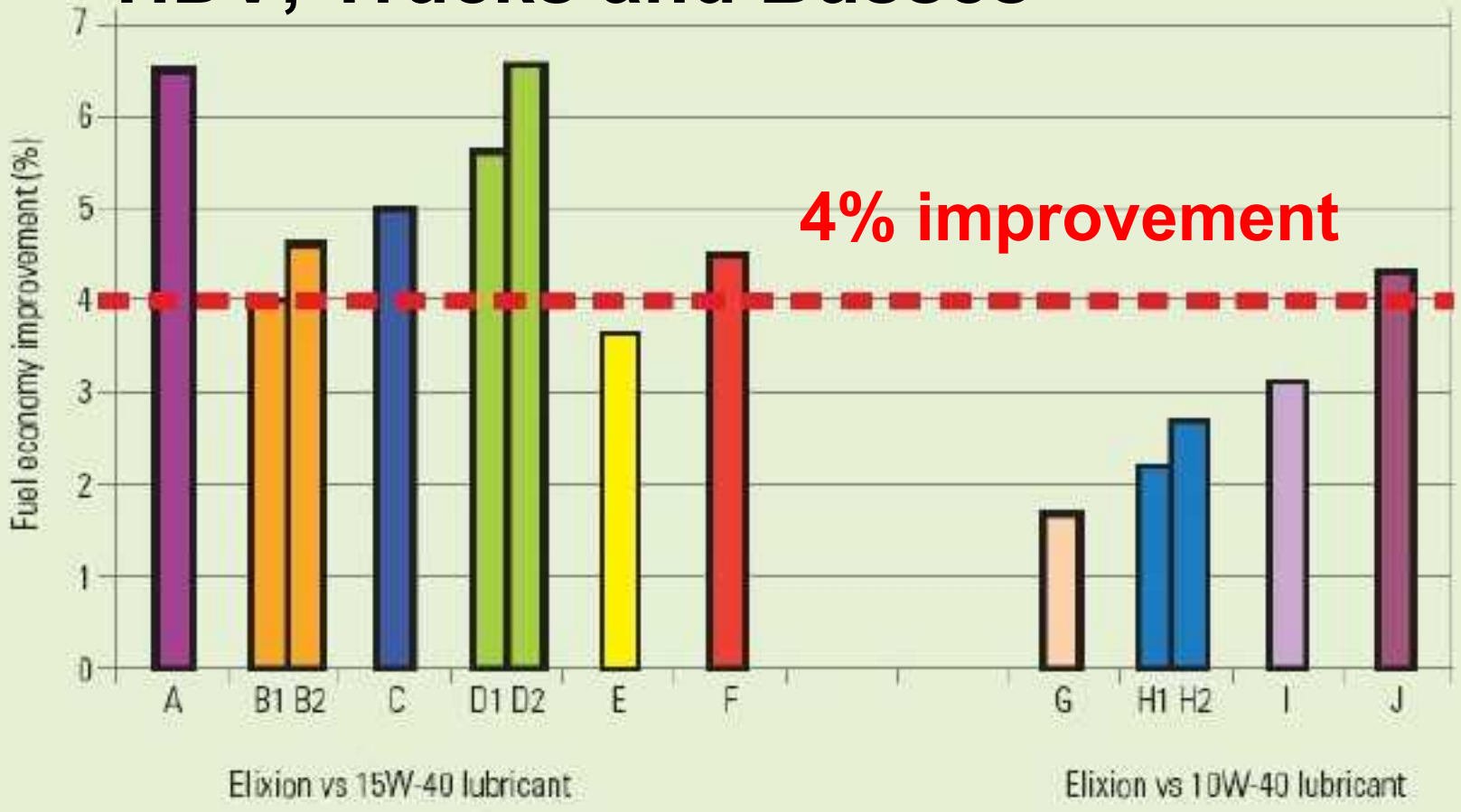
Measures to Reduce fuel consumption of HDV



Lubrication Oil

Fuel economy on test

HDV; Trucks and Busses



The graph shows the result of an extensive series of field trials carried out on fleets of commercial trucks and buses (plotted as A-J above). Elixion, BP's heavy duty diesel engine lubricant, was used in the trials, and consistently demonstrated improved fuel economy compared with conventional engine lubricants, giving an average improvement of around 4 per cent (red dotted line)

Source: BP Frontiers magazine, August 2005

Driver training

DAIMLERCHRYSLER

Driver Training Initiatives

DaimlerChrysler has been offering safe driving courses for commercial vehicle drivers since 1968. The programme started in Germany and is now running in 48 countries around the world.

