



Understanding energy efficiency improvements in road freight transport companies: the example of courier and parcel services

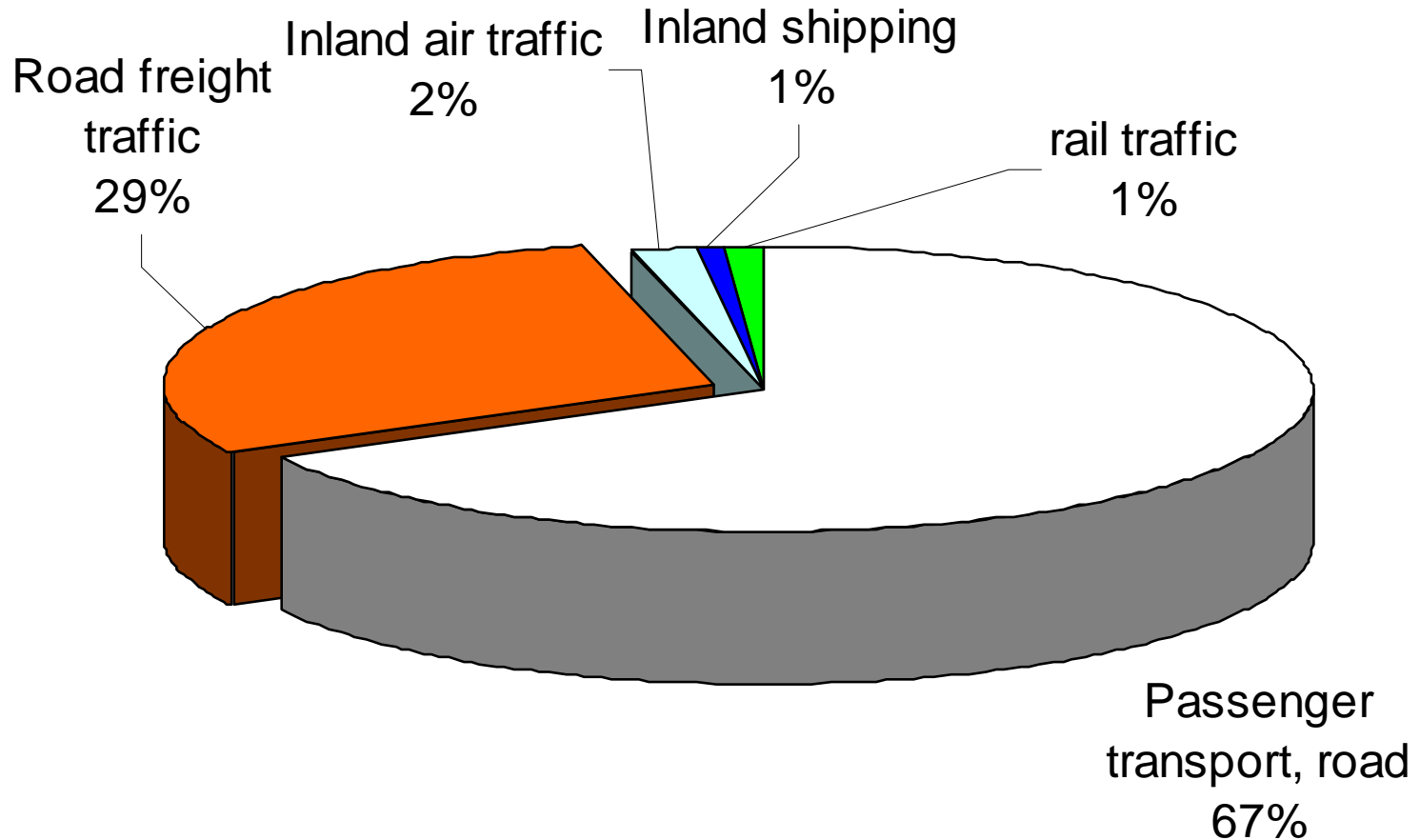
Dr. J. Leonardi, M. Baumgartner, O. Krusch

Berlin, 23 December 2005

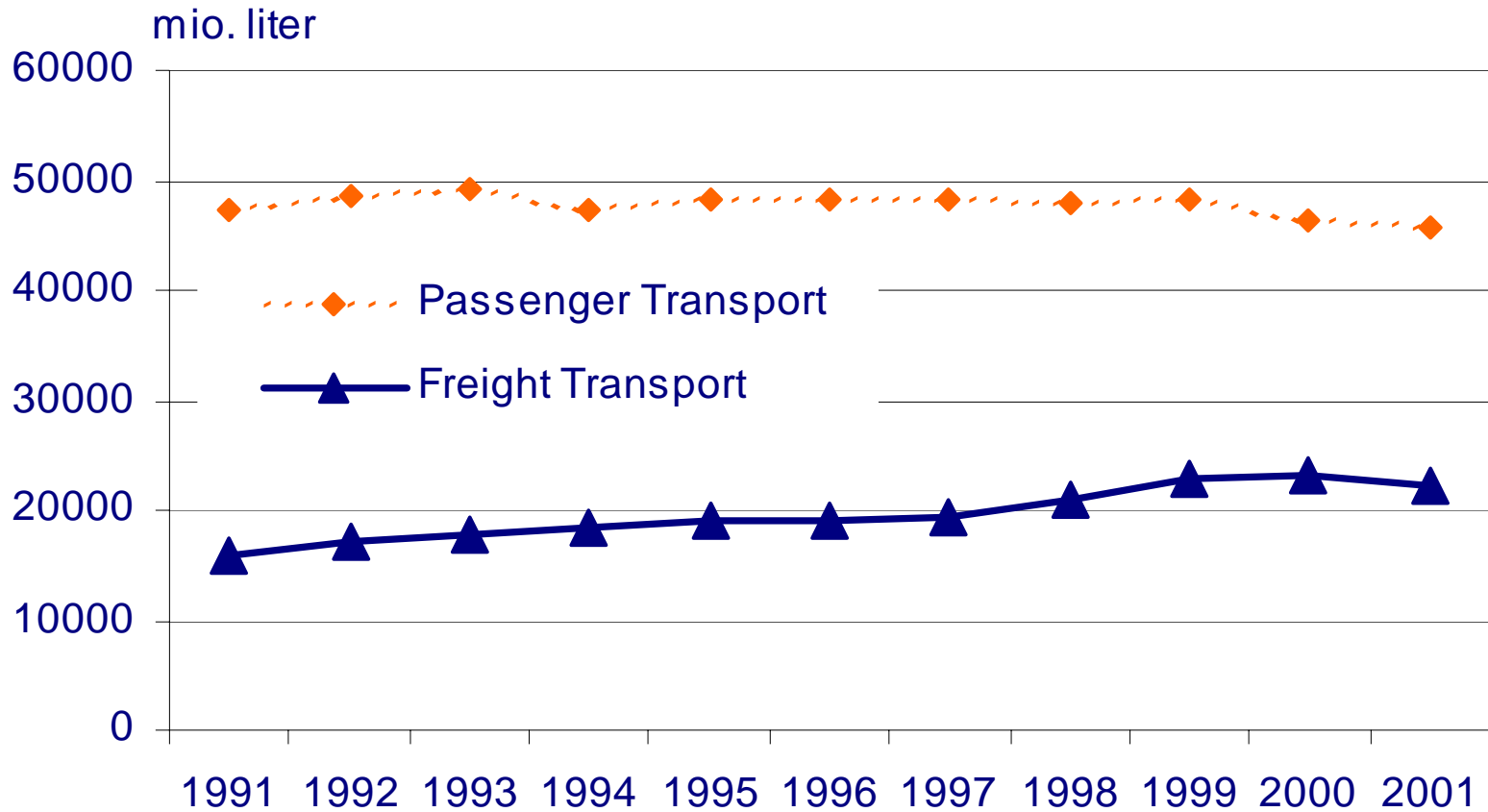
Design: Case studies in Germany

- In total 8 survey samples, 2003 to 2005
- Data and interviews from more than 300 companies
 - logistics and road freight transport sector
 - global player – SME – independent driver
- 3 branches/fields of activity:
 - Container hinterland transport
 - General cargo
 - Courier and parcel services
- 2 types of company measures:
 - Scheduling and telematics systems
 - Formal Co-operation
- 1 General representative survey (basis survey)

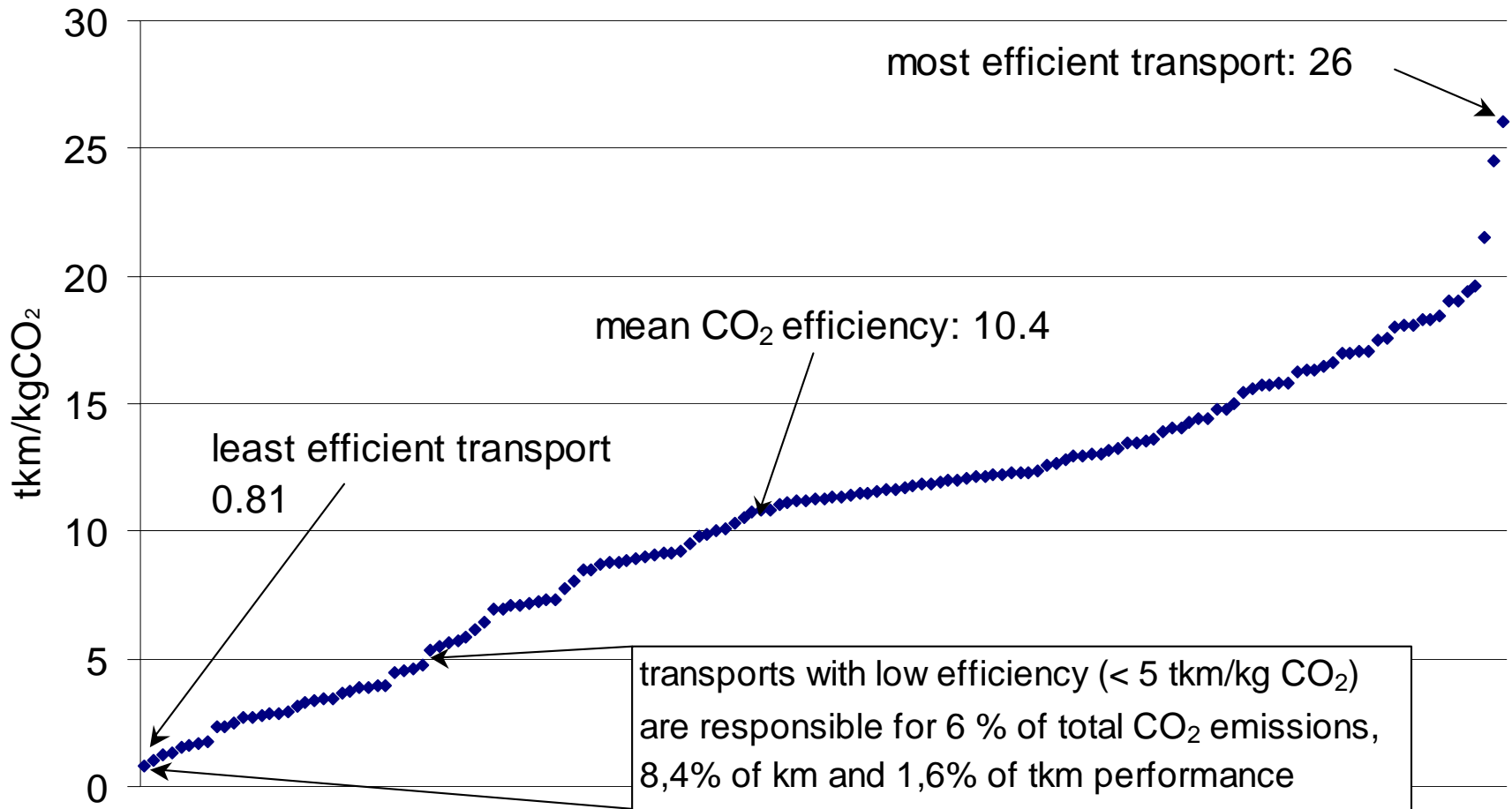
CO₂ emissions according to traffic sectors Germany 2000 (Source: UBA 2005)



Fuel consumption trends in road transportation Germany 1991-2001 (Source: DIW 2004)

