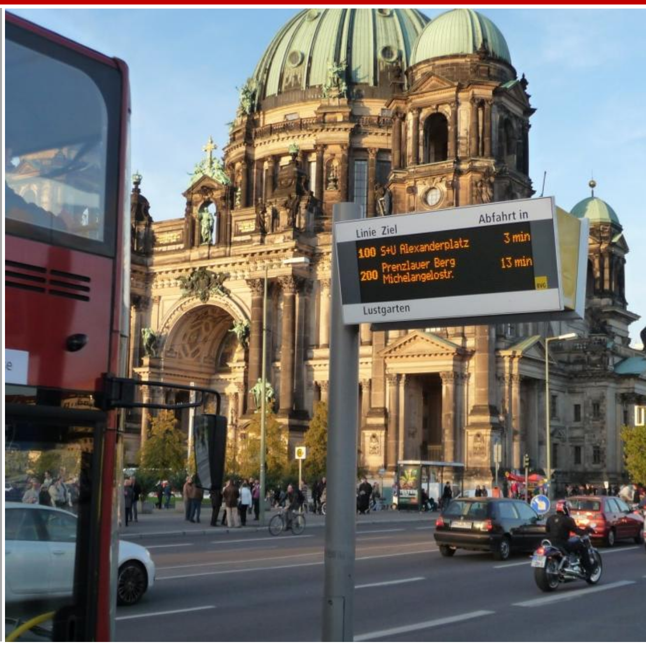
GIZ China | Low Carbon Transport Development



GHG Reporting and Inventorying in Germany – Assessing transport related emissions

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On behalf of
BMZ Federal Ministry for Economic Cooperation and Development

CUSTReC

GHG Reporting and Inventorying in Germany – Assessing transport related emissions

In compliance with the United Nations Framework Convention on Climate Change (UNFCCC), Germany is required to submit annual inventories with data for the emission and sinks of greenhouse gases (GHG). After the reporting on GHG was etablished, the "Conference of the Parties" (COP) passed a resolution, the Kyoto Protocol. This international treaty requires industrialised nations to reduce their emissions of the GHG by an average of 5.2 % until 2012. Germany agreed to reduce its emissions by 21 % in comparison with the base year. This report aims to provide a background of GHG emissions, an overview on the institutionalisation of inventory planning, preparation and management as well as a general description of the data and methods used for the calculation of transport related emissions.

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The Project Context

The Sino-German Climate Change Programme aims at supporting climate change mitigation and adaptation efforts in China. The four-year Programme is composed of three components:

1. Capacity building for Chinese officials and experts;
2. Development of mitigation strategies for the transport sector;
3. Development of mitigation strategies for the power sector.

The Programme is implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ) and the National Development and Reform Commission (NDRC).

Within the Low Carbon Transport Development component, the Programme supports national institutions in developing a climate protection strategy in the transport sector and to implement measures and incentive structures with a special focus on urban transportation. Assessing current and future GHG emissions lies at the core of designing a coherent and effective climate strategy. The Low Carbon Transport Development component therefore supports the development of tools to quantify and monitor GHG emissions in the Chinese transport sector both at the national and urban level. Implementing partner for the transport component is the China Urban Sustainable Transport Research Centre (CUSTREC) of the Chinese Academy of Transport Science.

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1 Background of GHG inventories

In compliance with the United Nations Framework Convention on Climate Change (UNFCCC), Germany is required to submit annual inventories with data for the emission and sinks of the greenhouse gases (GHG) shown in Table 1. Data for the inventoried gases has to be included beginning with the individual base year. [FEA2013]

After the reporting on GHG was etablished, the "Conference of the Parties" (COP) passed a resolution, the Kyoto Protocol. This international treaty requires industrialised nations to reduce their emissions of the GHG shown in Table 1 by an average of 5.2 % until 2012. Germany agreed to reduce its emissions by 21 % in comparison with the base year. [FEA2013]

