For our Environment

Umwelt Bundesamt

International BUR Champions Workshops:
Training on data access and MRV in the transport sector

Transport GHG Emission Inventories in Germany: General principles and access to data

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Berlin, 7th of April 2017

Agenda

1 COMPARISON OF TOP-DOWN AND BOTTOM-UP APPROACHES IN THE TRANSPORT SECTOR

2 OVERVIEW OF THE GERMAN TRANSPORT EMISSION MODEL

3 DATA NEEDED FOR GHG QUANTIFICATION USING A BOTTOM-UP APPROACH IN THE TRANSPORT SECTOR

4 CONCLUSSIONS BASED ON THE GERMAN EXPERIENCES

Top-down and bottom-up approaches in the transport sector: General principles

Top-down

Energy based

+ Germany: Combination of both approaches

Bottom-up

Activity based

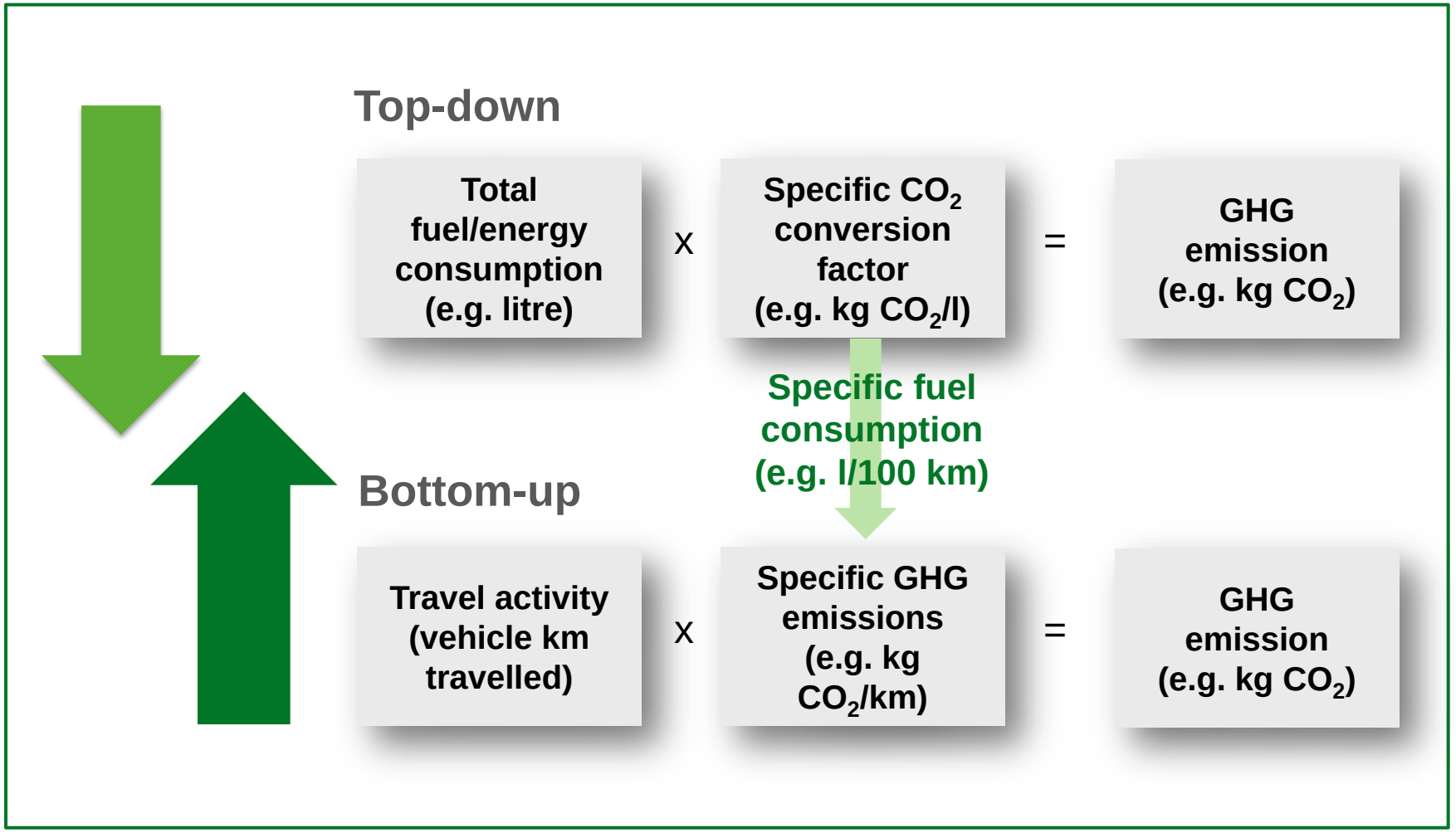
Input data:

- **Sales figures by fuels** or **energy statistic data** on national level (e.g. sales figures for diesel)
- **CO_2 conversion factors** per unit energy (kg CO_2/l)

Input data:

- **Activity data** of modes of transport, e.g. total vkt, pkm or tkm
- **Specific fuel consumption data** per vkt, pkm or tkm
- **CO_2 conversion factors** per unit energy (kg CO_2/l)

Formula for quantifying GHG emissions by using the top-down and bottom-up approach

