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Energy consumption and CO_2 emissions of road transport as part of the NAMEA compilation strategy

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List of abbreviations

CCC	= cubic capacity class
CPA	= Classification of products by activity
DK	= diesel fuel
EB	= energy balance
HGV	= heavy goods vehicles
IOT	= input- output table
LDT	= light duty trucks
LPG	= liquified petroleum gas
TT	= trailer trucks
WZ	= homogeneous branches
AGEB	= Working Group on Energy Balances
DIW	= German Institute for Economic Research, Berlin
EEA	= Environmental-Economic Accounting
IFEU	= Institute for Energy and Environmental Research, Heidelberg
KBA	= Kraftfahrtbundesamt (Federal Motor Transport Authority), Flensburg
TREMOD	= Transport Emission Model
KiD	= Kraftverkehr in Deutschland (Motor Transport in Germany) (transport survey)
MiD	= Mobility in Germany
ViZ	= Verkehr in Zahlen (Transport in figures) (publ. DIW Berlin)
Km	= kilometres
l	= litres
mn.	= millions
bn.	= billions
t	= tonnes
tkm	= tonne kilometres

1 Objective and calculation concept

When analysing energy consumption, greenhouse gases and air pollutants the transport sector is of great importance. Motorised road transport in particular is a major source of greenhouse gases. In 2008 the CO_2 emissions of road transport in Germany were just under 145 million tonnes[1]. That was 17.4% of the entire CO_2 emissions amounting to 833 million tonnes[2]. As far as energy consumption is concerned road transport has a share of 24.3% of final energy consumption as a whole (2007)[3].

A precise knowledge of the individual sectors of road transport is therefore extremely important for determining the sources of environmental pollution, from air emissions for example, and also for formulating measures to limit and reduce pollution. Compilation strategies for Environmental-Economic Accounting have been developed in Europe, which link environmental pollution connected with economic activities systematically with national accounts. In so-called NAMEA tables[4] environmental pollution is recorded in connection with the production activities of the industry and the consumption activities of private households. They facilitate direct descriptive analyses of the polluters along with more extensive model analyses for determining the forces driving the pollution[5]. We must mention here the method used for breaking down into components and extended input-output analysis[6].

Motorised road transport is operated by a large number of economic units in the corporate sector, the public sector and private households. In the national energy balances fuel consumption only appears as a total. For more extensive analyses, especially with regard to linking road transport performance, fuel consumption and road transport emissions with the details from the national accounts, the road transport performance (and energy consumption) must be assigned to the economic activities that carry them out. These are the economic sectors broken down into economic branches and private households[7].

In the national accounts the transport activities of the industries or homogeneous branches[8], such as road haulage are not collectively – i.e. in terms of function - assigned to a transport sector, but - as auxiliary activities or as a main activity - to the economic sector that carries them out. In goods transport statistics this distinction largely corresponds to the separate documentation relating to commercial transport and company transport.

[1] See National Inventory Report 2010, Federal Environment Agency, EU Submission – Dessau 15.1.2010, p.98.
[2] Excluding LULUCF.
[3] Energy Balance Sheet for Germany, published by Working Group on Energy Balances (AGEB).
[4] National Accounting Matrix including Environmental Accounts.
[5] See for example the analysis of greenhouse gas emissions of the manufacturing industry at European level "Statistics in Focus", Environment and Energy, 16/2006, Eurostat, 2006.
[6] Results of a breakdown into components of fuel consumption by privately used passenger cars were for example introduced by the Environmental-Economic Accounting in 2008 as part of a press conference on "Energy consumption by private households". See statement for the press conference, Diagram 6. Documents for this press conference are available on the Internet as a download under www.destatis.de – Environmental-Economic Accounting in the publication section.
[7] The breakdown into economic sectors used in the project is the die NACE Rev.1 or the German version – Gliederung der Wirtschaftszweige (WZ), Ausgabe 2003.
[8] Where transport activities are carried out as a subsidiary activity for payment, they should be assigned to the production sector that conducts them as a main activity.

Alongside the classifications used in the national accounts the concept of national accounts and NAMEA tables should be borne in mind when calculating road transport performance and fuel consumption. When economic activities are recorded the residence principle is applied in the national accounts, i.e. the economic performance of the resident units are measured[9]. That necessitates, especially in the transport sector, including even (transport) activities of domestic units, such as airlines for example, outside the national territory when calculating production values and value added. On the other hand, when measuring performance, the performance of non-resident units is not included.

In connection with the calculations on road transport the parameters are the mileages, the road transport performance and the associated fuel consumption of domestic road users, irrespective of where these take place – in Germany or abroad. Calculations of the so-called “transitional positions” - from the resident to the territorial concept - acquire a special significance under the NAMEA compilation strategy. On the one hand they ensure the consistency of the calculations of energy consumption as part of the national energy balances (according to the territorial principle), and on the other they facilitate original calculations of greenhouse gases or comparisons with the inventories, which are likewise referred to the national territory.

[9] The terms “residents” and “local residents” are used synonymously. The same applies to "foreigners" and “non-residents".

Diagram 1: Mileage and fuel consumption in road transport

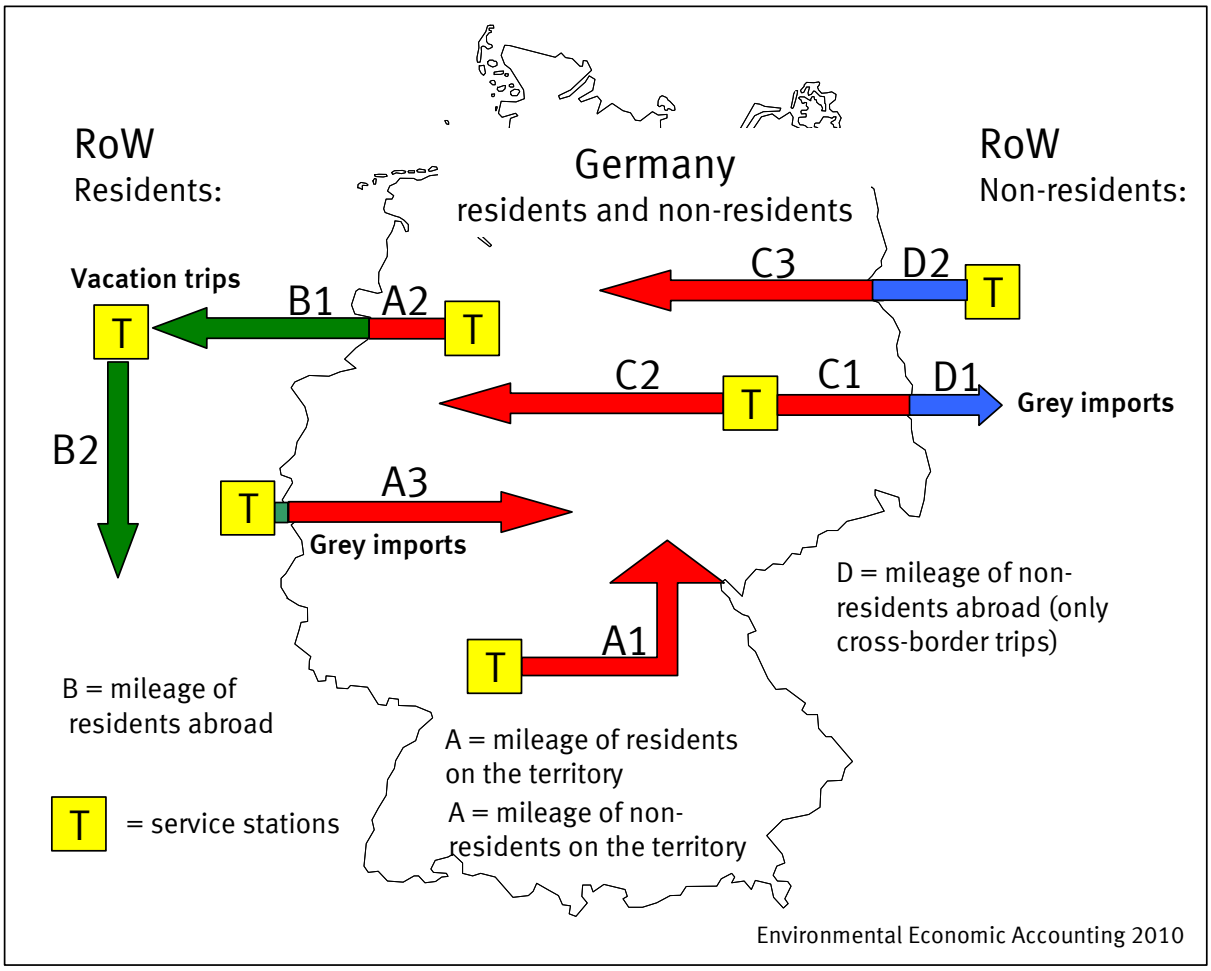


Diagram 1 highlights the difference involved in recording mileage and fuel consumption according to the resident concept and the territorial concept. In the case of the mileages in particular the portions of foreign roads travelled by residents (arrows labelled green) and the portions of roads travelled by non-residents (C1 to C3) have to be recorded separately. The diagram highlights the fact that the fuel purchases need not be proportional to the distances covered at home and abroad. Significant differences between fuel prices at home and abroad lead to “strategic” fuel purchases; when crossing borders people tend to fill up in the country where fuel is cheaper. In some cases this even leads to additional trips or diversions to get to the cheaper petrol stations abroad (“tank tourism”).

The divergence between foreign mileages and fuel purchases makes it difficult to calculate the “transitional positions” for fuel consumption. Fuel consumption can no longer be estimated simply according to the domestic roads covered (in the case of non-residents) or foreign roads (local residents). In the case of German residents, special fuel purchases (including tank tourism) abroad must be taken into account, which do not correspond to any relevant foreign roads covered. With higher domestic prices deductions must be made for the fuel purchased by foreigners, where domestic roads can be covered using fuel purchased abroad (see Section 6).

The report describes the calculation methods for calculating fuel consumption for motorised individual transport by passenger car (fuel model for passenger car) and for goods transport[10]. In the area of goods transport there is already comprehensive and detailed reporting on domestic and cross-border trips and transports by heavy trucks and trailer trucks[11]. Under this project calculation methods have been developed which select the database for the relevant facts and cover the road transport performance for both domestic and foreign transport units (in Germany). The road transport performance is subdivided according to the nature of the economic activity in line with the breakdown customary in national accounts. The road transport performance by German residents forms a basis for calculating the fuel consumption of the branches.

Alongside transportation by heavy lorry, transportation by light duty trucks has achieved an increased significance in Germany. As far as diesel trucks are concerned light duty trucks already make up 86% (2008). Their proportion of fuel consumption among diesel trucks was already 54% in 2008. In view of the particular makeup of vehicle stocks and the mileages covered based on keepers on the one hand, and the major discrepancies compared with heavy trucks on the other, we need to consider and calculate the mileages and fuel consumption of light duty trucks separately. In this project a strategy has been developed for calculating them. Results are presented in Section 5 of this report.

To summarise, the project's particular aim is to improve calculation methods in the area of road transport in three sectors:

1. linking the details from transport statistics for road transport performance in road goods transport with the calculations of fuel consumption;
2. separate calculation of mileages and fuel consumption by light duty trucks based on homogeneous branches;
3. developing a calculation module for the "transitional positions" (from the resident to the territorial concept).

The development of suitable calculation methods for fuel consumption is an important requirement for drawing up the NAMEA Energy (and NAMEA Air) tables. In the project calculation methods are described that facilitate a sound calculation of fuel consumption in terms of economic activities. Improving calculation methods will also make it easier to conduct better analyses in the area of road goods transport. In the further course of the project possibilities for analyses of this nature will be investigated such as breaking down goods transport into components.
First of all the report will go into the statistical initial scenario (Chapter 2). The method for calculating fuel consumption in road goods transport will be described in Chapter 4. Chapter 5 includes the calculation strategy for light duty trucks. Chapter 6 tackles the calculation of "transitional positions".

[10] The calculation of fuel consumption by passenger transport is described in the final report.
[11] With a load capacity of more than 3.5 tonnes.

2 Statistical base data

For a detailed calculation of energy consumption and carbon dioxide emissions by road transport based on vehicle types and keeper categories (homogeneous branches and private households) it is necessary to carry out a comprehensive evaluation of the existing statistics on road transport.

In Germany there is a large number of surveys and methods for calculating mileages and road transport performance. What is crucial for selecting the sources to be used is their compatibility with the definitions and the demarcations used in the Environmental-Economic Accounting.

In the case of the calculations details of the annual mileages are of great importance. Most of the surveys in Germany relating to this concern the mileages of German residents, such as for example the study "Mobility in Germany" (MiD 2002), the Mobility Panel (MOP), the basic survey of the Mileage Survey 2002, the survey "Kraftfahrzeugverkehr in Deutschland" (KiD 2002) ("Motor Vehicle Transport in Germany"), the tourism survey of the Federal Statistical Office, the journey analysis, the transport of goods survey of the Federal Motor Transport Authority (KBA) etc. The second part of the Mileage Survey 2002 includes the "Erhebung des grenzüberschreitenden Verkehrs" ("Survey of Cross-Border Transport"). The details stated here on the mileages covered by German residents when abroad and by non-residents in Germany provide important information on the transition from residents' mileage to domestic mileage.

The German Institute for Economic Research (DIW) publishes up-to-date details based on the resident concept every year as part of its "Weekly Report"[12]. This publication contains the "reference data" for our calculations regarding mileages and fuel consumption based on types of vehicle and propulsion types. Results of the calculations by the German Institute for Economic Research are also presented in "Verkehr in Zahlen" (ViZ) ("Transport in figures"). Here the transport performance for transport of goods appears in the "Territorial concept" section alongside the domestic mileages of different types of vehicle.

The computational model "TREMOD" (Transport Emission Estimation Model), commissioned by the Federal Environment Agency contains details of mileages, energy consumption and emissions of air pollutants by domestic vehicles in a very detailed subdivision based on types of vehicle (e.g. according to propulsion types, age, engine power, class of pollutant). Fuel consumption and greenhouse gas emissions are converted into the territorial concept (territorial concept) and are part of national reporting on greenhouse gases in accordance with the Kyoto Protocol[13].

Following an inspection of existing sources the following procedure was chosen: the detailed calculation based on vehicle types, propulsion types and keeper categories (homogeneous branches and private households) has been carried out in accordance with the resident concept. According to this "transitional positions" for the territorial concept (fuel purchase[14] and consumption concept) for passenger car vehicle types (Petrol engine and diesel), light duty trucks and trucks are estimated and a calculated value is determined for fuel consumption based on the territorial concept. This is followed by an adjustment of the calculations to the "reference value" arising from the energy balance.

[12] See for example Weekly Report 50/2009.
[13] National Inventory Report 2006 – Federal Environment Agency, see Chapter 3.1.5.2 Transport – Road Transport.
[14] Corresponds to the sale of fuel in Germany (Energy balance)

Overview 1 shows the most important primary data sources with their features in a table[15].

Overview 1: Statistical sources for the calculation model on fuels

	KBA 1)	DIW 2)	Tremod 3)	MiD/KiD/ FL-2002 4)
A Stocks				
Mode of drive				
Petrol	X	x 5)6)	x	
Diesel/Biodiesel	X	x 5)	x	
Liquified petrol gas	X	-	-	
Elektro, hybrid, other	X	-	-	
Vehicle types				
Passenger cars	X	x	x	X
cubic capacity	X	-	x	
motor capacity	X	-		
emission classes	X	-		
age	X	-		
segments	X	-		
registered keepers	X	x 7)	-	X 8)
Trucks (HGV)				X
‹ 3,5t net load	X	x	(X) 9)	X
› 3,5t net load	X	x	(X) 9)	X
registered keepers	X			
Trailer trucks (TT)	X	x	x	X
registered keepers	X			
Motor cycles	X	x	x	X
registered keepers	X			
Busses (Petrol/ Diesel)	X	x	x	X
registered keepers	X			
Other motor tractors (Petrol/ Diesel)	X	x	x	X
registered keepers	X			
Other vehicles (Petrol/ Diesel)	X	x	x	X
registered keepers	X			
B Mileage (vehicles km)				
Total (km/year)				
Cars (Petrol/Diesel)		x 10)	x 11)	X
Light-duty trucks (LNF) (Petrol/Diesel)		x 10)	x 11)	X
HGV/TT › 3,5t net load, residents (Diesel)	X	x		X
HGV/TT › 3,5t net load, on the territory (Diesel)	X	x	(x) 9)	X
Busses (Petrol/Diesel)		x 10)	x 11)	X
Motor cycles (Petrol)		x 10)	x 11)	X
Other trailers (Petrol/Diesel)		x 10)	x 11)	X
Other vehicles (Otto/Diesel)		x 10)	x 11)	X
Mileage per year (km/year)				
Cars		x 12)	x	X
cars - private households (Petrol/Diesel)		x 12)	x	X
cars - for business (Petrol/Diesel)		x 12)	x	X
cars - private households + cubic capacity			x	X
LNF (Petrol/Diesel)		x 12)	x	X
HGV/TT (Diesel)		x 12)	x	X
Other vehicles		x 12)	x	X

[15] The details that have been taken into account in the Environmental-Economic Accounting fuel model have been highlighted.

