

For Our Environment

Umwelt   
Bundesamt

10<sup>th</sup> Int. AVL Exhaust Gas and Particulate Emissions Forum

# HBEFA – a tool for the determination of real emission

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Federal Environment Agency (UBA)

Section I 3.2 "Pollution Abatement and Energy Saving in Transport"

## Agenda

**1**

**Need for transport emission inventories**

**2**

**Germany's tools to report transport emission inventories**

**3**

**Application areas**

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**Outlook and challenges**

## Status quo of nitrogen dioxide (NO<sub>2</sub>)

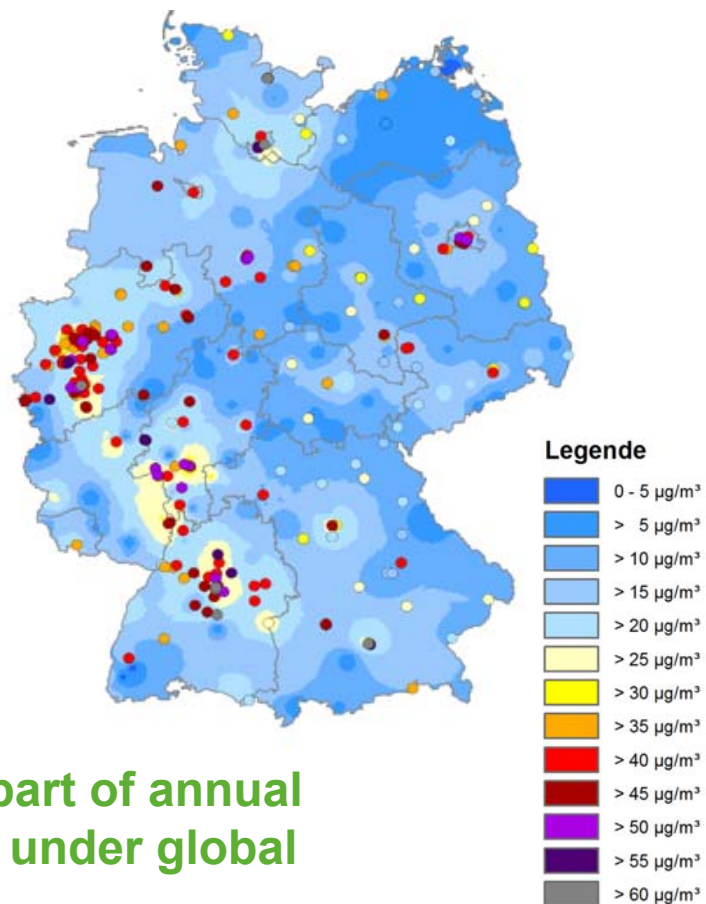
Air quality limit (EU) and target values (WHO)

Pollutant	EU limit values		WHO AQG*	
PM <sub>2.5</sub>	25 µg/ m <sup>3</sup>	(year)	10 µg/ m <sup>3</sup>	(year)
PM <sub>10</sub>	50 µg/ m <sup>3</sup>	(day)	20 µg/ m <sup>3</sup>	(day)
O <sub>3</sub>	120 µg/ m <sup>3</sup>	(8-hour)	100 µg/ m <sup>3</sup>	(8-hour)
BaP	1 ng/ m <sup>3</sup>	(year)	0.12 ng/ m <sup>3</sup>	(year)
NO <sub>2</sub>	40 µg/ m <sup>3</sup>	(year)	40 µg/ m <sup>3</sup>	(year)
SO <sub>2</sub>	125 µg/ m <sup>3</sup>	(day)	20 µg/ m <sup>3</sup>	(day)
CO	10 µg/ m <sup>3</sup>	(8-hour)	10 µg/ m <sup>3</sup>	(8-hour)
Pb	0.5 µg/ m <sup>3</sup>	(year)	0.5 µg/ m <sup>3</sup>	(year)
Benzene	5 µg/ m <sup>3</sup>	(year)	1.7 µg/ m <sup>3</sup>	(year)