Table 1: *Inventoried GHG*

GHG	Base Year
CO_2	1990
N_2O	1990
CH_4	1990
HFCs	1995
PFCs	1995
SF_6	1995

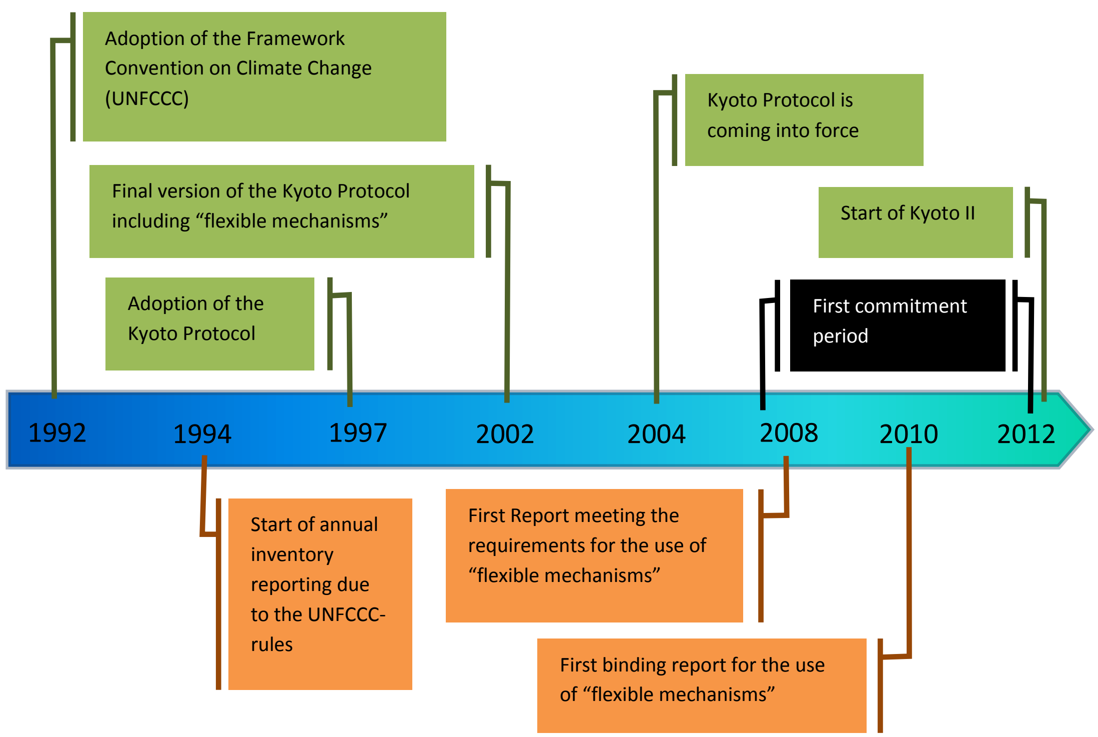

Figure 1: *Milestones of climate politics and Germany's inventory reporting; compiled by the author*

The final version of the Kyoto Protocol includes instruments to trade GHG-emission reduction internationally. These instruments are International Emissions Trading (IET), the Clean Development Mechanism (CDM), and Joint Implementation (JI). For the use of these so called "flexible mechanisms", supplementary information had to be included in the inventory. [FEA2013]

With Kyoto II a follow-up commitment period was established, in which the participating states bound themselves to reduce their GHG-emissions between 25-40%[1] until 2020. The inventory reporting will be continued. [FCCC2013]

2 Institutionalisation of inventory planning, preparation and management

Initially, the focus in inventory improvement was on the development of data, whereas subsequently, the main tasks have become the institutionalisation and the build-up of a quality management system. [FEA2013]

2.1 Organisation of the German national reporting system

Main levels of Germany's national reporting system are

- the federal departments,
- the Federal Environment Agency and
- organisations/ institutions outside of the federal government/ administration (see figure 2).

The **National Coordinating Committee** includes representatives of all federal departments involved in the inventory. It "has the tasks of supporting the emissions-reporting process and clarifying open issues pertaining to the National System. In particular, the Committee carries out consultations with regard to gaps in data streams and settles issues pertaining to assigned responsibilities." [FEA2013, p.69]

The Federal Environmental Agency serves as the **Single National Entity** for emission reporting. It has the tasks of "planning, preparing and archiving of inventories, describing inventories in the inventory reports and carrying out quality control and assurance for all important process steps." [FEA2013, p.70] For the execution of these tasks, the working group on emission inventories was set up within the Federal Environmental Agency.

1 in comparison to the base year

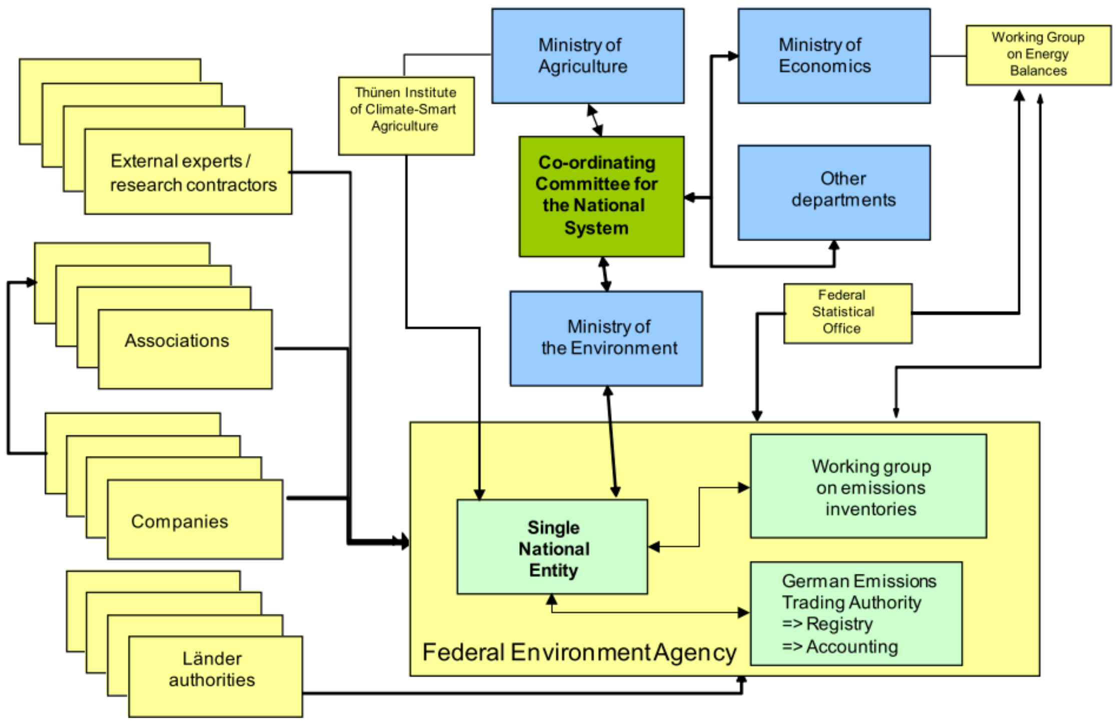

Figure 2: *Structure of Germany's national reporting system; from [FEA2013, p.69]*

