Transports and Mobility

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No One Can Hide From Climate Change – Challenges and Responses

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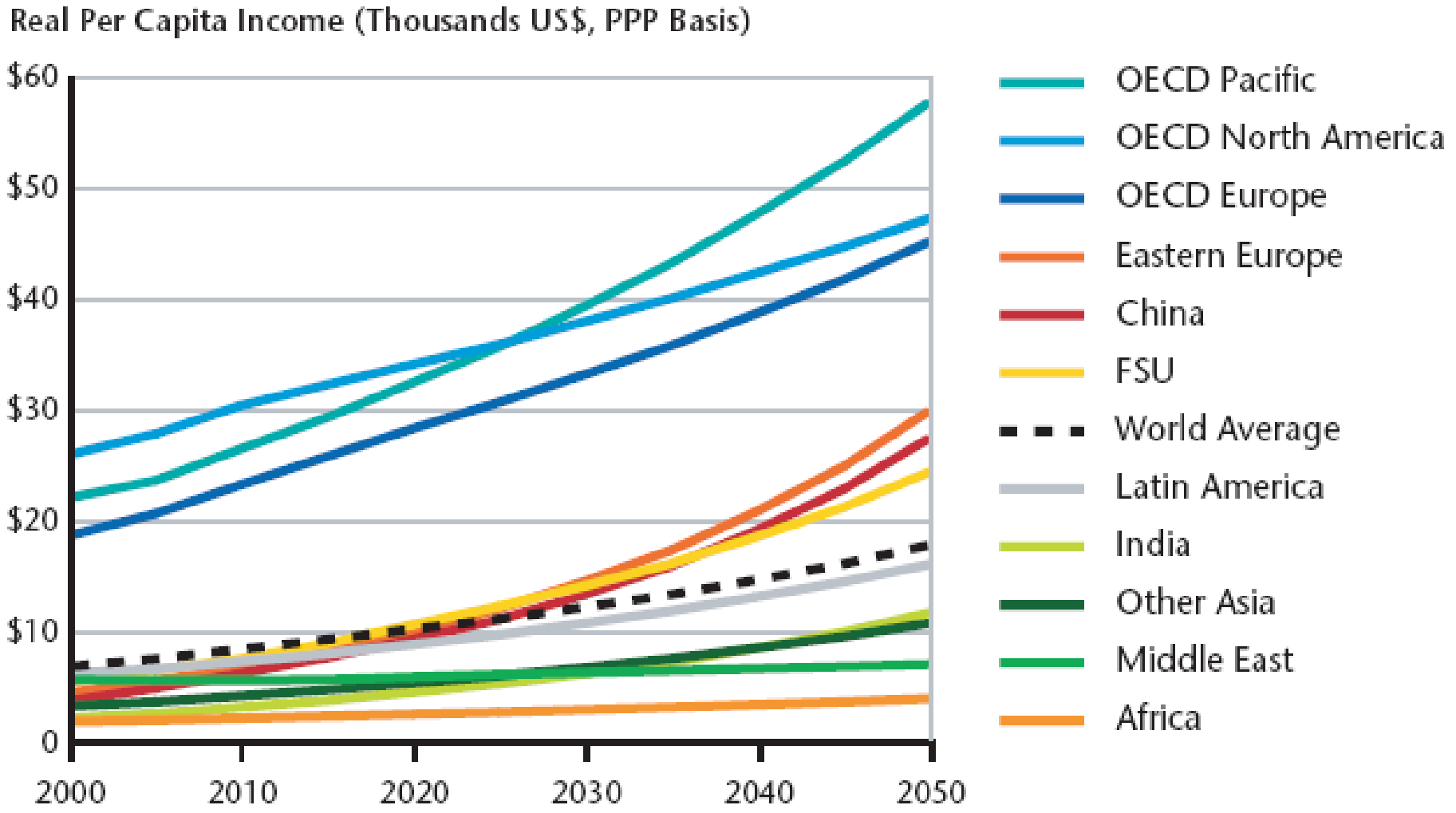
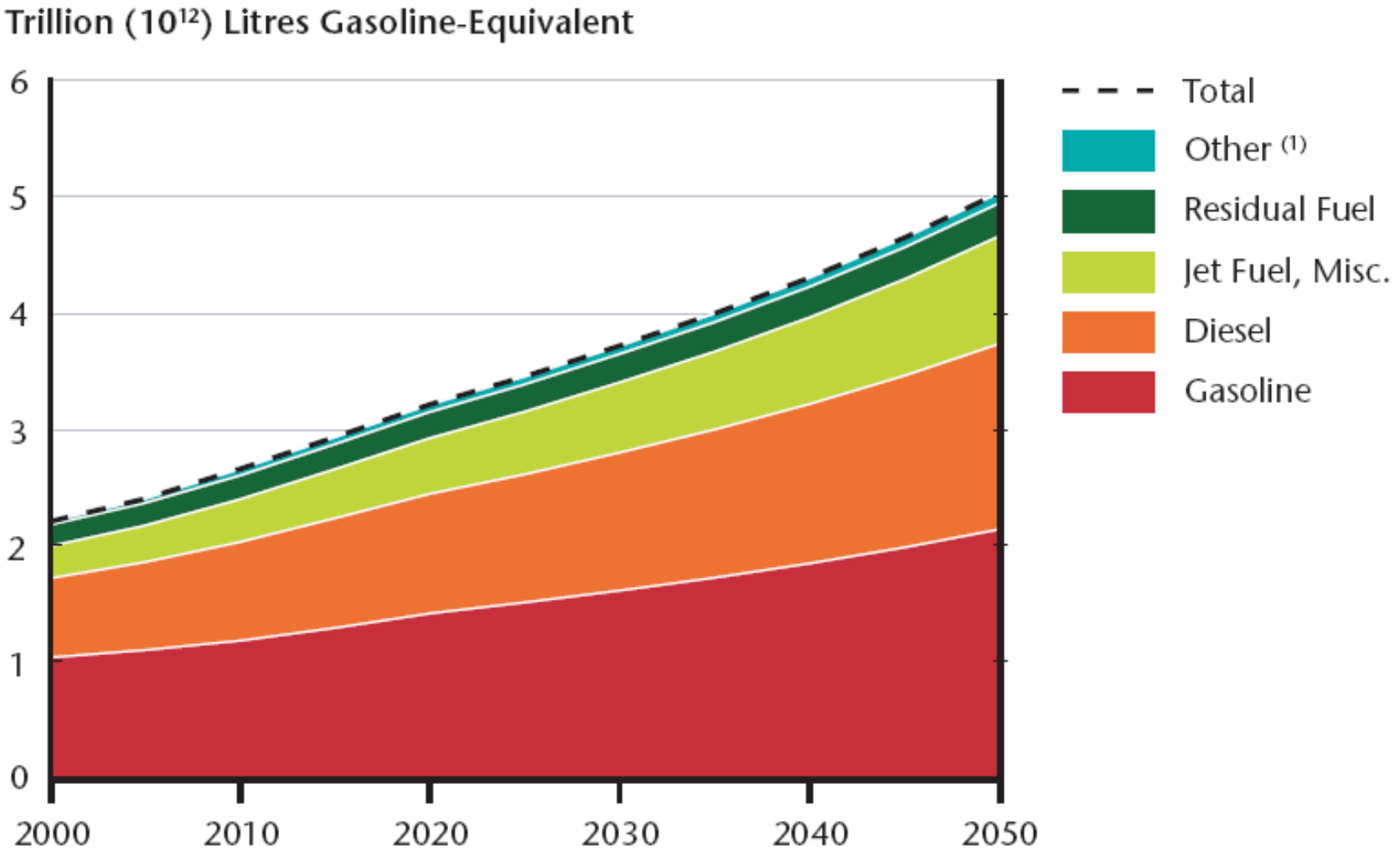
Global Developments