The aim of these courses is to improve drivers' technical knowledge of how to handle vehicles and to train them in coping with critical situations.

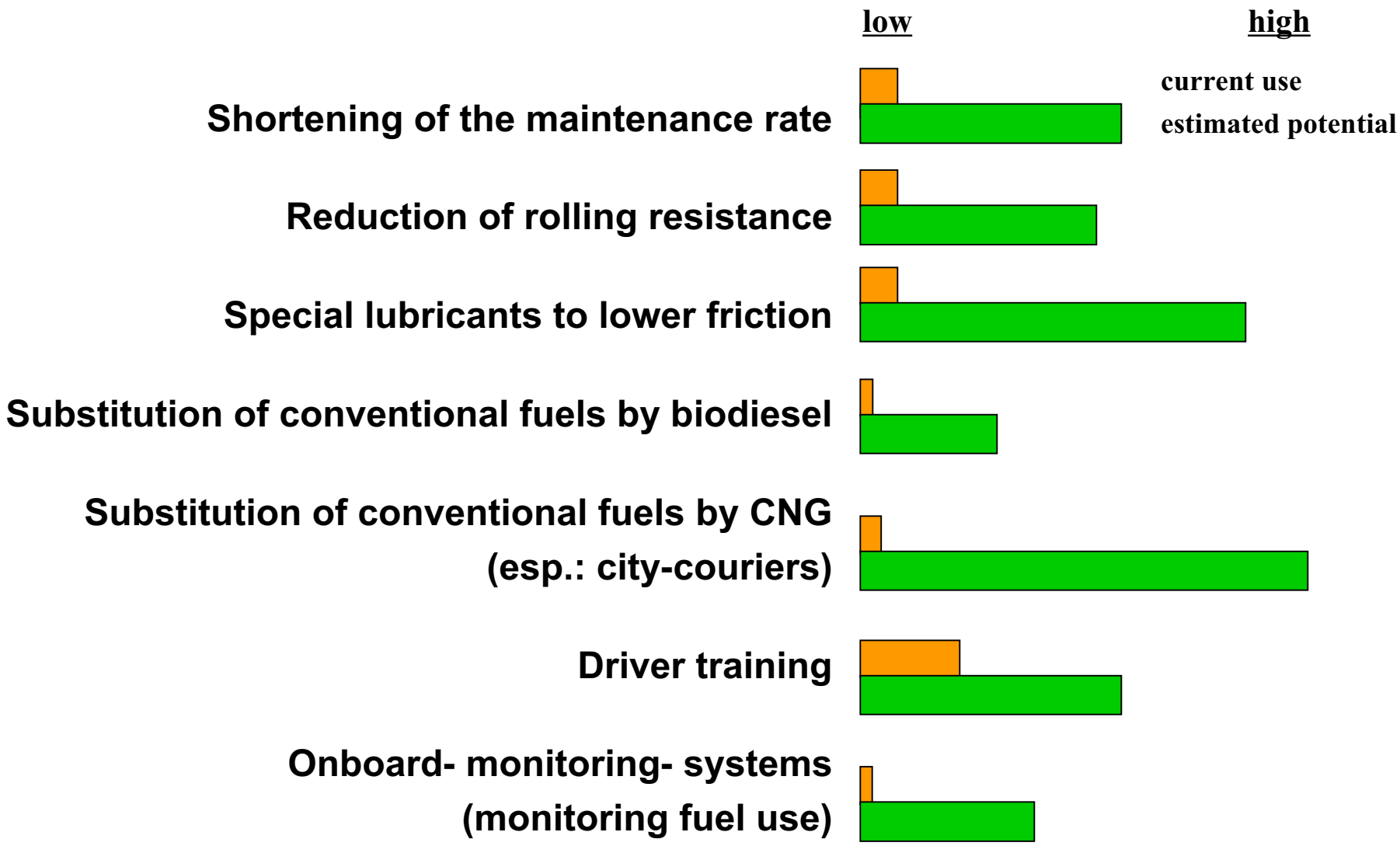
The courses also promote fuel efficiency. A proactive driving style can help lower fuel consumption by up to 20%.