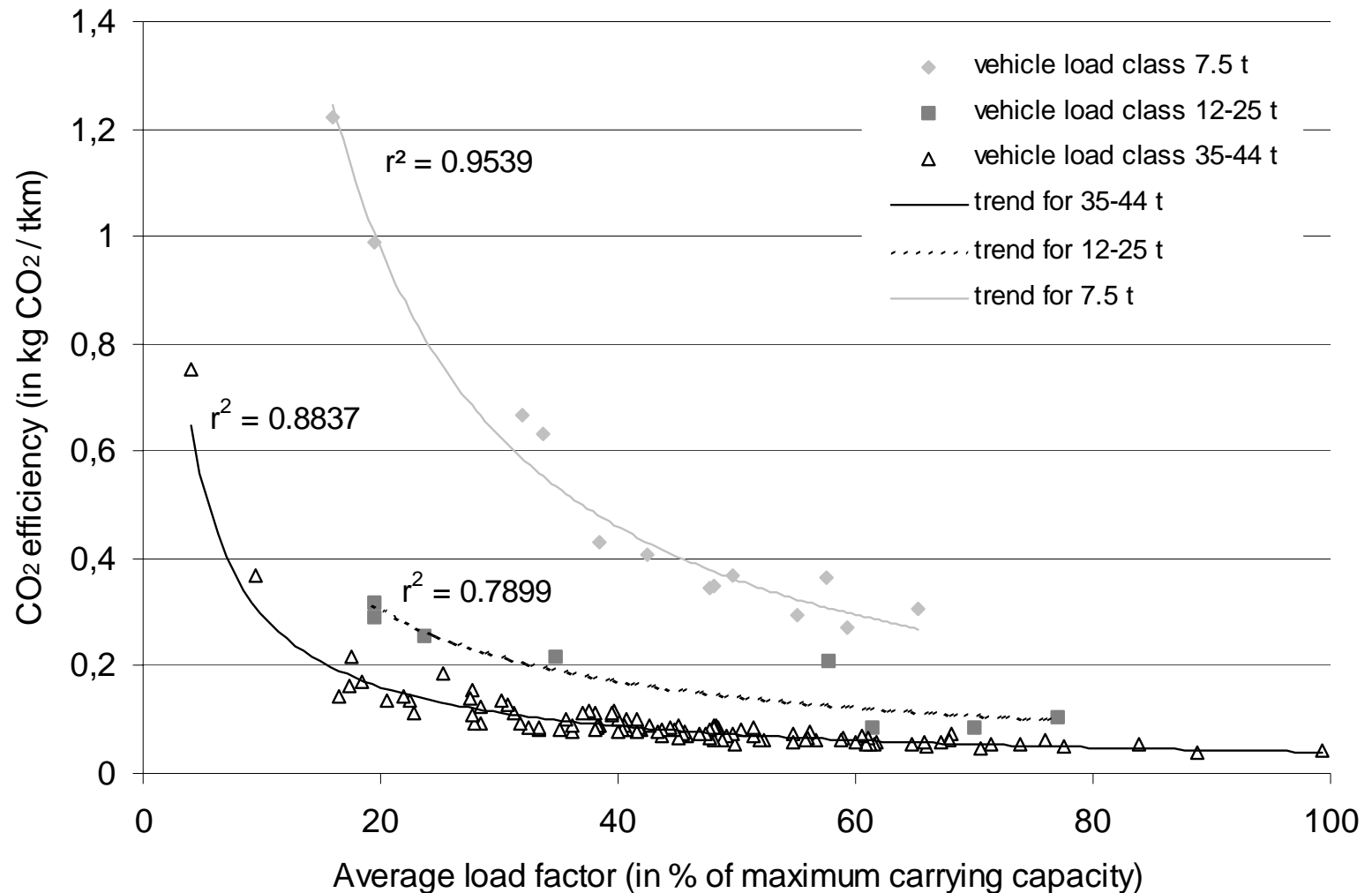


General survey: CO₂ efficiency in tkm/kg CO₂



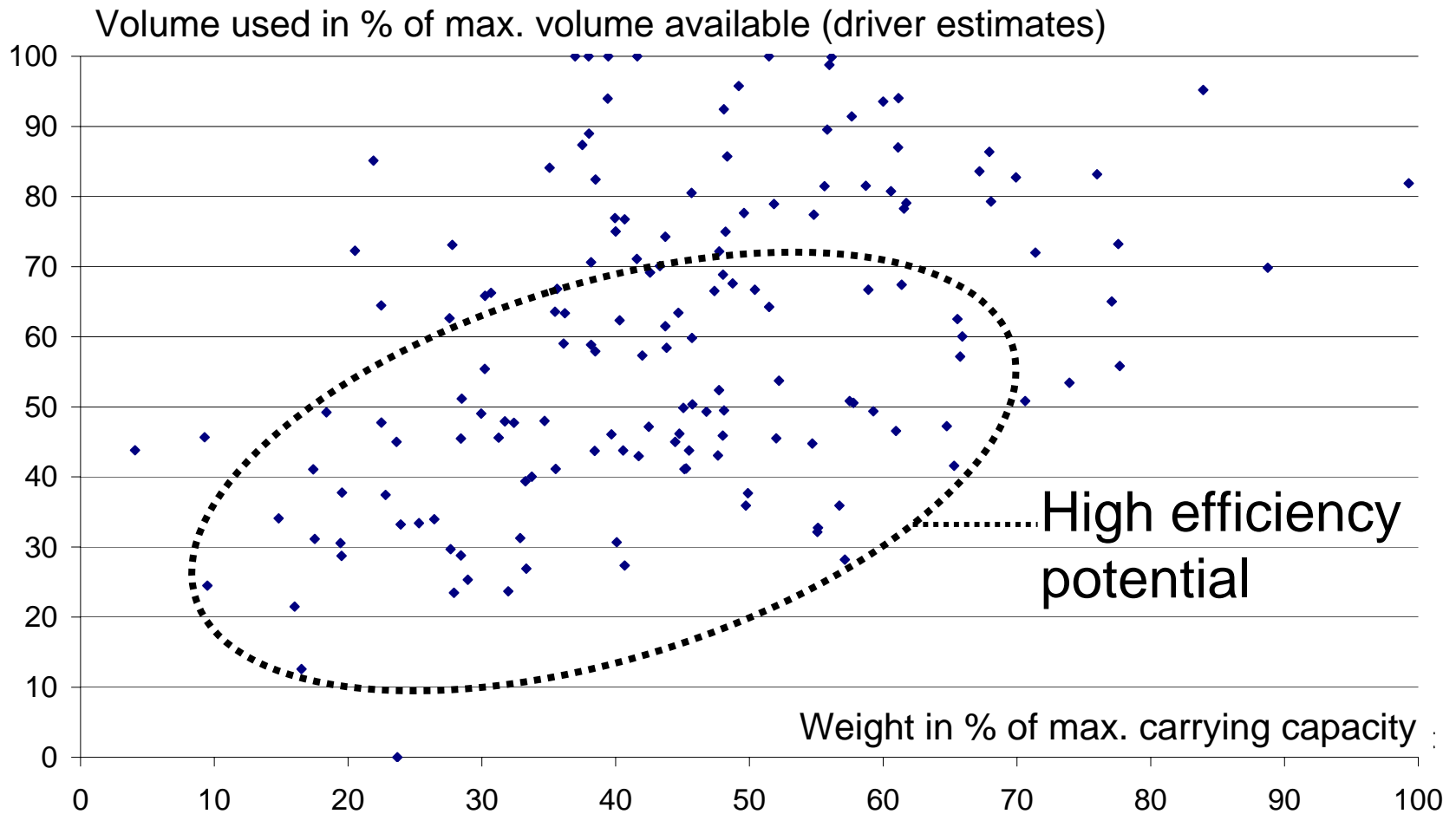
Source: Basis survey 2003

CO₂ efficiency in relation to load factor and vehicle size class



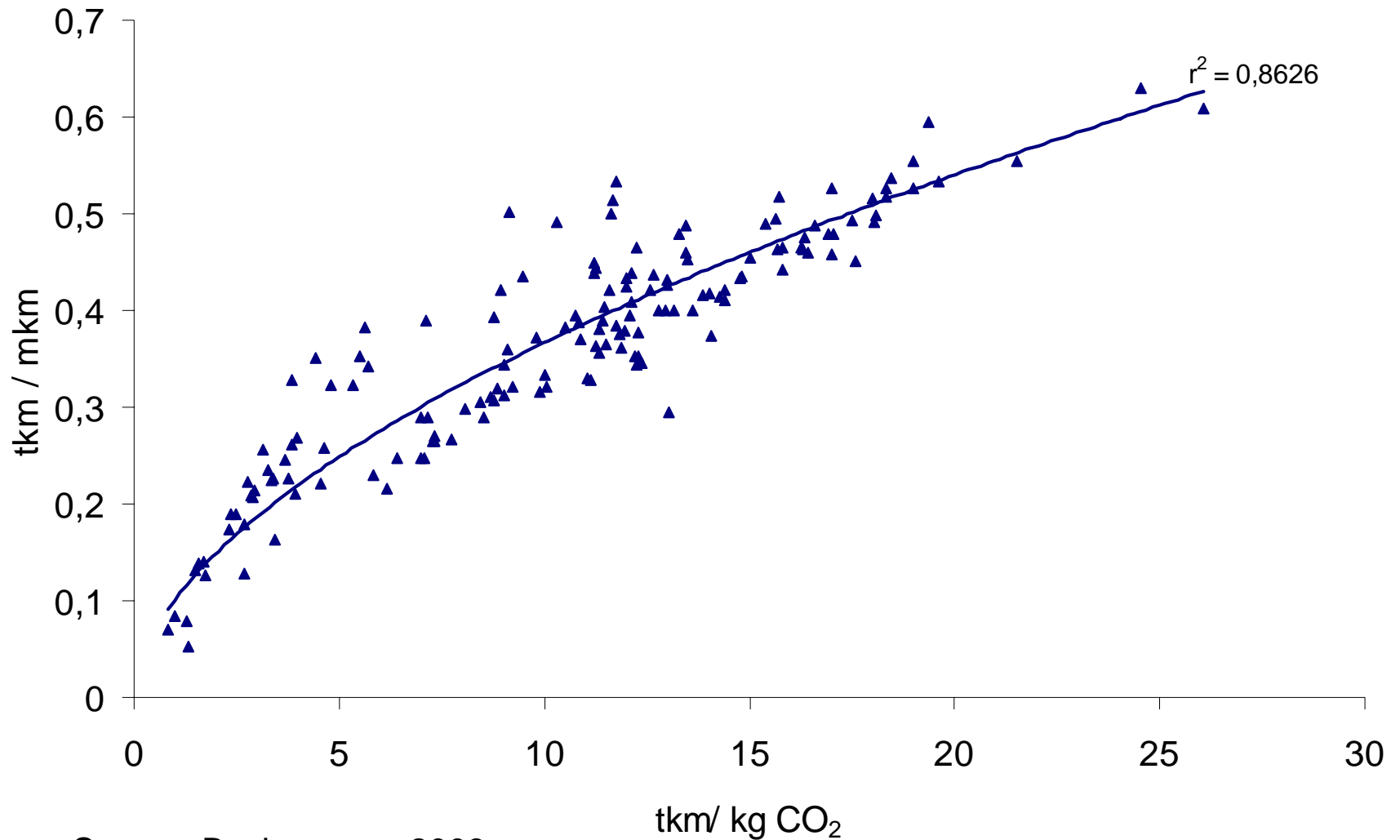
Source: Basis survey 2003

Load factor for volume and weight



Source: Basis survey 2003

Efficiency of vehicle use and CO₂ efficiency



Source: Basis survey 2003

Regression analysis for CO₂ efficiency and potential factors of influence

variables	r²
tkm/mkm and CO ₂ efficiency	0,98
Total CO ₂ and CO ₂ efficiency	0,89
Tkm and CO ₂ efficiency	0,89
Load weight and CO ₂ efficiency	0,87
Volume utilisation ratio and CO ₂ efficiency	0,65
Gross vehicle weight and CO ₂ efficiency	0,57
Mileage and CO ₂ efficiency	0,52
Empty run mileage and CO ₂ efficiency	0,16