Figure 2.1 Real GDP per capita, purchasing power parity (PPP) basis



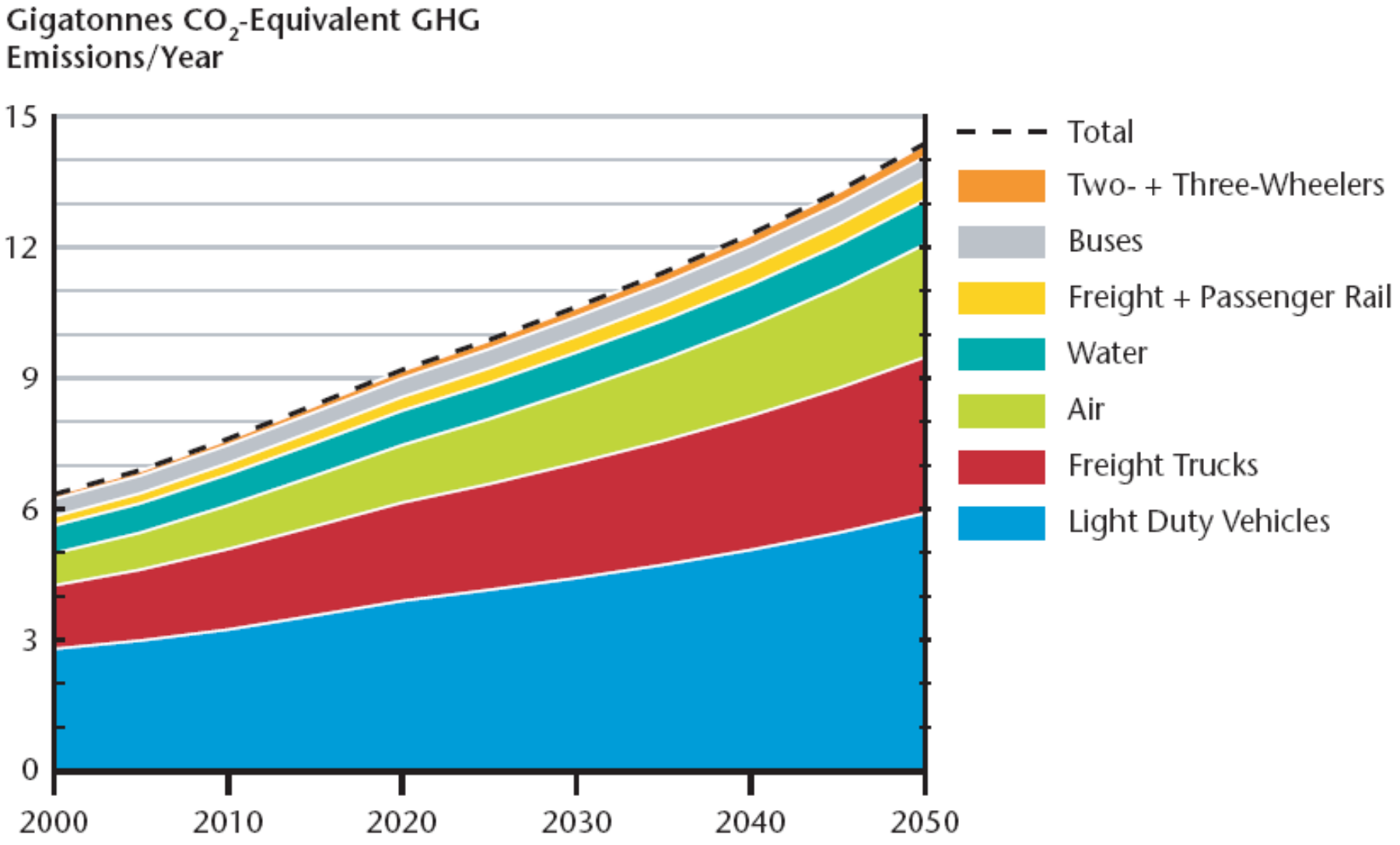
Source: Data for 2000, IEA; projections 2000-2030, **IEA 2002, p. 408**; projections for 2030-2050, SMP extrapolation of IEA projections.