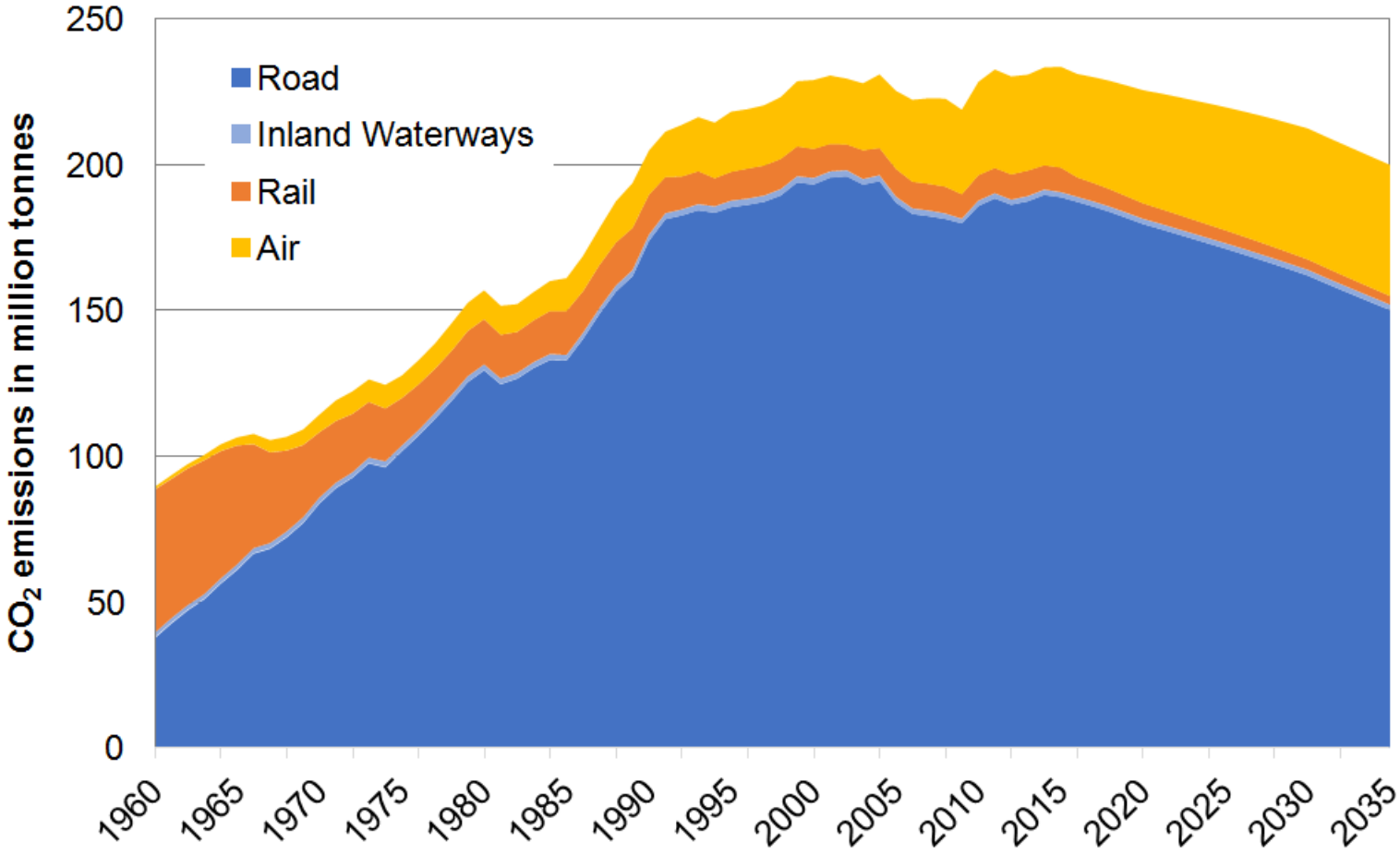


Main benefits and main challenges for top-down and bottom-up approach in the transport sector

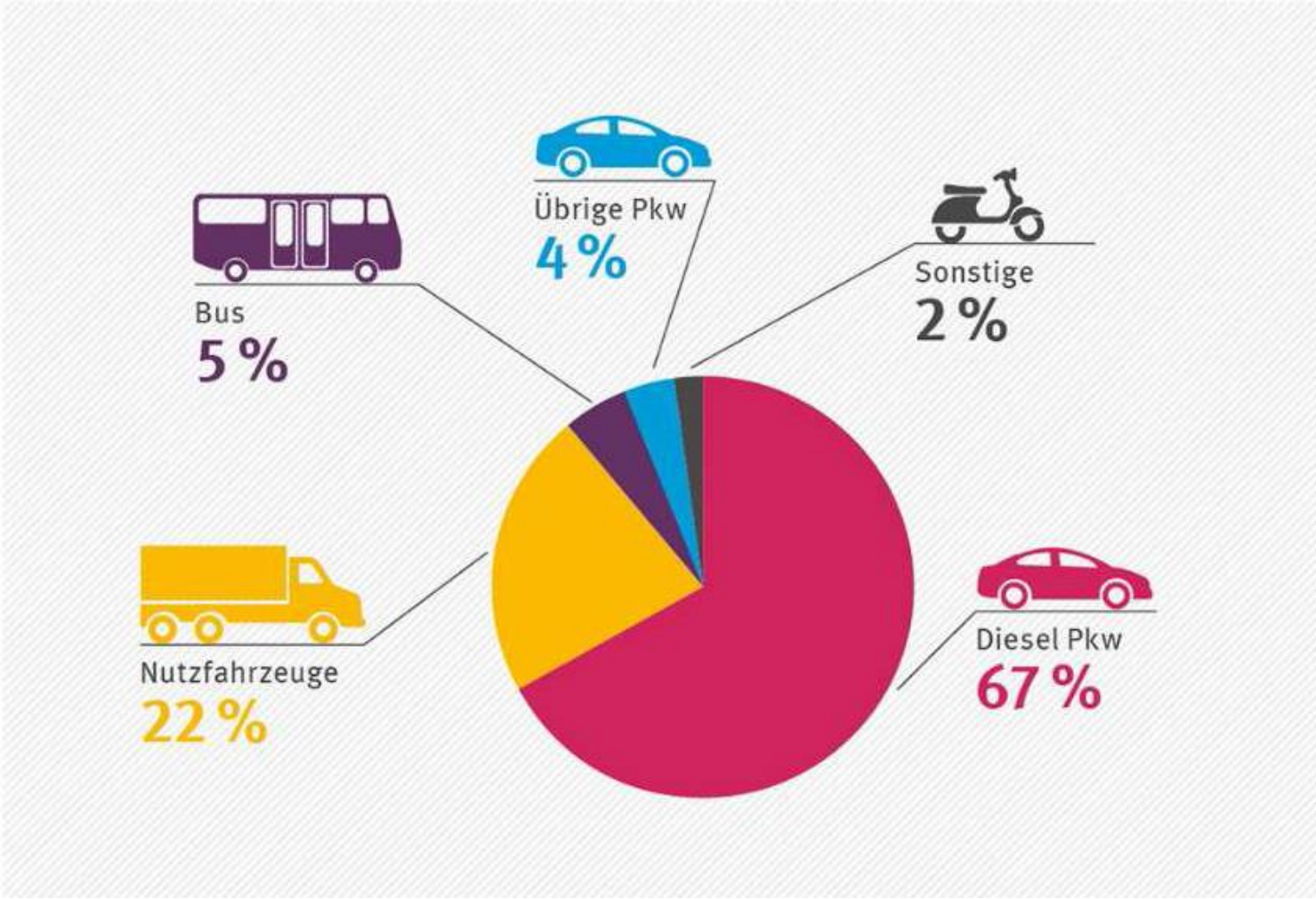
	Main Benefits	Main Challenges
Top-down approach	• Easy and straightforward • Fuel sale / consumption data may be easily available • Only one data source • Datasets are often consistent • Good for historic emission estimates	• Low level of detail • Not suited to assess impact of transport policies • Not suited for pollutants • Uncertain geographical boundaries • Fuels could be used in different sectors
Bottom-up approach	• Detailed assessment of emission sources possible • Allows policy evaluation • Can be used for quantification of air pollutants • Also useful for transport planning • Approach can also be used on regional an city level	• Requires an extensive amount of data collection and handling • Requires several data sets • Datasets can be inconsistent or of a relatively low quality • Requires more financial and human resources

Source: GIZ 2014; modified.