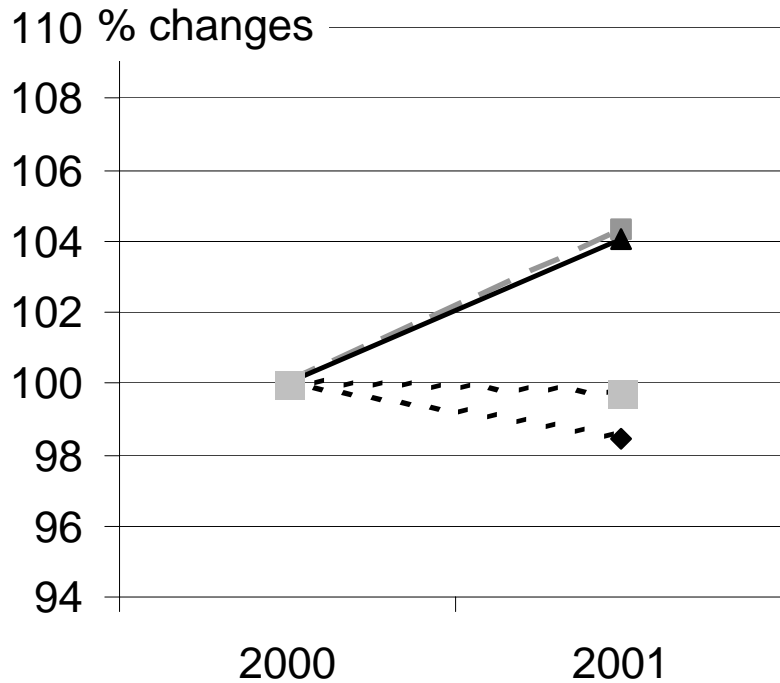
Implementation of existing CO₂ reduction measures in 52 German road freight firms

measure type	% of firms
Technical improvements	53.8
Driver training	51.9
Informal co-operation	40.4
Scheduling with IT	23.1
On-board systems	17.3
others	15.4
Shift to rail/ship	15.4
Scheduling with IT and telematics	9.6
Stacking area optimisation software	5.8
Formal co-operation	3.8

Source: Basis survey 2003

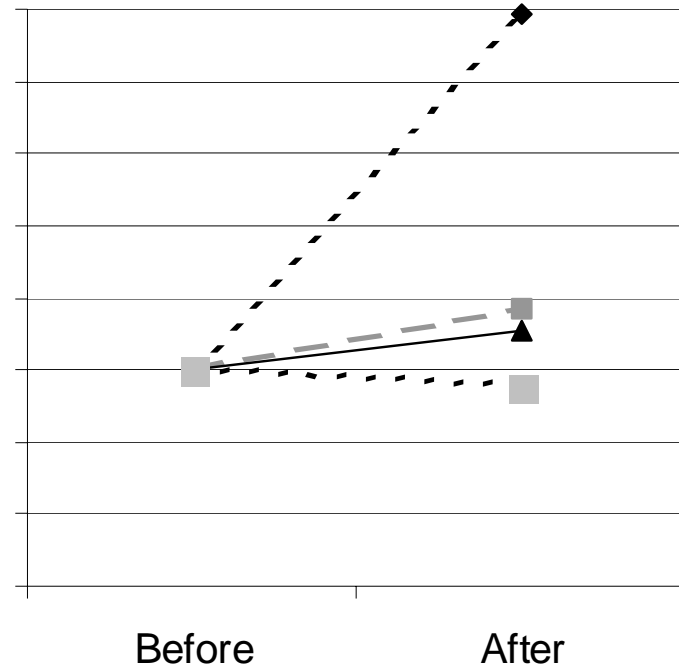
Effect of IT scheduling on t, km and fuel use

German mean 30-40 t trucks



- ◆ - Total load (t)
- ■ - Total distance (km)
- ▲ - Total fuel use (l)
- ■ - Mean fuel use (l/100km)

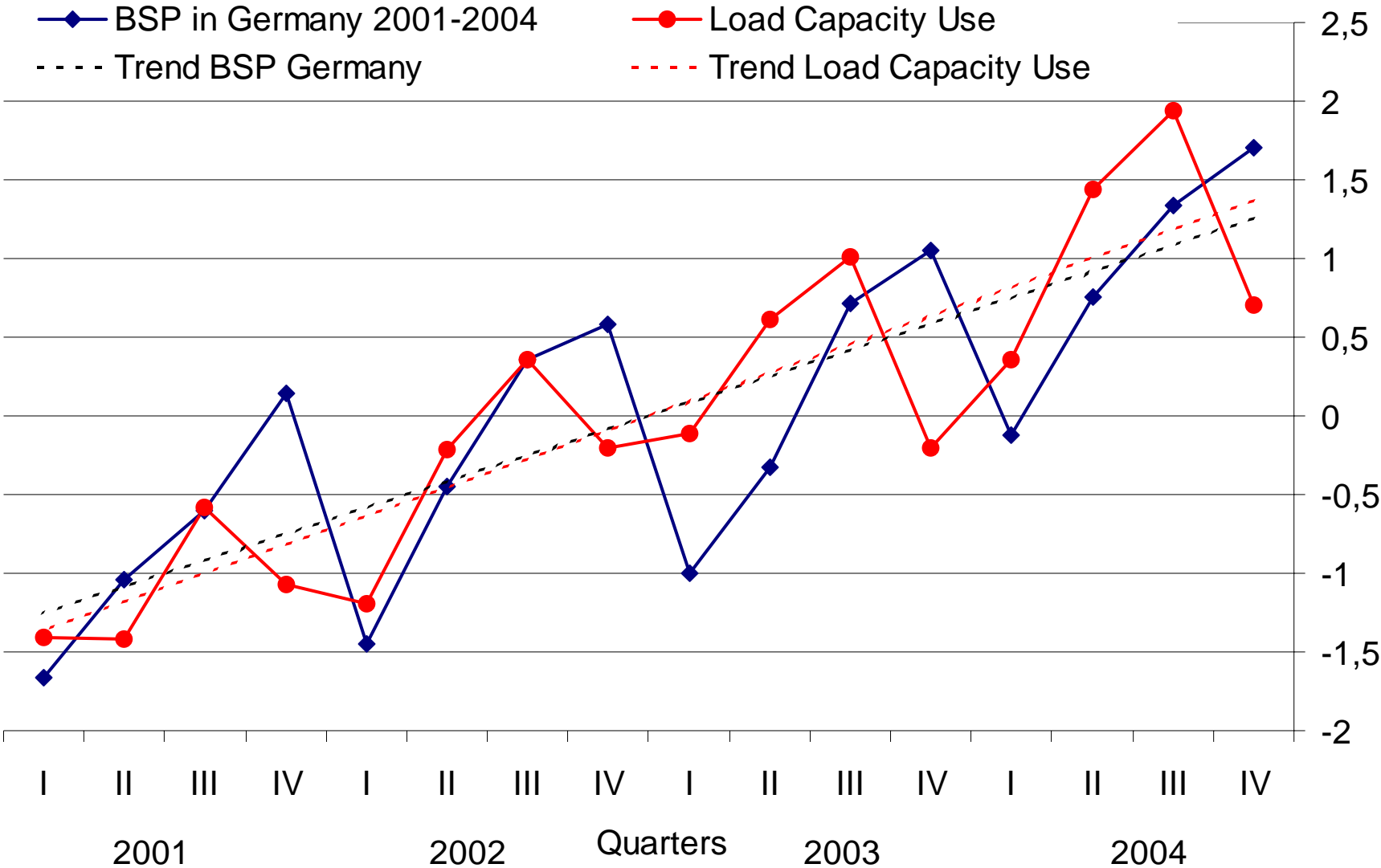
Sample with IT scheduling



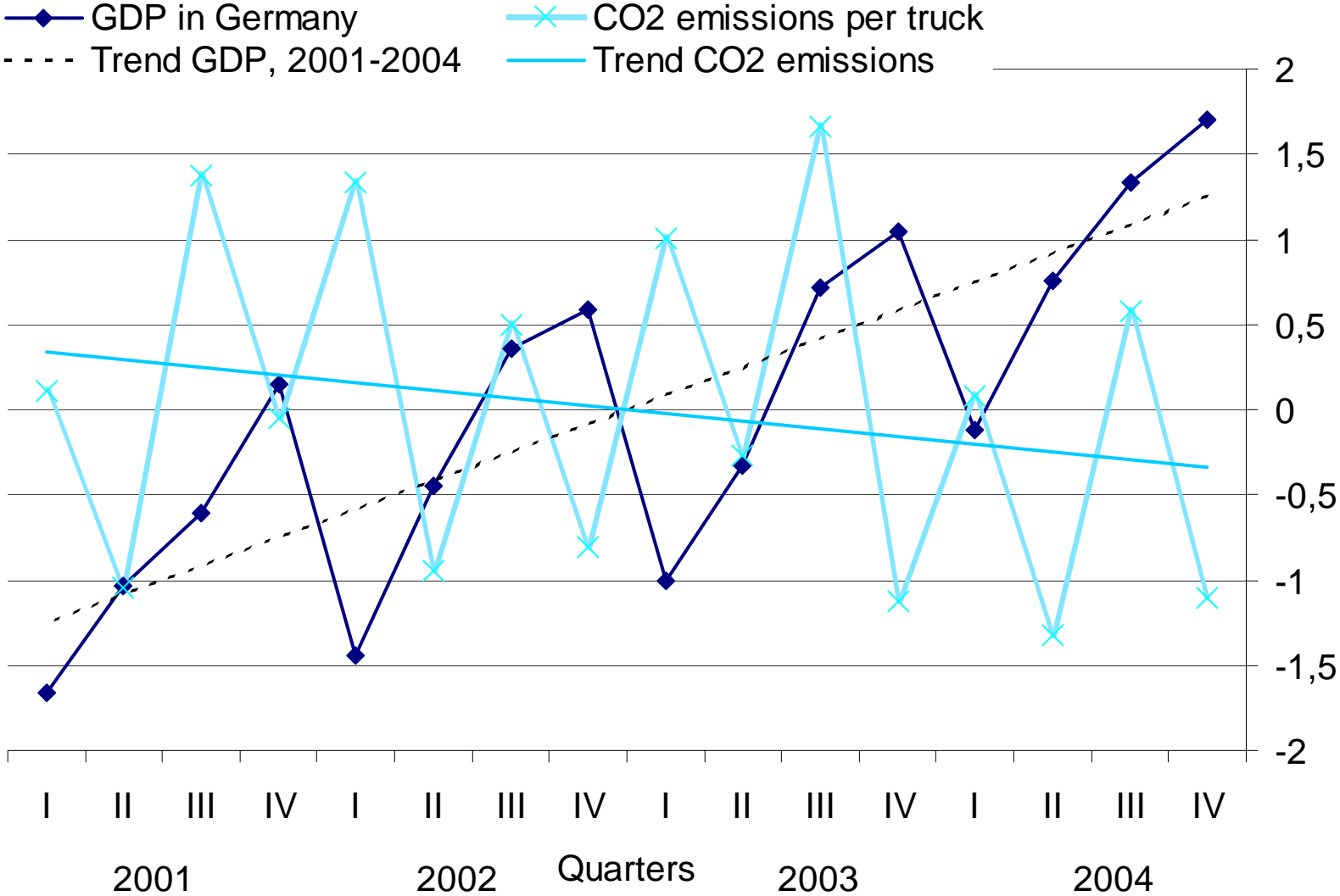
Source: IT-Scheduling Survey 2003
Stat. Bundesamt 2004
Leonardi & Baumgartner, TRD 2004

GDP growth and load factor (weight)

Source: Survey 2005: Company trend 2001-2004 South Germany
1.931 truck performance data, standardised **quarter** means