Figure 2.12 Worldwide transport-related fuel use – all transport modes



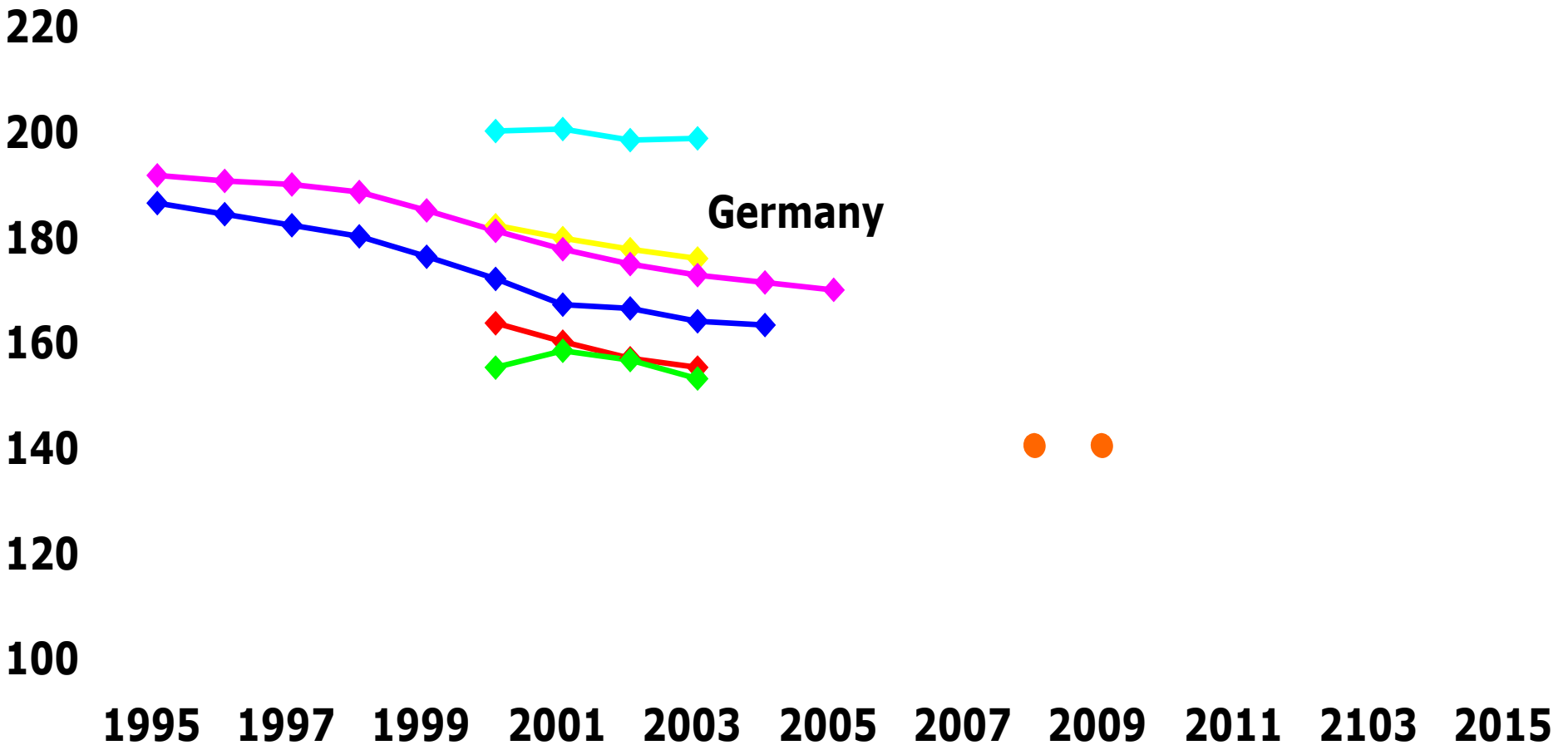
(1)CNG\LPG, Ethanol, Biodiesel, and Hydrogen Source: Sustainable Mobility Project calculations.