CO_2 emissions by mode of transport from 1960 to 2035 in Germany



Nitrogen dioxide (NO2) emissions caused by the transport sector in cities 2014 in Germany



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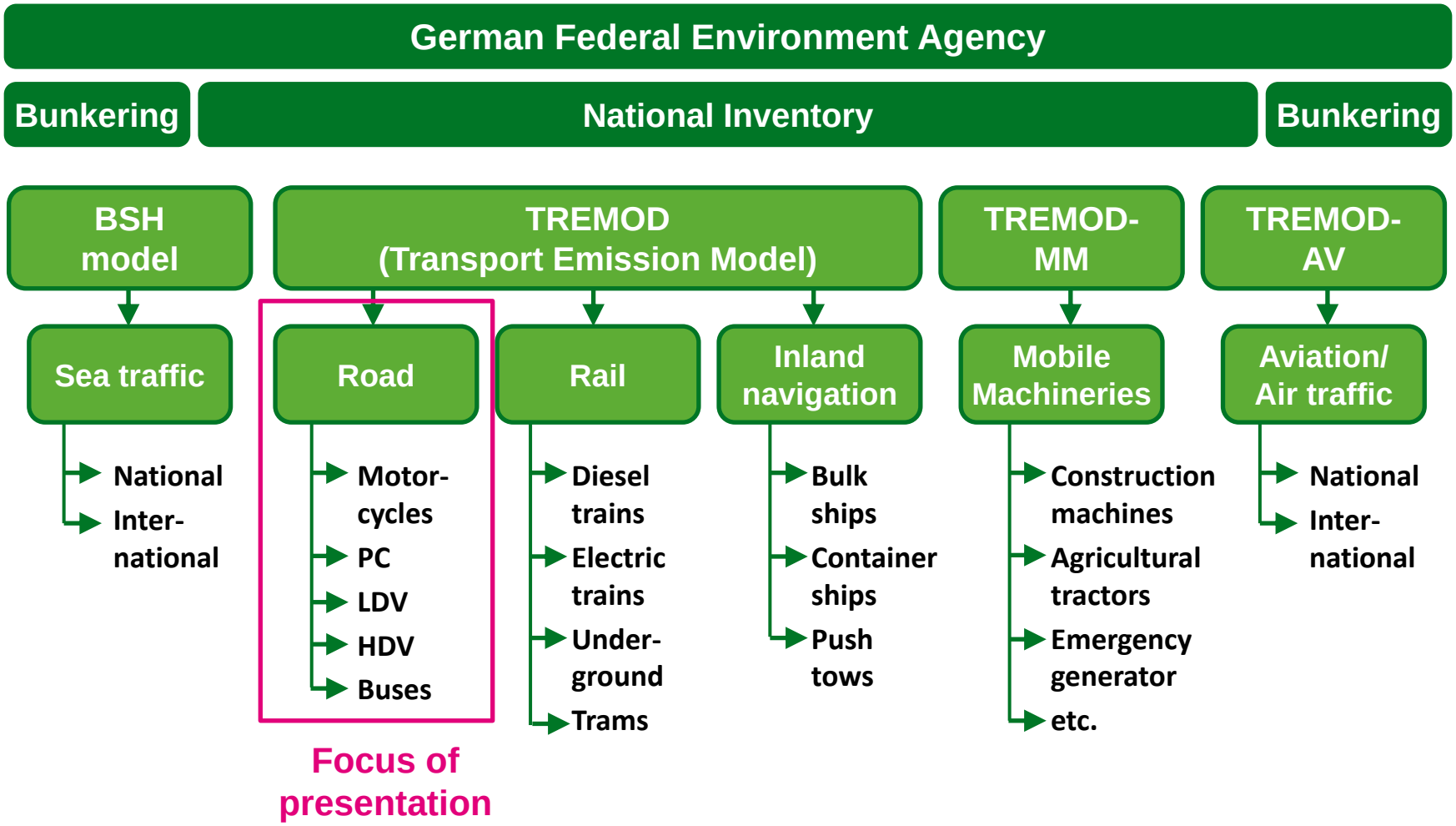
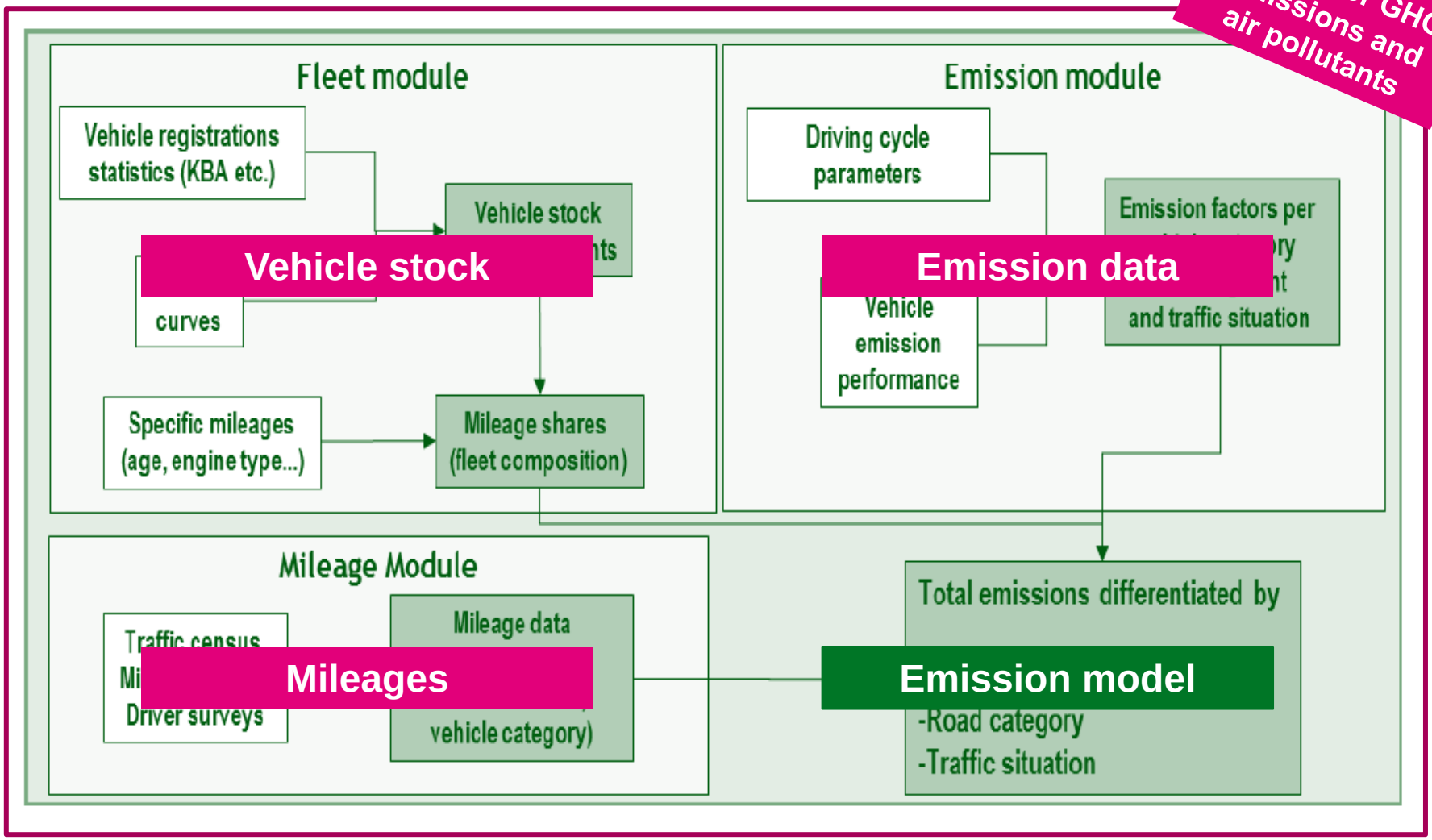
Overview of the transport emission models used by the German Federal Environment Agency