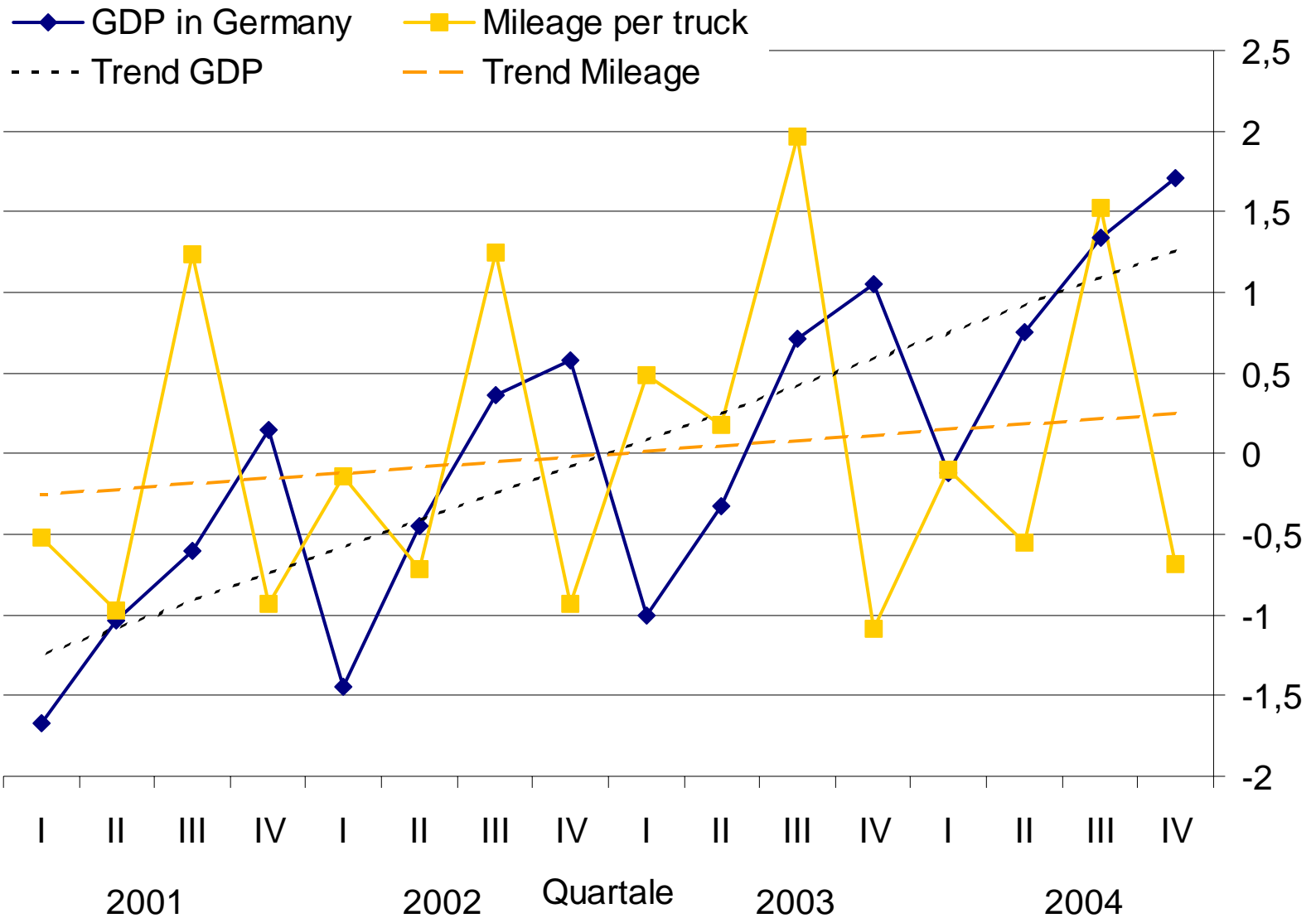


GDP growth and CO₂ emissions per truck



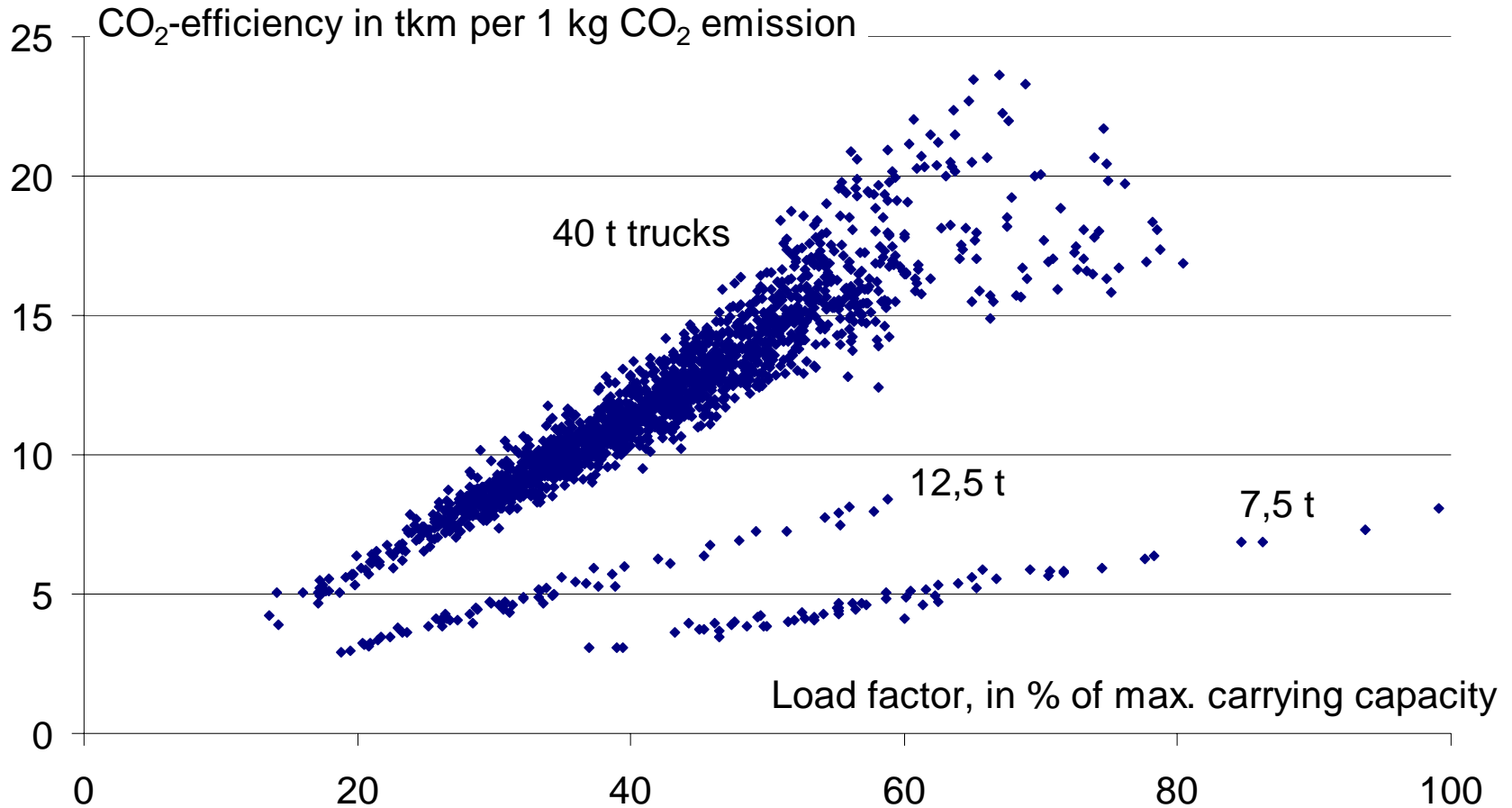
Source: Survey 2005

GDP growth and mileage per truck



CO₂ efficiency and load factor

1.931 truck **monthly** means 2001-2004

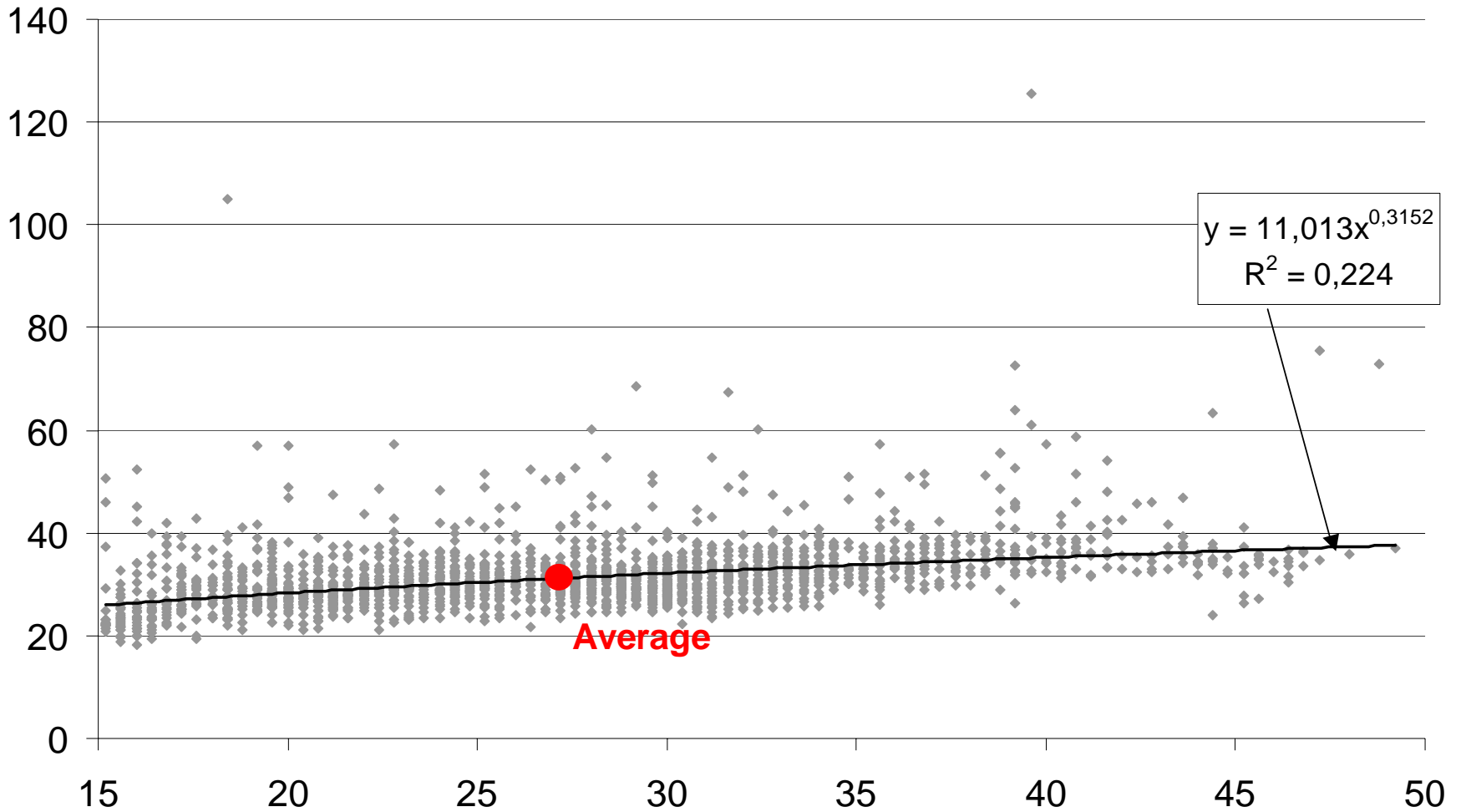


Source: Survey 2005

Consumption factor

Source: Survey 2005: 2110 **daily** means for fuel use and total vehicle weight (40t trucks)