	KBA [1]	DIW [2]	Tremod [3]	MiD/KiD/ FL-2002 [4]
C Transport performance HGV and TT › 3,5 t net load (tons-km)				
Residents (total)	X	X	-	
by registered keepers	X	-	-	
Residents on the territory	X	X	-	
loaden journeys	X	-	-	
Non-residents on the territory	X	X	-	
loaden journeys	X	-	-	
D Fuel consumption (liters)				
Domestic sales		x 13)	x 13)	
Total consumption (residents)		X 14)	x 15)	
Total consumption by vehicle type		X	x	
average mileage (l/100km)				
Cars (Petrol/Diesel)		X	x	
cars - private households (Petrol/Diesel)		X	x	
LNF (Petrol/Diesel)		X	x	
HGV/TT (Diesel)		X	x	
Other vehicle types		X	x	

1) Kraftfahrtbundesamt (KBA): Statistische Mitteilungen, special data evaluation for Federal Statistical Office of Germany.
2) Deutsches Institut für Wirtschaftsforschung, Berlin (DIW).
3) Transport Emission Estimation Model: Berechnungen von IFEU-Institut, Heidelberg i. A. von UBA-Berlin; Data on registered vehicles from Kraftfahrtbundesamt, DIW-Berechnungen, Verkehrszählungen.
4) Mobilität in Deutschland 2002 (Mobility in Germany); Kraftfahrzeugverkehr in Deutschland 2002 (Road transport in Germany
5) Until 2001 annual averages on basis of KBA-data, 2002 - 2006 ann. average (estimate by DIW), from 2007 on: figures from the beginning of the following year (KBA).
6) Incl. vehicles with other drive, e.g. LPG etc.
7) Private households and business vehicles.
8) Breakdown into private and business owners available.
9) Distinction accord. Gross vehicle weight: 6t GVW correspond with ca. 3,5t net load.
10) Mileage of residents, mileage on the territory: data for 1994 - 2003.
11) Mileage on the territory
12) Deduced from existing surveys (cf. DIW [2005]), no survey for their own.
13) Energy balance, Arbeitsgemeinschaft Energiebilanzen (AGEB).
14) Residents concept, cross-border transport taken into account.
15) Fuel consumption on the territory.

Source: Federal Statistical Office, Environmental Economic Accounting 2010.

2.1 Federal Motor Transport Authority (KBA)

The starting point for calculations of the mileages of German residents relates to the data on vehicle stock provided by the Federal Motor Transport Authority.

The Federal Motor Transport Authority provides very detailed data on vehicle stock. In the calculations the stock data are evaluated based on vehicle types (passenger cars, trucks, trailer trucks, buses, other vehicles), cubic capacity classes, propulsion types, kW performance, keeper categories and - in the case of the trucks - on the basis of load capacity groups (see Annex 2.1).

Until 2001 the stock was published with reference to the stock at the middle of the year. From 2002 the stock was given at the beginning of the relevant year. Until 2006 the German Institute for Economic Research made its own calculations on the stock in the middle of the year, as these appeared more sensible for determining the actual annual mileages. The annual mileage (excluding trucks and buses) can be ascertained by multiplying the average mileage by the stock of vehicles. From reporting year 2007 the German Institute for Economic Research has used the initial annual figure for the following year to calculate the year under review.

Methodical restructuring of Federal Motor Transport Authority statistics have proved to be problematic. These have led to breaks in the time series. And so on the one hand from 2006 ambulances and motor homes have no longer been assigned to "Other Vehicles" but to passenger cars. And from 2008 the stock details no longer include temporarily deregistered (laid up) vehicles.

The Federal Motor Transport Authority made a special evaluation of the stock data for the calculations in the Federal Statistical Office (last supplied in March 2009, data status from: 1.1.2008). This special evaluation includes data on the stock of passenger cars, trucks, trailer trucks, buses and coaches based on keeper categories, propulsion types, cubic capacity classes (six classes for the passenger cars), weight classes (total weight permissible), age and pollutant emission classes.

Alongside these stock data the Federal Motor Transport Authority also publishes data on transport of goods (number of trips, mileages and transport performance in commercial transport and in company transport by keeper categories) of German trucks as a whole, including domestic use, as well as the total number of European trucks on the roads, and domestically. In the fuel model this data is linked with the information on vehicle stock when calculating road transport performance and fuel consumption by homogeneous branches. This data also forms the basis for the "transitional positions" of transport of goods from the resident to the territorial concept[16].

The tables and data of the Federal Motor Transport Authority that have been used as a source for the fuel model are given below:

Stock data based on keeper categories

The stock data based on keeper categories was drawn from the aforementioned special evaluation for the Federal Statistical Office. The data supplied also includes, alongside the details of keeper categories, a distinction by type of propulsion, a distinction based on types of vehicle (passenger cars, buses, trucks, trailer trucks, motorcycles, tractors, other vehicles) based on size classes (passenger cars broken down into 6 cubic capacity classes, trucks into 10 classes of total weight permissible) and based on pollutant emission classes.

For 1995 to 2001/2002 data is available broken down into 13 keeper categories, and 18 keeper categories from 2002 (see Overview 2).

[16] The data sources of the Federal Motor Transport Authority (KBA) are described in Annex 1.2.

Overview 2: Classification for the registered keepers of motor vehicles in the statistics of KBA

1995 – 2001/2002 13 owner groups	2002 – 2008 18 owner groups
Agriculture, hunting and forestry, fishery	Agriculture, hunting and forestry
Electricity, gas and water supply , Mining and quarrying	Fishing
Manufacturing	Mining and quarrying
Construction	Manufacturing
Wholesale trade	Electricity, gas and water supply
Commission trade	Construction
Retail trade	Wholesale and retail trade; repair of motor vehicles etc.
Transport, storage and communication	Hotels and restaurants
Financial intermediation	Transport, storage and communication
Services	Financial intermediation
Non-profit organisations	Real estate, renting and business activities
Public administration; compulsory social security	Owners of vehicles for renting and leasing
Employees and non-occupied people and unknown	Public administration and defence; compulsory social security
	Education
	Health and social work
	Other community, social and personal service activities
	Extra-territorial organisations and bodies
	Employees and non-occupied people
	Unknown

In the publication "Fahrzeugzulassungen – Bestand an Kraftfahrzeugen und Kraftfahrzeuganhängern zum 1.Januar 2008 (FZ 6)" ("Vehicle registrations – stock of motor vehicles and motor vehicle trailers on 1st January 2008 (FZ 6)") the relevant details for 2008 can be found in Table 56.

With the help of conversion matrices for the stock data in the keeper category breakdown from the Federal Motor Transport Authority is converted into a breakdown into 70 homogeneous branches. A basis for further partitioning was provided on the one hand by details of the production values of homogeneous branches from the output tables in the input-output account (IOT) and also details of write offs from the balance sheet.

The detailed stock information obtained in this fashion has been drawn upon for calculating road transport performance by production sector (see Chapter 4).

Data on transport of goods

The relevant source for allocating the mileages of transport of goods (trailer trucks and trucks › 3.5 t load capacity) to the homogeneous branches is Table 4 published annually by the Federal Motor Transport Authority "Transport volume of German trucks by keeper categories, vehicle categories, and construction categories". This table contains the transport figures (in tonne kilometres) of road transport of goods broken down into 18 keeper categories and further subdivided into commercial transport and company transport. The table is available from 2002. (See for 2008: Annex 2.3)

The further subdivision into the 70 homogeneous branches is made with the help of the above conversion matrices for trailer trucks and trucks.

On top of this the details of the transport volume of transport of goods of European trucks in determining the "transitional positions" (transferring the mileages and fuel consumption from the resident concept to the territorial concept) are used for the lorry transport. In calculating mileages in domestic transport – separated into German and foreign trucks – the Internet table of the Federal Motor Transport Authority for the domestic transport of German and foreign trucks with details of the total distances covered in Germany (loaded and unloaded) are used.

The results of the statistics "Verkehr europäischer Lastkraftfahrzeuge – Inlandsverkehr" ("European lorry transport - domestic transport") are published in the "Statistische Mitteilungen" (Statistical Memoranda) of the Federal Motor Transport Authority VE 3 (Overview 3, Domestic transport based on the home country of the traction vehicle). This publication is at present not yet available for 2008. (See Annex 2.6)

2.2 German Institute for Economic Research, Berlin

The German Institute for Economic Research (DIW) is closing gaps in the reporting of official statistics in the area of passenger transport (mileages, transport performance, transportation purposes) and with regard to the mileages of all motorised vehicles, on behalf of the Federal Ministry of Transport, Building and Urban Development. With the help of model calculations the German Institute for Economic Research annually determines and publishes mileages based on vehicle types and the development and structure of passenger transport[17].

As part of mileage and consumption calculations, the German Institute for Economic Research has evaluated a series of transport surveys, especially from 2002 (as the base year). Special mention must be given to the Mileage Survey 2002, the survey „Kraftfahrzeugverkehr in Deutschland" (KiD 2002) ("Motor Vehicle Transport in Germany") and "Mobility in Germany" (MiD) 2002 (here in particular the details of mileages by passenger car).

The details of mileages in the German Institute for Economic Research model refer to the mileages of German residents and differ in this respect from the mileage figures based on road transport censuses. The latter relate to domestic travel, i.e. including the mileages of foreign vehicles in Germany but excluding the distances covered abroad by domestic vehicles.

[17] See "Wochenbericht" (Weekly Report) of the German Institute for Economic Research (DIW) and "Verkehr in Zahlen (ViZ)" (Transport in Figures).

For the fuel model of the Environmental-Economic Accounting the mileages of German residents determined by the German Institute for Economic Research based on vehicle types (see Table 1) and details of average annual mileages per vehicle, the details of fuel consumption by German residents and average consumption (per 100 km) by vehicle type form the most important basis for calculation purposes.

Table 1: Mileage in road transport by vehicle type (in mn. km)

Type of vehicle	2000	2001	2002	2003	2004	2005	2006	2007	2008
Motor cycles	13.0	13.8	12.2	12.5	12.7	13.0	13.2	10.8	11.1
Mopeds	3.8	4.0	3.8	3.9	4.2	4.3	4.6	4.6	4.7
Cars	559.5	575.5	583.6	577.8	590.4	578.2	583.9	587.5	584.6
petrol	442.9	438.9	431.2	418.3	412.8	391.4	378.7	370.7	368.0
diesel	116.6	136.6	152.3	159.5	177.6	186.7	205.2	216.8	216.6
Busses	3.7	3.7	3.6	3.6	3.6	3.5	3.5	3.4	3.3
petrol	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
diesel	3.7	3.7	3.6	3.6	3.6	3.5	3.5	3.4	3.3
Tractors	3.4	3.4	3.7	3.8	4.0	4.1	4.3	4.4	4.5
petrol	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
diesel	3.3	3.4	3.7	3.8	3.9	4.1	4.2	4.4	4.5
Trailer trucks	12.7	13.5	13.7	14.0	15.1	15.5	16.6	17.8	18.0
Trucks	58.9	60.3	58.2	57.9	57.7	57.0	57.6	59.8	60.3
petrol	3.4	3.4	3.1	2.9	2.7	2.4	2.3	2.2	2.0
diesel	55.5	57.0	55.1	55.0	55.0	54.5	55.4	57.6	58.3
diesel <=3,5t net load	39.4	41.4	40.9	41.1	41.3	41.2	41.7	44.0	44.6
diesel >3,5t net load	16.0	15.6	14.2	13.9	13.7	13.3	13.6	13.7	13.7
Other vehicles	8.1	8.3	8.5	8.6	8.7	8.7	3.6	3.6	3.5
petrol	1.0	1.0	0.9	0.9	0.8	0.8	0.3	0.3	0.3
diesel	7.0	7.3	7.5	7.7	7.9	7.9	3.3	3.3	3.2
All vehicles	663.0	682.6	687.2	682.2	696.4	684.3	687.3	692.0	690.1
petrol	464.2	461.1	451.3	438.6	433.3	412.0	399.1	388.7	386.1
diesel	198.9	221.5	235.9	243.6	263.1	272.3	288.2	303.4	304.0

Source: DIW-Wochenbericht 90/2009; DIW Methodenbeschreibung (2005).

2.3 TREMOD (TRansport Emission MODel)

The Institute for Energy and Environmental Research Heidelberg GmbH (IFEU) developed the TREMOD model to calculate the emissions of air pollutants and greenhouse gases.

The starting point for drawing up a balance sheet of emissions is transport within Germany's national borders. With TREMOD the emissions are calculated that arise from the mileages and transport performance within Germany. As well as road transport, balance sheets are produced for rail transport, inland waterways and air transport.

Calculations for road transport are based on the "Consumption concept". This concept differs from the "Sales concept" of the energy balance sheet, which shows fuel sales in Germany. The consumption concept takes account of the fact that some of the fuel sold in Germany will be used abroad and the resultant emissions cannot be added to domestic emissions. Of course we

must also take account of fuel consumption and the associated emissions arising from fuel purchased abroad but used for trips in this country. This means that fuel purchased by both non-residents and residents must be included. The balance arising from these two figures gives rise to the difference between the concepts referred to.

TREMOD contains very detailed information on vehicle stock in the area of domestic road transport, on mileages and road transport performance for all vehicle categories in a very comprehensive breakdown based on propulsion types, size classes and emission standards.

The results for energy consumption are adjusted to the details of the energy balance using factors. This is necessary, as it gives rise to a difference both conceptually and empirically between the consumption of fuels (domestically) and the sale of fuels according to the energy balance sheet.

As the residence concept is chosen as the starting point for calculations in the Environmental-Economic Accounting fuel model, the data computed in TREMOD is not used directly for the fuel model. As however the German Institute for Economic Research does not publish any mileages or average mileages by cubic capacity classes, these are estimated – when calculating the fuel consumption of passenger cars and light duty trucks – in the fuel model with the help of details from MID 2002 and – after conversion to the territorial concept - compared with the information from TREMOD.

3 The fuel calculation model for passenger cars

3.1 Overall passenger car traffic

Traffic made up of passenger cars constitutes the largest portion of road traffic. In 2009, 83.3% of registered vehicles were passenger cars[18]. Passenger cars make up a portion of 84.7% of the total mileage of motorised road traffic[19].

Of the over 41 million registered passenger cars as at 1 January 2009, 74.1% (30.6 mn.) of the vehicles ran on petrol and 24.9% (10.3 mn.) ran on diesel fuel. Around 1% of the vehicles ran on other fuels, whereby gas-powered vehicles made up the largest portion of this share. This type of propulsion has seen a significant increase over the last few years. In 2005 there were only around 35,000 vehicles running on liquefied petroleum gas (LPG) or natural gas. On 1 January 2009, however, over 367,000 vehicles were registered which ran on these types of propulsion. The fuel and emissions calculations of the Environmental-Economic Accounting only takes those vehicles into consideration that are powered by petrol, diesel or biodiesel fuels.

Table 2: Stocks, mileages, fuel consumption and CO_2 emissions of passenger cars

Bridging items	1995 [1]	2000 [1]	2007 [2]	2008 [2]
	in 1 000			
Stocks	**40,405**	**42,840**	**40,971**	**40,954**
Diesel passenger cars	5,545	5,961	10,046	10,290
Petrol passenger cars	34,860	36,879	30,925	30,664
	in 1 000 km			
Average mileage	**13.2**	**13.1**	**14.2**	**14.1**
Diesel passenger cars	18.0	19.6	21.6	21.1
Petrol passenger cars	12.5	12.0	11.9	11.7
	in mn. km			
Mileage	**535,132**	**559,468**	**583,616**	**576,769**
Diesel passenger cars	99,708	116,612	216,846	216,630
Petrol passenger cars	435,424	442,856	366,770	360,139
	in l / 100 km			
Specific fuel consumption	**8.8**	**8.3**	**7.7**	**7.6**
Diesel passenger cars	7.5	7.1	6.9	6.8
Petrol passenger cars	9.1	8.6	8.2	8.1
	in mn. Litre			
Fuel consumption	**47,263**	**46,389**	**44,750**	**43,748**
Diesel passenger cars	7,447	8,260	14,854	14,717
Petrol passenger cars	39,816	38,129	29,896	29,031
	in 1 000 tons CO_2			
CO_2-emissions [3]	**113,374**	**111,360**	**108,785**	**106,794**
Diesel passenger cars	19,732	21,683	38,569	38,594
Petrol passenger cars	93,642	89,676	70,216	68,200

1) Incl. momentary unsubscribe vehicles.
2) Ex. unsubscribe vehicles, incl. ambulance vehicles and caravans.
3) Ex. Biodiesel.