\*Air Quality Guidelines

Quelle: Umweltbundesamt

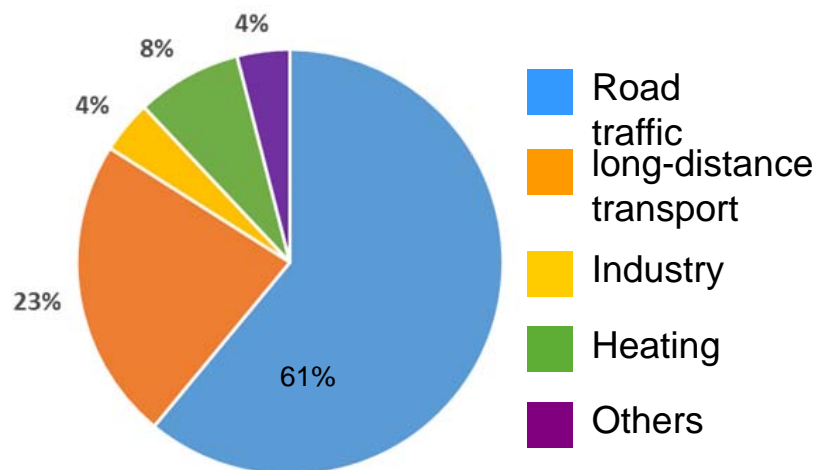
Annual NO<sub>2</sub> concentration in Germany in 2016



**Transport emission inventories needed as part of annual reporting to national and EU authorities i.a. under global agreements (e.g. Kyoto Protocol)**

## Urban NO<sub>2</sub> emissions in the transport sector (Germany, 2015)

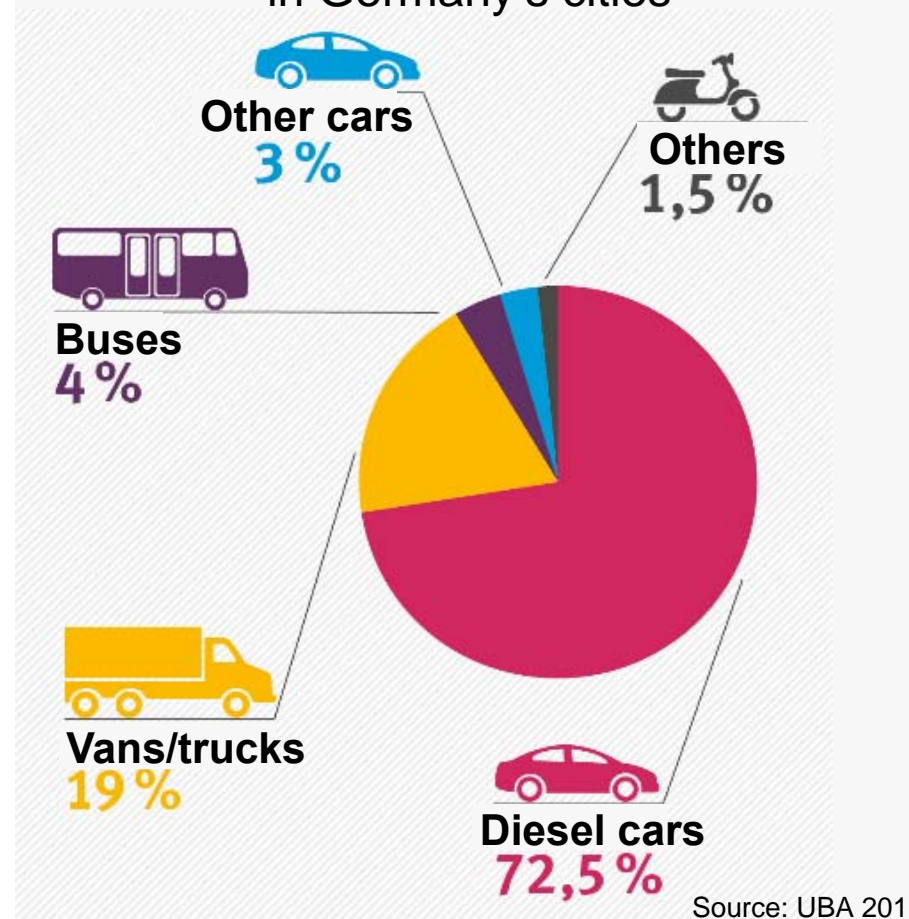
Share of NO<sub>2</sub> polluters in total in Germany's cities