In the framework of the national system the ministries are obliged to provide reliable data in accordance with their scope. One possibility to fulfil their obligations is to authorise reliable third parties outside of the federal sector to carry out data collection and compilation. Of special importance for the transport sector is the **Working Group on Energy Balances**. [FEA2013]

The Working Group on Energy Balances is an association founded in 1971 by the energy industry in corporation with a number of energy research institutes. Its aim is to compile information on energy statistics relevant for "...politicians, companies and associations within the energy industry as well as [...] research institutes concerned with energy matters." [AGEB2010, p.1]

For the compilation, the data has to be transformed into a coherent form and to be evaluated. The results are annually published energy balances, which contain information about energy consumption and energy flows between the economic sectors since 1950. [AGEB2010]

2.2 Key instruments of the German national reporting system

The planning, preparation and management of the inventory is an annual process that requires the integration and analysis of large volumes of data. In order to handle the complexity of this task, the Federal Environmental Agency has developed two main instruments: The Central System on Emissions and the Quality System for Emission Inventories.

2.2.1 Central System on Emissions (CSE)

The "Central System on Emissions (CSE) database is the national, central database for emissions calculation and reporting." [FEA2013, p.70] As emissions in the inventory process are calculated as an upstream process according to the basic principle

$$\boldsymbol{Emission = Activity * Emission\ Factor}$$

the CSE database needs to store information of the activity data for each process and of the process specific emission factors for each GHG. Being the basic instrument for data collection, management and documentation, it also contains methodological information on the data included. The central storage of the data significantly improves transparency and consistency, giving the possibility for simple plausibility checks and quality control measures. [FEA2013]

2.2.2 Quality System for Emissions Inventories (QSE)

The Quality System for Emissions Inventories (QSE) defines responsibilities and quality objectives for all work carried out in the inventory process. This includes "method selection, data collection, calculation of emissions and relevant uncertainties and recording of completed quality checks and their results" [FEA2013, p.70].
The quality criteria of the inventory report are:

- Transparency: Assumptions and methodology should be clearly explained
- Consistency: The elements of time series have to be calculated employing the same methodology
- Comparability: Use of a methodology which complies with the convention of the UNFCCC
- Completeness: The sources responsible for at least 95% of the total GWP should be included
- Accuracy: There should be no systematic error in the calculation and uncertainties should be reduced as far as practicable. [FEA2013]

The two major processes of the QSE are the selection of key categories and the analysis of uncertainties.

The definition of **key categories** should help to focus the work on the most important emitters. Therefore, the selection of key categories is an important step to ensure high quality of the inventory process. Furthermore, it significantly influences[2] which level of methodological complexity (*tier level*) is chosen for which category.

Box 1: *Description of the Tier system*

A tier represents the level of complexity in calculating the emissions of a category. Higher tiers are usually more accurate, but also more demanding in terms of data availability and in the handling of methodological complexity. Usually three tiers are provided, from Tier 1 (the basic method, which should be possible to perform for each category) to Tier 3 (the most complex method). The data needed, as well as the principal calculation rule for the provided tier levels, are defined separately for each category and each pollutant. For instance, in road transportation, the basic tier 1 approach for CO_2 emission calculation is to multiply the estimated fuel sold with a default emission factor [IPCC2006].

For the selection of key categories, the emission levels of individual source and sink categories are annually evaluated. The evaluation consists of the

- calculation of the emission level in the base year and for the trend (the last reported year in comparison with the base year) in the Tier 1 approach (see Table 2)

and, if available, through the analysis of uncertainties,

- an uncertainty assessment in the more detailed Tier 2 approach [FEA2013].

Table 2: *Suggested IPCC Source Categories for Energy [IPCC2006, p.6]*

Source Categories to be assessed in Key Source Category Analysis	Special Considerations
CO_2 Emissions from Stationary Combustion	Disaggregate combustion to the level where emission factors are distinguished. In most inventories, this will be the main fuel types. If emission factors are determined independently for some sub-source categories, these should be distinguished in the analysis.
Non-CO_2 Emissions from Stationary Combustion	Assess CH_4 and N_2O separately.
Mobile Combustion: Road	Assess CO_2, CH_4 and N_2O separately.
Mobile Combustion: Water-borne Navigation	Assess CO_2, CH_4 and N_2O separately.
Mobile Combustion: Aircraft	Assess CO_2, CH_4 and N_2O separately.
Vehicles Fugitive Emissions from Coal Mining and Handling	If this source is key, it is likely that underground mining will be the most significant sub-source category
Fugitive Emissions from Oil and Gas Operations	This source category comprises several sub-source categories which may be significant. Inventory agencies should assess this source category, if it is key, to determine which sub-source categories are most important.

In the **analysis of uncertainties**, uncertainties for activity data and emission factors are estimated by external experts. In the next step, these estimates are converted into uncertainties for each emission source in the CSE and subsequently aggregated. This assessment is made annually on the aggregated Tier 1 level and should be repeated every three years on the Tier 2 level. The last Tier 2 level assessment in the transport sector was made for the 2010 report. The main results of the uncertainty assessment are presented in chapter 3.

Box 2: *Tier 1 and Tier 2 methodology for uncertainty estimation [IPCC2010, chapter 6]*

Tier 1: Estimation of uncertainties by source category using the error propagation equation and simple combination of uncertainties by source category to estimate overall uncertainty for one year and the uncertainty in the trend.

Tier 2: Estimation of uncertainties by source category using Monte Carlo analysis, followed by the use of Monte Carlo techniques to estimate overall uncertainty for one year and the uncertainty in the trend.