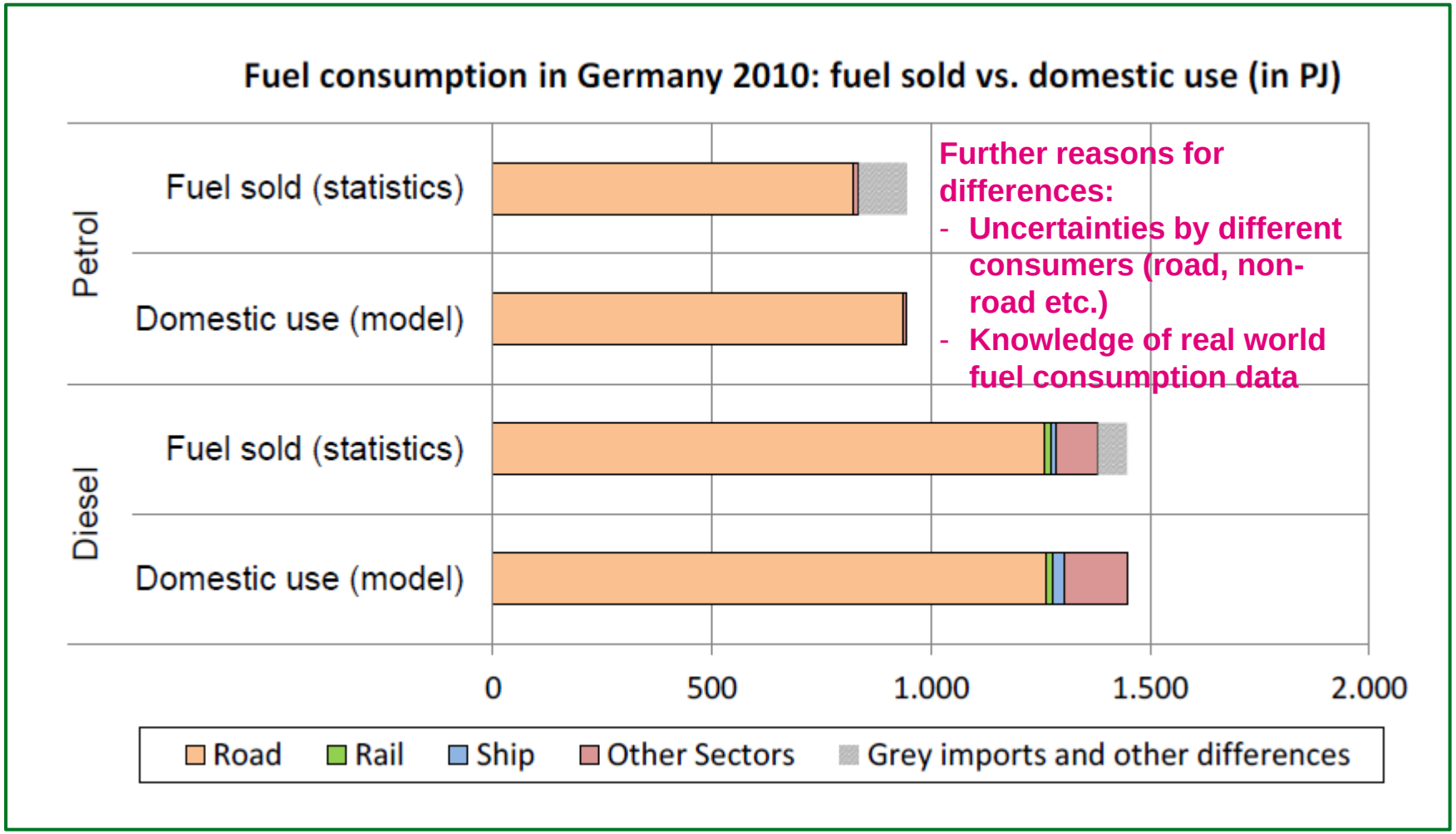


Modules of TREMOD for the calculation of emissions of road transport



Source: IFEU 2015.

Fuel consumption in Germany: Fuel sold versus domestic use of all sectors calculated by TREMOD/TREMOD-MM



Source: IFEU 2015.