In 2005, 65,000 people worldwide had participated in these training programmes.

Source:ACEA

Courier & Parcel Services:

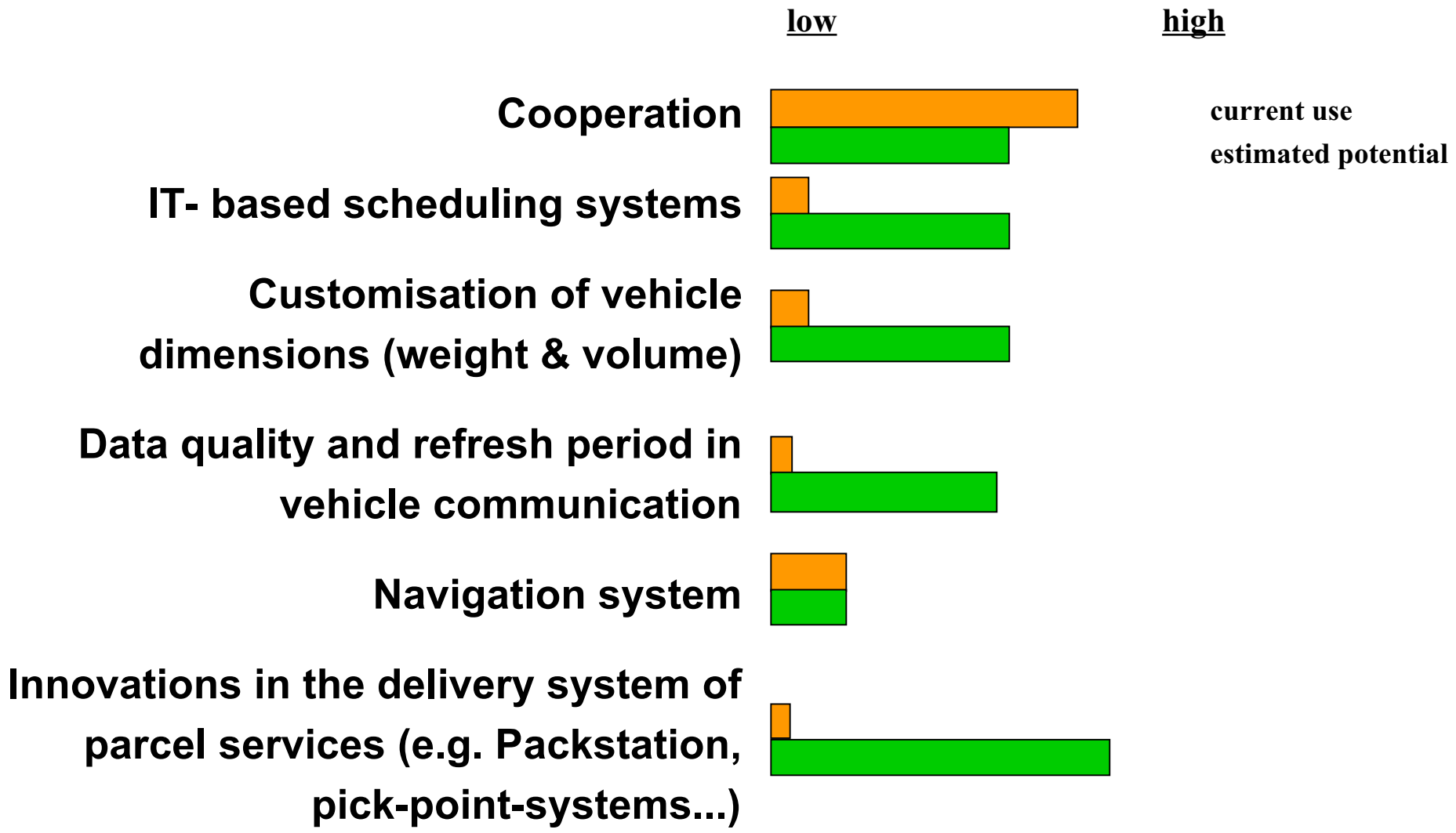
Current use and potential for CO_2-measures in driving operation