Litres/100km



Gross vehicle weight in tons for each trip (mostly one day) June-Sept. 2004

Courier survey 2005

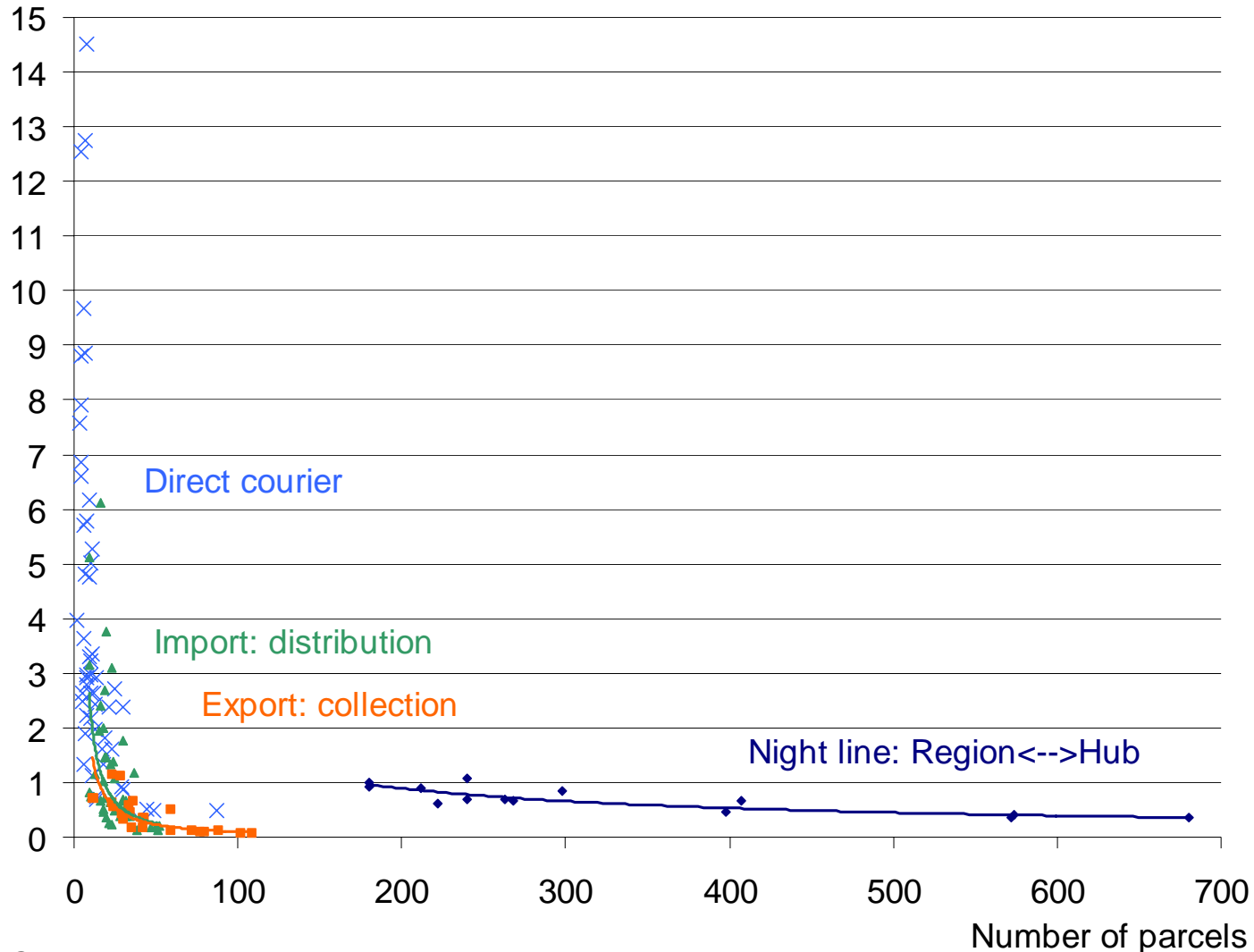
- 16 interviews in companies (+4 experts)
- Measurements in March and April

- Sample in one station of one large company (3000 vehicles, 60 stations)
 - Import (Distribution): 48 Day trips
 - Export (Collection): 24 Day trips
 - City (Direct courier transport): 53 Day trips
 - Night line: 14 Night trips
 - = Total: 139 Datasets
- Variables collected per day or per trip
 - Shipment (Number of parcels/packages)
 - Road performance (km)
 - Gasoline use (litre)
 - Time
 - Vehicle data (type, empty weight)

Stopp Abfahrt	Teilstrecke Sendungen		Sendungen zugeladen	Sendungen an Bord	Teilstrecke skm	Beladung in kg	Teilstrecke tkm	Gewichtsauslastung in		Betankung
	km	km abgeladen						mkm	%	
1	69275	0	392	0	0	0	0	0		
2	69640	365,0	392	180	143080,0	1568	572,32	1371,67	120,615	
3	69642	2,0	0	0	360,0	720	1,44	5,82	55,385	54
4	70011,0	369,0	180	0	66420,0	720	265,68	1073,79	55,385	
5	70019,0	8,0	0	0	0,0	0	0,00	17,52	0,000	63

Number of parcels per day-trips and mean energy efficiency (1 parcel = 1 package)