3 General description of the data and methods used for the calculation of transport related emissions

The CSE serves as a tool carrying out the final calculations of GHG emission factors and activity data. However, calculations on a higher level of detail (in order to determine the values used in the CSE) are computed with special models. The principal model for the transport sector is TREMOD (Transport Emission Model).

The Federal Environmental Agency commissioned TREMOD in the early 1990ies to design a suitable tool that covered the current state of knowledge for emission calculation in Germany at the time. It is constantly updated for the use in the GHG inventory reports and the projection of past trends and future scenarios [IFEU 2010]. Detailed information about TREMOD can be found in [IFEU2012b] (in German).

Box 3: *Overview TREMOD; from [IFEU2012a, p. 13]*

Purpose	Generate a reliable and harmonized database for the energy and emission inventory of all transport modes in Germany for various tasks, e.g. statistical reports, political decisions, information of public, environmental reports, data base for life cycle assessments
Commissioner	Federal Environmental Agency (Germany)
Stakeholder	Ministry of Environment, Federal Highway Research Institute, Ministry of Transport, other public authorities, Automotive Industry (VDA), German Railways (DB AG), Oil industry (MWV), Deutsche Lufthansa
System boundaries	Road, Rail, Inland Water and Aircraft Transport in Germany Timeline 1960-2030 Well-to-Tank and Tank-to-Wheels energy consumption and emissions Components: CO, HC, NO_x, PM, several components of HC (CH_4, NMHC, benzene, toluene, xylene), fuel consumption (gasoline, diesel), CO_2, NH_3 and N_2O. New in HBEFA 3.1: NO_2, PN and PM
Model structure	Offline tool in MS ACCESS (MS ACCESS required), different databases. Different modules for each transport sector Input tables for differentiated fleet and traffic data and scenario designs Result forms with flexible possibilities of data selection with different aggregation levels for each transport mode and all modes
Availability	Not publicly available due to complexity Available for public authorities and cooperation partners
Model applications (examples)	- National Inventory Report in Germany - Life cycle assessment tools and databases (Probas, Umberto, Railway Association “Allianz pro Schiene”) - Tools for the estimation of the environmental impact of individual transports (EcoTransIT, EcoPassenger, UmweltMobilCheck) - National inventories of other countries, e.g. Belgium, China, different German Federal Lands - Delivery of German fleet data for European TREMOVE- & Copert-model - Different studies with scenarios for the future development of energy consumption and emissions for the transport sector

3.1 Methodological approach

TREMOD calculates the emissions of transport on the basis of detailed data of transport activities for each mode. In principal, there are two different types of results for the emission calculation in TREMOD:

- based on the bottom-up calculation of territorial transport activity
- based on the energy balance (i.e. fuel sold)

In the **bottom-up calculation process** the emissions are calculated on the basis of the transport activities within the borders of Germany ("In-country-approach"). The basic calculation rule is stated in Figure 3 for one means of transport. [IFEU2012a]

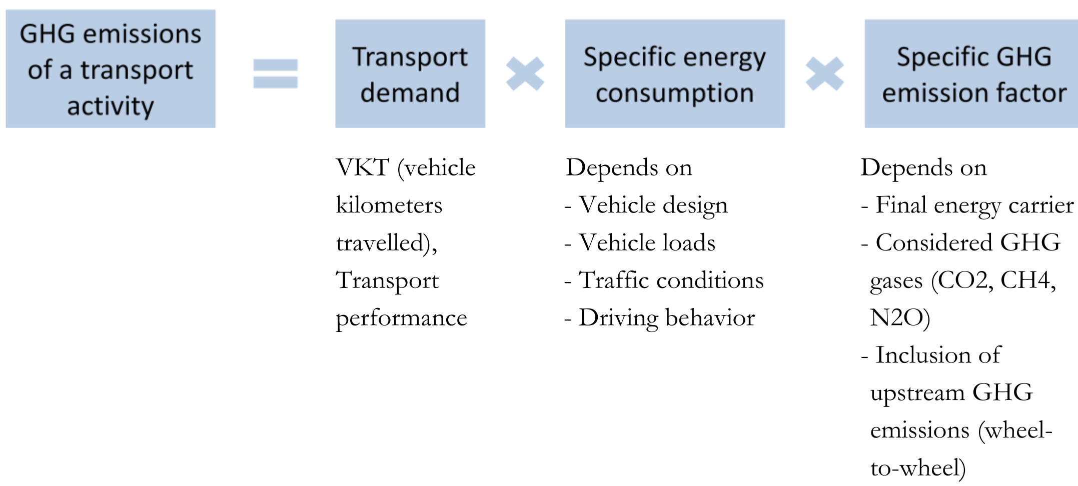

Figure 3: *GHG emissions calculation scheme for motorised transport activities [IFEU2012a]*

According to the QSE (see chapter 0), consistency is one of the quality criteria for the inventory process. For this reason the GHG emissions in the energy sector are calculated **based on the energy balance** [AGEB2010]. The relevant figure in the energy balance is the value for the energy consumption of the transport sector per energy carrier.

The energy balance value is the basis of a top-down calculation for the emission of each source category. To allocate the emissions to the different source categories, the bottom-up calculation process described above is used. The result of this calculation is corrected by a factor to correspond with the energy balance values (for uncertainties and challenges arising out of this linkage, see chapter 3.3).