- In Germany more than 60% of NO<sub>2</sub> measured in cities originated from road traffic
- Main causer of the air pollutant are diesel vehicles, particularly diesel-fueled passenger cars

Source: UBA 2016

Share of NO<sub>2</sub> polluters in road traffic in Germany's cities



Source: UBA 2017

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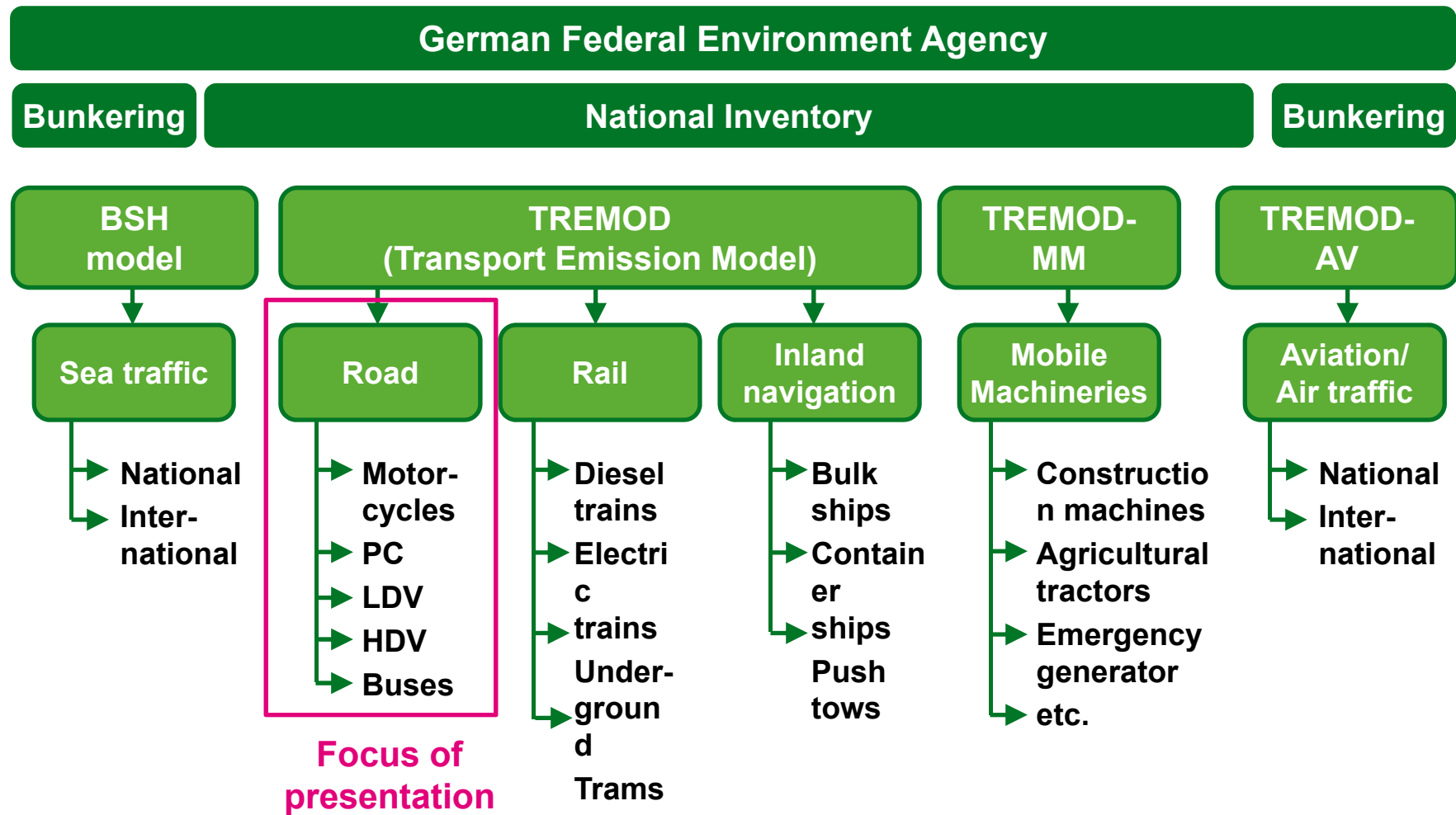
**3**