Sources: DIW, own calculations.

[18] Federal Motor Transport Authority: data from 1 January 2009.
[19] DIW Wochenbericht (German Institute for Economic Research weekly report) 50/2009.

97% of the petrol used by German residents in 2008 for road traffic can be attributed to passenger cars. Just less than 48% of diesel fuel (including biodiesel) was used by passenger cars. While the number of petrol vehicles has experienced a slight decrease since 2001, diesel vehicles have seen a steady increase in number (+2.4% on 1 January 2009 compared to 1 January 2008). The total number of diesel and petrol cars has remained constant with regard to the current situation. No increase has been recorded for the first time since 1995.

Table 2 shows the reference data on passenger car stocks, mileages and fuel consumption for selected years. Likewise, the CO_2 emissions from passenger cars are presented. The calculation results from the DIW (DIW) are used as a main data source for the fuel calculations. These were published separately according to petrol passenger cars and diesel passenger cars (see the original tables in the Annex 1.6 and 1.7 from the DIW weekly report 50/2009).

3.2 Calculation sequence for passenger cars

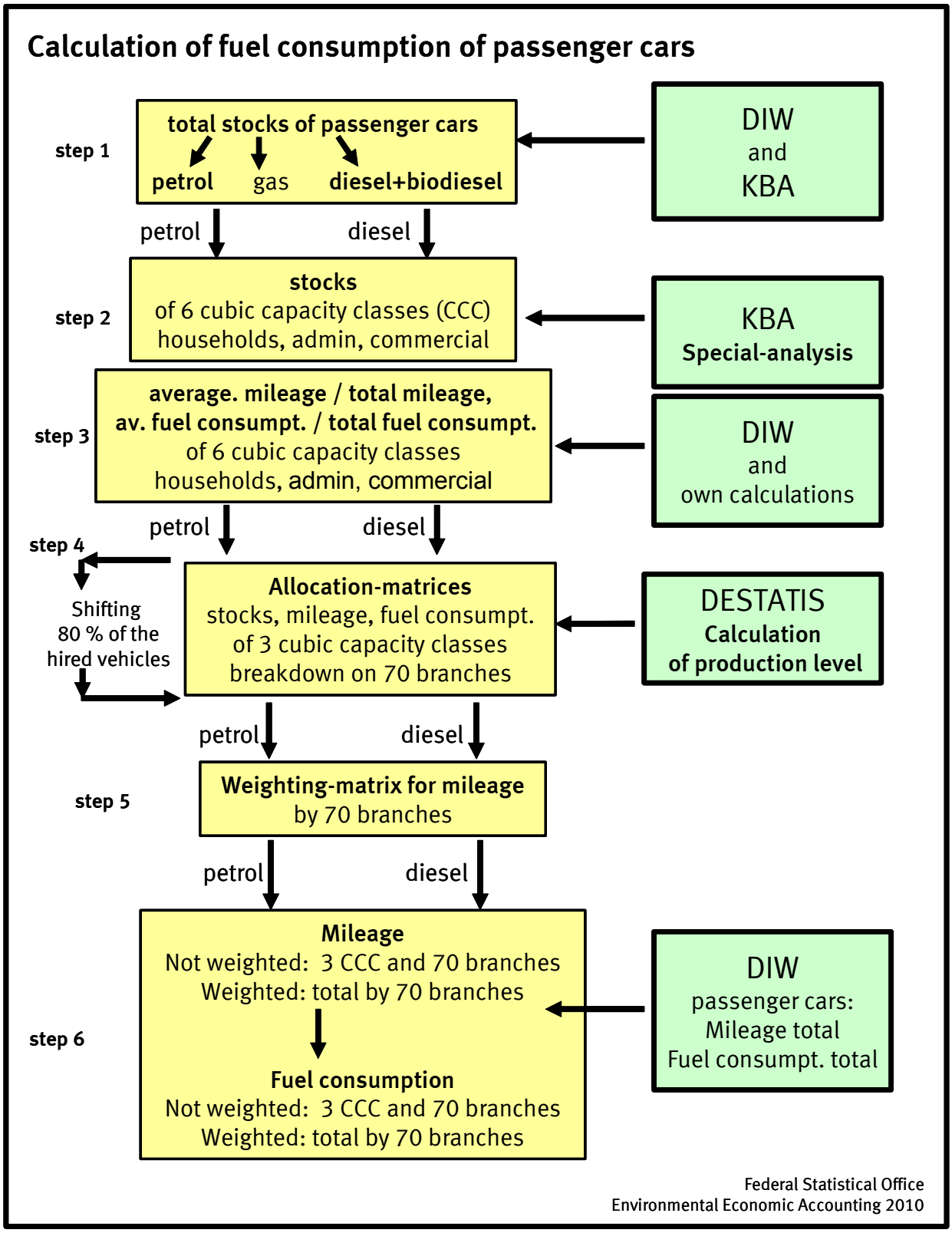
Diagram 4 shows the steps of the calculation which are performed in order to calculate passenger car fuel consumption of German residents according to industries, separated into petrol cars and diesel cars.

The reference data of the calculation is determined in the first step. As previously mentioned, the data from the DIW on passenger car traffic of German residents is used as a basis.

The stocks shown by DIW are annual mean values up until the 2006 reporting year. This stock data was identified by the DIW at the beginning of the year based on Federal Motor Transport Authority (KBA) stocks. As from the 2007 reporting year, the Federal Motor Transport Authority data on the starting stock of a given year (on 1 January) is used for the expired reporting year (i.e. for 2007, the Federal Motor Transport Authority (KBA) stock from 1 January 2008 is used). As from the 2007 reporting year, the stocks are recorded without unregistered vehicles. Further modification of the record of stock took place as from 2006: after this point, motor homes and ambulances are also counted as passenger cars. The modifications in 2006 and 2007 led to breaks in the time series for the parameters “stock” and “average mileage”. The stock data from the DIW on vehicles with petrol engines also contains vehicles with other types of propulsion. Likewise, the data on total mileage also includes the mileages of these other vehicles. In our calculations, those vehicles powered with gas have been removed from the stocks (data on the stocks of gas-powered vehicles is published by the Federal Motor Transport Authority). Passenger cars powered by LPG or natural gas constitute a portion of 94% of the group of other types of propulsion in 2008. Due to these modifications to the stock data, slightly deviating results arise to the data from the DIW (reference data) regarding total mileage and average annual mileage of petrol cars. The DIW data on the specific consumption of petrol and diesel cars as well as on fuel consumption is also adopted as reference data.

After the total figures have been determined, the stocks are tabulated according to 6 cubic capacity classes (see Chapter 3.3) and 3 keeper categories in a second step - again separated into petrol and diesel cars. The Federal Motor Transport Authority undertook a special evaluation for the Environmental-Economic Accounting (see Annex 2.7). The keeper categories are private households, administrations and commercial keepers. The separation by cubic capacity class is undertaken, as this leads to a more precise calculation of mileage and consumption by industry (see Chapter 3.3).

Diagram 2: Calculation sequence for fuel calculation of passenger cars



In the third step, the calculation of average mileage by 6 cubic capacity classes takes place, separated into the 3 keeper categories named above. The basis for this is formed by the results on the mileages of private households by cubic capacity class from the survey "Mobility in Germany 2002" (see Table 3 in Chapter 3.3) as well as data from the DIW on average mileages of private and commercial keepers. The average mileages of all passenger cars (separated into petrol and diesel cars) are aligned with the published values from the DIW. Using the stocks and the calculated average mileages, the total mileages are calculated by 6 cubic capacity classes and three keeper categories.

In order to calculate the consumption in the same structure, firstly the specific consumption according to the 6 cubic capacity classes is estimated. In doing so, no differences are drawn within the three keeper categories regarding specific consumption. The DIW publishes figures for the specific consumption of petrol and diesel passenger cars. We assume that the specific consumption in the two middle cubic capacity classes almost corresponds to that of the DIW. For cubic capacity classes three and four, therefore, the DIW figure is multiplied with a factor of 1. Passenger cars with smaller cubic capacities require less fuel per 100 km. The specific consumption of the smallest cubic capacity class is therefore calculated with a factor of 0.75, and the second cubic capacity class is calculated with a factor of 0.85. Cubic capacity class five has a factor of 1.1, and cubic capacity class six a factor of 1.2. Finally, the total consumption by cubic capacity class is calculated using the calculated specific consumption figures and the available mileages. The total consumption of all cubic capacity classes together must be aligned with the default value from the DIW. The alignment is performed with the help of correction factors. In doing so, it is important to ensure that the specific consumption in total, that of the private households, and that of the commercial keepers in total, remains unchanged.

In the fourth step, the passenger car stocks, mileages and fuel consumptions are split up across the industries. In doing so, the stocks must be distributed across 70 industries on the basis of 18 keeper categories (prior to 2002 this was 13 keeper categories; see Chapter 2.1, Overview 2). This is performed using a conversion matrix. The calculation of this process is described in Chapter 3.4. The distribution of the stocks to the industries then serves as a basis for dividing the mileages and the consumption across the sectors. The mileage and consumption results by cubic capacity class and the three keeper categories calculated in steps two and three are incorporated in the further calculations.

The results of the available calculations refer to mileage by type of propulsion, cubic capacity class and industry. In doing so, the various mileages are taken into consideration by cubic capacity class and by the three keeper categories. For private households, for example, lower annual mileages than the average were assumed. Within the group of commercial users, no differences were assumed in annual mileages. It can be assumed, however, that vehicles in certain industries will report higher average mileages. For example, the cars of taxi drivers, courier services or postal services will report higher annual mileages than those of other sectors. The fifth step aims, with the help of a weighting matrix, to take these different mileages into consideration. After this step weighted mileage results are available, according to 70 industries.

The consumption by industry is calculated using the conversion matrix from step 4 and the weighting matrix from step 5. Table 6 in Chapter 3.5 shows the results of the calculations for the year 2008.

3.3 Passenger car traffic by cubic capacity class and three keeper categories

The various keepers have vehicle fleets which are composed differently, due to unequal utilization of the vehicles. In particular, the vehicle fleets differ with regard to vehicle size. The cubic capacity class is the most significant influencing factor for how high the annual mileage is, alongside keeper category and type of propulsion. The results of the mileage calculation by industry are improved by taking the mileages depending on cubic capacity class into consideration. Here, under or overestimating the mileages of sectors with mainly large passenger cars is avoided.

In the fuel model, 6 cubic capacity classes are differentiated:

Class 1 = ‹ 999 ccm;

Class 2 = 1000 - 1399 ccm;

Class 3 = 1400 - 1599 ccm;

Class 4 = 1600 - 1999 ccm;

Class 5 = 2000 - 2499 ccm;

Class 6 = › 2500 ccm.

The Federal Motor Transport Authority undertook a special evaluation of the stock data for the Federal Statistical Office (see Annex 2.7). This enables an evaluation of the vehicle stocks in this division, separated according to the fuel types of petrol or diesel.

Analogous to the division by cubic capacity class, the data is also sub-divided according to the consolidated keeper categories of “private households”, “administrations” and “commercial keepers”. The stock data is also included in the Federal Motor Transport Authority’s special evaluation for this division - combined with the cubic capacity classes.

The most important source regarding the annual mileages by cubic capacity class is the “Mobility in Germany 2002” survey. This nationwide survey collected data from private households (25,000 households were surveyed, with almost 34,000 passenger cars, see Annex 5.1) on their mobility. They were also asked about their estimated annual mileage and cubic capacity class. The results on this can be seen in Table 3.

Table 3: Average annual mileage of passenger cars by cubic capacity class in 2002

Cubic capacity classes in ccm	passenger cars [1] in 1000	Average mileage in km
up to 999	997	9,743
1000 - 1499	8,418	11,612
1500 - 1999	14,336	14,924
2000 - 2499	4,798	16,770
2500 - 2999	1,391	19,282
3000 - 3999	555	19,512
4000 - 4999	134	17,022
5000 - 5999	59	15,931
6000 a. more	40	11,840
n.a. [2]	8,333	13,999
Total	**39,061**	**14,333**

1) Base: Passenger cars with mileage up to 200000 km per year.
2) Not available: because of refusal, implausible, missing or declaration "I don't know"

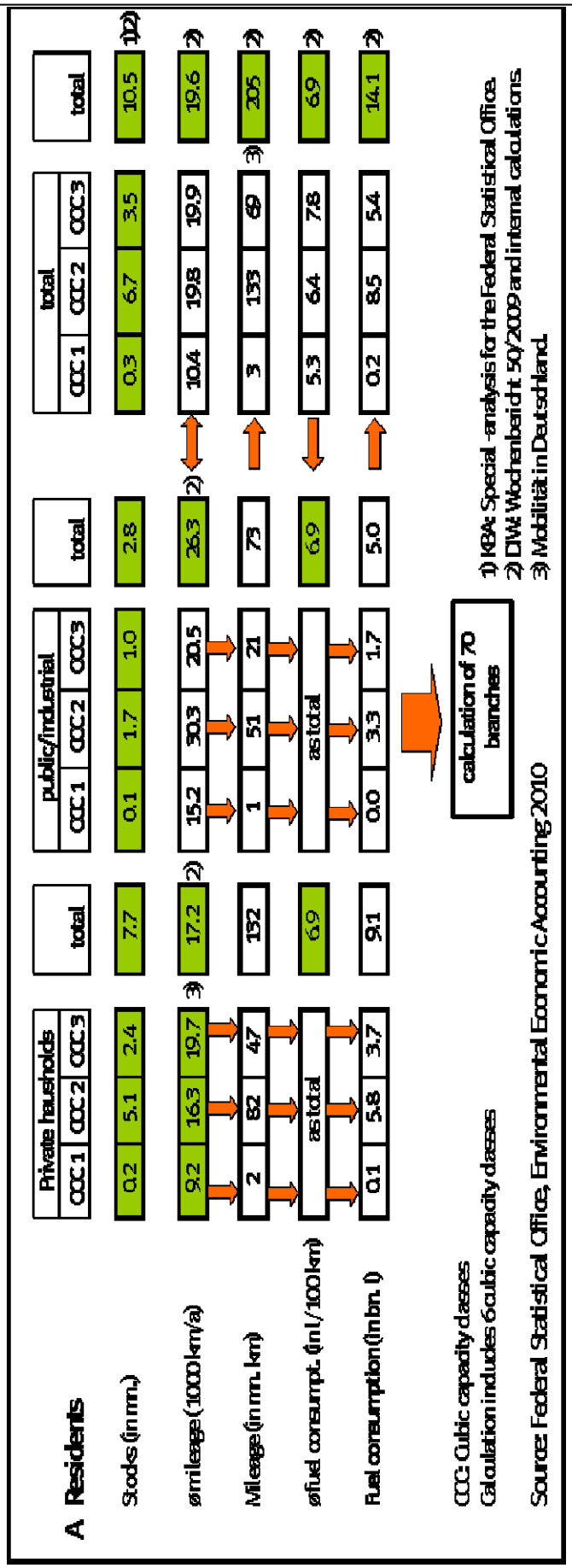
Source: Mobilität in Deutschland 2002

The DIW provides internal data on average mileages of private and commercial keepers by type of propulsion.

Diagram 5 shows the calculation scheme for steps 2 and 3 together with the results on fuel consumption for diesel cars for the year 2006. The highlighted data is either taken directly from the previously mentioned sources or derived from them. All other data comes from estimates and calculations.

The available results for the combined keeper categories are included in the following mileage and fuel consumption calculations by 70 industries.

Diagram 3: Passenger car mileages and fuel consumption (diesel vehicles) in 2006



Tables 4 and 5 show the results of average mileages for selected years according to type of propulsion, 3 cubic capacity classes and divided into the three keeper categories “private households”, “administrations” and "commercial keepers”. The highlighted data corresponds to the details provided by the DIW.

Here, the middle cubic capacity class (1400–1999 ccm) corresponds best to a cubic capacity class (1500–1999 ccm) from the table out of the Mobility in Germany 2002 (MiD 2002) survey (see Table 3). Therefore at this point, these cubic capacity classes are used for a comparison of our results with those from the Mobility in Germany 2002 survey. Due to the differentiation of propulsion types between petrol and diesel, two different statements resulted for the private households in the year 2002. Aside from the influence of cubic capacity class (CCC) on mileage, the influence of the type of propulsion also becomes clear.