3.2 Input data and calculation procedure per transport mode

The level of detail and the methodology of GHG emission calculation are different for each mode. For road transport there are detailed calculations based on a differentiated model. However, the emissions of the other modes are generally derived from fixed emission factors per fuel use. Therefore, the calculation procedure and the input data are shown for each mode separately. [IFEU2012b]

3.2.1 Road transport (1.A.3.b)

Road transport in TREMOD is divided by vehicle category. In principal, these are 2-wheelers, passenger cars, light commercial vehicles and heavy duty vehicles. For each category the transport performance and the fleet composition are calculated separately.

The calculation in TREMOD can be broken down further into two general levels:

- the derivation of the emission factors of the individual vehicle and
- the calculation of the emissions for the vehicle fleet.

Derivation of emission factors for the individual vehicle

On the level of the individual vehicle, emissions of GHG per vehicle kilometre travelled are depending on

- technical characteristics and
- operational conditions.

As shown in Figure 4 below, the **technical characteristics**[2] include

- the **propulsion type**, determining which kind of energy carriers can be used in the vehicle;
- the **engine size**, as there is a significant dependency between engine size and specific emissions and
- the **emission standard**, aggregating vehicles with comparable emission reduction technology;
- the **vehicle age**, to represent the technical progress in efficiency over tim

2 In TREMOD and HBEFA propulsion type, engine size and emission standard define a subsegment of vehicles

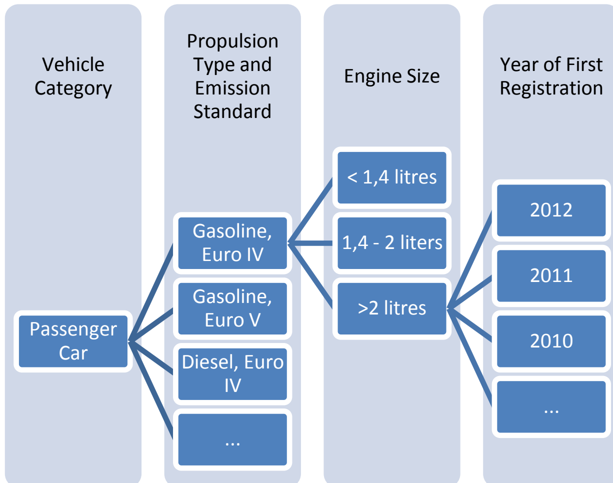

Figure 4: *Technical Characterisation of a road transport vehicle (example); own composition*

The **operational conditions** are mainly described by vehicle speed patterns (in a second per second resolution), clustered with the concept of **traffic situations**. These are representing real world driving behaviour, differentiated by

- the road type (e.g. "rural motorways")
- the speed limit and
- the level of service (free flow, heavy, saturated and stop + go).

These individual traffic situations are weighted, providing aggregated traffic situations for specific road and vehicle categories.

As the emission factors of the traffic situations are covering the emissions during the use of the vehicle with a warm engine only, there are additional factors representing the emissions of

- the vehicle use with cold engine and
- emissions out of the vaporising of fuel.

Based on typical use patterns, these values are transformed into emission factors per vehicle kilometre travelled.

Therefore, the result of this model step provides an emission factor per vehicle-kilometre travelled for each subsegment and age class (representing technical characteristics) and for each road category (representing the typical driving behaviour of a vehicle category on a type of road).

The emission factors used in TREMOD are taken from HBEFA (Handbook of Emission Factors for Road Transport [INFRAS2010]). The HBEFA data is based from a number of research programmes which are coordinated by the European Research group on Mobile Emission Sources (ERMES).

Calculation of emissions for vehicle fleet

The next modelling step in TREMOD is the calculation of the emissions of the vehicle fleet on the base of the individual vehicle's emissions. Basic input data for this calculation are the

- vehicle stock and the
- vehicle mileage
- on a highly differentiated level.

The following figure shows the basic elements and data sources of the calculation in TREMOD for road transport.

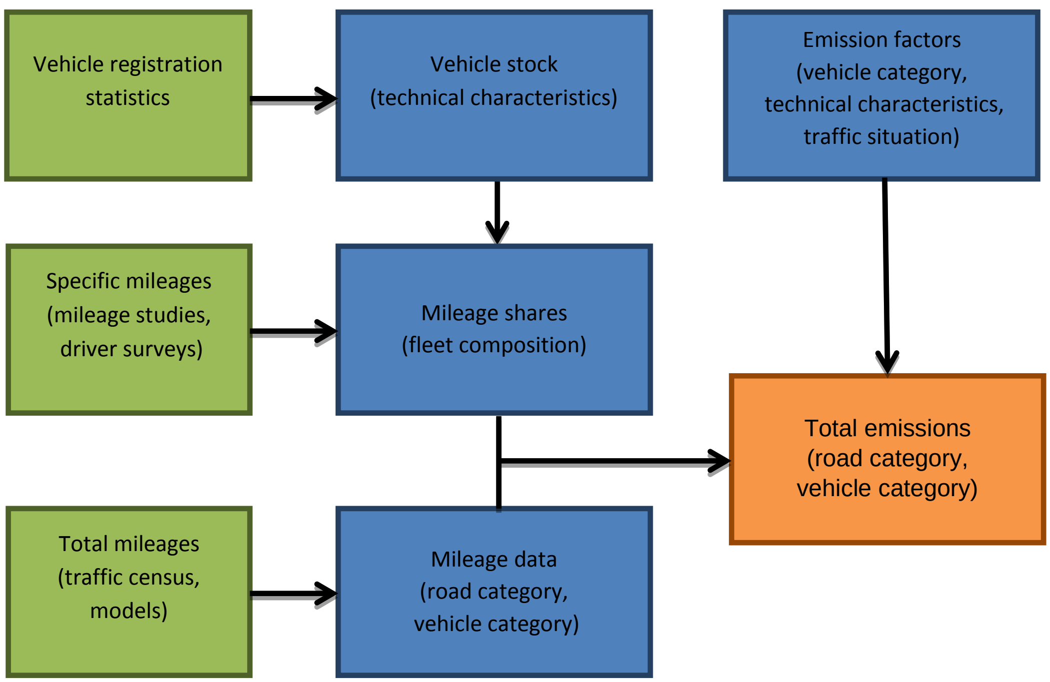

Figure 5: *Emission Calculation for road transport in TREMOD; compiled by the author*