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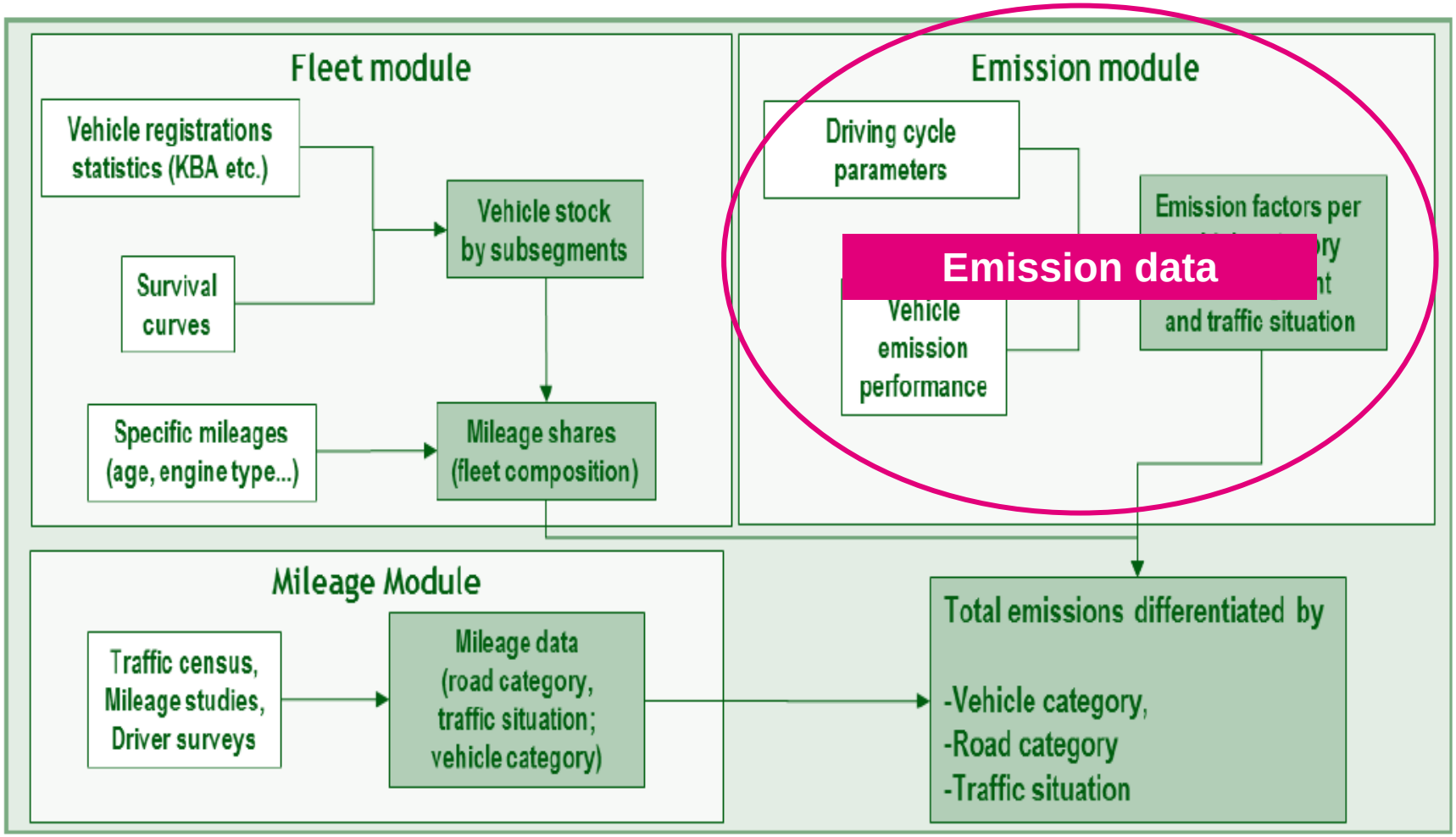
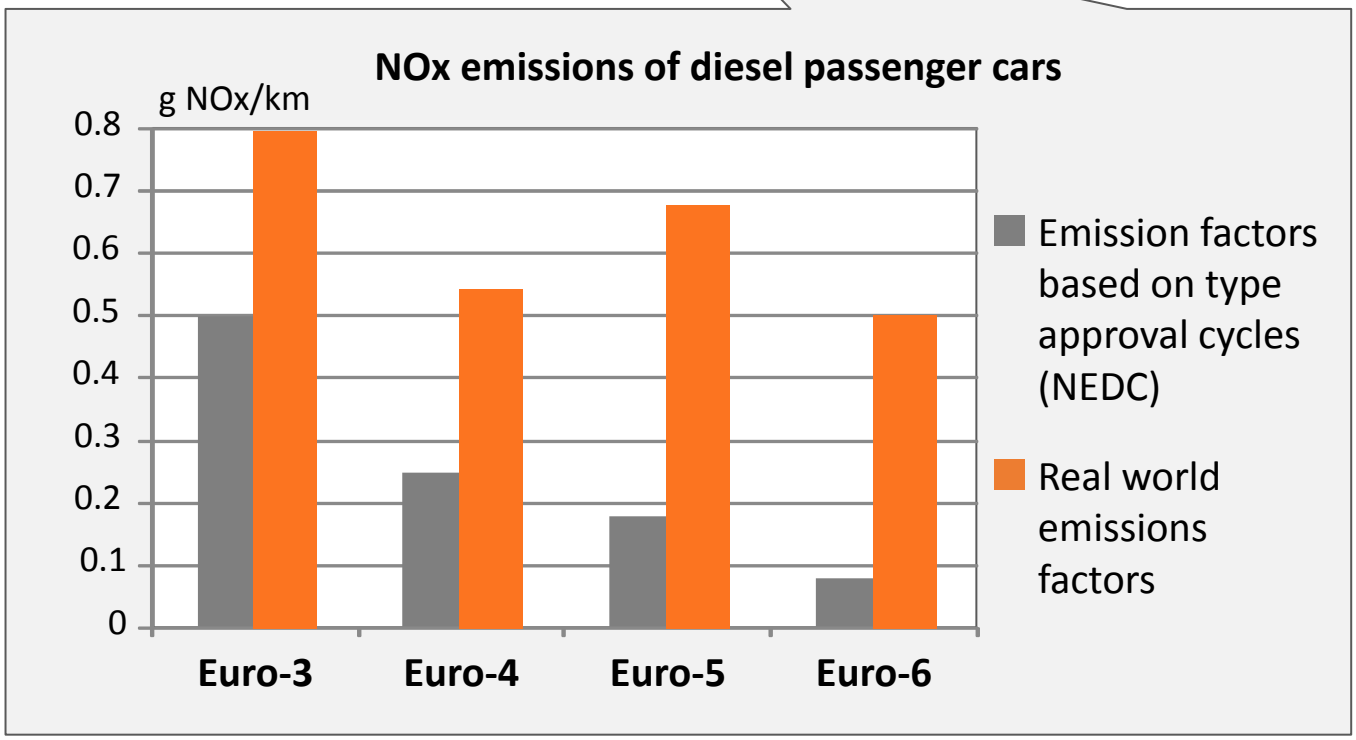


Source: IFEU 2015.