Fuel model:

- Annual mileage of households in 2002, diesel cars, CCC: 1400-1999 ccm: 17,500 km
- Annual mileage of households in 2002, petrol cars, CCC: 1400-1999 ccm: 11,600 km

Mobility in Germany 2002:

- Annual mileage of all passenger cars from the households; CCC: 1500-1999 ccm: 14,900 km

Tables 4 and 5 show that including the available data sources leads to very different average mileage results for the keeper categories. The calculation of fuel consumption by industry, which builds upon this information, is significantly improved by taking these facts into consideration.

Table 4: Average annual mileages of diesel cars

	up to 1399 ccm				1400-1999 ccm			
Year	commercial	administr.	housholds	total	commercial	administr.	housholds	total
2000	19.0	16.9	10.5	**11.6**	29.8	26.5	16.1	**19.4**
2002	15.2	13.1	9.8	**10.7**	32.4	26.0	17.5	**21.0**
2004	15.2	13.3	9.4	**10.5**	31.4	26.6	16.8	**20.3**
2006	15.2	13.4	9.2	**10.4**	30.3	26.2	16.3	**19.8**
2008	16.8	13.3	10.1	**11.3**	33.2	25.6	17.7	**21.3**
	>= 2000 ccm				**total**			
Year	commercial	administr.	housholds	total	commercial	administr.	housholds	total
2000	20.8	18.2	19.9	**20.2**	26.0	22.7	17.4	**19.6**
2002	20.3	19.3	21.1	**20.8**	27.6	22.7	18.4	**20.8**
2004	21.0	18.9	20.2	**20.5**	26.9	22.7	17.6	**20.2**
2006	20.5	18.7	19.7	**19.9**	26.8	23.5	17.6	**19.6**
2008	22.5	18.7	21.1	**21.5**	29.1	24.7	18.8	**21.1**

Table 5: Average annual mileages of petrol cars

Year	up to 1399 ccm commercial	administr.	housholds	total	1400-1999 ccm commercial	administr.	housholds	total
2000	15.8	12.3	10.2	**10.4**	18.5	14.8	12.1	**12.5**
2002	14.9	12.7	10.0	**10.2**	17.5	14.8	11.6	**11.9**
2004	14.0	12.6	9.7	**9.9**	16.7	15.0	11.6	**11.8**
2006	13.1	12.7	8.9	**9.1**	15.8	15.1	10.9	**11.1**
2008	15.4	14.1	10.1	**10.3**	18.2	17.0	12.2	**12.4**
Year	**>= 2000 ccm** commercial	administr.	housholds	total	**total** commercial	administr.	housholds	total
2000	18.8	15.2	13.4	**14.5**	18.0	14.2	11.5	**12.0**
2002	17.1	15.0	13.3	**14.0**	16.8	14.2	11.2	**11.6**
2004	16.3	15.0	13.0	**13.6**	15.9	14.2	11.0	**11.3**
2006	15.4	15.3	12.1	**12.6**	14.9	14.2	10.2	**10.5**
2008	18.3	17.2	13.4	**14.0**	17.0	16.2	11.6	**11.7**

3.4 Allocating the mileages to industries and weighting the mileages of individual industries

The aim of the fuel calculations in the Environmental-Economic Accounting is to present fuel consumption and emissions of the German residential units by industries and private households. The data recorded in steps 2 and 3 (see Chapter 3.3) according to cubic capacity class and three sectors is included as reference data in the further sub-division.

The Federal Motor Transport Authority stock data according to keeper categories, sub-divided according to type of propulsion and cubic capacity class, is used for the allocation to the industries. In the reporting years after 2002, this data is available in a division according to 18 keeper categories. From 1995 to 2001, the vehicle stocks were sub-divided according to 13 keeper categories (see Overview 2, Chapter 2.1). As from the 2009 reporting year, the Federal Motor Transport Authority introduced a new keeper division with 23 keeper categories.

A conversion matrix was prepared for the further allocation of the 13 / 18 keeper categories to the industries. In doing so, the production values table from the input-output calculation was used. Other features were also conceivable for the allocation such as, for example, the number of employees. However, none of the features were optimum for the allocation. Thus manual corrections in the matrix were necessary to check the plausibility of the results. This way, in the trade sector, for example, the passenger cars of wholesale and retail trade are not divided in equal parts in accordance with the production values, but a larger part of the car stock is allocated to retail trade. In doing so, it is assumed that the wholesale trade vehicle fleet is more likely to be full of trucks than passenger cars, whereas retail trade has more to do with deliveries, etc., with small delivery vans or passenger cars.

The conversion matrix makes no differentiations between petrol and diesel vehicles, as no special information is available on this. The matrix is also applied for the allocation of other types of vehicle such as light duty trucks and motorcycles. A modified matrix is used for trucks and trailers.

As part of this division, a reclassification of the vehicle stocks of keeper category 111 'rented vehicles for owner-drivers' already takes place at the level of the Federal Motor Transport Authority keeper categories. The background for this is that, in Environmental-Economic Accounting, the causative principle is used when allocating environmental pollution. In doing so, the mileages and the fuel consumption associated with these mileages are not allocated to the keeper or owner of the rented vehicles, but to the industries which use these vehicles.

In order to avoid inconsistencies in values arising during the later reverse projection of average mileage per industry, the rented vehicles are accordingly reclassified in the stock. In doing so, the majority (80%) of the stock is allocated to keeper category 17 "employees and non-working persons". The remaining 20% of the rented vehicles are divided equally among the keeper categories "manufacturing" and "trade, repair of vehicles and consumer goods".

Corrected tables on mileages according to propulsion types, cubic capacity class and industries are available as results of the fourth step. In these tables, the annual mileages - differentiated against according to cubic capacity class - and according to the keeper categories "private households", "administrations" and "commercial keepers" are shown.

In the last step - the fifth step - the different mileages of individual industries are taken into account with the help of a weighting matrix. No source data is available for this in Germany, meaning that some estimation was required here.

The fuel consumption by 70 industries can be calculated using the conversion matrix from step 4 and the weighting matrix from step 5.

3.5 Average mileages and specific fuel consumption by industries

Determining average mileages by industry is carried out by reverse projection:

Average mileage per industry = mileage per industry/ stock per industry

The different results for annual mileages per industry alone (see Table 6) can not be traced back solely to the weighting matrix, but to the detailed calculation of mileage by cubic capacity class. An industry with a high annual mileage generally has a vehicle fleet consisting of passenger cars with larger cubic capacities. The highest annual mileage for diesel cars in 2008 was shown in sector I "traffic performance, communication" at 37,800 km.

The specific fuel consumption per 100 km is found by reverse projection:

Specific fuel consumption per 100 km = fuel consumption / mileage

Slightly differing results in the industries are also shown in this calculation, which can be traced back to a different composition of the industry stocks by cubic capacity class (see Table 6). In 2008, diesel cars had an average consumption of 6.8 litres per 100 km. The specific consumption of diesel cars has hardly decreased since 2001 (6.9 litres per 100 km). In the case of petrol vehicles, the average consumption in 2008 was 8.1 litres per 100 km; in 2001 it was 8.5 litres.

Table 6: Passenger car stocks, mileages and fuel consumptions by industry in 2008

CPA [1]	Industries	Stocks [2]	Annual mileage	Total mileage	specific fuel consump-tion	Fuel consump tion
		1000	1000 km	mn. km	l/100 km	mn. L
				diesel		
A	Agriculture, hunting and forestry	22.4	18.3	410	6.84	28
B	Fishing	0.2	27.5	6	6.96	0
C	Mining and quarrying	3.3	29.5	96	6.79	7
D	Manufacturing	372.9	30.2	11,270	6.73	758
E	Electricity, gas and water supply	16.5	30.4	502	6.68	34
F	Construction	137.5	25.6	3,525	6.80	240
G	Wholesale and retail trade; repair of motor vehicles	393.1	26.5	10,415	6.73	701
H	Hotels and restaurants	18.0	28.2	508	6.88	35
I	Transport, storage and communication	144.1	37.8	5,451	6.75	368
J	Financial intermediation	33.5	29.5	987	6.77	67
K	Real estate, renting and business activities	688.9	29.3	20,203	6.78	1369
L	Public administration and defence; comp. soc. security	77.0	22.4	1,728	6.78	117
M	Education	9.7	30.0	291	6.72	20
N	Health and social work	60.5	28.1	1,701	6.82	116
O	Other community, social & personal service activities	485.0	29.9	14,507	6.78	984
	Total	**2,463**	**29.1**	**71,601**	**6.8**	**4,842**
	Private households	7,828	18.5	145,029	6.8	9,874
	Industries and private households [3]	**10,290**	**21.1**	**216,630**	**6.8**	**14,717**

CPA [1]	Industries	Stocks [2]	Annual mileage	Total mileage	specific fuel consump-tion	Fuel consump-tion
		1000	1000 km	mn. km	l/100 km	mn. L
				petrol		
A	Agriculture, hunting and forestry	19.9	12.2	243	8.30	20
B	Fishing	0.1	19.3	2	8.46	0
C	Mining and quarrying	1.2	18.4	23	8.72	2
D	Manufacturing	179.3	17.9	3,217	8.63	278
E	Electricity, gas and water supply	12.5	18.3	228	8.26	19
F	Construction	58.4	13.8	806	8.86	71
G	Wholesale and retail trade; repair of motor vehicles	326.0	15.5	5,055	8.30	420
H	Hotels and restaurants	21.6	18.5	399	8.54	34
I	Transport, storage and communication	41.2	22.7	935	8.53	80
J	Financial intermediation	13.7	18.2	249	8.69	22
K	Real estate, renting and business activities	402.4	17.5	7,057	8.53	602
L	Public administration and defence; comp. soc. security	47.8	15.8	757	8.08	61
M	Education	4.9	17.6	85	8.43	7
N	Health and social work	63.8	14.8	943	8.04	76
O	Other community, social & personal service activities	277.8	17.9	4,984	8.53	425
	Total	**1,471**	**17.0**	**24,984**	**8.5**	**2,117**
	Private households	29,193	11.5	335,155	8.0	26,915
	Industries and private households [3]	**30,664**	**11.7**	**360,139**	**8.1**	**29,031**

1) Classification according Statistical Classification of Products by Activity in the European Economic Community (version 1993).
2) Composition according KBA vehicle owner categories after transfer of vehicels for renting and leasing to users; stocks total: DIW data.
3) Residents concept.

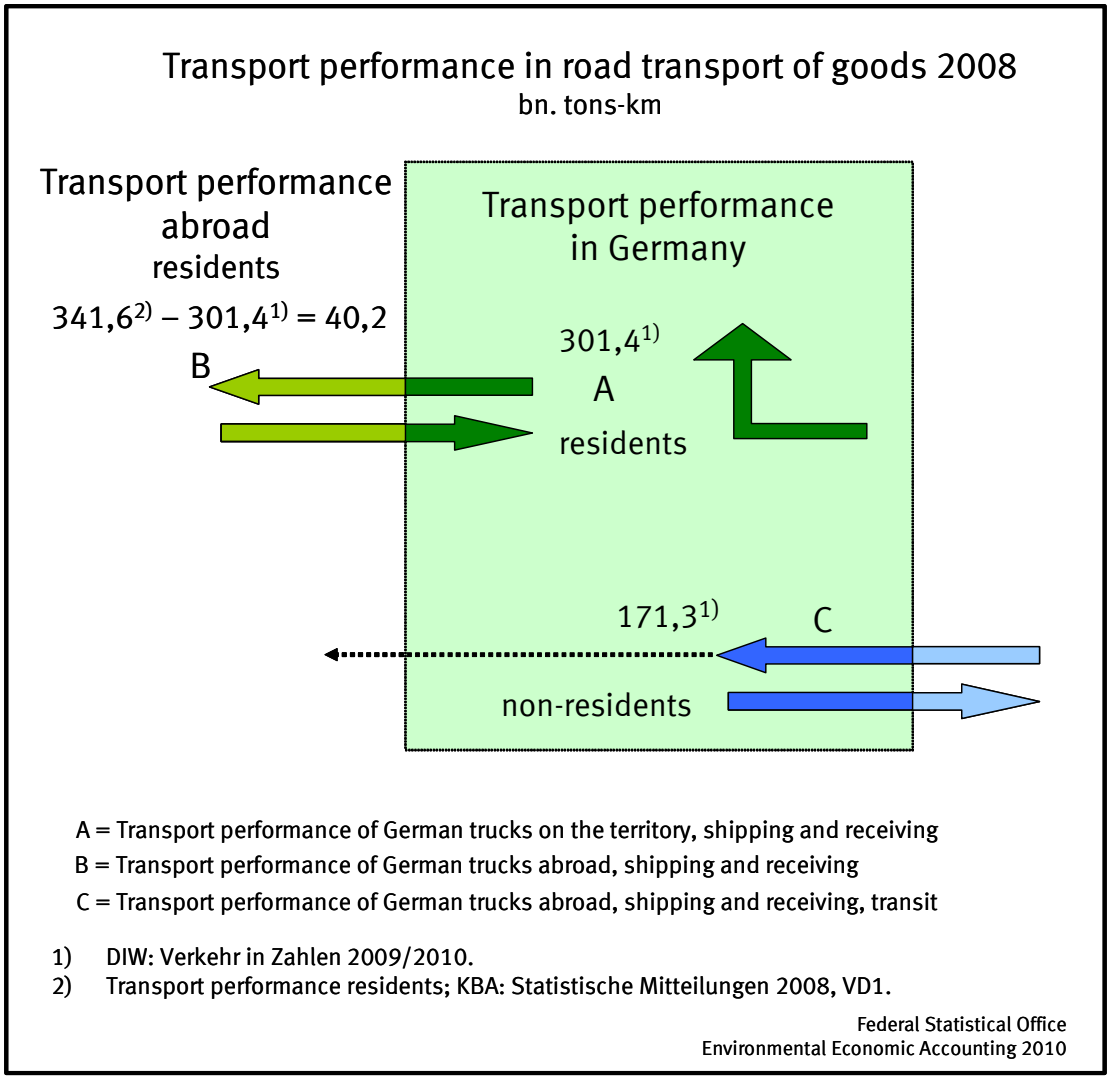
Source: Federal Statistical Office, Environmental Economic Accounting 2010.

4 Transport performance and mileages in road freight traffic (trucks › 3.5 t load capacity and trailer trucks)

4.1 Overall road freight traffic

Road freight traffic in Germany has the largest proportion of all domestic freight transport. In 2008 the proportion was 70.8%. The transport performance for road freight traffic [20] on German roads (residents and non-residents) came to 472.7 billion tonne kilometres in 2008. That is an increase of 117.7% compared to 1995, meaning that road transport performance has more than doubled. The proportion of foreign trucks was 36.2% in 2008. The increase in road transport performance for trucks of non-residents is considerably higher than for trucks of residents: + 174% compared to 1995 (2008: 171.3 bn. tkm) (see Diagrams 4 and 5).

Diagram 4: Transport performance in road freight transport (loading trips) in 2008



[20] Transport performance of trucks with a load capacity of more than 3.5 t and of articulated trucks.

Diagram 5: Calculation of transport performance and fuel consumption of trucks (› 3.5 t load capacity) and trailer trucks.

Calculation of transport performance and fuel consumption in road transport of goods
Trucks (› 3,5 t load capacity) and trailer trucks
- Fuel consumption of reseidents - Domestic sales (Energy balance) -
Diesel vehicles

			2006	
A	**Residents**			
	Stocks (in 1000)	X	537	1)
	Transport performance (in Mrd. tkm)	X	330.0	2)
	ø fuel consumption (in l/tkm)	E	2.9	
	Fuel consumption of loaded journeys (in bn. l)	=	9.5	
	Fuel consumption of all journeys (in bn. l)		12.7	3)
B	**Residents abroad**			
	Transport performance (in Mrd. tkm)	X	41.1	4)
	ø fuel consumption (in l/tkm)	wie in A	2.9	
	Fuel consumption of loaded journeys (in bn. l)	=	1.2	
	Refuelling abroad (in bn. l)		2.5	6)
C	**Non-residents on the territory**			
	Transport performance (in Mrd. tkm)	X	150.2	5)
	ø fuel consumption (in l/tkm)	E	2.0	6)
	Fuel consumption of loaded journeys (in bn. l)	=	3.0	
	Refuelling on the territory (in bn. l)		1.8	6)
D	**Residents on the territory**			
	Transport performance (in Mrd. tkm)	= A - B	288.9	4)
	Refuelling on the territory (in bn. l)	= A - B	10.2	
E	**On the territory (Energy-balance)**			
	Transport performance (in Mrd. tkm)	= C + D	439.1	
	Refuelling on the territory (in bn. l)	= C + D	12.0	

X : Basic value; **E :** Estimate; **'='** : calculated value.