Source:Leonardi; survey 2005

Courier & Parcel Services

CO_2- reduction in transport organisation

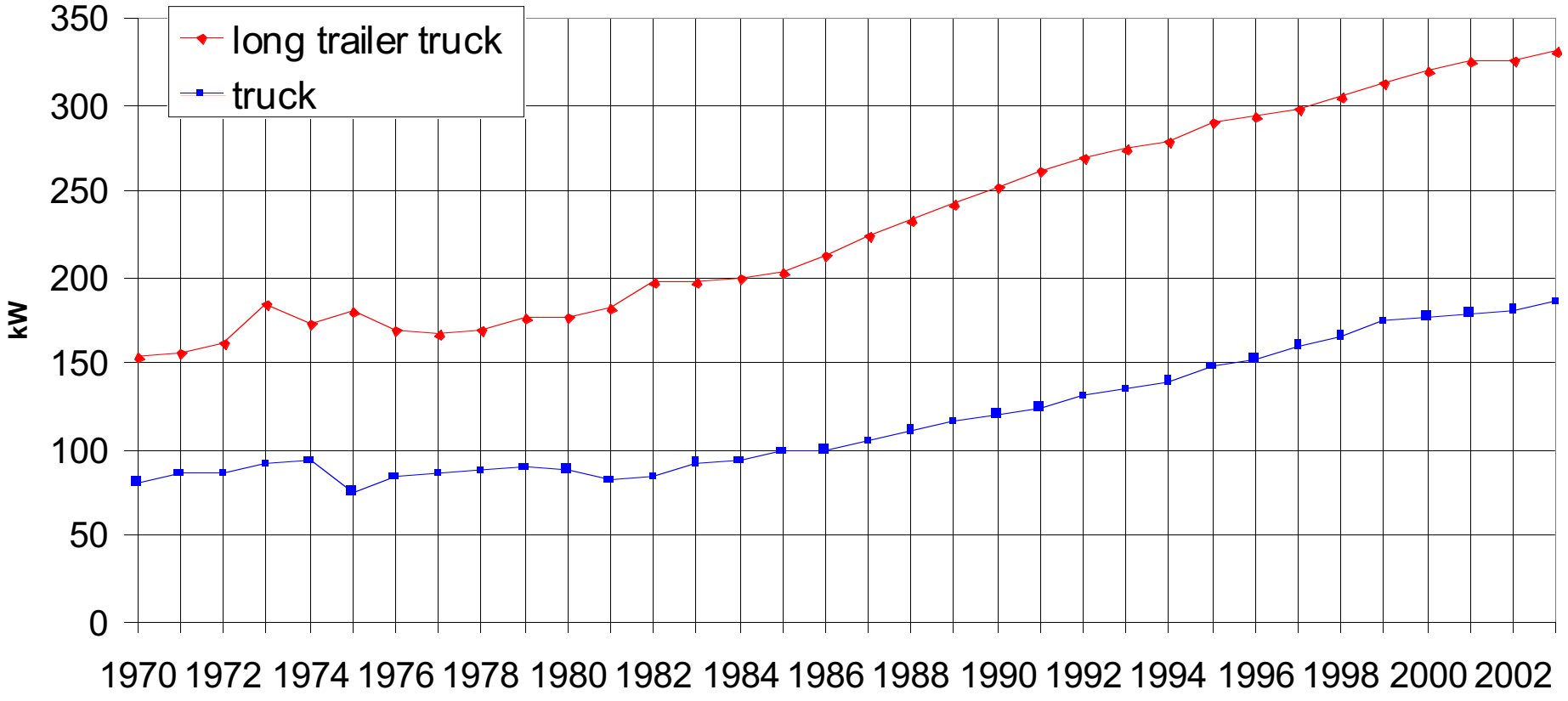


Source: Leonardi;survey 2005

Voluntary Measures aren‘t enough

Av. Engine Power of HDV >3,5t and Long Trailer Trucks in Germany

at 1.1.2004 to registration years (1970-2003)