The **vehicle stock** is based on detailed statistics about vehicle registration, which are available from the Federal Motor Transport Authority [KBA]. For the calculation, not the absolute numbers of vehicles are important, but the share of a group of vehicles from the total fleet.

The **mileage shares** and the **mileage data** are closely linked and derived from different statistics. Due to the considerable costs associated with mileage examinations in the detail required, only the mileage of important national roads (e.g. motorways) is available annually. More detailed activity data is used from older examinations. The resulting uncertainties are explained in chapter 3.3.

Finally, the mileage shares and the absolute mileage data are linked with the emission factors of the vehicles to calculate the total emissions of the vehicle fleet. [IFEU2012b]

3.2.2 Rail transport (1.A.3.c)

Rail transport in TREMOD is differentiated on the base of

- the type of operator and
- the offered transportation service.

The different types of operators in Germany in principal can be grouped in publicly owned (e.g. on the federal level the Deutsche Bahn AG) or private companies. A separate criterion examines whether transport services are being offered on public infrastructure as opposed to a private network (e.g. industrial railways). The offered transport service is classified into

- local and regional public transport
- long-distance passenger transport
- freight transport

TREMOD is calculating the emissions with aggregated values (energy consumption and energy related emission factors) for every combination of service type and operator group.

An important aspect for the calculation of GHG emissions is the type of train propulsion. As electric trains have no direct emissions, only diesel-powered trains are relevant for the inventory. The share of diesel-powered trains and their energy consumption are known for each transport service category from the Deutsche Bahn AG (which is operating around 80% of Germany's rail transport [DBAG]). For private companies, the diesel share is derived from several surveys and estimations. [IFEU2012b]

3.2.3 Inland navigation (1.A.3.d.II)

The GHG emissions for inland navigation are calculated based on the amount of diesel fuel sold for inland vessels in the energy balance. For cross-checking purposes, activity data combined with an average emission factor are used. Apart from records on the mileage travelled, the information quality for inland navigation is poor, especially for the energy balance values. For reasons and resulting uncertainties, see chapter 3.3. [IFEU2012b]

3.2.4 Air transport (1.A.3.a)

The GHG emissions of air transport is modelled in TREMOD as a function of

- plane model
- flight cycle (LTO, cruise) and
- flight distance.

The data is provided by official statistics containing all plane movements of relevant airports. [IFEU2012b]

These detailed activity data are combined with specific emission factors for each plane model and flight cycle (based on [EMEP2009]). The total amount of fuel consumed is corrected to be consistent with the energy balance values.

For the GHG emission calculation of the inventory only inland flights are relevant. Therefore, the overall fuel consumption needs to distinguish between fuel used for national as opposed to international flights. The necessary data for the split factor is derived from plane movement statistics from the European air traffic management organisation, EUROCONTROL.

3.3 Challenges and Uncertainties

All data used for the calculation are fraught with uncertainty. Therefore, the inventory procedure requires that uncertainties for all activity data and emission factors must be specified. A particular challenge is to align the calculations for domestic traffic and the statistical data based on the fuel sold. [AGEB2010]

With respect to domestic traffic, calculation uncertainties exist in the underlying traffic performance (total vehicle mileage per year), the fleet structure and their specific performance and driving behaviour as well as the specific consumption values:

- The total vehicle mileage per year is not measured but calculated based on different traffic counts for roads and motorways, individual studies and assumptions.
- The vehicle registration statistics in Germany are highly differentiated [KBA], however, the driving performance and driving frequency behaviour can only be based on individual interviews and some special surveys. In addition, foreign fleets also contribute to the domestic vehicle mileage and domestic fleets are driving outside Germany.

- The specific fuel consumption values from the HBEFA-database are modelled and therefore affected with uncertainties.

The quality of the energy balance's fuel sales data is high. Nevertheless, significant uncertainties arise out of the use of the energy balance values for the inventory, as shown in Figure 6.

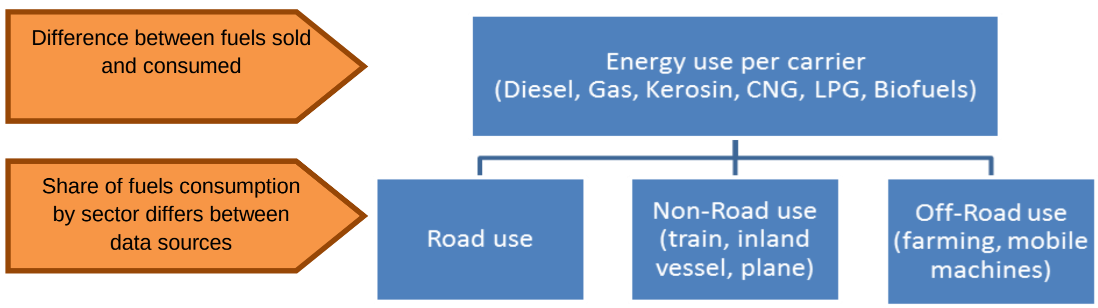

Figure 6: *Uncertainties of the use of Energy Balances in transport; compiled by the author*