1) KBA data of stocks.
2) KBA: Transportleistungen Inländer (VD1) (loaded journeys).
3) DIW: Wochenbericht 50/2009 and internal calculations.
4) KBA: Transportleistungen im Inland (VD3) (loaded journeys).
5) KBA: Transportleistungen der Ausländer im Inland (VE3) (loaded journeys).
6) Estimate.

Source: Federal Statistical Office, Environmental Economic Accounting 2010

Diagram 5 shows, amongst other information, the reference data for calculating the fuel consumption of heavy trucks in road freight transport. The calculation of fuel consumption of German residents is performed on the basis of data on road transport performance (consumption due to loading trips). The consumption specified by the DIW (DIW weekly report) is more than 30% higher than the calculated consumption, as the consumption for "non-loading trips" and from other mileages - not taken into consideration in the freight transport statistics - is included (see Chapter 4.2). According to the Federal Office of Goods Transport (BAG), the share of loading trips for German trucks in 2008 amounted to 80.2% of the total number of trips.

In addition, the calculation of German residents' consumption abroad and the consumption of non-residents in Germany is presented in the overview. The Federal Motor Transport Authority data on road transport performance is also included here. The fuel purchases are compared to the calculated fuel consumption. The differences between consumption and fuel purchases result from specific fuel purchasing behaviours, depending on the origin of the trucks. The obvious price difference for fuel in European countries is the reason behind certain fuel purchasing in the originating country, the country which is passed through, or the country of destination. In 2008, German trucks abroad refuelled for more than double as much fuel than the amount which would have been necessary for the trips abroad. Vice versa, only half of the fuel that foreign trucks required for trips in Germany was actually purchased in Germany. This different fuel purchasing behaviour must be taken into account in the transition of resident consumption to domestic sales (the energy balance sheet concept). A detailed description of the calculation of "bridging items" from the resident concept to the domestic concept takes place in Chapter 6. Section 6.2.4 explains the assessment of bridging items for heavy trucks.

In the case of mileages the proportion of road freight traffic (trucks › 3.5 t load capacity) only amounted to 4.6 % of the total mileages of German residents (2008). In 2000, this was 4.3 %. The increased significance of road freight traffic is more evident from the trend in fuel consumption. In 2008 17.7 % of the entire fuel consumption of German residents in road traffic (petrol and diesel) was used by heavy trucks and articulated trucks. In 2000 it was still 16.0 %. The rise of road goods transport is most evident when observing the trend in road transport performance. Here, a rise of 21.7 can be seen in the period between 2000 and 2008 (see Table 7).

Table 7: Fuel consumption and mileage in road goods transport (residents)

Type of vehicle	Unit	1995	2000	2008	Change 2008 against 2000
Mileage of trucks and trailer trucks	bn. km	26.0	28.7	31.8	10.6
Transport performance of trucks and trailer trucks	bn. tkm	237.8	280.7	341.6	21.7
Fuel consumption of trucks	mn. litre	6,466	6,255	5,155	-18
Fuel consumption of trailers	mn. litre	3,556	4,646	6,426	38
Total	mn. litre	10,021	10,901	11,582	6
Share on total fuel consumption	%	15.1	16.0	17.7	-

Source: DIW Wochenbericht 50/2009.

In calculating fuel consumption in road goods transport, light duty trucks (LDT) are examined separately from heavy trucks[21]. Two reasons are decisive for this: On the one hand, only road transport performances with trucks over 3.5 t load capacity are recorded in the goods transport statistics. On the other hand, LDT have obtained a substantially increased significance. In 2008 the stock of these vehicles came to almost 87% of the total lorry stock. As the keeper structure of these vehicles differs significantly from that of heavy trucks, it is necessary to calculate their mileages, consumption and air emissions separately (see Chapter 5).

4.2 Under-recording of mileages in the freight traffic statistics

Data from the freight traffic statistics by the Federal Motor Transport Authority is used as a source for mileages in lorry traffic. According to the results of the research project "Evaluation und methodische Weiterentwicklung der Güterkraftverkehrsstatistik" (Evaluation and methodical further development of the freight traffic statistics),[22] the mileages are clearly under-recorded in the Federal Motor Transport Authority statistics. Certain purposes of a trip, such as trips to garages and other trips which are not directly goods transport, are not recorded there. These trips use significant amounts of fuel. The DIW describes the fuel consumption for these trips as "unassigned consumption". The DIW shows the overall diesel consumption in road transport, including the "unassigned consumption", in the Weekly Report 50/2009 under the heading "total diesel consumption". With this, a calculation of consumption is obtained which is consistent to the fuel sales (energy balance sheet).

In the fuel calculation, the "unassigned consumption" for lorry traffic is divided across trucks and trailers. In doing so, as in the study, it is assumed that the truck mileages are under-recorded by between 12% and 15% and even by 16% for trailers. (see Table 8).

[21] The weight limit by load capacity is 3.5 t for light duty trucks. This approximately corresponds to a permissible total weight of 6 t.

[22] IVT - Forschung Mobilität Transport Verkehr (Research Mobility Transport Traffic) (2006): final report: Evaluation und methodische Weiterentwicklung der Güterkraftverkehrsstatistik, on behalf of the Federal Ministry of Transport, Building and Urban Development, Heilbronn, Mannheim, September 2006.

Table 8: Allocation of the consumption not recorded in the freight traffic statistics (in mn. litres)

Additional fuel consumption	1995	2000	2004	2008
Trucks (› 3,5 t net load)	388	626	667	516
Trailer trucks	356	650	925	900
Total	743	1,276	1,593	1,415

Source: DIW Wochenbericht 50/2009 an own calculations.

4.3 Calculating the fuel consumption of trucks by industry

The division of fuel consumption for trucks and trailers across the industries takes place on the basis of the road transport performance of these vehicles recorded in the goods transport statistics, in the division by keeper category.

The details of road transport performance in road freight traffic are published by the Federal Motor Transport Authority[23]. The results of the "Traffic of German trucks" are presented as part of the Statistical Memoranda issued by the Federal Motor Transport Authority and the Federal Office of Goods Transport in the volume "VD1". Within these calculations, the overview 4 "Traffic volume by keeper categories" is used (see Annex 2.3 and Table 9). The data is available from 2002 on.

Table 9 contains the transport performance in road transport as a whole (combination of company transport and commercial transport) broken down into 18 keeper categories. Presented here is total transport performance by residential trucks (› 3.5 tonnes load capacity) and trailers, irrespective of the location of rendering. The presentation therefore is based on the residence concept.

[23] See Annex 2.2 – 2.6.

Table 9: Freight transport of German trucks from 2002 – 2008 - actual transport performance (in mn. Tkm)

Classification of registered keepers (Federal Motor Transport Authority)		2002	2004	2006	2008
1	Agriculture, hunting and forestry	1,708	1,863	1,949	2,089
2	Fishing	0	0	0	0
3	Mining and quarrying	1,793	1,636	1,532	1,454
4	Manufacturing	11,939	11,726	11,580	12,163
5	Electricity, gas and water supply	132	136	134	106
6	Construction	8,645	9,308	9,429	10,243
7	Wholesale and retail trade; repair of motor vehicles	25,893	27,656	28,622	29,253
8	Hotels and restaurants	0	0	43	32
9	Transport, storage and communication	141,884	156,293	168,370	175,457
10	Financial intermediation	166	114	0	0
11	Real estate, renting and business activities (excl 111)	1,289	3,026	4,221	4,524
111	Renting of automobiles	2,711	5,781	7,779	8,072
12	Public administration and defence; comp. soc. security	225	127	127	141
13	Education	0	0	0	0
14	Health and social work	0	0	0	0
15	Other community, social & personal service activities	58,458	55,674	62,659	65,809
16	Extra-territorial organisations and bodies	0	0	0	0
17	Employees and un-occupied people	29,085	31,036	33,169	31,944
18	Unknown	0	0	0	0
	Total	**283,927**	**304,373**	**329,614**	**341,285**

Source:: Statistische Mitteilungen of KBA and BAG - Verkehrsaufkommen deutscher Lastkraftfahrzeuge (VD1)

The following steps are necessary for calculating the consumption by residents broken down into 70 industries (see also Diagram 6):

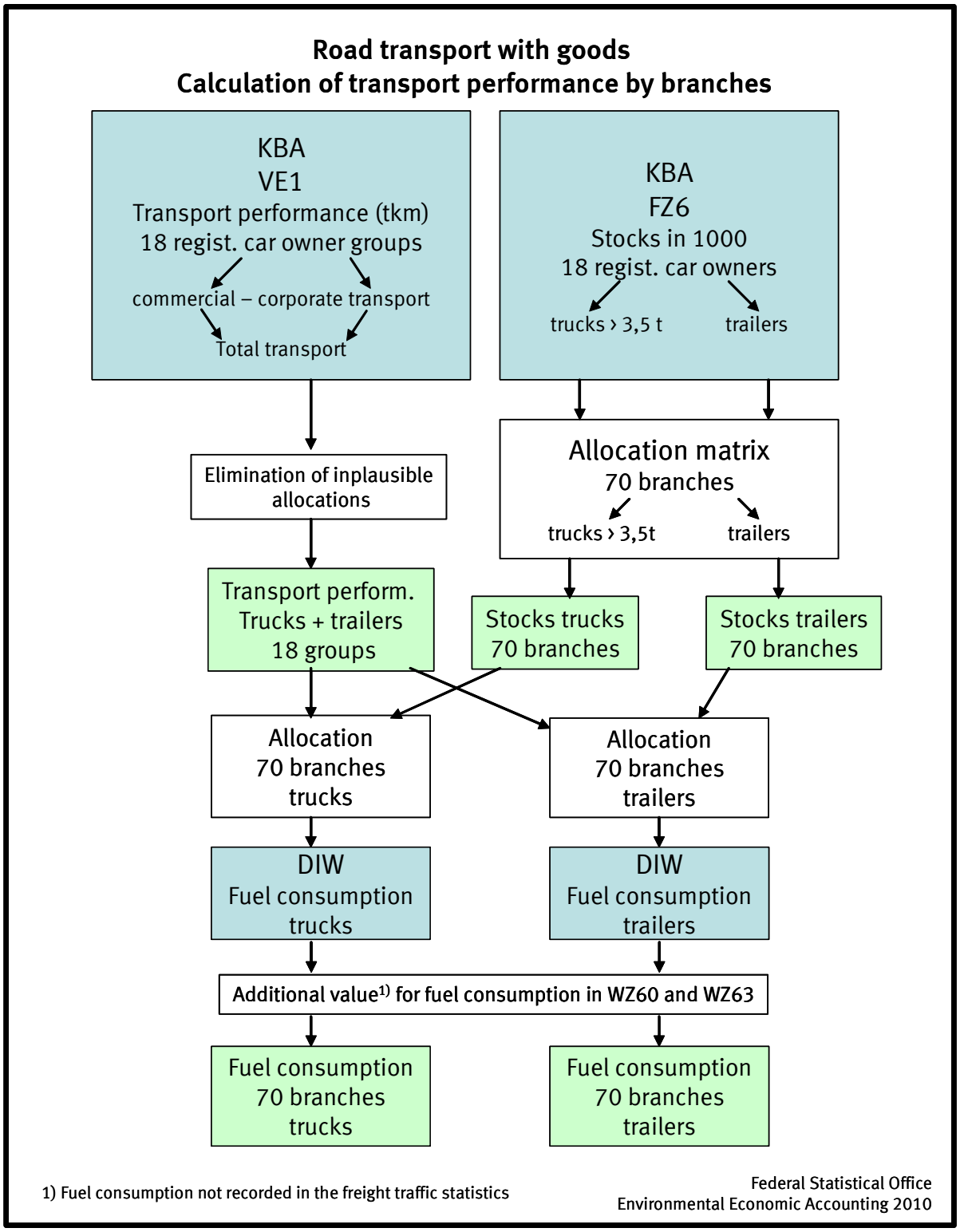
1) Inspection and review of the source data on transport performance. In the course of this, implausible assignments of transport performance for certain keeper categories are inspected.
2) The creation of a table with - partly corrected - shares of road transport performance according to the 18 keeper categories for the years from 2002 - 2008. The calculation of transport performance for the years prior to 2002 is taken from the year 2002.
3) The calculation of detailed stock data with the help of conversion matrices according to 70 industries - sub-divided according to trucks › 3.5 tonnes load capacity and trailers. The matrices are produced on the basis of additional data from the supply table of the input-output accounts.
4) Linking the conversion matrices with the transport statistics data and drawing up apportionment tables for trucks and trailers into 70 industries[24].

[24] Distribution of the 70 homogeneous branches to the 18 KBA keeper categories: see Annex 1, Overview 6

5) A mark-up for the consumption of fuel with regard to mileages which are under-recorded in the goods transport statistics in certain industries.
6) Calculation of the fuel consumption by 70 industries based on the tables produced in 4).

The following diagram shows how the data on transport performance in freight traffic is included into the fuel model and the calculation sequence to determine fuel consumption of trucks by industries.

Diagram 6: Calculation of the resident's fuel consumption in freight transport by 70 branches



Regarding step 1: Implausibility in the source data: During the inspection of the source data is it clear that distributing the transport performance to keeper categories can produce implausible assignments. And so in the road transport performance of commercial traffic, for example, almost 10% of the road transport performance is assigned to the keeper category "employees and non-working persons". It does not appear plausible that private households are actually responsible for these figures[25]. Consequently this transport performance is assigned to the most important sectors in commercial traffic.

The corrections in transport performance, which are made in the form of reclassifications at the level of the 70 industries, are listed below.

a) Cancellation of the position "private households".

   50% to "land transport services" (WZ 60.2):

   50% to "auxiliary and subsidiary activities for transport" (WZ 63)

b) Reducing the sector "Providing miscellaneous public and personal services" (WZ 90 – 99) by 70%

   25% to "land transport services" (WZ 60.2)

   25% to "auxiliary and subsidiary activities for transport" (WZ 63)

   20% to "commercial agency and wholesale services" (WZ 51)

c) Reducing the road transport performance in the sectors railway, shipping, aviation services (WZ 60.1, 61, 62) and assigning these at a rate of

   90% from WZ 60.1 to WZ 60.2/60.3

   80% from WZ 61 and 62 to WZ 63

There is a further reclassification for rented vehicles. In the tables of the Federal Motor Transport Authority by 18 keeper categories, the keeper category "Rented vehicles for owner-drivers" is a sub-position of the category "Real estate and housing, data processing, research, letting, services". In the freight transport statistics, the mileage covered is assigned to the relevant vehicle keeper.

This assignment is not appropriate for an originator-oriented calculation. In Environmental-Economic Accounting the causative principle is used when assigning environmental pollution. Accordingly, the environmental pollution is assigned to the sector (the economic activities) that causes it. As it is not known which industries make use of rented vehicles and to what extent, a reclassification of the road transport performance of the rented vehicles is carried out at the level of the 18 keeper categories to the largest sector - the sector of "transport and communications".

[25] It is obligatory to provide information for freight transport statistics. To draw them up keepers were selected from the Central Vehicle Register (ZFZR) of the Federal Motor Transport Authority. Presumably the question as to keeper category is frequently incorrectly entered, which leads to the aforementioned implausibilities.

One other unclear point must be mentioned regarding the calculation of fuel consumption for freight transport. The transport statistics do not distinguish between the vehicle types of trucks and trailers. The data for the transport performance refers to the performance of both vehicle types. We must assume, however, that the distribution of the transport performance by keeper categories is different for the two vehicle types. As the differing distribution of the stock of the two vehicle types - using the two conversion matrices - is included in the mileage calculation (see Diagram 6), the problem of differing distributions is, as at this point, at least partly taken into account.

According to the "reclassifications" referred to, corrected tables can be produced with the proportions of the transport performance based on 70 industries for the years 2002 to 2008 - separated into trucks and trailers (see Table 2, Annex 2).

These two tables form the basis for calculating fuel consumption by industry. Here recourse is made to the data provided by the DIW on the total fuel consumption of trucks and on that of trailers (resident concept). This data does not only relate to the transport performance (loading trips), however, but also to the total mileages, including consumption during non-loading trips. It is assumed that the distribution of consumption from unloaded trips to the industries matches that of loading trips.

In this approach it is assumed that all industries have the same specific consumption figure per tonne-kilometre covered. In actual fact, the vehicle fleets of individual sectors can be combined differently regarding the lorry type and size. Some industries, such as for example commercial freight traffic, with a greater proportion of heavy trucks and trailers, may have lower specific consumption figures because of the higher loading per kilometre covered than sectors with trucks that hold less. For a more precise assessment of different specific consumption figures for industries, more extensive analyses would be necessary.