Application areas

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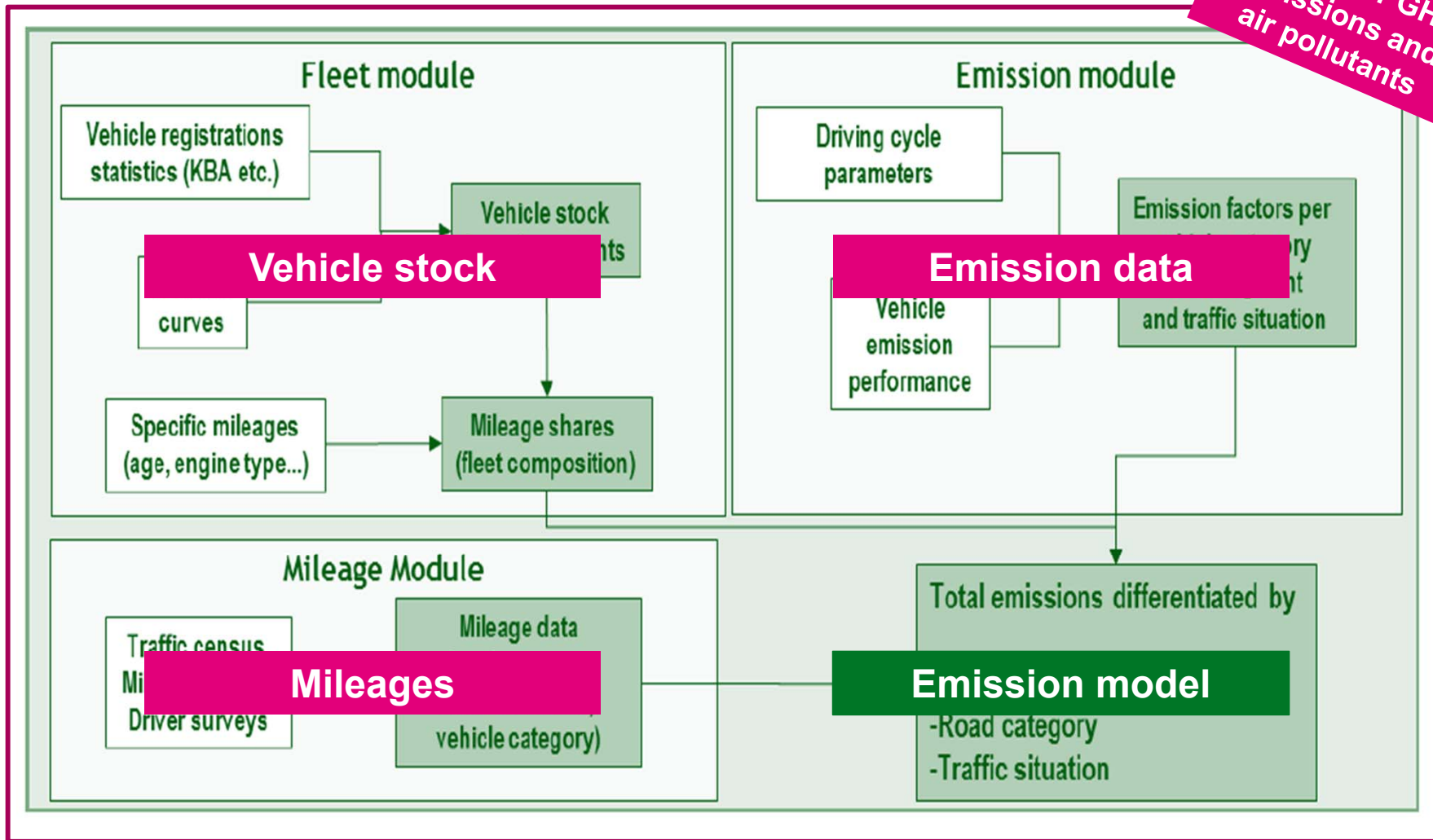
Outlook and challenges