Figure 2.13 Transport-related Well-To-Wheels CO_2 emissions by mode

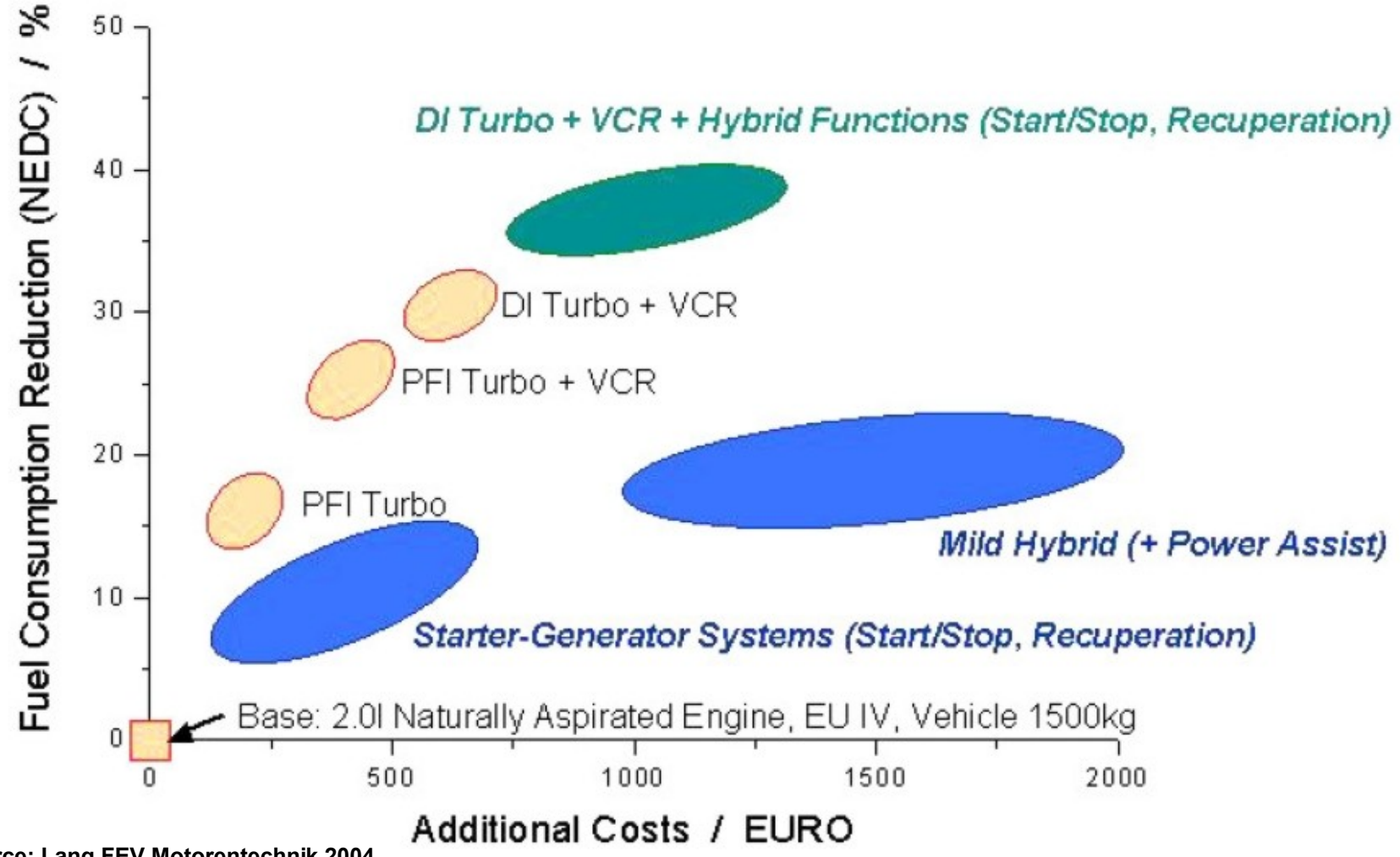


Source: Sustainable Mobility Project calculations.

The Existing Voluntary Agreements



Assessment of Fuel consumption, Potential and Cost of Hybrid Concepts



Source: Lang,FEV Motorentechnik 2004

Fuel Consumption Reduction by Retrofit

Golf TSI 1,4 l 125 kW

Comparison Petrol versus Diesel

Petrol

1.4 TSI 125 kW 6- gear box

7,2 l/100km CO_2 169 g/km Price 22.700,00 €

1.4 TSI 125 kW DSG

7,2 l/100km CO_2 169 g/km Price 24.375,00 €

Diesel

2.0 TDI DPF125 kW 6-gear box

6,0 l/100km CO_2 158 g/km Price 25.175,00 €

2.0 TDI DPF125 kWDSG

6,4 l/100km CO_2 173 g/km Price 26.850,00 €

Fuel saving measures

carbon engine hood

transmission with long gear ratios

AGM-battery

gear shift indicator

lightweight seats

downsized engine (1.4l / 125 kW)

start-stop function

heat storage

mirror substitution

low resistance tyres with high pressure

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Reduction Potential in the Simulation