Emission factors influence strongly the quality of quantification of traffic-related emissions

Travel activity (vehicle km travelled) x **Specific emission factors (e.g. kg NOx/km)** = **GHG emission/ air pollutants (e.g. kg NOx)**



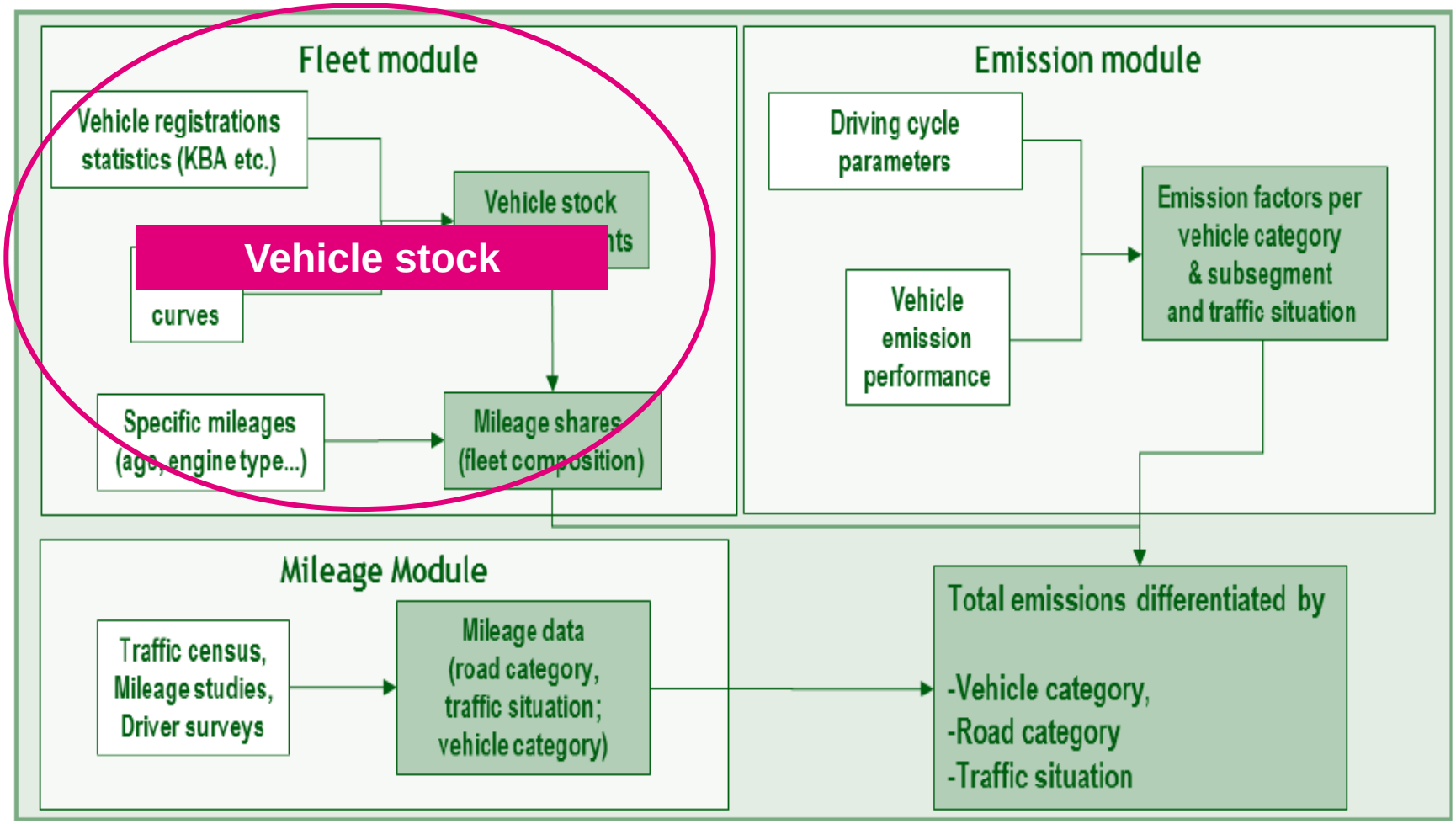
Need of reliable emission factor database ⇨ HBEFA

Source: UBA/HBEFA..

HandBook of Emission FActors for Road Transport (= HBEFA)