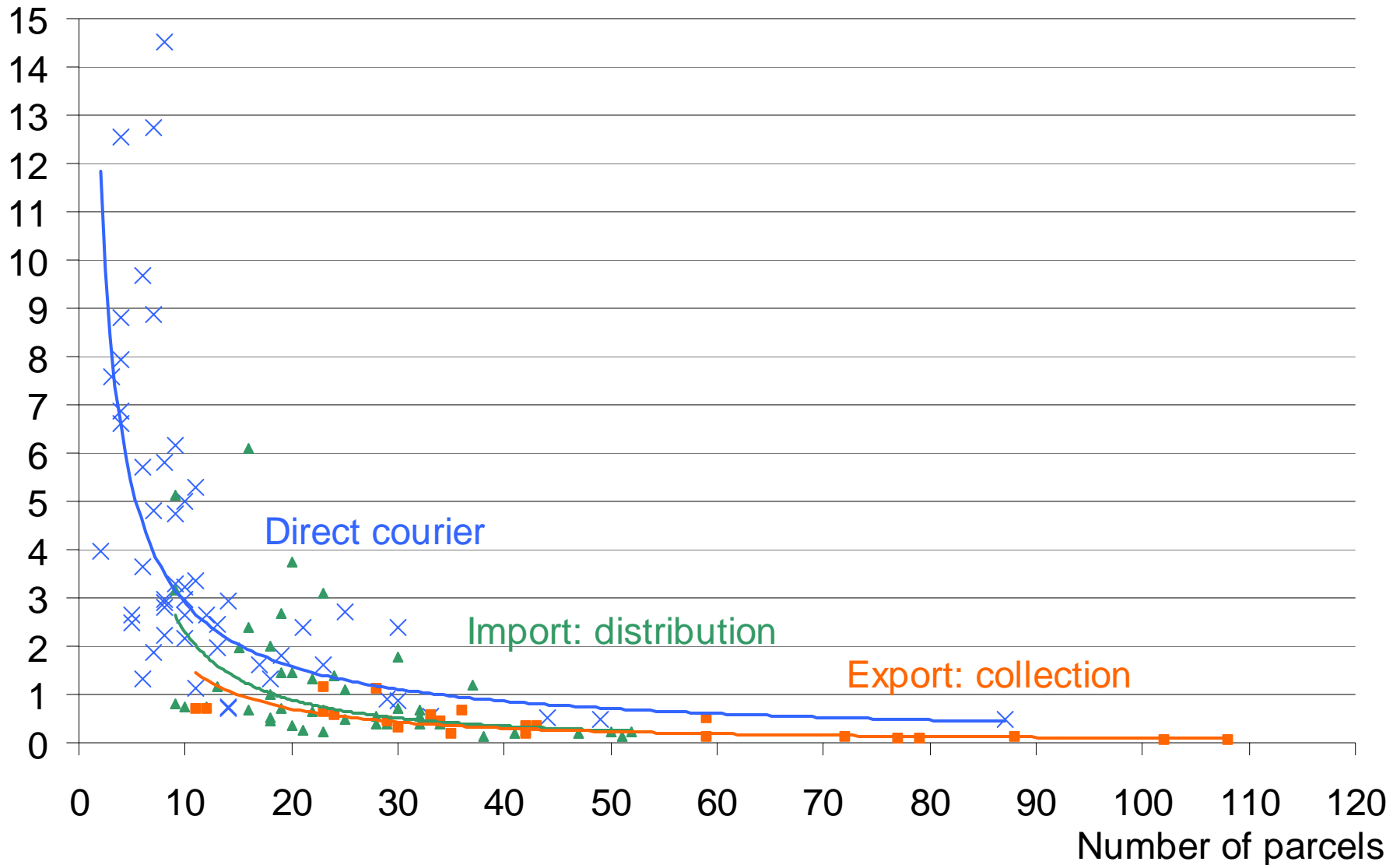
Efficiency in kg CO₂ per parcel



Source: Courier survey 2005

Number of parcels and mean efficiency

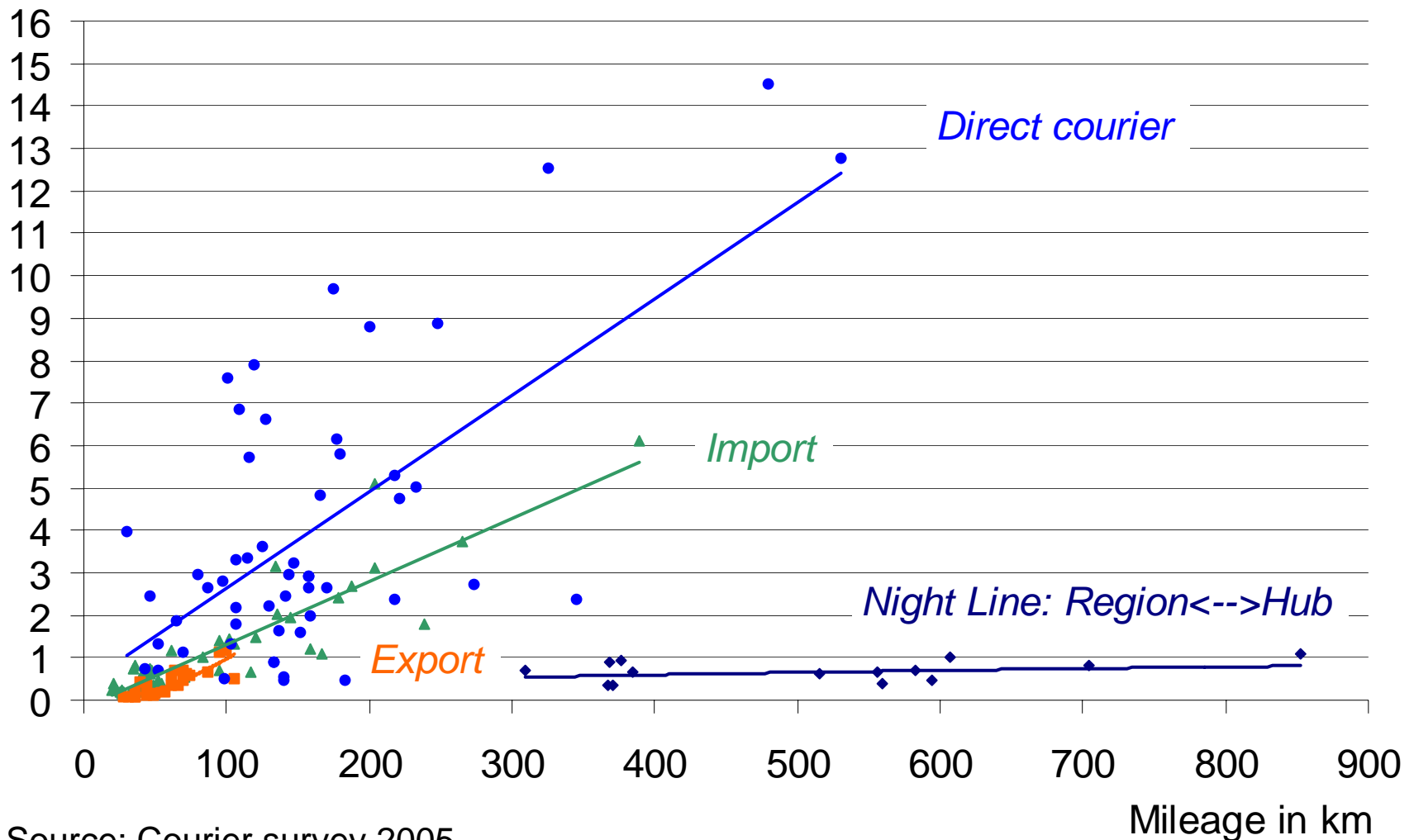
Efficiency in kg CO₂ per parcel



Source: Courier survey 2005

Mileage per trip and CO₂ efficiency

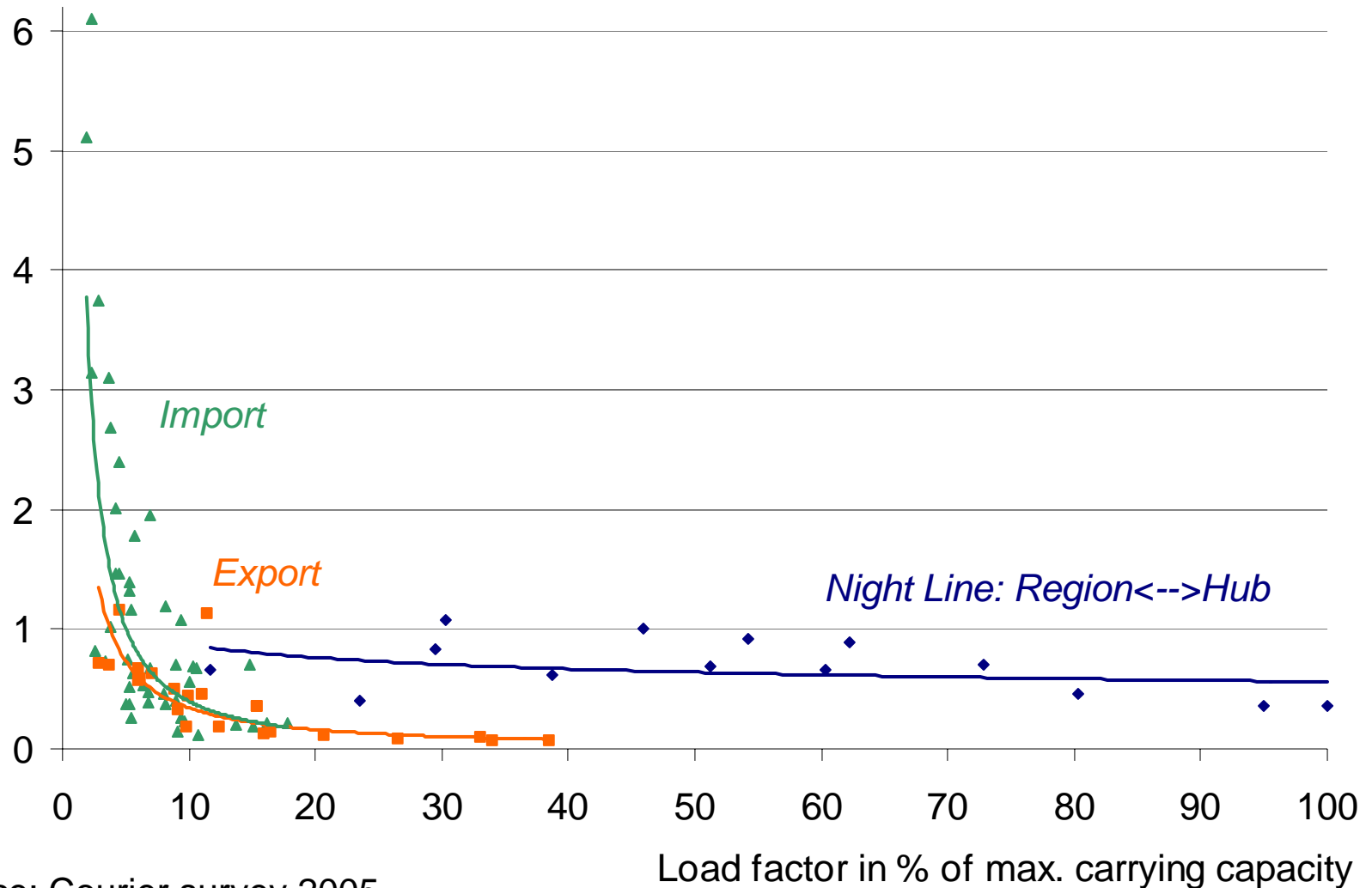
Efficiency in kg CO₂ per parcel



Source: Courier survey 2005

Load factor and efficiency I

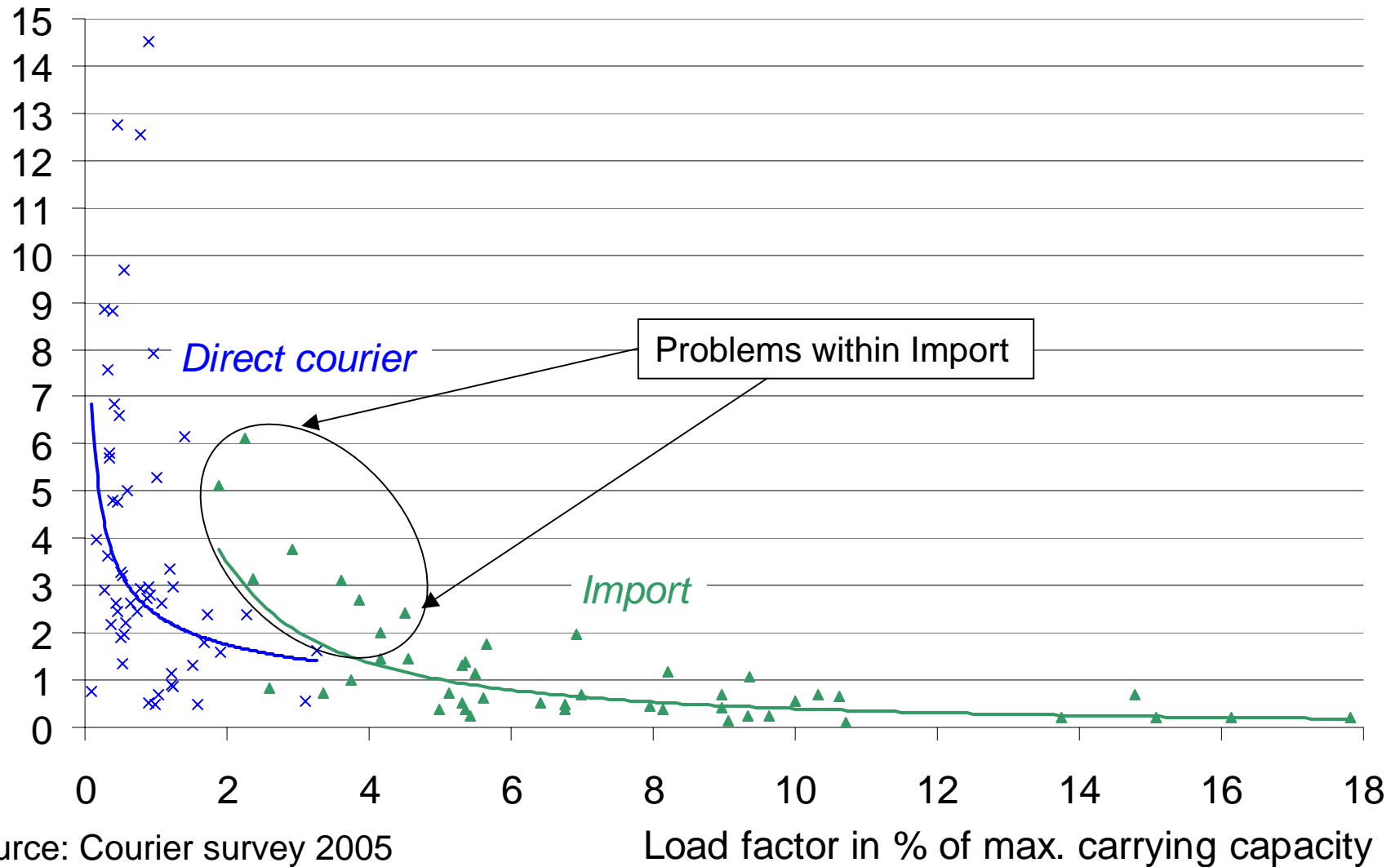
Efficiency in kg CO₂ per parcel



Source: Courier survey 2005

Load factor and efficiency II

Efficiency in kg CO₂ per parcel



Source: Courier survey 2005

Minimum and maximum daily means for efficiency in kg CO₂ per parcel

	Minimum	Maximum	Factor
Export (Region Hamburg (HH))	0,06	1,15	19
Night line (Germany)	0,4	1,5	3,7
Import (Region HH)	0,11	6,10	55
<i>Total Overnight (Germany)</i>	<i>0,57</i>	<i>8,75</i>	<i>15</i>
Direct courier (HH)	0,47	14,52	31

Source: Courier survey 2005

Costs

Fuel costs per parcel

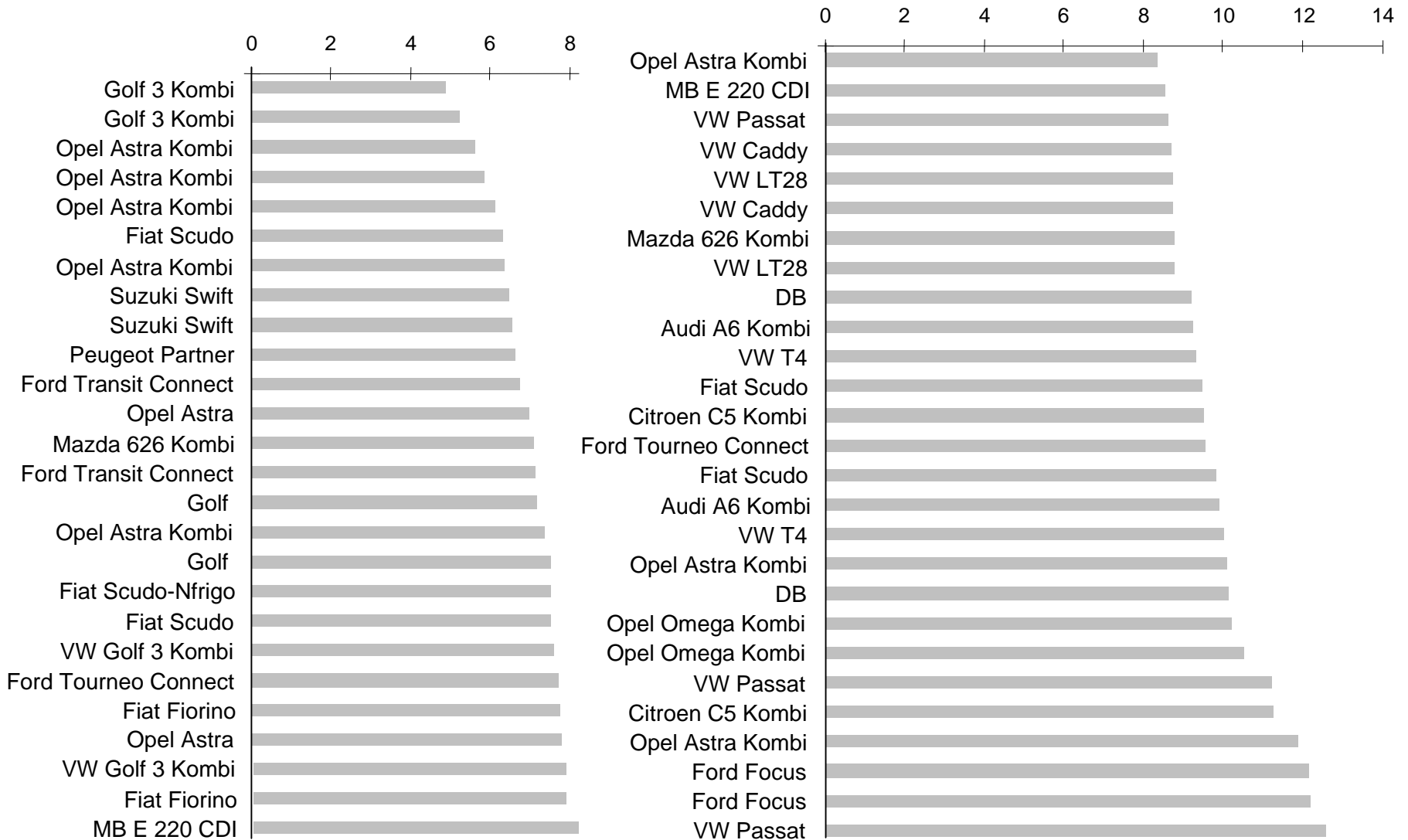
	Min	Max
Overnight	0,23 €	3,61 €
Direct courier	0,19 €	6,00 €