Single Measures in the EUDC

	NEDC			
	Consump. [l/100km]	CO_2 [g/km]	Reduction [l/100km]	Reduction [%]
Basic car				
Golf 1.4l TSI	7.24	173.7	0.00	0.0
Single measure				
c_w=0.28	7.11	170.6	0.13	1.8
f_R=0.9%	6.89	165.5	0.34	4.7
2.0l-TDI-gear box	6.57	157.6	0.67	9.3
2.0l-TDI-gear box, $0.9*i_{Achse}$	6.56	157.5	0.68	9.3
m=1250kg	7.05	169.2	0.19	2.6
Start-Stopp	6.90	165.6	0.34	4.7
Gearshift Indicator	6.62	158.9	0.62	8.5
warm start	6.65	159.7	0.58	8.1

Reduction Potential in the Simulation

combined Measures in the NEDC

	NEDC			
	consumption [l/100km]	CO_2 [g/km]	reduction [l/100km]	reduction [%]
Basic car				
Golf 1.4l TSI	7.24	173.7	0.00	0.0
combined measures				
c_W=0.28, f_r=0.9%, m=1250kg 2.0l-TDI-gear box, start-stop	5.58	133.8	1.66	22.9
c_W=0.28, f_r=0.9%, m=1250kg 2.0l-TDI-gear box, GSI start-stop,	5.44	130.6	1.80	24.8
c_W=0.28, f_r=0.9%, m=1250kg 2.0l-TDI-gear box, GSI Start-Stop warm	4.85	116.5	2.38	32.9

Reduction of CO_2-emissions

Measures	Reduction of CO_2-Emissions in NEDC [g/km]
already implemented:	
Narrow tyres (205/55 R16)	6
Transmission with long gear ratios	6
Gear shift indicator	12
Mirror substitution *	0
Heat storage	5
Start-stop-function	7
planned:	
Regenerative braking *	2 - 5
Low-viscosity engine and transmission oil *	5 - 7
Weight reduction *	2 - 5
Narrow tyres (185/65 R15) *	2 - 5

CO_2-emissions of base vehicle:

172 g/km

-24 %

current CO_2-emissions of demonstrator vehicle:

131 g/km

* impact calculated / estimated

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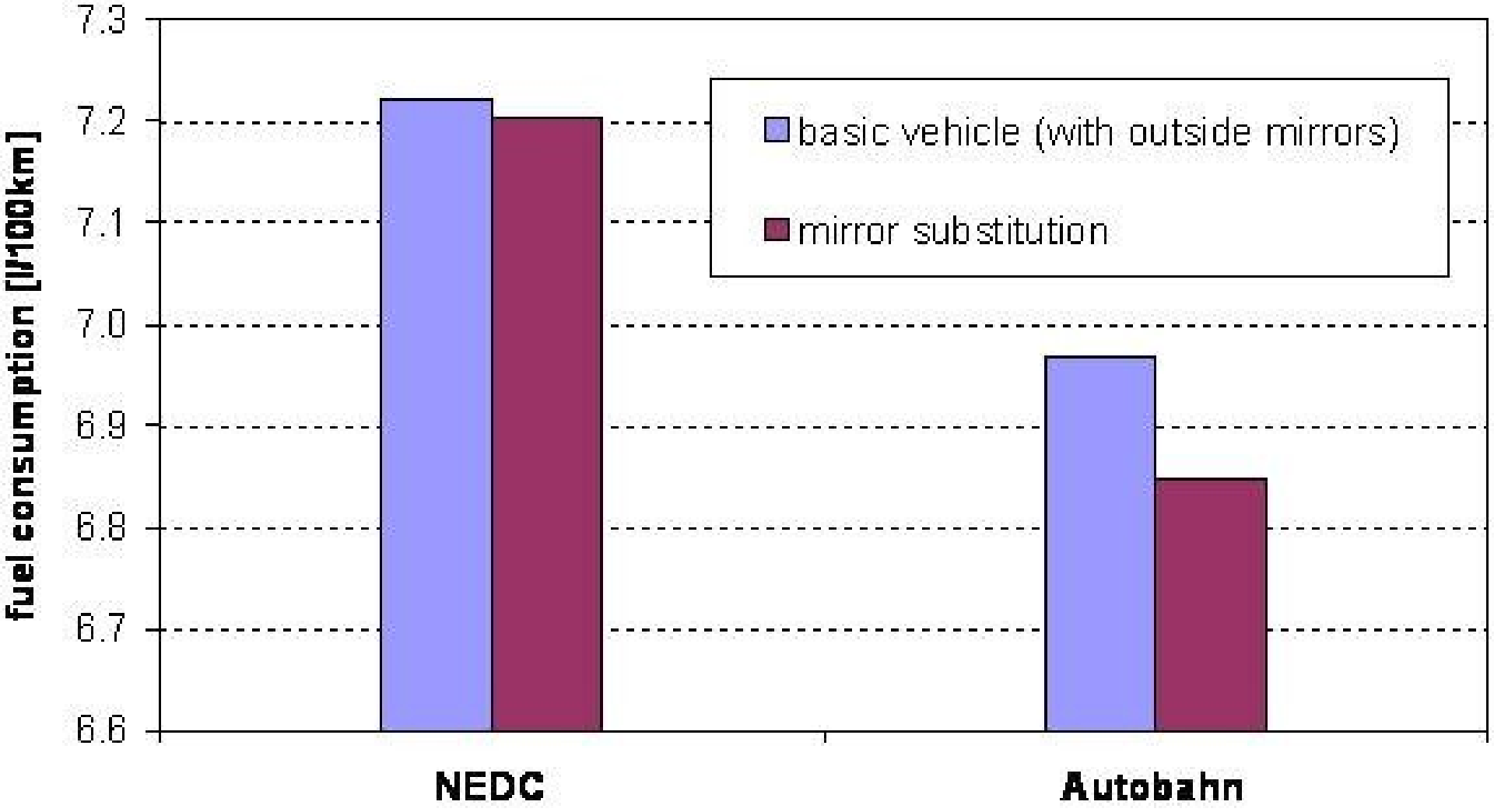
Outside Mirror