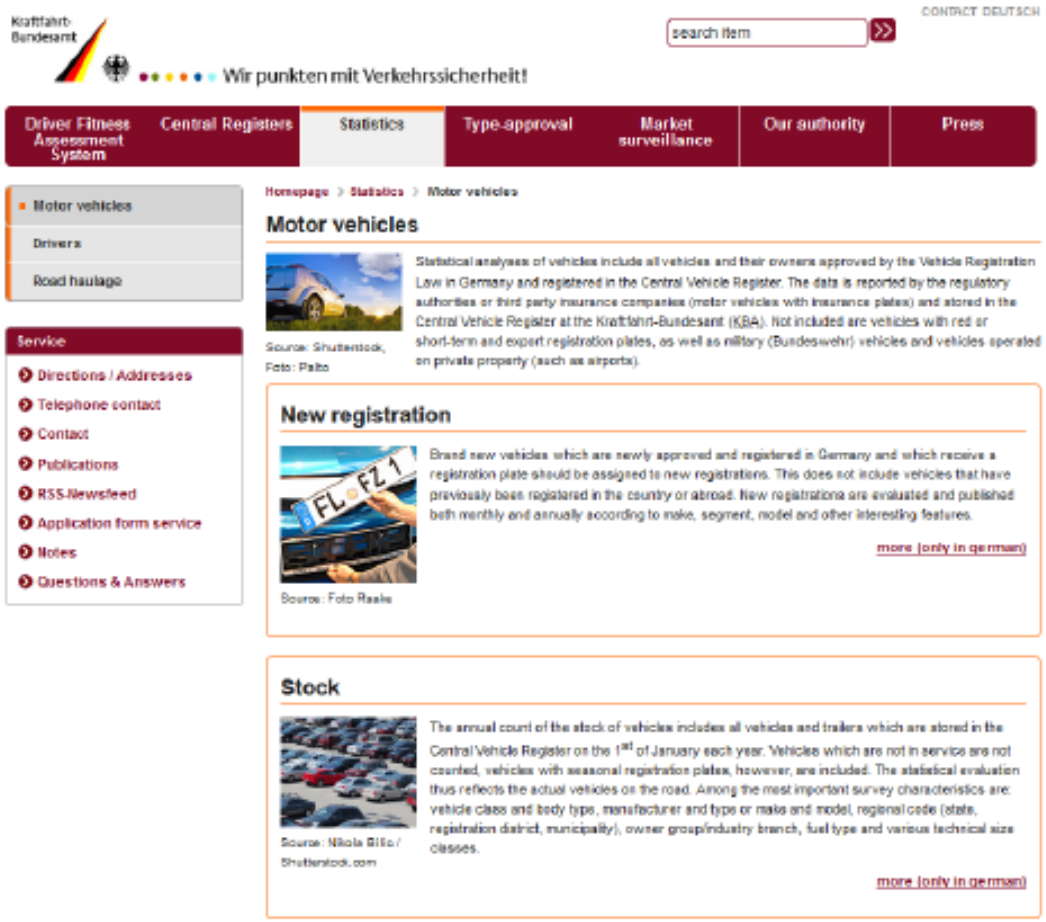
- **HBEFA** is **emission factor database** for road transport which is developed on behalf of several European countries (e.g. Germany, Switzerland, Austria, Sweden, Norway, France).
- In **1995** the **first version** of HBEFA was published, since there it was **continuously enhanced.**
- HBEFA provides **emission factors** (**hot, cold start, evaporation**) for **all regulated** and **important non-regulated air pollutants** as well as for **fuel consumption** and **CO_2 emission**

TREMOD needs data for vehicle stock, vehicle registrations and survival curves for the fleet module



Source: IFEU 2015.

Example Germany: data for vehicle population provided by the Federal Motor Transport Authority (KBA)



- Vehicle stock and new registration based on KBA statistics (www.kba.de)
- Key information:
  - Vehicle type
  - Vehicle size (segment, weight, capacity, engine power, ...)
  - Fuel type
  - Year of registration
  - Fuel consumption in type approval cycle (NEDC)
- Annually updated in TREMOD

Source: IFEU)

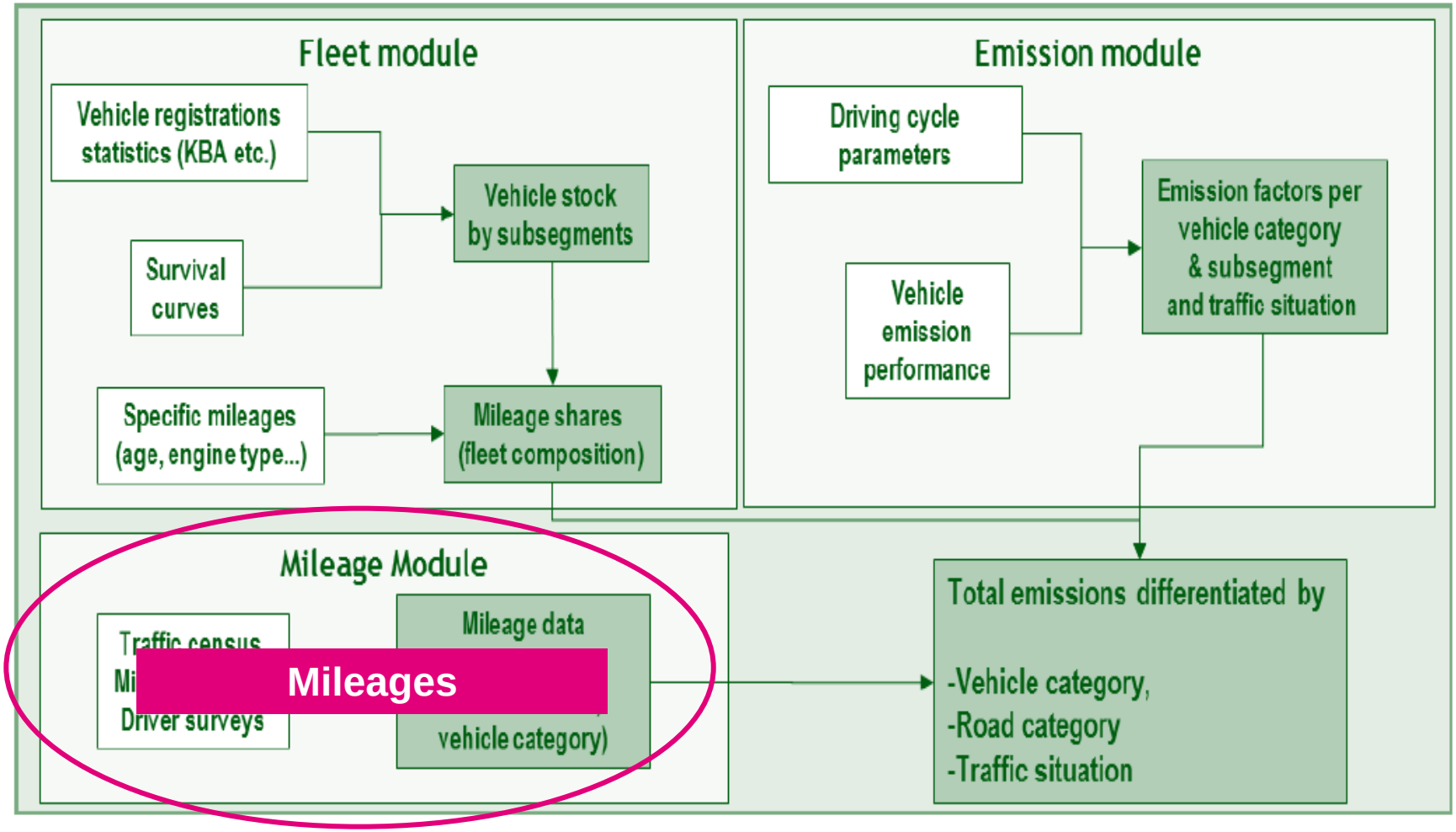
HBEFA provides emission factors for different sub-segments of vehicles

Vehicle categories	Vehicle size	Fuel types	Emission Standards	Reduction technologies
Passenger Car	PC < 1.4 L	Gasoline	Pre Euro 1	Particle filter
Motorcycle	PC 1.4-2.0 L	Diesel	Euro 1	SCR
Urban bus	PC > 2.0 L	LPG	Euro 2	EGR
Coaches	Truck ≤ 7.5 t	CNG	Euro 3	…
Light duty veh.	Truck 7.5-12 t	FFV	Euro 4	
Single truck	Truck 12-14 t		Euro 5	
Truck trailer[1)]	…		Euro 6	

Abbreviations: PC = Passenger car; LPG = Liquefied Petroleum Gas; CNG = Compressed Natural Gas; FFV = Flexible Fuel Vehicles; SCR = Selective Catalytic Reduction; EGR = Exhaust Gas Recirculation

Source: **INFRAS.**

TREMOD needs total mileages of the vehicles for the mileage module



Source: IFEU 2015.