As a last step, the “unassigned consumption” from trucks and trailers described in Chapter 4.2 must be distributed across the industries. 50% each is assigned to the sectors “services regarding auxiliary and subsidiary activities for transport" (WZ 63) and “other land traffic and road transport services via pipelines (WZ 60.2/3).

Table 10 contains the original values (total values) used in the calculation and the results on fuel consumption, transport performance and vehicle stock by (combined) industry. Likewise, the calculated values on the average road transport performance and on specific consumption per road transport performance is presented.

4.4 Determining average transport performance and specific consumption

Determining average road transport performance by industry is carried out by reverse projection:

Average mileage per industry = mileage per industry / stock per industry

In order to display the actual average transport performance for all industries, an appropriate correction is made to the vehicle stock because of the re-classification of mileages from rented vehicles. In 2008 the average annual transport performance amounted to 720 tkm per vehicle. At the same time, the commercial traffic sector (CPA I) had mileages that were well above average, at 1,542 tkm per vehicle in the year.

The specific fuel consumption is also determined by reverse projection of the results of the road transport performance and fuel consumption:

Specific fuel consumption = fuel consumption / road transport performance

2008 saw an average specific consumption figure of 3.4 L/100 tkm. As mentioned previously, the different vehicle fleet structure of certain industries can not be taken into account due to a lack of data. Thus the same specific consumption arises for all sectors.

Table 10 shows the results of the calculations for 2008. In doing so, the data on trucks and trailers has been combined (see Annex 2 for more tables of results).

Table 10: Heavy truck stocks, transport performance and fuel consumption by branches in 2008 (residents concept)

CPA [1]	Homogeneous branches	Stocks [2]	Annual transport performance	Transport performance	Specific consumption	Fuel consumption
		1000	1000 tkm/a	mn. tkm	l/100 tkm	mn. l
A	Products of agriculture, hunting and forestry	7.1	293	2,089	3.4	71
B	Fish and other fishing products; services incidental to fishing	0.1	0	0	-	0
C	Products from mining and quarrying	0.5	2,667	1,454	3.4	49
D	Manufactured products	38.7	315	12,163	3.4	413
E	Electrical energy, gas, steam and water	2.4	43	106	3.4	4
F	Construction work	39.8	257	10,243	3.4	348
G	Wholesale and retail trade services; repair services of motor vehicles	61.2	693	42,414	3.4	1439
H	Hotel and restaurant services 3)	0.8	38	32	3.4	1
I	Transport, storage and communication services 4)	161.0	1,542	248,377	-	9842
J	Financial intermediation services	0.3	205	68	3.4	2
K	Real estate, renting and business services	91.2	50	4,524	3.4	153
L	Public admin. and defence services; compulsory social security services	13.7	10	141	3.4	5
M	Education services 3)	0.9	0	0	-	0
N	Health and social work services 3)	1.1	0	0	-	0
O	Other community, social and personal services	66.6	296	19,743	3.4	670
	All homogeneous branches 4)	**486**	**703**	**341,353**	**-**	**12,997**
	Private households	0	0	0	-	0
	All homogeneous branches and private households (residents concept) 4)5)	**486**	**703**	**341,353**	**-**	**12,997**

1) Classification of products by activity (CPA) in the European Community (1993 edition).
2) Heavy trucks (› 3,5 t net load) and trailer trucks; Composition according KBA vehicle owner categories after transfer vehicles for renting and leasing to users stocks total: DIW data.
3) Statistical informations about transport for goods of the Federal Motor Transport Authority (KBA) includes no data about transport performance.
4) Presentation of the specific fuel consumption make no sense. Fuel consumption incl. fuel consumption of journeys, that are not included in the statistics of the Federal Motor Transport Authority (2008: 1415 mn. litre). These journeys are not included in the values of mileage.
5) National accounts (residents) concept: including mileages of residents abroad, excluding mileages of non-residents on the territory.

Source: Federal Statistical Office, Environmental Economic Accounting 2010

5 Mileage of light duty trucks (trucks < 3.5t load capacity)

Another objective of the project is improving the calculation of mileages and fuel consumption of the industries with trucks by way of a special calculation for light duty trucks (LDT).

The LDT (with a load capacity of less than 3.5 t) form a very high proportion of the stock of trucks (2008: 86.8%) and of the fuel consumption (55% for diesel vehicles) (see Table 11). The keeper structure of these vehicles and the intensity of use of the industries differ significantly from that of the heavy trucks. Consequently a separate calculation of mileages and fuel produces significant changes in the results for fuel consumption and CO_2 emissions of trucks.

The Federal Motor Transport Authority distinguishes the stock of trucks by various criteria. There are details by permissible total weight and also a subdivision by load capacity. For the Federal Statistical Office, a special evaluation of the Federal Motor Transport Authority databases for trucks took place in a subdivision by permissible total weight. From this special evaluation the following data on the stock of LDT with a permissible total weight of less than 3.5 t is available based on keeper categories (see Table 13). LDT comprise by definition vehicles with a permissible total weight of 6 t. The partial figure on which this is based is however regarded as being largely representative for LDT with a load capacity of less than 3.5 tonnes. This limit is the relevant borderline for recording road transport performance in freight traffic statistics.

There are details available from the DIW as source and reference data for the calculations of mileages and fuel consumption in the desired subdivision for the diesel vehicles (see Table 11). The data on petrol trucks is fully assigned to the light duty trucks.

Table 11: Truck and trailers stocks, mileages and fuel consumption from 2000-2008 by size class

Vehicle type	1995	2000	2002	2004	2006	2008
			Total mileage bn. km			
Trailers (DK)	9.4	12.7	13.7	15.1	16.6	18.0
Trucks	52.6	58.9	58.2	57.7	57.6	60.3
petrol	4.1	3.4	3.1	2.7	2.3	2.0
diesel (DK)	48.5	55.5	55.1	55.0	55.4	58.3
DK‹=3,5t net load	31.9	39.4	40.9	41.3	41.7	44.6
DK ›3,5t net load	16.6	16.0	14.2	13.7	13.6	13.7
			Vehicle stock in 1000			
Trailers (DK)	124	162	179	182	201	177
Trucks	2,215	2,527	2,632	2,579	2,584	2347
petrol	345	284	264	224	193	142
diesel (DK)	1,870	2,243	2,368	2,355	2,391	2204
DK‹=3,5t net load	1,418	1,843	1,984	2,007	2,055	1896
DK ›3,5t net load	452	400	384	348	336	309
			Fuel consumption mn. liter			
Trailers (DK)	3,556	4,646	5,052	5,444	6,038	6,426
Trucks	11,743	12,379	11,569	11,087	11,473	11,622
petrol	538	426	390	331	284	229
diesel (DK)	11,205	11,953	11,179	10,756	11,189	11,393
DK‹=3,5t net load	4,739	5,697	5,716	5,623	6,029	6,237
DK ›3,5t net load	6,466	6,255	5,463	5,133	5,161	5,155

Quelle: DIW Wochenbericht 50/2009; Working table.

Table 12 shows the average figures for mileages and fuel consumption of the LDT and heavy trucks resulting from the above details. The annual mileages of the heavy trucks are about twice as high as those of the LDT. In terms of fuel consumption per 100 vehicle kilometres, the light duty trucks have a much lower figure by comparison with the heavy trucks.

Table 12: Average mileages and specific fuel consumption of diesel trucks by load capacity class

load capacity	1995	2000	2002	2004	2006	2008
			annual mileage (in 1000 km)			
DK‹=3,5t net load	22.5	21.4	20.6	20.6	20.3	23.5
DK ›3,5t net load	36.7	40.1	37.0	39.3	40.6	44.5
			specific fuel consumption (l/100 km)			
DK‹=3,5t net load	14.9	14.5	14.0	13.6	14.5	14.0
DK ›3,5t net load	39.0	39.0	38.5	37.5	37.8	37.5

Quelle: DIW working table, own calculations.

For calculating fuel consumption by industry, details of transport performance cannot be used as a basis as with the heavy trucks, as there are no primary statistical details available regarding this. In fact, the fuel consumption must be based on the estimate of mileages. In doing this the data provided by the Federal Motor Transport Authority on vehicle stock is used as a basis while assumptions are made concerning the mileages of certain sectors. The total figure for fuel consumption is taken from the DIW – see the above table.

The stocks according to 18 keeper categories are distributed to the 70 industries with the help of the conversion matrix described above, separated according to petrol and diesel vehicles.

Table 13: Light duty trucks stocks (trucks < 3.5 t permissible total weight) be keeper category in 2008

No.	Classification of registered keepers (Federal Motor Transport Authority)	diesel	petrol
1	Agriculture, hunting and forestry	17,346	1,057
2	Fishing	196	8
3	Mining and quarrying	3,690	300
4	Manufacturing	100,650	7,775
5	Electricity, gas and water supply	20,368	4,238
6	Construction	147,056	7,832
7	Wholesale and retail trade; repair of motor vehicles	107,480	7,553
8	Hotels and restaurants	4,958	952
9	Transport, storage and communication	80,472	2,108
10	Financial intermediation	812	177
11	Real estate, renting and business activities (excl 111)	26,947	2,144
111	Renting of automobiles	26,605	70
12	Public administration and defence; comp. soc. security	36,474	6,067
13	Education	298	43
14	Health and social work	5,725	929
15	Other community, social & personal service activities	394,109	32,521
16	Extra-territorial organisations and bodies	326	60
17	Employees and un-occupied people	632,543	84,596
18	Unknown	498	171
	Total	**1,606,553**	**158,601**

Source: Federal Motor Transport Authority: special evaluation of data for Federal Statistical Office.

As the Federal Motor Transport Authority data is based on details relating to the vehicle keepers, while the calculations of the Environmental-Economic Accounting are cause orientated, there is an allocation problem at keeper category 111 “Rented vehicles for owner-drivers”. The stocks and mileages for rented vehicles must be assigned to the users (parties hiring out the vehicles). There is no data available on the parties hiring out LDT, however. An estimate must therefore be made based on industries. It is assumed that half of the mileages for rented LDT are provided by private households, 40% by the sector "Miscellaneous public and personal services" and 10% by the sector "Trade, repair of vehicles and consumer goods". In order to avoid distorting the final record, the stock data was implemented accordingly.

The result of the allocation was checked for plausibility. In doing so, the mileages for private households appeared to be too high at around 30%. Although LDT are hired out to a great extent by private individuals for moving and the like, we cannot assume that the latter - in line with the proportion of vehicles - take-up an equally high proportion of the mileages[26]. Consequently the details of the mileages for private households have been corrected and transfers made to other sectors.

Especially for the sectors "Commercial agency and wholesale" (WZ 51), “Retail excluding motor vehicle trade" (WZ 52) and “Miscellaneous land transport” (WZ 60.2) additions were made to the mileages (see Table 14). Higher mileages are assumed for “Miscellaneous land transport”, as here in particular account needs to be taken of haulage companies that carry out commercial transportation with "small transporters". More supplements could be found in the sectors “Auxiliary and subsidiary activities for transport” (WZ 63). Forwarding companies must also be considered here, which also perform transportations - and the “Communications” (WZ 64). The latter also includes the postal services, which we feel are responsible for a substantial volume of the transport performance by LDT.

Recourse is made to the distribution of mileages that has been corrected in this fashion for the distribution of fuel consumption by LDT. Table 14 shows the results of the calculations for light duty trucks in 2008 (see Annex 2 for more tables of results).

[26] Presumably, when the vehicles are registered, they are incorrectly assigned to a more than negligible extent to employee households instead of commercial keepers.

Table 14: Light duty trucks (diesel) stocks, mileages and fuel consumption in 2008 by branches

CPA [1]	Homogeneous branches	Stocks [2]	Annual mileage	Mileage	Specific consumption	Fuel Consumption
		1000	1000 km	mn. km	l/100 km	mn. l
A	Products of agriculture, hunting and forestry	19.9	23.5	467	14.0	65.4
B	Fish and other fishing products; services incidental to fishing	0.2	23.5	5	14.0	0.8
C	Products from mining and quarrying	2.1	23.5	50	14.0	7.0
D	Manufactured products	122.9	23.5	2,889	14.0	404.4
E	Electrical energy, gas, steam and water	20.5	23.5	481	14.0	67.4
F	Construction work	170.9	23.5	4,017	14.0	562.4
G	Wholesale and retail trade services; repair services of motor vehicles	131.1	50.8	6,664	14.0	932.9
H	Hotel and restaurant services	6.4	23.5	151	14.0	21.2
I	Transport, storage and communication services	93.4	100.3	9,361	14.0	1,310.5
J	Financial intermediation services	1.0	23.5	23	14.0	3.3
K	Real estate, renting and business services	296.3	23.5	6,962	14.0	974.7
L	Public admin. and defence services; compulsory social security services	42.9	23.5	1009	14.0	141.2
M	Education services	3.0	23.5	71	14.0	10.0
N	Health and social work services	6.8	23.5	159	14.0	22.2
O	Other community, social and personal services	216.0	23.5	5,077	14.0	710.7
	All homogeneous branches	**1,133**	**33.0**	**37,386**	**14.0**	**5,234**
	Private households	762	9.4	7,166	14.0	1,003
	All homogeneous branches and private households (residents concept)	**1,896**	**23.5**	**44,552**	**14.0**	**6,237**

1) Classification of products by activity (CPA) in the European Community (1993 edition).
2) Composition according KBA vehicle owner categories after transfer vehicles for renting and leasing to users stocks total: DIW data.

Source: Federal Statistical Office, Environmental Economic Accounting 2010

6 Defining the "bridging items" from the resident concept to the domestic concept

6.1 Calculation concept

One aim of the project is consistently estimating the so-called "bridging items" for the mileages and fuel consumption in road traffic. The bridging items facilitate the transition between the different consumption concepts in the final record. A calculation model was developed in the project, which facilitates recording fuel consumption based on the domestic concept and the resident concept -- and in this case both consumption and (domestic) sales.

The starting point for the calculations was the consumption data from the DIW on fuel consumption by German residents. The figure for domestic sales in road traffic from the energy balance sheet forms the other reference value (target value) in the calculations. In addition, the results on domestic fuel consumption, found as part of the TREMOD-Model[27] are also taken into account (see Chapter 2.3).

Diagrams 7 and 8 show the connection between the DIW's original values and the Working Group on Energy Balance's (AGEB) target value. The estimation model for transfer parameters takes the most significant vehicle types regarding fuel consumption, "passenger cars", "light duty trucks" and "heavy trucks including articulated trucks" into consideration. It is assumed that the balance from residents' refuelling abroad and the non-residents' refuelling in Germany is insignificant for all other vehicle types. Diagram 10 shows the model with the results for diesel vehicles for the year 2006.

Diagram 7: Bridging items for the fuel consumption of vehicles

Transfer parameters of fuel consumption of road transport
- Fuel consumption of reseidents - Domestic sales (Energy balance) -
Diesel vehicles

		cars	trucks	LDT [1)]	Other	Total
1	**Fuel consumption of residents**	X	X	X	X	1
2	**Refuelling residents abroad**					-
	2a refuelling for journeys abroad					2
	2b refuelling for journeys in Germany					
3	**Refuelling non-residents on the territory**					+
	3a refuelling for journeys in Germany					3
	3b refuelling for journeys abroad					
						=
4	**Domestic sales (Energy-balance)**					EB

1) Light duty trucks.
X = Basic value.

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Environmental Economic Accounting 2010

[27] Calculations of the Institute for Energy and the Environment (IFEU) as part of national reporting on greenhouse gases. The results are integrated into the national inventory by the Federal Environment Agency.