Influence of the outside Mirror to c_w x A

- Golf GT: c_w x A = 0,74 m²
- Without outside mirror: c_w x A = 0,713 m²
- dc_w x A = -0,027 m²

Cameras/Monitors instead of Outside Mirror



Source: ika

CO_2 Reduction by Down- Sizing

Simulation Results Engine Downsizing

Task and & Procedure

Estimate the fuel consumption reduction potential of a Golf V by limiting the maximum velocity 160 km/h.

- Starting with the basis engine (1,4l TSI, 125 kW) and scaling down to v_{max} =160 km/h. The new engine power is 50 kW.
- As a result of the lower max speed the car can be equipped with smaller tires, which reduces the vehicle weight and additionally the aerodynamic drag. The smaller engine has also a positive effect for the vehicle mass.
- To estimate the impact the following assumption are made for the simulation:
  - Reduction of the vehicle weight by 100 kg
  - Reduction of the rolling resistance by 10%
  - Reduction of the aerodynamic drag by 5 %

CO_2- Emission Reduction by Downsizing

Basic vehicle:	156 g/km CO_2
Engine Downsizing (direct effects)	113 g/km CO_2
Vehicle (indirect effects)	**105 g/km CO_2**

Reduction Potential

	• NEDC (warm start)		• Autobahn cycle	
	Consumption • [l/100km]	Reduction • [%]	Consumption • [l/100km]	Reduction • [%]
Basic vehicle Golf GT 1,4l TSI	• **6.66**	• -	• **7.13**	• -
Engine downsizing: • Design of the engine to 50 kW	• **4.81**	• **27.8**	• **6.42**	• **10.0**
Subsequent impacts: weight reduction (-100 kg), reduction rolling resistence (-10 %) reduction aerodynamic drag (-5 %)	• **4.45**	• **33.3**	• **5.91**	• **17.0**

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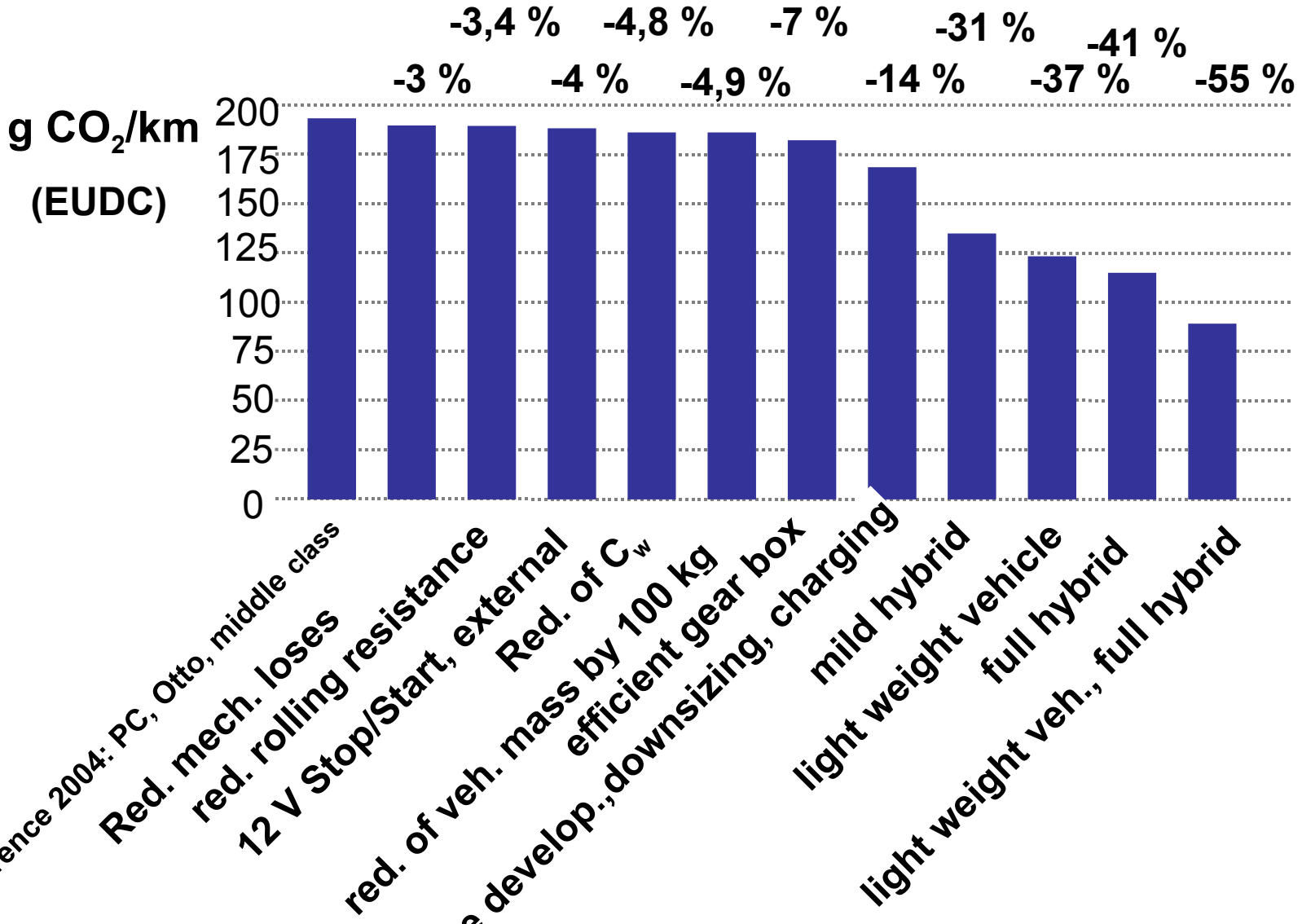
Future Technology