Example Germany: data on vehicle kilometers travelled provided by the Federal Highway Research Institute

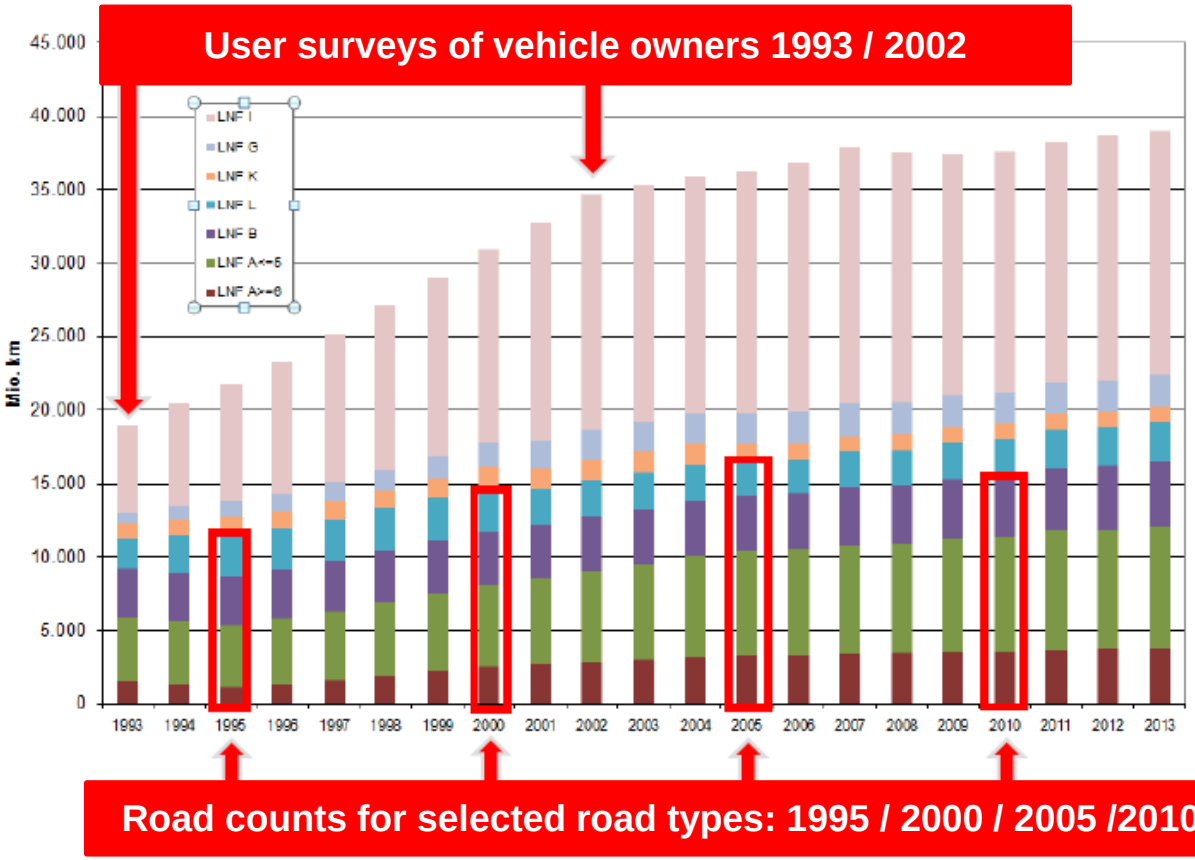
Input for TREMOD	Data collections in Germany	Frequency
Total VKT (per vehicle category and road category years)	Automatic traffic counting	annually
	Manual traffic counting	5 years
	Comprehensive survey of counts, inspection data, interviews, etc., (1990, 1993, 2002, new in 2014)	10 years
	Other surveys (toll statistics, mobility panel, mobility in Germany)	depends
Average VKT per vehicle (by vehicle type, size fuel, age)	Main source: Survey of vehicle mileage 1993 and 2002 (questionnaire); new values 2014 will be integrated in 2017	10 years

Info Federal Highway Research Institute (BASt) on: www.bast.de

Source: IFEU)

Quantification of total annual mileages based on the available data sources: Example of of light duty vehicles

Total annual mileages of light duty vehicles in Germany by road types:



Calculation for each year based on vehicle stock and averages mileages (estimation)

Automatically road counts for motor-ways (each year)

Source: IFEU (modified)

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Transport GHG Emission Inventories in Germany: Conclusions (1)

- **Clear determination of responsibility** for GHG emission inventory is a **key issue for success** (Germany: Federal Environment Agency) ⇨ independent of centralising the responsibility **all stakeholders must be work together** (and deliver data).
- For **reliability** of the results as well as for **assessment of measures bottom-up approaches should be used** for GHG inventories ⇨ the results must be compared with the results derived from top-down analyses.
- Top-down and bottom-up approaches are only comparable if other users of fuels are considered (e.g. non-road sector like construction machineries) ⇨ ideally **non-road sector should also be included**.
- Quantification of **GHG emissions** and **air pollutants** are based on the same traffic data (vehicle stock, new registration data etc.) ⇨ both **approaches should be compatible**.

Transport GHG Emission Inventories in Germany: Conclusions (2)

- **Crucial point is the reliability of data** (traffic and fuel efficiency data) ⇨ quality of data **must be evaluated regularly**; particularly the real world fuel consumption data must be reviewed.
- GHG inventory delivers only historical data but methodology could also be used for analyses of future developments and scenarios ⇨ **transport emission models should allow to calculate scenarios**.
- Data derived on national level can also be used on regional and local level ⇨ **results should be provided in an easy way for users like cities or regional governments**.

Thank you for your attention!

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