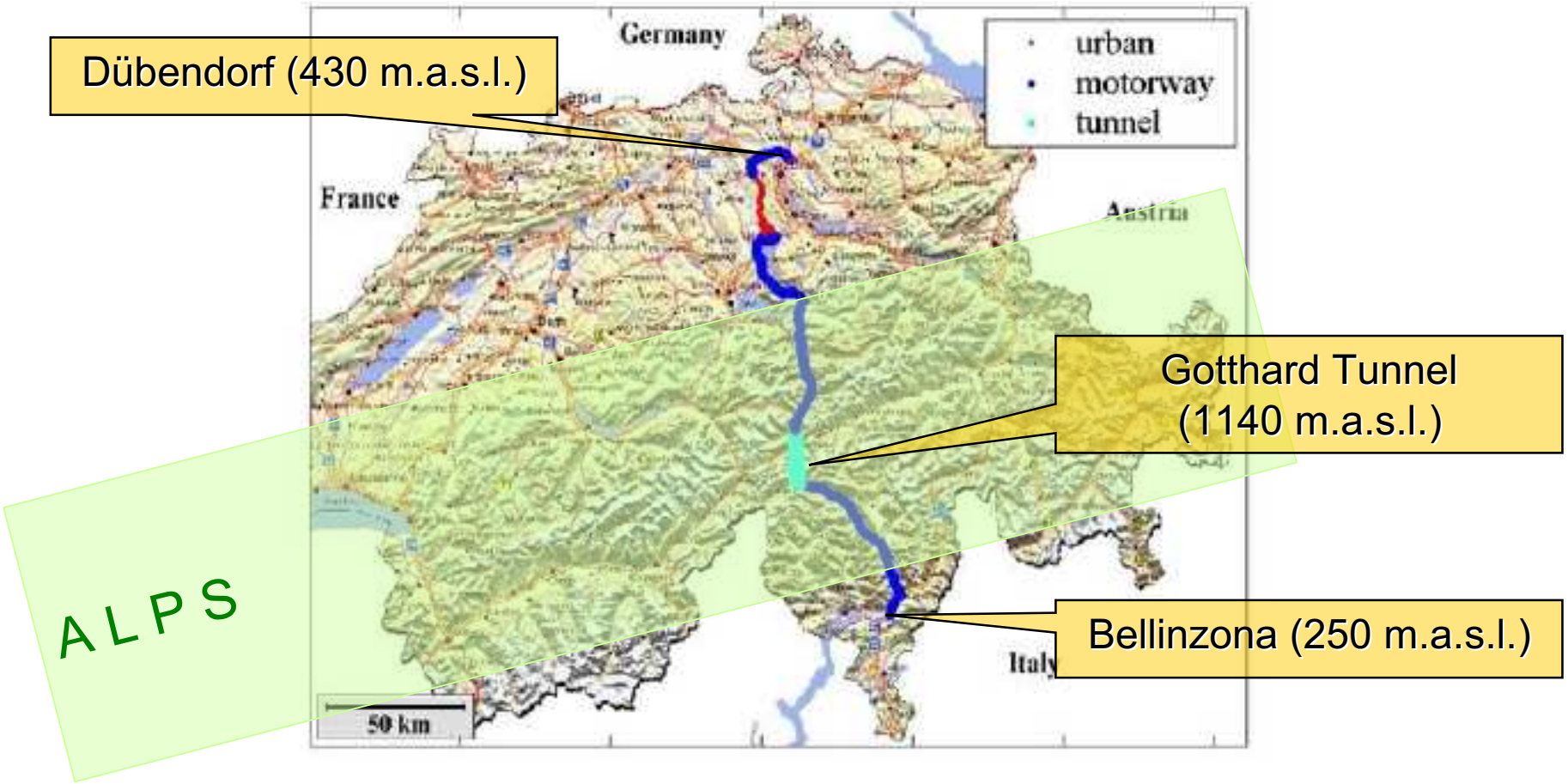


Source: KBA-evaluation for TREMOD 4

Emission Measurement and Modelling of a Tractor-Semitrailer in Trans-Alpine Operation

Source:Patrik SOLTIC,Empa, Switzerland;Stefan HAUSBERGER TU Graz, Austria

Driven Tests: Gotthard Route (main Swiss alp transit route)