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



# TREMOD - Modules to calculate emissions of road transport

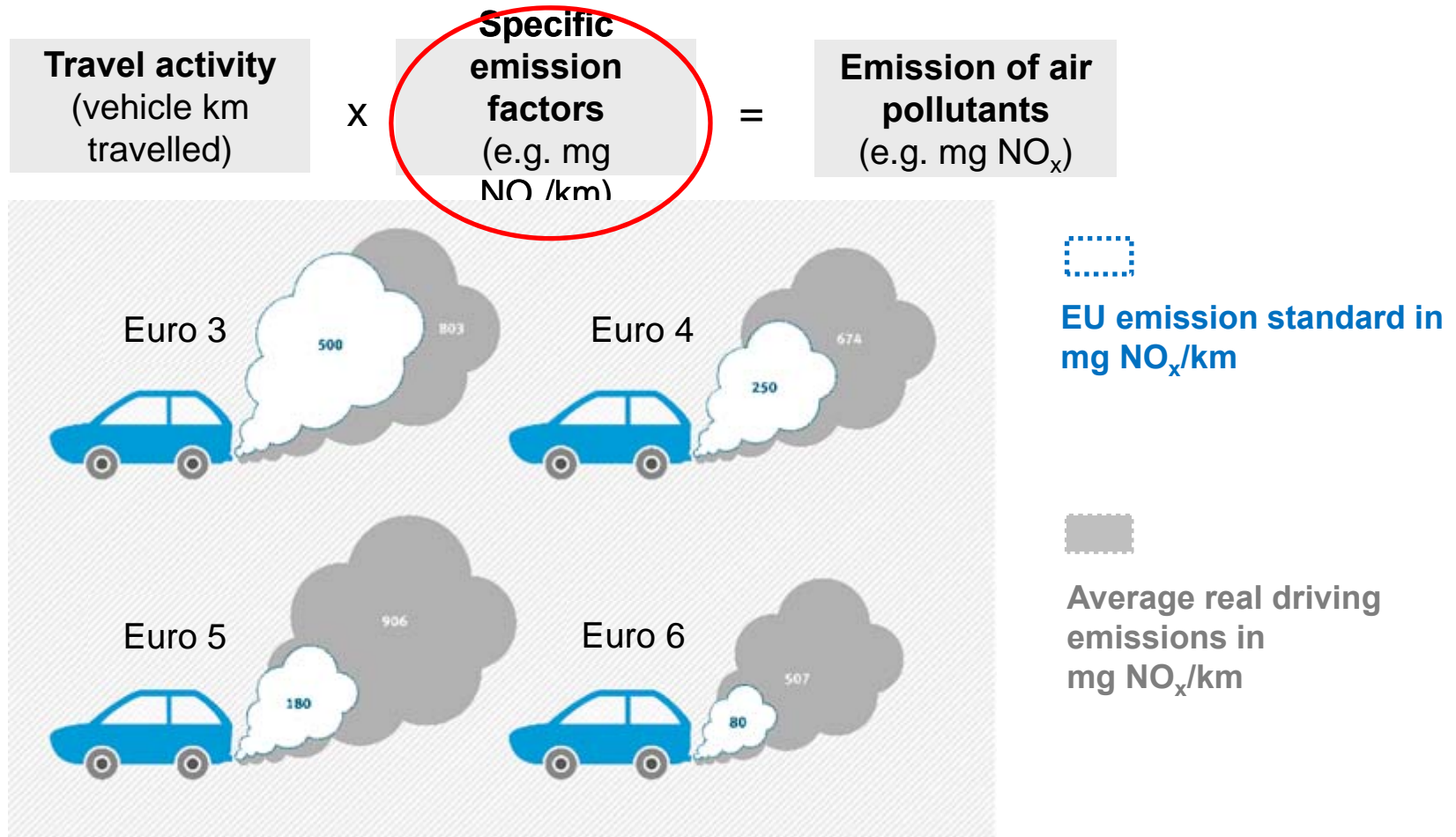
Similar for GHG emissions and air pollutants