Reduction Potential Technical Measures



Source: S.Schmidt

Basis Data for a 4-Seater

Motor + Starter-Generator:

Basic engine maps as for the 1-liter-car, scaled to twice the power

- Hybrid strategy:
  - equivalent to 1-Liter-car
- car data:
  - gross weight: 580 kg (equal 2 x $m_{1\text{-Liter-car}}$)
  - total weight: 680 kg (normal), 905 kg (full loaded, 4Persons)
  - c_w-value: 0,19 (equal Mercedes Study Bionic car)
  - front area: 2 x $A_{1\text{-Liter-car}}$
  - rolling resistance: equal $f_{roll,1\text{-Liter-car}}$

Mercedes Studie Bionic car

Source: ika

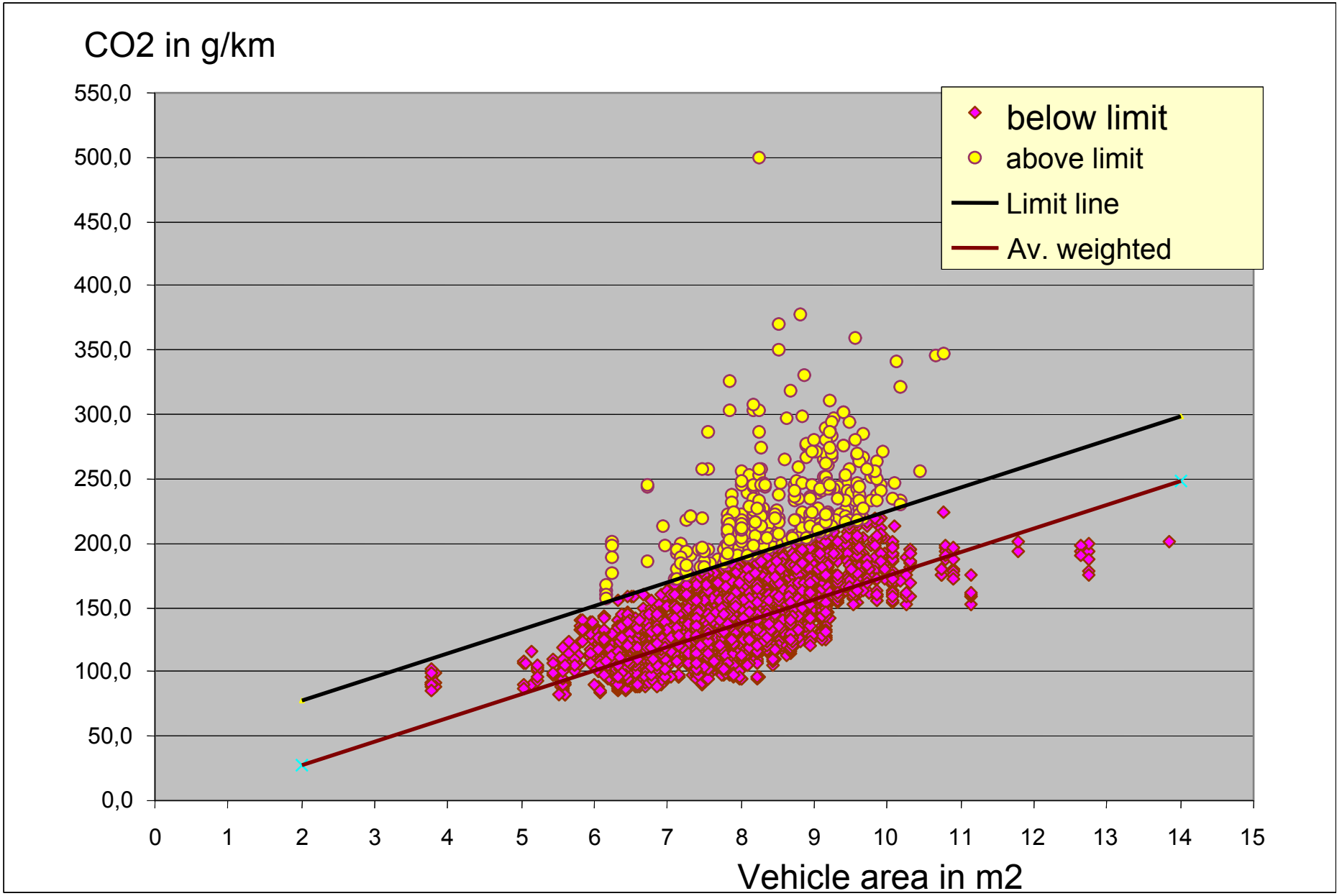
Simulation Results 4-Seater

vehicle:		
mass	[kg]	680 (580+100)
c_w-value	[-]	0.19
front area	[m²]	2.0
rolling restistance	[%]	0.8
engine:		
fuel		Diesel
max. power	[kW]	12.6