Source:Patrik SOLTIC,Empa, Switzerland;Stefan HAUSBERGER,TU Graz, Austria

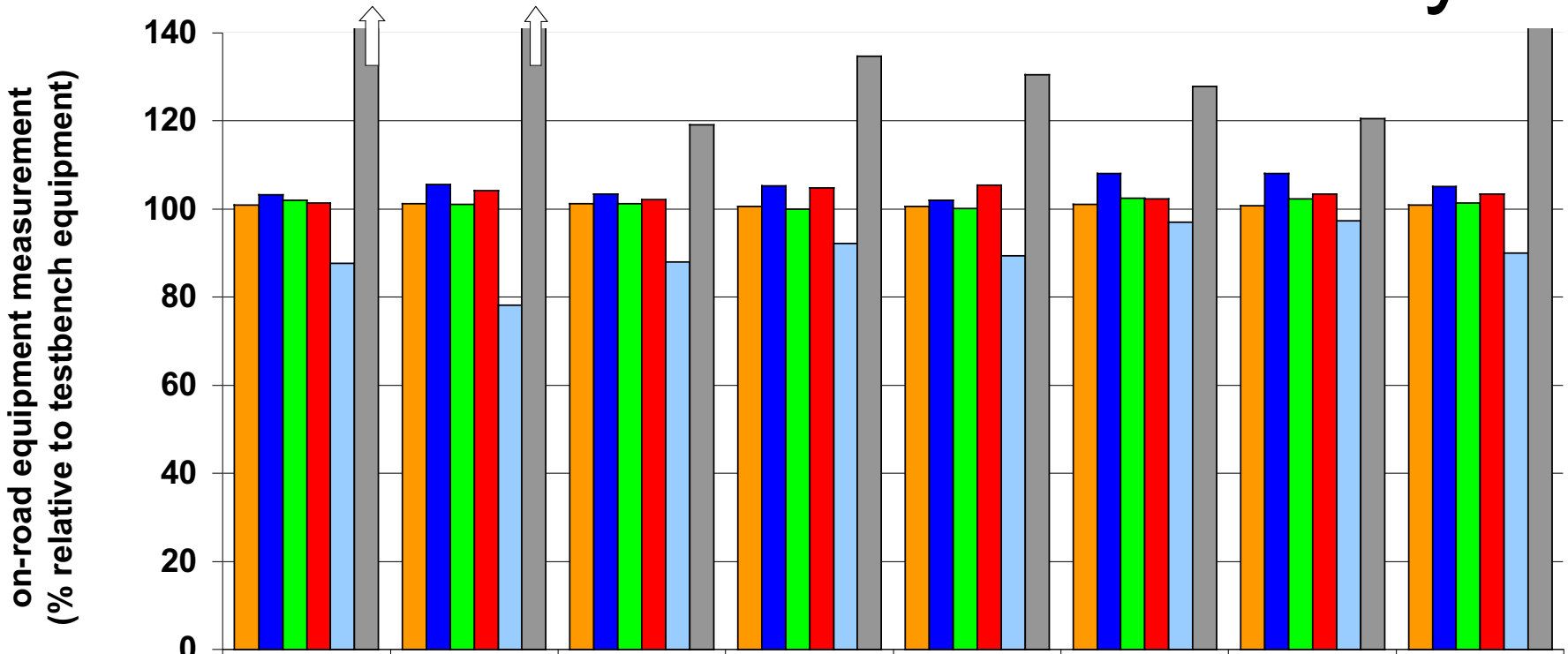
On-Road Results: Comparison

	Gotthard	San Bernardino
Average Speed [km/h]	65	63
Total trip -length [km]	397	490
Av. engine propulsion energy [kWh/km]	1.827	1.995
Av. fuel cons. [g/km] / [l/100 km] / [g/kWh]	380 / 45.9 / 208	412 / 49.8 / 207
Av. CO_2 emissions [g/km] / [g/kWh]	1188 / 650	1288 / 645
Av. NO_x emissions [g/km] / [g/kWh]	9.4 / 5.13	10.3 / 5.18
Av. CO emissions [g/km] / [g/kWh]	3.9 / 2.15	4.7 / 2.37
Av. THC emissions [g/km] / [g/kWh]	0.27 / 0.15	0.32 / 0.16

similar engine work
specific emission

Source:Patrik SOLTIC,Empa, Switzerland;Stefan HAUSBERGER,TU Graz, Austria

Test Bench: Comparison of Results from On-Road Versus Laboratory



	ESC	ETC	FTP	WHTC	TUG	TNO7	TNO12.5	Average
air+fuel mass	100.9	101.2	101.2	100.7	100.5	101.0	100.8	100.9
engine work	103.3	105.6	103.5	105.3	102.0	108.1	108.1	105.1
CO2 mass	102.0	101.1	101.2	99.9	100.2	102.5	102.4	101.3
NOx mass	101.3	104.2	102.2	104.9	105.4	102.4	103.4	103.4
THC mass	87.7	78.3	87.9	92.3	89.4	97.1	97.4	90.0
CO mass	237.7	144.3	119.2	134.7	130.5	127.8	120.5	145.0