Diagram 8: Fuel consumption by diesel vehicles in 2006

Fuel consumption of diesel vehicles 2006
- Fuel consumption of reseidents - Domestic sales (Energy balance) -
in bn. Litre

		cars	trucks	LDT [1]	Other	Total
1	**Fuel consumption of residents**	14.1	12.7	6.0	3.1	35.9
2	**Refuelling residents abroad**					-
2a	2a refuelling for journeys abroad	0.8	1.1	0.5		4.7
2b	2b refuelling for journeys in Germany	0.6	1.4	0.3		
3	**Refuelling non-residents on the territory**					+
3a	3a refuelling for journeys in Germany	0.6	1.7	0.5		3.0
3b	3b refuelling for journeys abroad	0.1	0.1	0.0		
4	**Domestic sales (Energy-balance)**					= 34.2

1) Light duty trucks.
Source: DIW Wochenbericht 50/2009; Federal Statistical Office
Working Group on Energy Balance's (AGEB): Energy-balance 2006 Environmental Economic Accounting 2010

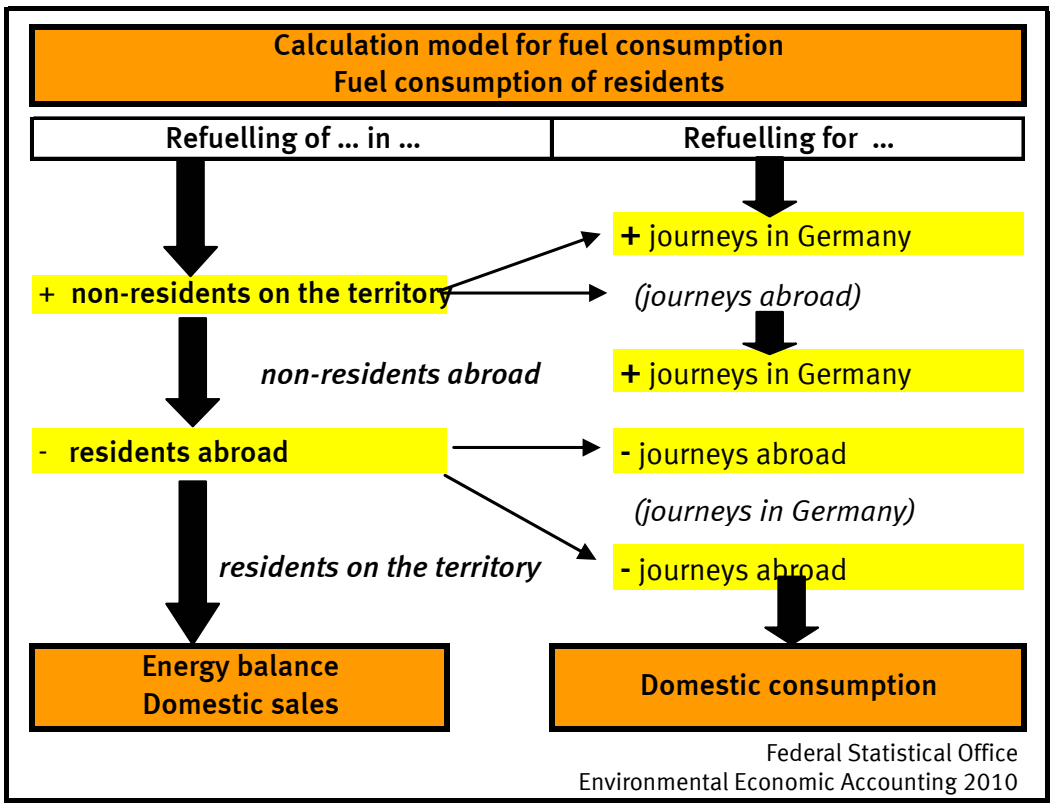
Residents' refuelling abroad is consolidated for the calculation, regardless of where the fuel is actually used. The same also applies for non-residents refuelling in Germany. The destination for residents' refuelling (see Diagram 8: 2a and 2b) and that of non-residents (3a and 3b) is irrelevant for the transition of residents' fuel consumption to the domestic sales (energy balance sheet).

If direct data on the refuelling amounts of residents abroad and vice versa were available, the transition to the energy balance figure could be calculated easily. Unfortunately, this is not the case. Here, what is available is rather data on residents' mileages / road transport performance abroad, or that of non-residents in Germany. It is therefore essential to provide the connection between mileage and refuelling of residents abroad and non-residents in Germany, for the calculation of transitional figures. Diagram 11 shows this connection. The domestic consumption can be calculated on the basis of the fuel actually used by residents abroad, as well as the mileages of non-residents in Germany, and the fuel consumption resulting from this. It becomes clear that further sub-divisions are necessary when determining transitional figures - on the basis of mileage data (see Diagrams 7 and 8: sub-division of positions 2 and 3).

Data on mileages / transport performance can be taken from the Federal Motor Transport Authority's statistics on freight traffic, with details on the distances covered or on the freight transport performance for German and European trucks (see Annex 2.2 - 2.6) in Germany and abroad. Apart from this there are details available of distances covered abroad by passenger cars (holiday travel) from surveys of the mileages covered by the keepers of passenger cars, such as for example the Mileage Survey 2002 and the "Mobility in Germany 2002" survey. The DIW evaluated these surveys as part of a report (DIW [2005]) and produced tables showing domestic mileages as well as residents' mileages separated by vehicle type (see Annex 1.3 and 1.4). These

details are utilised within the Environmental-Economic Accounting calculation model. Details regarding the extent to which these mileages are covered using domestic or foreign fuel are not available, meaning that these sub-divisions must be estimated.

Diagram 9: Concepts on fuel consumption in road traffic



Firstly, the proportion of fuel purchased abroad is estimated which is used solely for foreign trips. The remainder of the fuel purchased abroad is used for trips in Germany. Bringing fuel into Germany that was purchased abroad is known as a “grey import”. A large proportion of “grey imports” can be attributed to “tank tourism”. Here, refuelling is carried out abroad with the intention of using the fuel in Germany. The reason for this “strategic” refuelling behaviour lies in the large differences between domestic prices and the prices in bordering countries. This refuelling behaviour is of great significance, in particular, in HGV traffic. A German truck transporting goods abroad will refuel in the cheaper foreign countries where possible, and fill up again when returning to Germany.

As with the estimation of the refuelling behaviour of the Germans abroad, the proportion of fuel purchased in Germany by non-residents that is actually used in Germany is also estimated. The data in Diagram 10 clarifies the special refuelling behaviour. Trucks originating in Germany refuelled more abroad for trips in Germany (1.4 bn. litres) in 2006 than for trips in other countries (1.1 bn. litres). Vice versa, keepers of non-resident trucks only refuelled as much in Germany as was absolutely necessary to be able to travel the required routes in Germany. In addition to this amount, only 100 million litres were refuelled in Germany and used abroad.

The specific refuelling behaviour plays an especially large role in calculating the domestic consumption in Germany, due to the high price differences in fuel compared to neighbouring states. Tables 15 and 16 show the fuel prices in Germany and the neighbouring states. Although the prices between 2004 and 2008 moved closer together in Europe, 2008 still contained significant price differences.

Table 15: European prices of super unleaded petrol (including all taxes, in EUR per litre)

Countries	1998	2004	2006	2008	Neighbour countries against Germany 2004 in %	2008 in %
Belgium	0.888	0.992	1.305	1.415	-7.9	4.8
Czech Republic	-	-	0.980	1.196	-	-11.4
Denmark	0.856	1.071	1.267	1.335	-0.6	-1.1
Germany	**0.808**	**1.077**	**1.262**	**1.350**		
France	0.941	0.997	1.220	1.338	-7.4	-0.9
Luxembourg	0.648	0.826	1.066	1.154	-23.3	-14.5
Netherlands	0.967	1.188	1.407	1.494	10.3	10.7
Austria	0.834	0.858	1.052	1.183	-20.3	-12.4
Poland	-	-	0.970	1.182	-	-12.4

Based on prices displayed on the 1st Monday after the 15th January of each year.

Source: Eurostat: Panorama of energy, 2009 edition.

Table 16: European prices of diesel fuel (including all taxes, in EUR per litre)

Countries	1998	2004	2006	2008	Neighbour countries against Germany 2004 in %	2008 in %
Belgium	0.626	0.731	1.029	1.095	-16.6	-11.5
Czech Republic	-	-	0.970	1.212	-	-2.0
Denmark	0.647	0.823	1.075	1.174	-6.1	-5.1
Germany	**0.591**	**0.876**	**1.094**	**1.237**		
France	0.673	0.791	1.054	1.187	-9.7	-4.0
Luxembourg	0.542	0.622	0.881	1.016	-29.0	-17.9
Netherlands	0.670	0.826	1.043	1.173	-5.7	-5.2
Austria	0.679	0.727	0.973	1.156	-17.0	-6.5
Poland	-	-	0.965	1.122	-	-9.3

Based on prices displayed on the 1st Monday after the 15th January of each year.

Source: Eurostat: Panorama of energy, 2009 edition.

Diagram 10 shows the connection between mileage and fuel consumption for lorry traffic in 2006. It shows how domestic fuel sales and domestic fuel consumption are inferred. The difference between domestic consumption and domestic sales is particularly significant in lorry traffic: only 80% of the fuel which was used according to truck mileages on German roads was refuelled in Germany. The gap of roughly 20% is closed by refuelling abroad.

Diagram 10: Mileages and fuel consumption in truck traffic in 2006 - domestic sales and domestic consumption

Transport performance and fuel consumption in road transport of goods 2006
Fuel consumption of residents, domestic sales and domestic consumption
Trucks (› 3,5 t load capacity) and trailer trucks

Journeys of…	Transport performance in bn. tkm	Fuel consumption		Refuelling with… external fuel		domestic fuel
		in bn. L				
A Residents abroad	3.7	1.4	=	1.1	+	0.2
B Residents on the territory	30.7	11.4	=	1.4	+	9.9
Residents	34.4	12.7				
C Non-residents on the territory	9.8	3.7	=	2.0	+	1.7
D Non-residents abroad	X	X		X		0.1
		B + C				A + B + C + D
Domestic consumption		15.1		Domestic sales		12.0

1) DIW Wochenbericht 50/2009 a. internal calculations.

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Diagram 11 shows the composition of the computational model with all necessary divisions of mileages and fuel purchases for the vehicle type "passenger car". The letters given in the last column enable a comparison to be made with the presentation of mileages and fuel purchases in Diagram 1 (see page 7).

Positions 3AN/6AN and 7AN/10AN contain the estimated geographical division of the fuel purchased in the respective foreign country according to the area where this fuel is used. The corresponding mileages (pos. 3a/6a and 7a/10a) can be calculated on the basis of the average consumption. Residents’ mileages abroad with domestic petrol (position 2a) and those of foreigners in Germany with foreign petrol (position 8a) are estimated.

Positions 11b and 12 show the results of the calculation for fuel consumption according to both domestic concepts. At the end of the calculation, based on the fuel purchases for passenger cars (position 11b), the transition to the total value of the energy balance sheet for fuel sales in road traffic is established (position 19).

Diagram 11: Computational scheme to infer "bridging items" for passenger car mileage and fuel consumption

No.[1]	Calculation	Bridging items	cf. graph 1
		Mileage (Mil) - mn. km -	
1a		**residents - total - (DIW)**	**A + B**
2a		residents abroad with domestic petrol	B1
3a	3b / D * 100	residents abroad with foreign petrol	B2
4a	**2a + 3a**	**residents abroad**	**B**
5a	**1a - 4a**	**residents on the territory**	**A**
6a	6b / D * 100	residents on the territory with foreign petrol (grey-imports)	A3
7a	7b / D * 100	non-residents on the territory with domestic petrol	C2 + C1
8a		non-residents on the territory with foreign petrol	C3
9a	**7a + 8a**	**non-residents on the territory**	**C**
10a	10b / D * 100	non-residents abroad with domestic petrol	D1
11a	**5a + 9a**	**on the territory**	**A+C**
		Refuelling - million liter -	
1b		**residents - total - (DIW)**	**A + B**
D	1b / 100 * 1a	*specific fuel consumption*	
5b		**residents abroad** [2]	**B2 + A3**
3b	5b / 100 * 3AN	thereof: for journeys abroad	B2
3AN		*for journeys abroad in %* [2]	
6b	5b / 100 * 6AN	thereof: for domestic journeys (grey-imports)	A3
6AN		*for domestic journeys in % (= 100 - 3AN)* [2]	
2b	D * 2a / 100	residents on the territory for journeys abroad	B1
9b		**non-residents on the territory** [2]	**C1 + C2 + D1**
7b	9b /100 * 7AN	thereof: for domestic journeys	C1 + C2
7AN		*for domestic journeys in % (= 100 - 7AN)* [2]	
10b	9b /100 * 10AN	thereof: for journeys abroad	D1
10AN		*for journeys abroad in %* [2]	
8b	D * 8a / 100	non-residents abroad for domestic journeys	C3
11b	**1b - 5b + 9b**	**Total refuelling on the territory (according energy balance)**	**A+B-B2-A3 +C1+C2+D1**
12b	**1b - 3b - 2b + 7b + 8b**	**Total consumption of petrol (cars) on the territory**	**A+B-B2-B1+C**
13		domestic consumption trucks	
14		domestic consumption busses	
15		domestic consumption motor cycles	
16		domestic consumption mopeds	
17		domestic consumption tractors	
18		domestic consumption other vehicles	
19	**11b + 13+ 14+...+18**	**Total consumption of petrol on the territory (energy balance)**	

1) Comprarable bridging items of Mileage (a) and Refuelling (b) have the same continuing number.
2) Estimate.

Source: Federal Statistical Office, Environmental Economic Accounting 2010.

6.2 Calculation sequence and results

In calculating the bridging items, a combination of a “bottom-up” procedure and a “top-down” approach is applied. The relevant mileage figures of individual vehicle types for fuel consumption and the resultant fuel purchases are determined “bottom-up”. To determine total fuel consumption, "top-down" estimated predefined variables are used (steps 1 and 2). The calculation results are adjusted to the reference values from the energy balance sheet and the calculations of the DIW (on consumption by German residents).

The calculation is carried out in four steps:

1. Distributing the total balance between the fuel consumption of the German residents (according to information provided by the DIW) and domestic sales according to the energy balance sheet (see Chapter 6.2.1) to the bridging items “fuel purchases by residents abroad” and "fuel purchases by foreigners in Germany”.
2. Allocating and distributing the bridging items determined in 1. to vehicle types (see Chapter 6.2.2).
3. Alternating determining mileages/fuel purchases in cross-border traffic and allocating mileages/fuel purchases geographically in connection with fuel purchases abroad.
4. Aggregating individual accounts for the vehicle types, inferring the total amount of fuel consumption and if appropriate correcting the assumptions in steps 2 and 3.

Following on from this, the calculations are described in more detail and the results are presented. In Chapter 6.2.3 particular attention is devoted to calculating the bridging items for passenger cars, and in Chapter 6.2.4 for those of trucks.

6.2.1 Determining the total figure for the bridging items

First of all the total difference between consumption by German residents according to the fuel model and domestic sales is determined for all vehicles - separated by petrol and diesel. The total difference must then be distributed to the two transitional figures “fuel purchases by residents abroad” and “fuel purchases by non-residents in Germany” (step 1).

The source for evaluating transitional figures is the table published by the DIW on fuel consumption in road traffic according to the domestic concept and the resident concept (DIW, 2005, see Annex 1.5). The table includes the bridging items “fuel purchases by German residents abroad for travel abroad”, “fuel purchases by foreigners in Germany for travel in Germany” and the balance for grey imports.

Based on this DIW table we have developed our own, more sharply differentiated estimate approach regarding the bridging items. This step is necessary for several reasons. On the one hand it is not sufficient simply to show the balance of grey imports. Separate documentation according to residents and non-residents must be created. Grey imports are mainly related to “tank tourism”. These fuel purchases are determined separately in the fuel model from miscellaneous cross-border trips and fuel purchases, such as for example holiday-related fuel purchases. The totals of the grey imports and fuel purchases in the respective foreign country for trips abroad produce the two bridging items that are to be determined (see Table 17).

Table 17: Bridging items on fuel consumption in the EEA fuel model

	2000	2002	2004	2006	2008
Petrol			**bn. litre**		
Refuelling of residents abroad	2.1	2.6	2.8	3.3	3.6
Refuelling of non-residents on the territory	0.6	0.6	0.7	0.7	0.7
Diesel					
Refuelling of residents abroad	2.5	3.8	4.0	4.5	4.9
Refuelling of non-residents on the territory	3.8	3.1	3.3	3.0	2.8

Source: DIW (internal table) and own calculations.

Another reason for using our own estimate approach is the use of different sales figures by the DIW, which do not fully coincide with the energy balance sheet. The DIW sources the information from the Association of the German Petroleum Industry. These figures differ from the reference values of the energy balance sheet (e.g. for the sale of petrol for road traffic in 2003: DIW: 34,011 bn. litres, energy balance sheet: 33,950 bn. litres: sale of diesel fuel: DIW: 29,016 bn. litres, energy balance sheet: 30,071).

The detail provided by the DIW on fuel purchases by German residents abroad has been included as a reference value in our estimation model, firstly unchanged. With these details it can be assumed that the statistical sources are more reliable than is the case with the fuel purchases by foreigners in Germany (e.g. by including the results of Mobility in Germany 2002, which also cover data regarding foreign trips by the households surveyed). The attempt was also made to orientate the balance of "tank tourism" as closely as possible to the DIW data.

The total balance of diesel vehicles differs significantly from the DIW data, however, due to the reasons mentioned above, in our estimation model. Our data on the fuel purchases of German residents in foreign countries for trips abroad, as well as of foreigners in Germany for trips within Germany, is significantly higher than the DIW figures. Table 18 below shows the results of our estimate approach compared with the data provided by the DIW.