Source: IFEU 2015.

2 Germany's tools to report transport emission inventories

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



**Need of reliable emission factor database**

⇒ **HBEFA**



## 2 Germany's tools to report transport emission inventories

# HBEFA - HandBook of Emission Factors for road transport

The image shows two screenshots related to the HBEFA tool. The top screenshot is the HBEFA website homepage, which includes logos for participating countries (Germany, Austria, Switzerland, Sweden, France, Norway) and technical partners (Umwelt Bundes Amt, umweltsam, bmv, lebensministerium.at, TRAFIKVERKET, ADEME, sfft). It displays the version (3.3) and date (24 April 2017), along with dropdown menus for language and country. The bottom screenshot is the HBEFA configuration window, titled "Select all parameters for your case. Then specify a name for this set and let the program calculate the emission factors." It features several sections for parameter selection: "Select VEHICLE CATEGORIES" (PC, LCV, HGV, Utben Bus, Coach, MC), "Select COMPONENTS (Pollutants)" (regulated, Fuel consumption, CO2 rep, others), "Select YEARS" (1995, 2000, 2005, 2010, 2015, 2020, 2025, 2030), "Select FLEET COMPOSITION (traffic scenario)" (EF weighted with fleet composition, EF per subsegment), "Specify parameters for HOT EMISSION FACTORS" (Individual Traffic Situations, Aggregate Traffic Situations), "Specify parameters for COLD START EXCESS EMISSION FACTORS", and "Specify parameters for EVAPORATION EMISSION FACTORS". It also includes a "Name of parameter set" field, a "Selected Country" dropdown, and buttons for "Calculate", "Reset to default", and "Return".

- **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).
- HBEFA is **publicly** available.
- 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<sub>2</sub> emission**

## HBEFA - Data collection

Emission factors are calculated by a simulation tool named PHEM (Passenger car and Heavy duty vehicle Emission Model)