Average parcel delivery price, Germany 2005: 9,- €

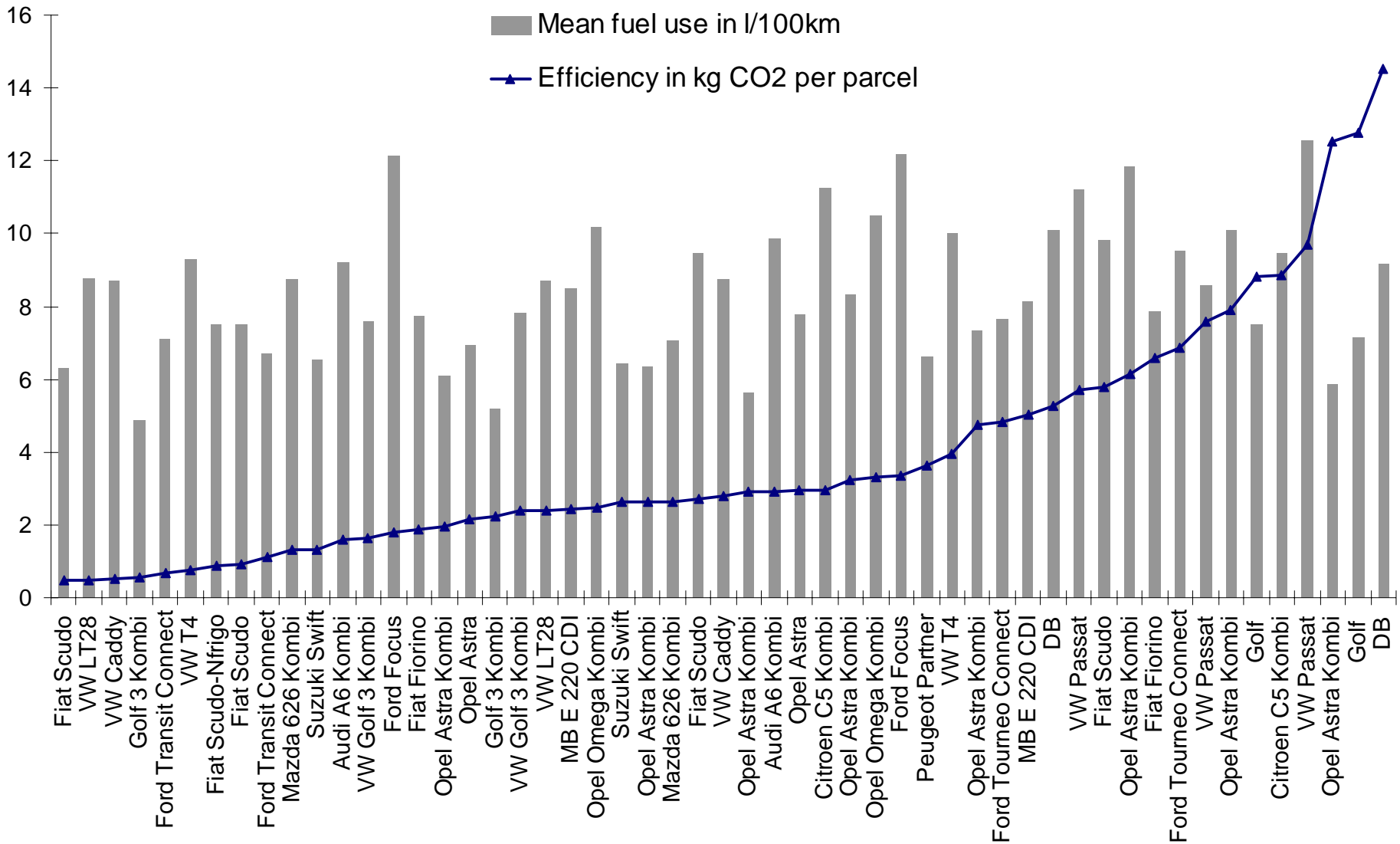
Fuel costs in relation to total revenues per parcel (estimates)

- Overnight: 2,5% - 40,1% (min-max)
- Direct courier: 2,1% - 66,6%

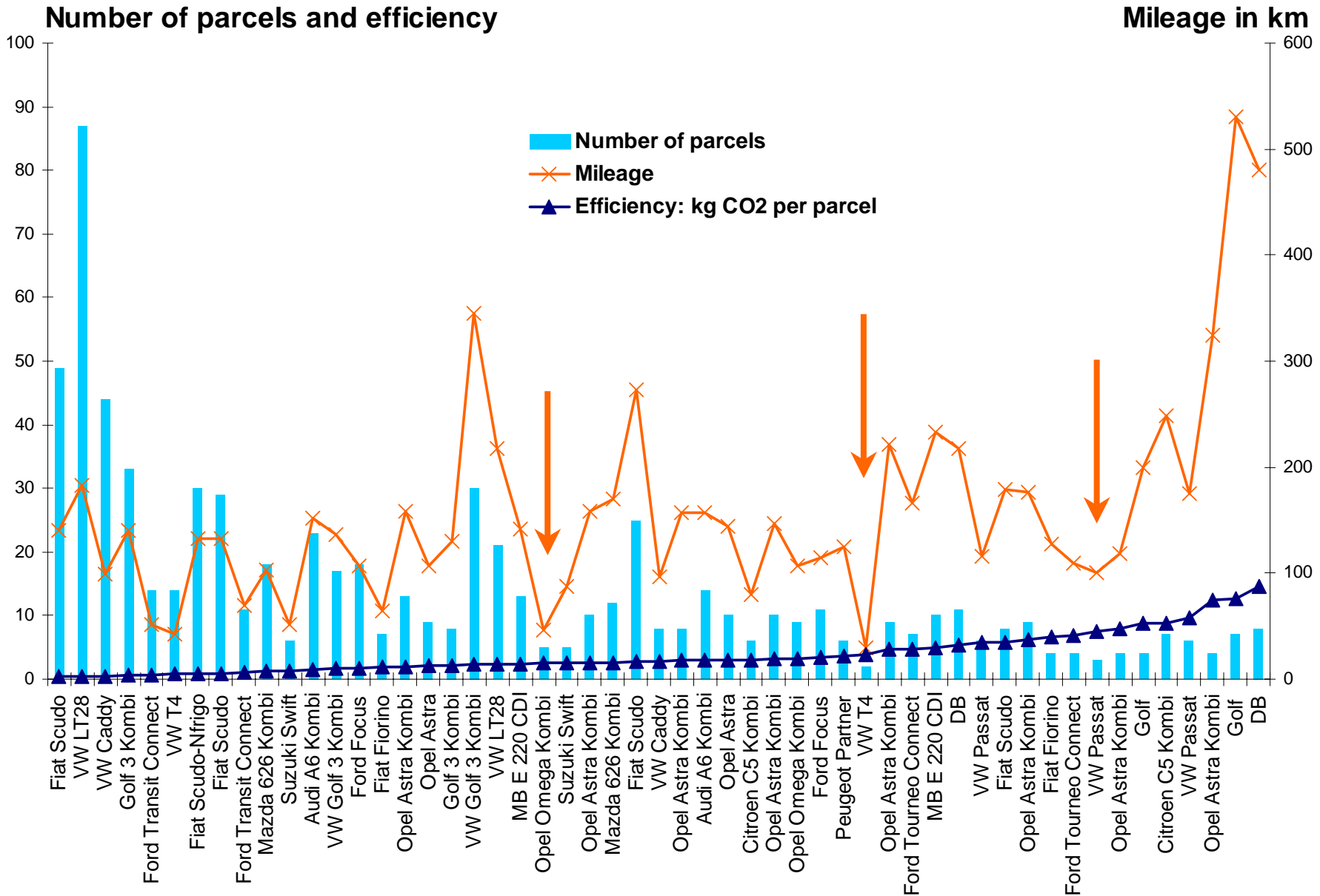
Direct courier: Fuel use in Liter/100 km