Table 18: Bridging items on fuel consumption according to the DIW and the EEA fuel model (in mn. Litres)

	2000	2001	2002	2003
Petrol				
DIW balance (total)[1)]	**1,350**	**1,880**	**2,075**	**2,520**
Refuelling of residents abroad for journeys abroad	1,560	1,600	1,600	1,650
Refuelling of non-residents on the territory for domestic journeys	420	420	425	430
Balance of grey-imports [2)]	210	700	900	1300
EEA-Model on fuel consumption balance[1)]	**1,563**	**1,994**	**2,145**	**2,580**
Refuelling of residents abroad for journeys abroad	1,604	1,790	1,814	1,956
Refuelling of non-residents on the territory for domestic journeys	472	461	586	578
Balance of grey-imports [2)]	431	666	917	1,202
Diesel				
DIW balance (total)[1)]	**-100**	**1,800**	**2,143**	**2,650**
Refuelling of residents abroad for journeys abroad	1,400	1,500	1,500	1,500
Refuelling of non-residents on the territory for domestic journeys	1,400	900	857	850
Balance of grey-imports [2)]	-100	1,200	1,500	2,000
EEA-Model on fuel consumption balance[1)]	**-1,306**	**655**	**748**	**1,528**
Refuelling of residents abroad for journeys abroad	1,858	2,561	2,293	2,426
Refuelling of non-residents on the territory for domestic journeys	3,296	2,801	2,955	2,720
Balance of grey-imports [2)]	133	895	1,411	1,822

1) Balance = Refuelling of residents abroad and of non-residents on the territory.
2) Balance = Refuelling of residents abroad and of non-residents on the territory, in each case for consumption in the own country.

Source:. DIW internal table, own calculations.

No more data is available from the DIW after the 2003 reporting year. Therefore, for the years following on from 2003 there was a complete recalculation of the bridging items. The two bridging items" fuel purchases by German residents abroad" and "fuel purchases by foreigners in Germany" (see Table 17) that have been determined are included in further, more detailed calculation of the concept transition.

6.2.2 Distribution of the bridging items for fuel purchases to passenger and goods transport

The figures "fuel purchases by German residents abroad" and "fuel purchases by foreigners in Germany" that have been determined in step 1 must be distributed to passenger and goods transport. As no detailed information is available for this distribution, an estimate approach must be developed.

It is assumed that in the case of petrol, fuel purchased by German residents abroad and - vice versa - by non-residents in Germany is only for passenger cars. This assumption appears reasonable as the consumption by domestic passenger cars in 2008 was 97% of all domestic petrol consumption.

In the case of diesel vehicles the fuel purchases are distributed over the different vehicle types, as cross-border fuel purchases are very significant for both passenger cars and trucks. First of all a sub-division is made into passenger transport (passenger car traffic) and goods transport. Estimates are made of the fuel purchases abroad for the passenger cars of resident private

households in close connection with the calculation of private consumer expenditure in the national accounts. The bridging items for the passenger cars were projected on the basis of these calculations.

Goods transport is sub-divided into the vehicle types "heavy trucks" (trucks › 3.5 t and trailers) and "light duty trucks". In view of the minor importance of the miscellaneous vehicle types, these are excluded from the bridging items.

After assessing the fuel purchases for diesel passenger cars, the figures for heavy trucks are estimated (see Chapter 6.2.4). The residual amount is assigned to LDT. Following the initial determination of all bridging items, the distribution of fuel purchases to heavy trucks on the one hand and light duty trucks on the other can be corrected, in case the initial estimate has led to implausible developments of the residual amount.

Table 19 shows the results of the distribution of diesel fuel purchases for 2 selected years, separated by vehicle type. A clear change can be seen between the two years which can be put down to changes in refuelling behaviour resulting from the developments in fuel prices. In the year 2000, non-residents in Germany refuelled significantly more diesel than German residents abroad. This proportion was completely reversed in 2006. Large increases in fuel prices and big price differences in some neighbouring countries led to this change in refuelling behaviour.

Table 19: Distribution of the bridging items to vehicle types (diesel vehicles)
mn. litres

diesel	cars	trucks	LDT [1]	total	cars	trucks	LDT [1]	total
	2000				2006			
Refuelling residents abroad	550	1,257	693	**2,500**	1,400	2,532	768	**4,700**
Refuelling non-residents on the territory	700	2,313	792	**3,805**	615	1,849	500	**2,963**

1) Light duty trucks.

Source: Environmental Economic Accounting 2010.

6.2.3 Determining the bridging items for passenger cars (steps 3 and 4)

The calculation of bridging items is described here for petrol-driven passenger cars as an example. In the case of petrol-driven passenger cars, calculation step 2 can be bypassed, as here the distribution of the transitional position by vehicle types does not apply. All of the fuel purchases by German residents abroad and foreigners in Germany are assigned to the passenger cars (see Table 17). The geographical allocation of mileages and fuel purchases is carried out in Step 3.

Table 20 shows the assumptions of the (proportionate) mileages that are actually covered with the fuel purchases in the relevant fuel-purchase country (Germany or abroad).

The first column shows the actual mileages, as a percentage of the total possible mileage, of German residents covered abroad with the fuel purchased abroad. These trips are mostly holiday trips by private households. The second column shows the same information on mileages of

foreigners in Germany. It is assumed, for foreigners, that only a - relatively small - proportion of approximately 5% (2008) of the fuel purchased in Germany is also used for mileages outside Germany. We can assume that foreigners will purchase cheaper fuel abroad for cross-border trips out of Germany into bordering countries.

Table 20: The geographical allocation of passenger car (petrol) mileages
- mileages within the country where the fuel is purchased, as a % of the total possible mileages -

Year	Mileage residents abroad	Mileage non-residents on the territory
1995	80	80
1996	80	80
1997	80	80
1998	80	80
1999	83	80
2000	75	82
2001	70	82
2002	64	85
2003	60	85
2004	60	85
2005	60	85
2006	55	95
2007	54	95
2008	54	95

Source: Environmental Economic Accounting 2010.

The absolute mileages on roads at home and abroad can be determined based on these proportions (see Diagram 11: positions 3a and 6a for German residents, 7a and 10a for foreigners). After calculating mileages on roads at home and abroad, fuel purchases by German residents (positions 3b, 6b and 7b, 10b) are determined with the help of details of the average consumption of passenger cars per 100 km.

With the increase in grey imports of petrol up to the middle of the previous decade, an increasing proportion of the petrol purchased abroad was no longer used abroad but in Germany. This leads to a drop in the proportion of foreign trips using the fuel purchased abroad. It is estimated that in 2001, 30% of the petrol purchased abroad was used for trips in Germany. In 2008 the proportion was almost 50%. This development reflects the diverging price trends for fuel at home and abroad. There were major price differences in particular in the years after 2002; in 2008 the differences compared with some neighbouring states fell again for the first time (see Tables 15 and 16)[28].

[28] EUROPEAN COMMISSION (2009): Statistical books. Panorama of Energy, p.113 et seq.

Table 21 shows the results of calculating the "bridging items" for mileages and fuel consumption (for petrol-driven passenger cars). In the case of fuel consumption in Germany both fuel purchases according to the energy balance sheet (position 27) and the actual consumption (position 28) are shown. It appears that the actual fuel consumption by petrol-driven passenger cars in Germany in 2008 is substantially in excess of fuel purchases - by 13 %.

Table 21: Mileages and fuel consumption of German and foreign passenger cars in Germany - transitional figures for (petrol driven) passenger cars

No.	Bridging items	Unit	2002	2004	2006	2008
	Mileage of German cars					
1a	**Annual mileage of residents**	1000 km	11.6	11.3	10.5	11.7
1b	**Residents** [1]	bn. km	431	413	378	360
2	**Residents within the territory**	bn. km	405	383	345	328
	thereof:					
3	with foreign petrol	bn. km	12.0	17.2	22.8	23.9
4a	**Annual mileage abroad**	1000 km	0.7	0.8	0.9	1.1
4b	**Residents abroad**	bn. km	26.7	30.1	32.4	32.5
	thereof:					
5	with domestic petrol	%	20	14	14	14
6	with foreign petrol	%	80	86	86	86
7	with domestic petrol	bn. km	5.3	4.3	4.6	4.5
8	with foreign petrol	bn. km	21.4	25.8	27.8	28.0
9	**Specific fuel consumption** [1]	l /100 km	8.5	8.4	8.2	8.1
	Fuel consumption of German cars					
10	**Fuel consumpt./refuelling of Residents** [1]	bn. litre	36.6	34.6	31.2	29.0
	thereof:					
11	Refuelling within the territory	%	92	90	87	86
12	Refuelling abroad	%	8	10	13	14
13	**Refuelling of residents on the territory**	bn. litre	33.8	31.0	27.0	24.8
	thereof:					
14	for journeys abroad	bn. liter	0.5	0.4	0.4	0.4
15	**Refuelling of residents abroad** (=10-13)	bn. litre	2.8	3.6	4.2	4.2
	thereof:					
16	within the territory	bn. litre	1.0	1.4	1.9	1.9
	Mileage of non-residential cars					
17	**Non-residents within the territory**	bn. km	23.2	22.8	25.9	25.7
	thereof:					
18	with domestic petrol	%	30	30	20	18
19	with foreign petrol	%	70	70	80	82
20	with domestic petrol	bn. km	6.9	6.9	5.2	4.7
21	with foreign petrol	bn. km	16.3	15.9	20.7	21.0
22	**Specific fuel consumption** [2]	l /100 km	8.5	8.4	8.2	8.1
	Fuel consumption of non-residential cars					
23	**Refuelling of non-resid. within the territory**	bn. Litre	0.7	0.7	0.4	0.4
	thereof:					
24	for journeys abroad	bn. km	0.1	0.1	0.0	0.0
25	Refuelling of non-resid. abroad for domestic journeys	bn. km	1.4	1.3	1.7	1.7
26	**Mileage on the territory** [3] (=2+17)	bn. km	427.7	405.6	371.1	353.3
27	**Domestic refuelling (EB)** (=13+23)	bn. litre	34.5	31.7	27.4	25.2
28	Domestic consumption (13-14+23-24)	bn. km	36.2	33.9	30.6	28.5
29	Consumption - Refuelling (=28-27)	bn. km	1.7	2.2	3.2	3.2

1) DIW: Wochenbericht 50/2009.
2) Specific fuel consumption as for residents.
3) DIW-Daten until 2003, from 2004 on own estimate.

Sources: DIW Wochenbericht 50/2009, own calculations.

6.2.4 Determining the transitional figures for trucks (› 3.5t load capacity) and trailers

The bridging items for fuel consumption for trucks and trailers is calculated based on information regarding the mileages of German residents abroad (foreign trips) and of foreigners in Germany (domestic road portions). The estimate approach must be consistent on the one hand in terms of the individual figures “total mileages - road portions - fuel consumption” and also in terms of the resultant total figures - taking the results for passenger cars and light duty trucks into consideration.

As in the case of the passenger cars, an assessment of the geographical assignment of mileages is also carried out for goods transport, with the fuel purchased abroad (step 3). The results of the assessment appear in the table below (Table 22).

Table 22: The geographical assignment of transport performance of trucks (› 3.5t load capacity) - mileages within the country where the fuel is purchased, as a % of the total possible mileages -

Year	Mileage residents abroad	Mileage non-residents on the territory
1995	80	85
1996	80	85
1997	80	85
1998	75	85
1999	75	85
2000	70	85
2001	65	90
2002	60	90
2003	55	90
2004	50	90
2005	50	90
2006	50	90
2007	50	90
2008	45	90

Source: Environmental Economic Accounting 2010.

The data used as a basis for calculating the bridging items for trucks is more extensive than that for passenger cars. And so for trucks and trailers there are details from the Federal Motor Transport Authority on the mileages of German residents at home and abroad, as well as details of the mileages of foreign vehicles in Germany. As there is, in principle, no difference drawn here between trucks and trailers, no separate calculation for trucks and trailers is undertaken when calculating the bridging items.

As from 2005, the Federal Motor Transport Authority published separate data on truck and trailers domestic mileages for German residents and non-residents[29]. Up until 2003 details are also available – as is the case with the passenger cars – from the DIW on the domestic mileages of trucks and trailers (see Overview 3).

Overview 3: Statistical sources for calculating "bridging items" for trucks

Mileage on the territory with and without load (km)	
Residents	from 2005 on: KBA, VE3+Internet table
Non-residents	from 2005 on: KBA, VE3+Internet table
Total	until 2003: DIW, interne Berechnungen
Mileage of residents with and without load (km)	1994 - DIW: Wochenbericht [1)]

1) DIW-Wochenbericht 50/2009: Kraftfahrzeugverkehr 2008 noch auf hohem Niveau.

Source: Federal Statistical Office, Environmental Economic Accounting 2010.

In the case of goods transport, a deviating average consumption by foreign trucks and trailers is assumed, in comparison to German vehicles. It is assumed that foreign trucks are, on average, bigger (heavier) and more frequently loaded for trips to or through Germany than the German trucks are. Consequently the average consumption of foreign vehicles is set slightly higher than that of domestic vehicles.

Table 23 shows the results of calculations for selected years.

[29] [29] See Internet table "Inlandsverkehr - Deutschland und seine Länder in den Jahren 2008 und 2007" (www.kba.de) or also in the annual publication "Statistische Mitteilungen des Kraftfahrt-Bundesamtes VE 3", Übersicht 3 (Inlandsverkehr nach Heimatstaat des Zugfahrzeugs).

Table 23: German and foreign truck mileages and fuel consumption in Germany – bridging items for trucks (› 3.5t load capacity) and trailer trucks –

No.	Bridging items	Unit	2002	2004	2006	2008
	Mileage of German trucks - all journeys					
1a	**Annual mileage of residents**	1000 km	56	63	64	73
1b	**Residents** [1]	bn. km	32	33	34	36
2	**Residents within the territory** [2]	bn. km	28	30	31	32
	thereof:					
3	with foreign diesel [3]	bn. km	3.1	4.2	3.8	4.8
4a	**Annual mileage abroad**	1000 km	6.1	6.6	6.8	7.6
4b	**Residents abroad**	bn. km	3.4	3.5	3.7	3.7
	thereof:					
5	with domestic diesel [3]	%	15	14	18	14
6	with foreign diesel [3]	%	85	86	82	86
7	with domestic diesel	bn. km	0.5	0.5	0.7	0.5
8	with foreign diesel	bn. km	2.9	3.0	3.0	3.2
9	**Specific fuel consumption**	l /100 km	37.5	36.7	37.0	36.4
	Fuel consumption of German trucks - all journeys					
10	**Fuel consumpt./refuelling of Residents** [4]	bn. litre	11.9	12.2	12.7	13.0
	thereof:					
11	Refuelling within the territory	%	81	78	80	78
12	Refuelling abroad	%	19	22	20	22
13	**Refuelling of residents on the territory**	bn. litre	9.7	9.5	10.2	10.1
	thereof:					
14	for journeys abroad	bn. litre	0.2	0.2	0.2	0.2
15	**Refuelling of residents abroad** (=10-13)	bn. litre	2.3	2.7	2.5	2.9
	thereof:					
16	within the territory	bn. liter	1.2	1.5	1.4	1.8
	Mileage of non-residential cars					
17	**Non-residents within the territory** [2]	bn. km	8.5	8.5	9.8	10.4
	thereof:					
18	with domestic diesel [3]	%	56	49	46	42
19	with foreign diesel [3]	%	44	51	54	58
20	with domestic diesel	bn. km	4.7	4.2	4.5	4.3
21	with foreign diesel	bn. km	3.7	4.3	5.3	6.0
22	**Specific fuel consumption**	l /100 km	38.6	37.9	38.2	37.6
	Fuel consumption of non-residential trucks					
23	**Refuelling of non-residents within the territory**	bn. litre	2.0	1.7	1.8	1.7
	thereof:					
24	for journeys abroad	bn. km	0.2	0.1	0.1	0.1
25	Refuelling of non-resid. abroad for domestic journeys	bn. km	1.4	1.6	2.0	2.3
26	**Mileage on the territory** [3] (=2+17)	bn. km	36.8	38.1	40.5	42.4
27	**Domestic refuelling (EB)** (=13+23)	bn. litre	11.7	11.2	12.0	11.8
28	Domestic consumption (13-14+23-24)	bn. km	13.9	14.1	15.1	15.6
29	Consumption - Refuelling (=28-27)	bn. km	2.3	2.9	3.1	3.7

1) DIW-Daten: Wochenbericht 50/2008 and working tables.
2) KBA-Daten since 2005: Inlandsverkehr: total mileage on the territory with residental and non-residental trucks.
3) Estimate.
4) DIW-Daten: Wochenbericht 50/2008.
Sources: DIW Wochenbericht 50/2009, own calculations.

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