Reasons for these uncertainties are:

- There may be time shifts between refuelling and fuel consumption (For reporting purposes, this is relevant if the shifts occur at the turn of the year).
- The total volume of fuel consumption is known, but not the sector that consumes the fuel.
- The purchase of fuel abroad for domestic use (the so called "grey imports")

The Working Group on Energy Balances makes assumptions for the **share of fuel consumption** for each of the sectors, some based of sector specific statistics, some of secondary indicators. The difference of all sectors except road is allocated to the road. As a result according to IFEU studies, traffic tends to be associated with more diesel fuel than is consumed in this sector.

Major causes for the importance of **grey imports** are the price differences of fuels between Germany and the neighbouring countries. Since 1999 (start of introduction of a new ecological tax in Germany), the fuel in many neighbouring countries has tended to be less expensive than in Germany.

The amount of grey imports can only be estimated. For 2006, [ADAC2007] estimated a share of 5% grey imports for gasoline and 7% for diesel related to energy sold. Newer estimations are not available. For 2010, IFEU found a difference of 5% for diesel fuel and 13% for petrol [IFEU2012b], which can be allocated to grey imports and other reasons mentioned above. Figure 7 shows the difference between the amounts of fuel sold for each sector [AGEB2010] compared to the calculation of domestic fuel consumption [IFEU2012b].

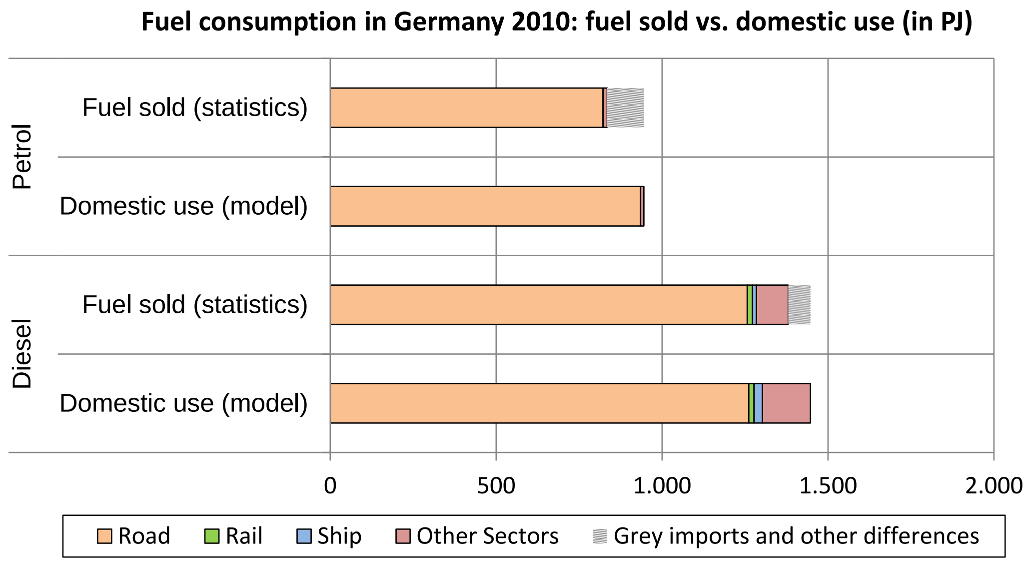

Figure 7: *Fuel consumption in Germany: fuel sold versus domestic use of all sectors*

In order to balance the domestic calculation (the bottom-up calculation of TREMOD) with the energy statistics, correction factors are used. The correction factors are derived for **each vehicle category separately, according to the following assumptions:**

1. The correction factor for gasoline fuel is obtained for each year from the difference of the model calculation for the domestic traffic and the statistical values of fuel sold.
2. This correction factor of point one is used for all cars. It is assumed that the refuelling habits of diesel and petrol car drivers are the same.
3. The difference between diesel sold for cars (= car diesel consumption according to the domestic calculation multiplied with the correction factor of point one) and the entire diesel fuel sold is attributed to heavy duty vehicles. On the base of this value the heavy duty vehicle correction factor is calculated.

Values of correction factors for the last years can be found in [FEA2013, p. 766]

Uncertainties in the inventory report

For the quantification of uncertainties of activity data and emission factors in the inventory, an uncertainty analysis was carried out [IFEU-INFRAS2010]. In this survey, the findings from the differences described above have been taken into account. Uncertainties are described in the inventory.

3.4 Output data and interaction with the CSE

In principal, the interaction of TREMOD with the CSE is the correction with the energy balance values (as described in chapter 3.1) and an aggregation to the CSE differentiation level. Another step in the transformation is the recalculation of emission factors, as in TREMOD emission factors are mostly related to mileage and in CSE emission factors are related to energy. The main steps of the transformation process are shown in Figure 8.