Source:Patrik SOLTIC,Empa, Switzerland;Stefan HAUSBERGER TU Graz, Austria

PHEM Simulations of the Vehicle Test Runs (Simplified)

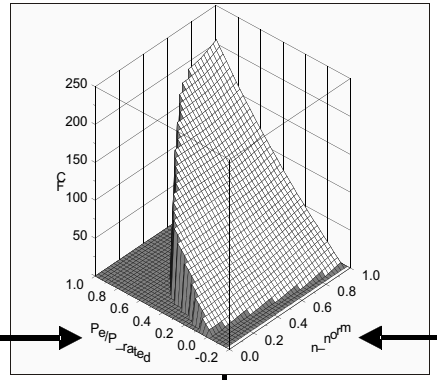
Standard HBEFA values for „tractor-semitrailer 34 to 40 tons“

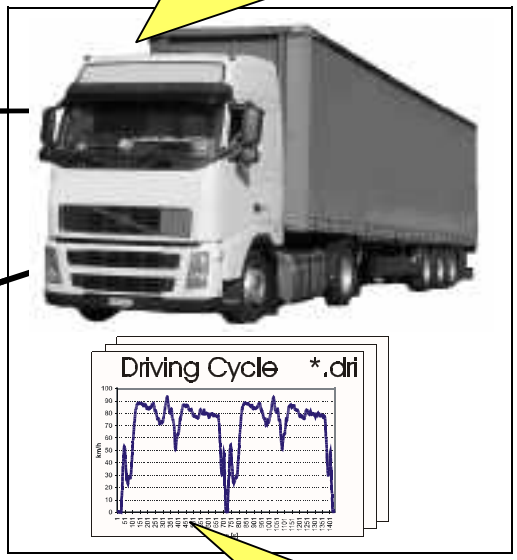
Vehicle specific values for gearbox ratios and vehicle mass

Driving resistancese & transmission losses

From test bench Measure-ments

Emission maps





Gear-shifting model

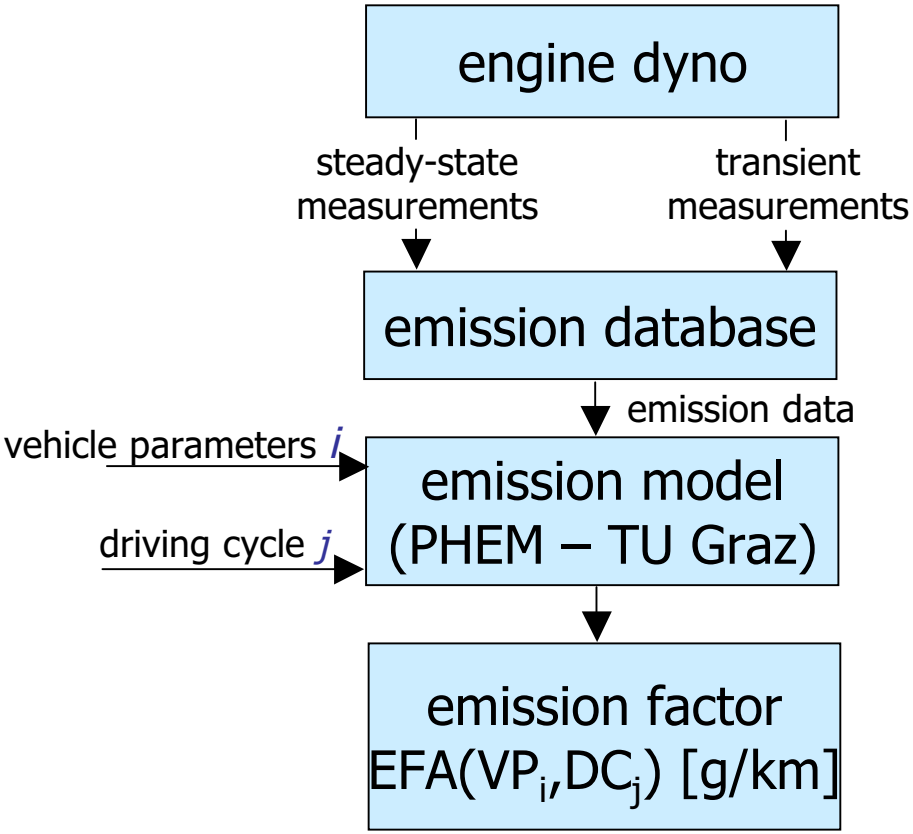
Engine work, fuel consumption, emissions