at	[U/min]	4000
max. torque	[Nm]	38.2
at	[U/min]	1800 - 2800
starter-generator:		
max. power	[kW]	•5
fuel consumption:		
NEDC	[l/100km]	**1.78**
NEDC (full loaded	[l/100km]	**2.08**
Hyzem 905kg)	[l/100km]	**3.04**
Hyzem (full loaded 905kg)	[l/100km]	**3.42**

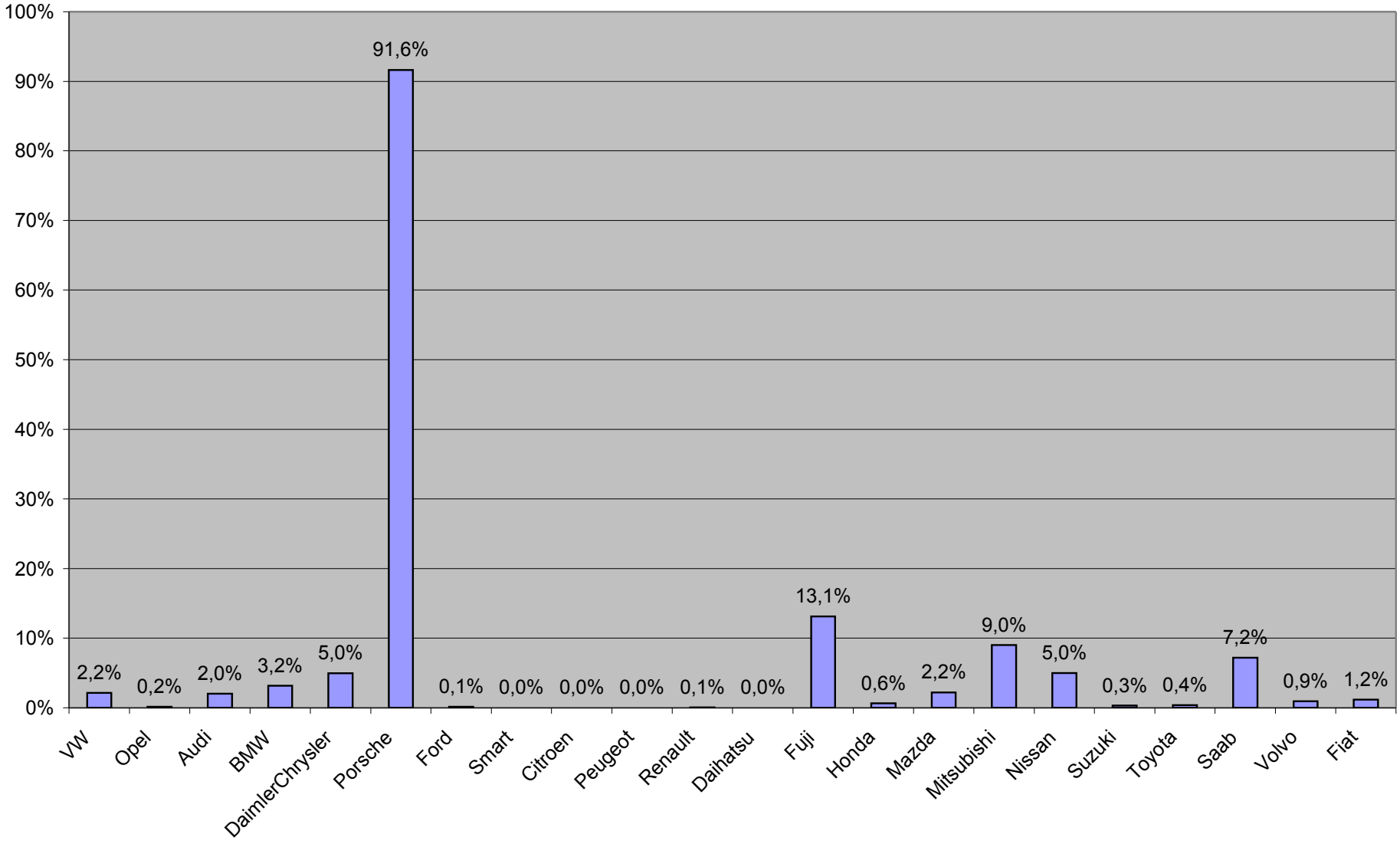
Source: ika

What Parameters for a CO_2 Limit?

Proposal for a CO_{2-} Limit



Share of Vehicles above the Limit Line



Conclusions

There is a clear need to control the carbon dioxide emission as other pollutants.

It should be emission limit per vehicle based on the vehicle area.

It is no need to develop new vehicles.

Only exchange of parts and improvements are enough to meet the 130 g/km target in 2012

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Integrated Approach