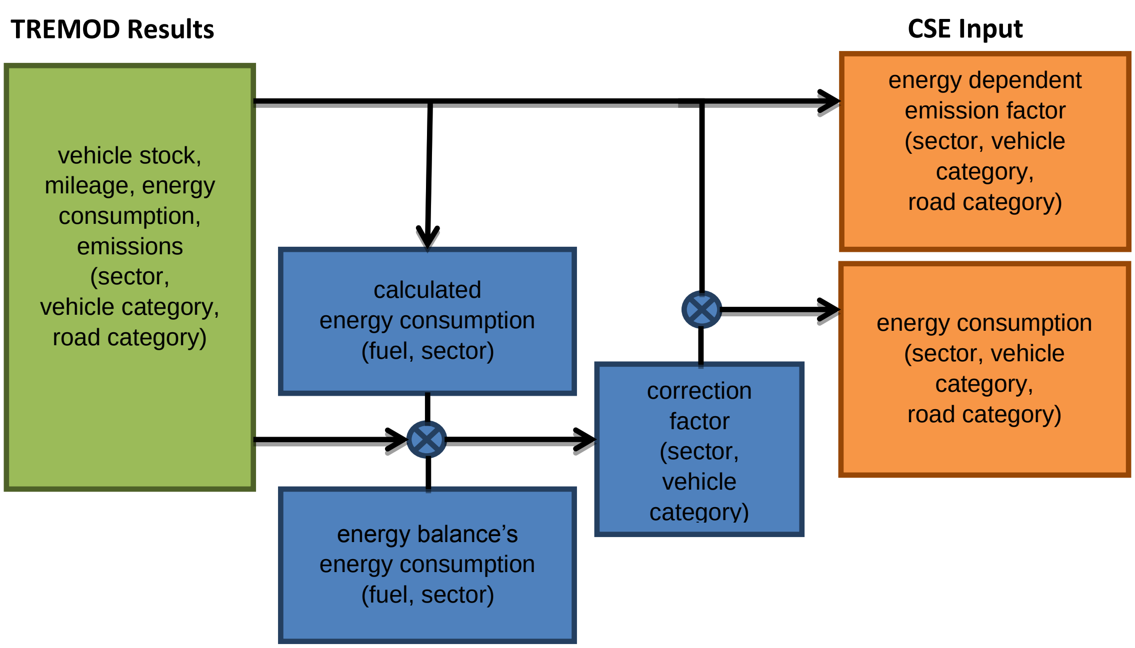

Figure 8: *Conversion of TREMOD results into the CSE structure; compiled by the author*

For rail transport and inland navigation, no differentiation is made in the CSE database. For air transport the activity data and emission factors are grouped for kerosene into LTO/ cruise and national/ international. For avgas no differentiation is made. The CSE differentiation in road transport is shown in Table 3.

Table 3: *Structure of road transport in the CSE*

<table>
<tr><th>Vehicle Category</th><th>emission control system</th><th>road category</th></tr>
<tr><td>passenger cars/ light commercial vehicles with petrol engine</td><td rowspan="2">with catalytic converter (petrol)/
as of EURO I standard (diesel)</td><td>highway</td></tr>
<tr><td>passenger cars/ light commercial vehicles with diesel engine</td><td rowspan="2">rural road</td></tr>
<tr><td>Buses</td><td rowspan="3">without catalytic converter (petrol)/
prior to EURO I standard (diesel)</td></tr>
<tr><td>heavy duty vehicles</td><td rowspan="2">city road</td></tr>
<tr><td>motorcycles</td></tr>
</table>

The data are annually updated between TREMOD and the CSE. The update contains the data of the previous year. As the national inventory report is published one year after the update of the CSE, it covers the emissions from the period two years ago (e.g. in the 2014 submission the emission data are from the year 2012).

4 Description of the transport sector in the inventory

The structure of the inventory follows the source categories, which in the transport sector equal the transport modes. International air and sea transport is reported in an extra chapter ("international bunker fuels"), as the emissions from these modes are stated, but are not relevant for the calculation for the German GHG emissions according to the rules of the Kyoto Protocol.

In the beginning of each category, there is a brief table, containing the GHG key figures for both the base and the reported year, and the detail level (Tier 1-3) of analysis per gas (see Table 4). Consequently, the data in the CSE is further compressed to fit into the report.

Table 4: *Key figures of road transport as described in the inventory report [FEA2013; p. 196]*

CRF 1.A.3.b	Gas	Key category		1990 Total emissions (Gg) & percentage (%)		2011 Total emissions (Gg) & percentage (%)		Trend
All fuels	**CO_2**	**L**	**T/T2**	**150,358.3**	**(12.34%)**	**147,867.4**	**(15.97%)**	**-1.66%**
All fuels	N_2O			1,158.4	(0.10%)	1,338.3	(0.14%)	15.53%
All fuels	CH_4			1,106.1	(0.09%)	148.1	(0.02%)	-86.61%

Gas	Method used	Source for the activity data	Emission factors used
CO_2	Tier 2	NS	CS D (biodiesel, lubricants)
CH_4	Tier 3	NS	CS/M/D
N_2O	Tier 3	NS	CS/M
NO_X, CO, NMVOC, SO_2	Tier 3	NS	CS/M

In addition to these key figures, the report contains for each category

- a short description of the methodology and data used for calculation,
- causes for changes in the emission level,
- time series for all reviewed gases,
- a summary of uncertainties and time-series consistency analyses of the given values,
- information about source-specific quality assurance, control and verifications measures (e.g. cross-checking emission factors with other countries) and
- information about planned improvements.

Furthermore, if there are some methodological changes, the recalculation of the time series is described. Also, additional information on the topics of this summary can be found in the inventory report (see Table 5).

Table 5: *Assignment of the summary's topics with chapters of the inventory report containing additional information*

Topic	Inventory report chapter
Institutionalisation	1.2
Determination of key categories	17
Input data, calculation and uncertainties per transport mode	3.2.10; 19.1.3
Energy Balances (Uncertainties)	18 (18.4)
Correction Factors	19.1.3

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