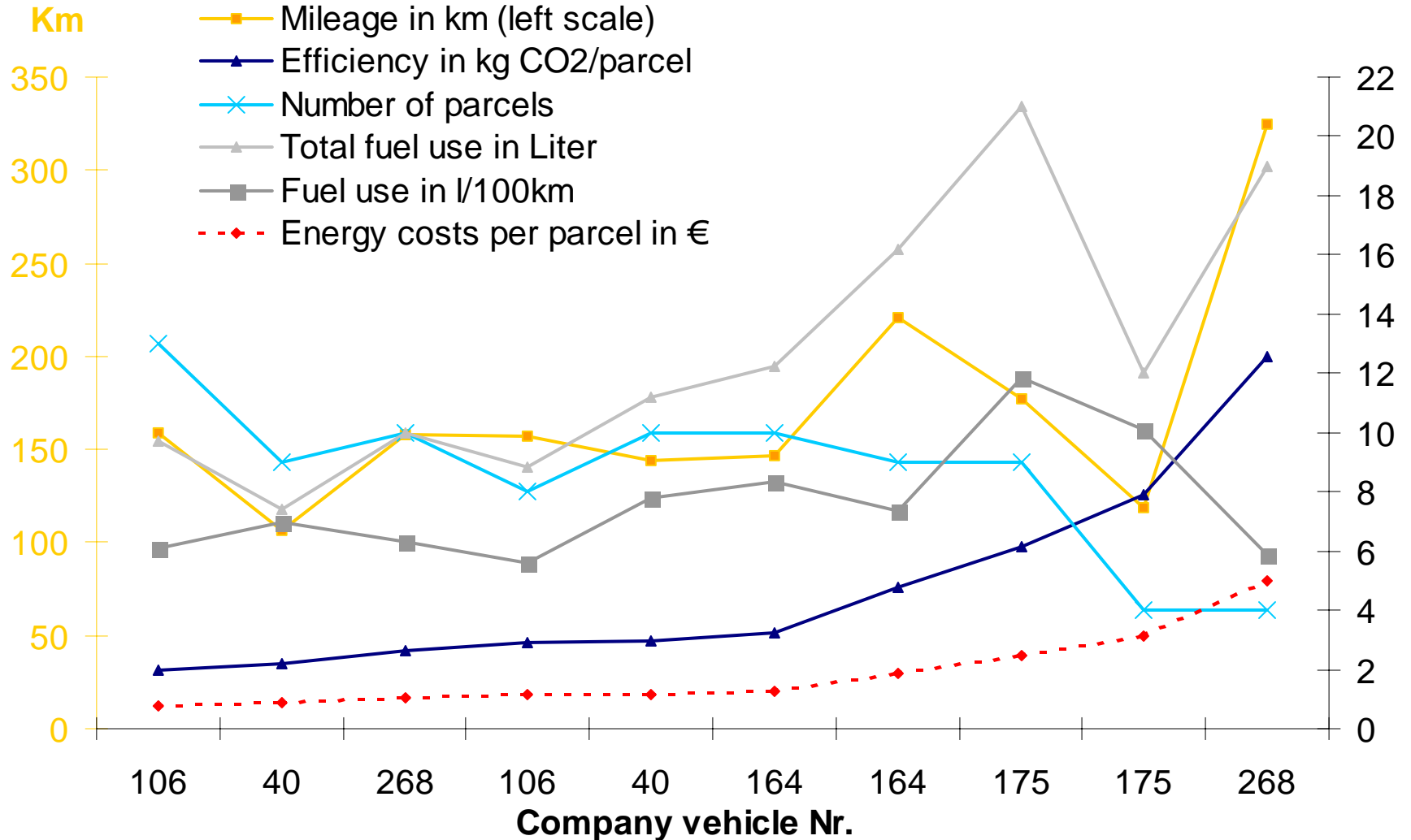
Direct courier: Fuel use and efficiency



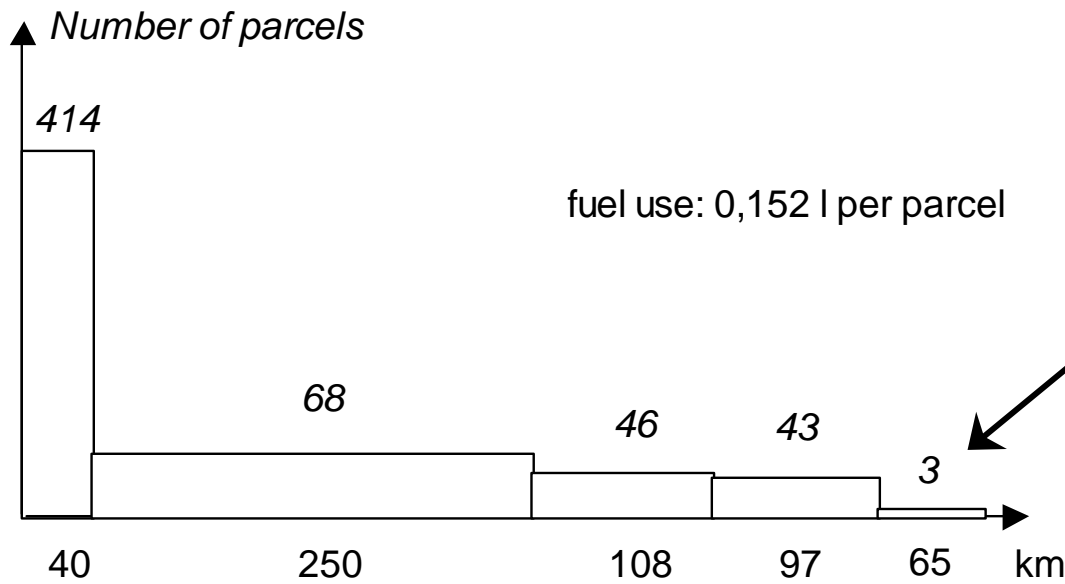
Direct courier: Vehicle analysis



Efficiency analysis Opel Astra

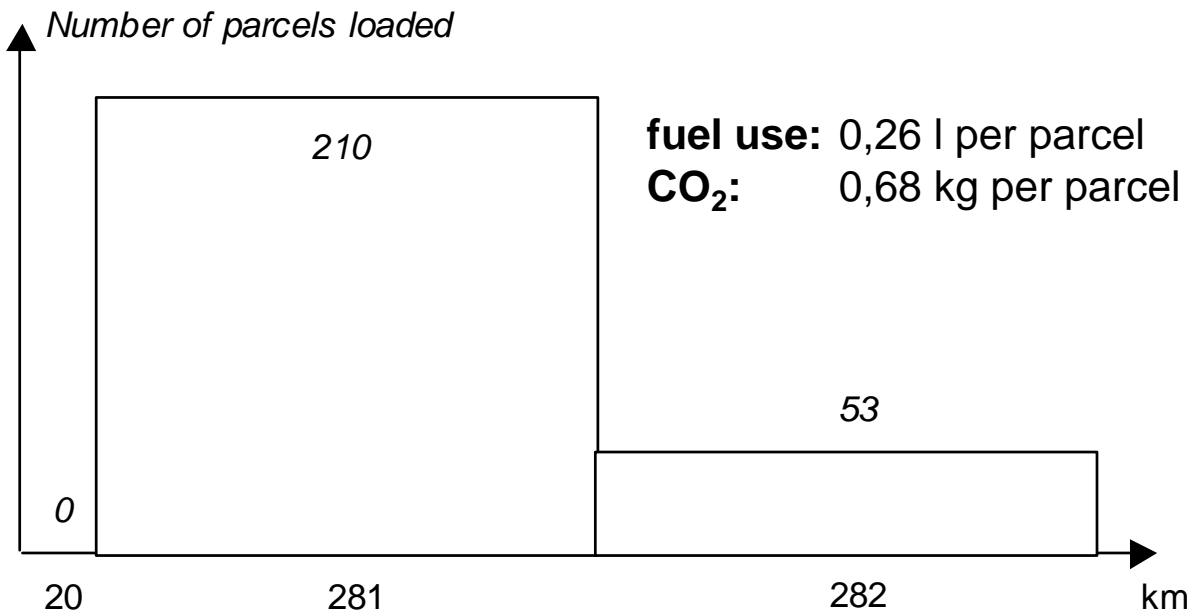


Source: Courier survey 2005

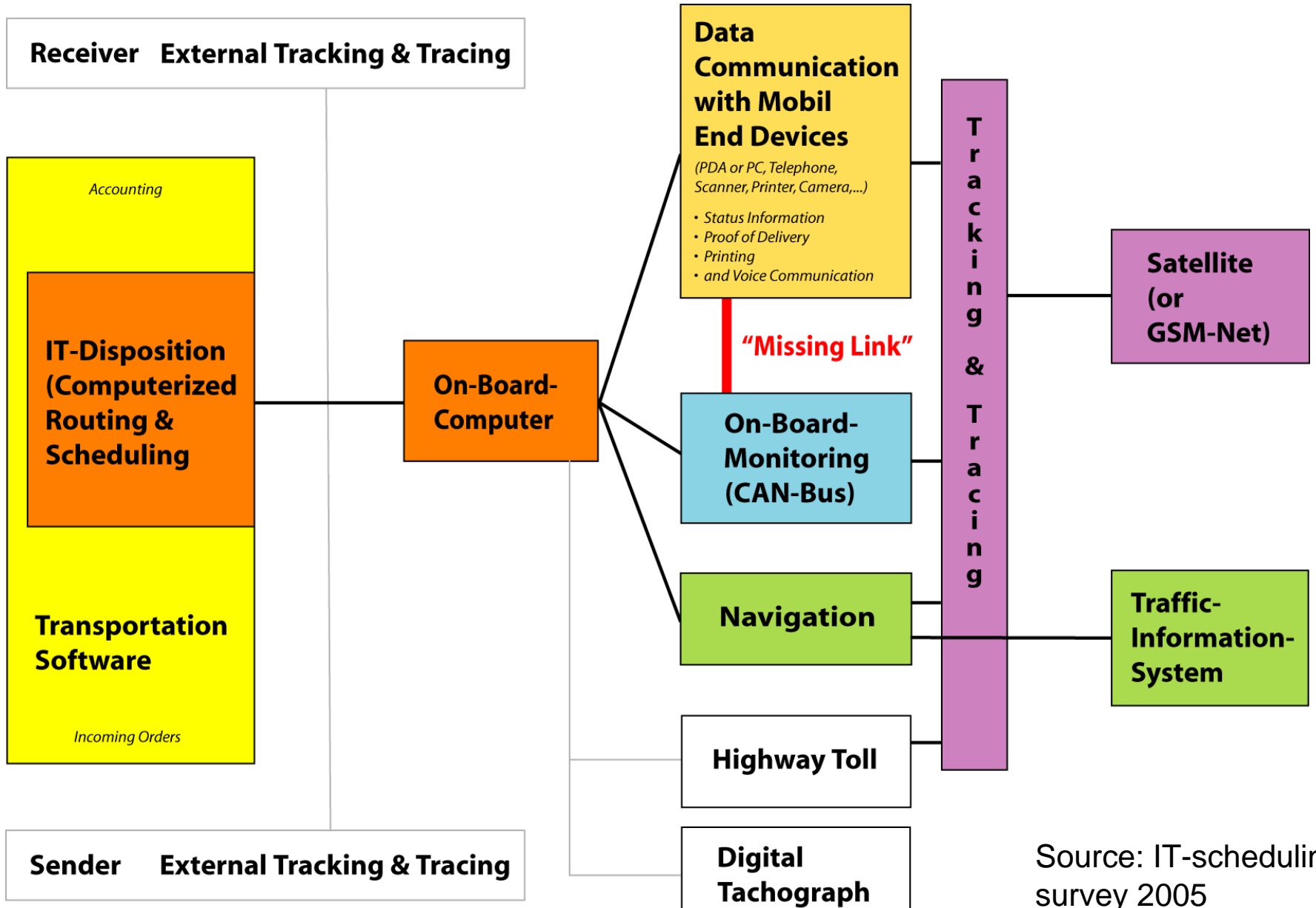


Fuel used only for the last 3 parcels = 8,5 l (2,8 l per parcel)

Two cases of night transport between hub and regional centers



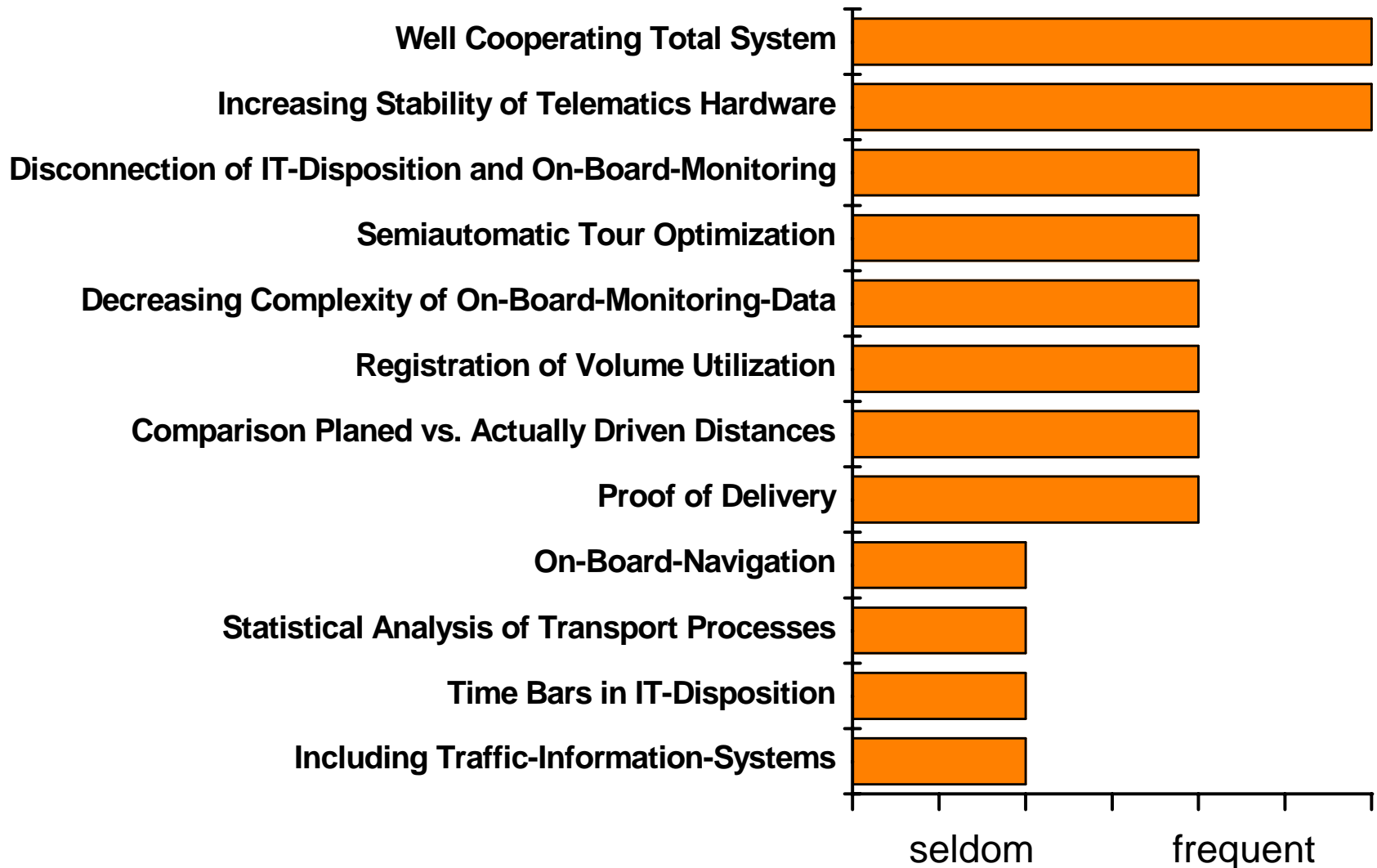
Scheduling and telematics technologies



Source: IT-scheduling survey 2005

Scheduling and telematics technologies:

Current topics named by experts in survey 2005



Source: IT-scheduling survey 2005

Analysis for parcel service: transport operations (fleet, vehicle, driver) I

Potentials identified

- Education of drivers
- Technical optimisation of trucks and vehicles
 - Substitution of classic fuels with bio-diesel or natural gas
 - Onboard monitoring systems (fuel consumption, load capacity)
 - Further technologies (bar code scan etc.)
- Market (in)transparency for efficiency measures

Analysis for transport operations II

- **Problems**

- Structure of the sector is an obstacle for more efficiency measures
- Cost-benefits analysis is still not performed for many instruments
- Variations in load factor complicate the identification of potentials

- **Solutions and approaches (to activate the potential)**

- Increase the quality of market information for efficiency technologies
- More co-operation between transport operators, constructors and technology supplier on solutions
- Take influence on fleet and drivers through awareness of clients and forwarders

- **Benefits**

- Improved income situation at the level of transportation systems
- Low environmental pressure as marketing instrument? (e.g. bike courier)

Analysis for organisation efficiency I

Potentials identified

- Co-operation with other companies
- Use of telematics and IT-scheduling systems
 - Navigation systems
 - Optimise vehicle (fleet) to the order (situation)
 - Quality of data in the vehicle communication
 - Further technologies
- Combine transport & other services
- Specialists could cover some potentials in special business types

Analysis organisation II

- **Problems**

- Co-operations are already well developed
- Exclusivity of courier transport service as main quality
- Limits between products
- Thinking in labels
- Structure of the sector (transport separated from organisation)
- IT-System not very user friendly

- **Solutions and approaches**

- New products – user / customers / IT supplier

- **Benefits**

- Improvements in economic and ecological efficiency

Thank you for your attention!