„average driver“ (not the known gears)

Recorded vehicle speed and road gradients during the on-road measurement test runs

Source:Patrik SOLTIC,Empa, Switzerland;Stefan HAUSBERGER,TU Graz, Austria

HBEFA Emission Factors for Deavy Duty Vehicles



CO_2 Reduction by Weight Reduction

Carbon fibre composite: Increase of pay load:
6 t for a trailer truck

Proposal to Control CO_2 Emissions from HDV

1. Setting a standard for trucks in CO_2/ tkm payload
2. Standard should be applied to each truck model and structure
3. Estimate the driving resistance by a coast down test on the road for each individual truck model half loaded
4. Calculate the CO_2 emissions for the WHTC by modeling from the engine map

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Energy Label for Refrigerated Vehicles

according to draft norm refrigerating unit

2008/2009

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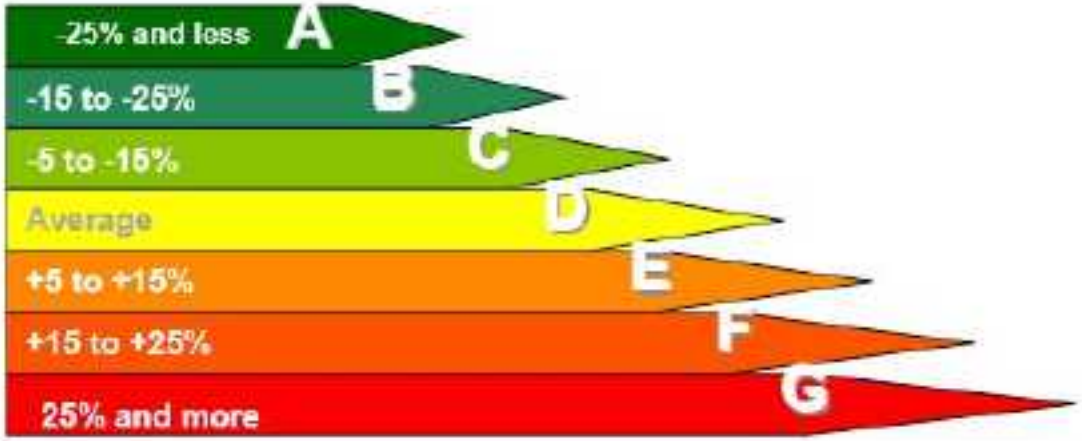
Brand **Model**	....
Coefficient of Performance (COP)	
Heat transmission coefficient (K-value)	
Cold retention system	
Comparison of energy consumption **with the average consumption of all refrigerated vehicles** offered in 2007	Reserved for systems using CO2/propane/propen **Annual additional costs +,-€ !** G - %
CO_2 emissions	....g/km
Fuel costs per 100,000 km determined in accordance with ../.../EC and at a fuel price of	....,-€ ..... €/Litre



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COP in operation Diesel nominal speed [kWh/l]

Label class	from	to	normalized-value
A*	is bigger	3.27	1.60
B	3.27	3.01	1.53
C	3.01	2.75	1.42
D (AV)	2.75	2.48	1.30
E	2.48	2.22	1.18
F	2.22	1.96	1.06
G	is smaller	1.96	1.00

COP standby electric [W/W]

Label class	from	to	normalized-value
A*	is bigger	1.25	1.60
B	1.25	1.15	1.53
C	1.15	1.05	1.42
D (AV)	1.05	0.95	1.30
E	0.95	0.85	1.18
F	0.85	0.75	1.06
G	is smaller	0.75	1.00

* Reserved for natural refrigerants such as CO_2

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K-value [W/m²K]

Label class	from	to	normalized-value
A	is smaller	0.30	1.67
B	0.34	0.30	1.56
C	0.38	0.34	1.39
D (AV)	0.38	0.42	1.25
E	0.42	0.46	1.14
F	0.46	0.50	1.04
G	is bigger	0.50	1.00