⇒ random measurements ensure the validity of the tool and its results

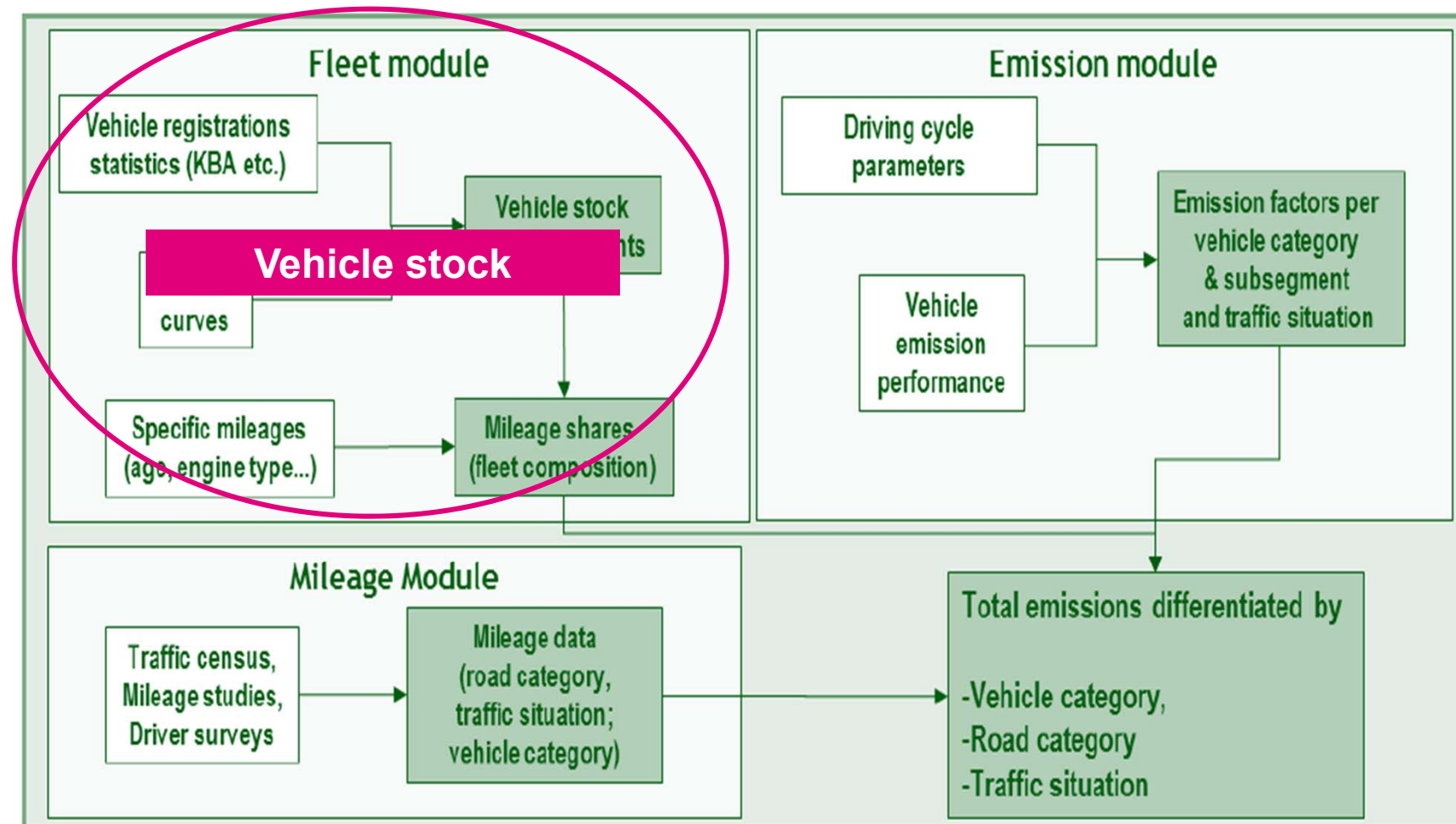
- Chassis dynamometer measurements with driving cycles close to real world
  - ⇒ pro: enable comparability and repeatability of the test
- PEMS (Portable Emission Measurement system)
  - ⇒ pro: reflects real world situation; includes i.e. environmental conditions
- Remote Sensing measurements
  - ⇒ pro: enables data collection of a vast amount of vehicles in a short

**Collaborations of different nations yield a larger amount of data, hence covering a wider range of vehicle segments**

**HBEFA updates are released every 4-5 years**

2 Germany's tools to report transport emission inventories

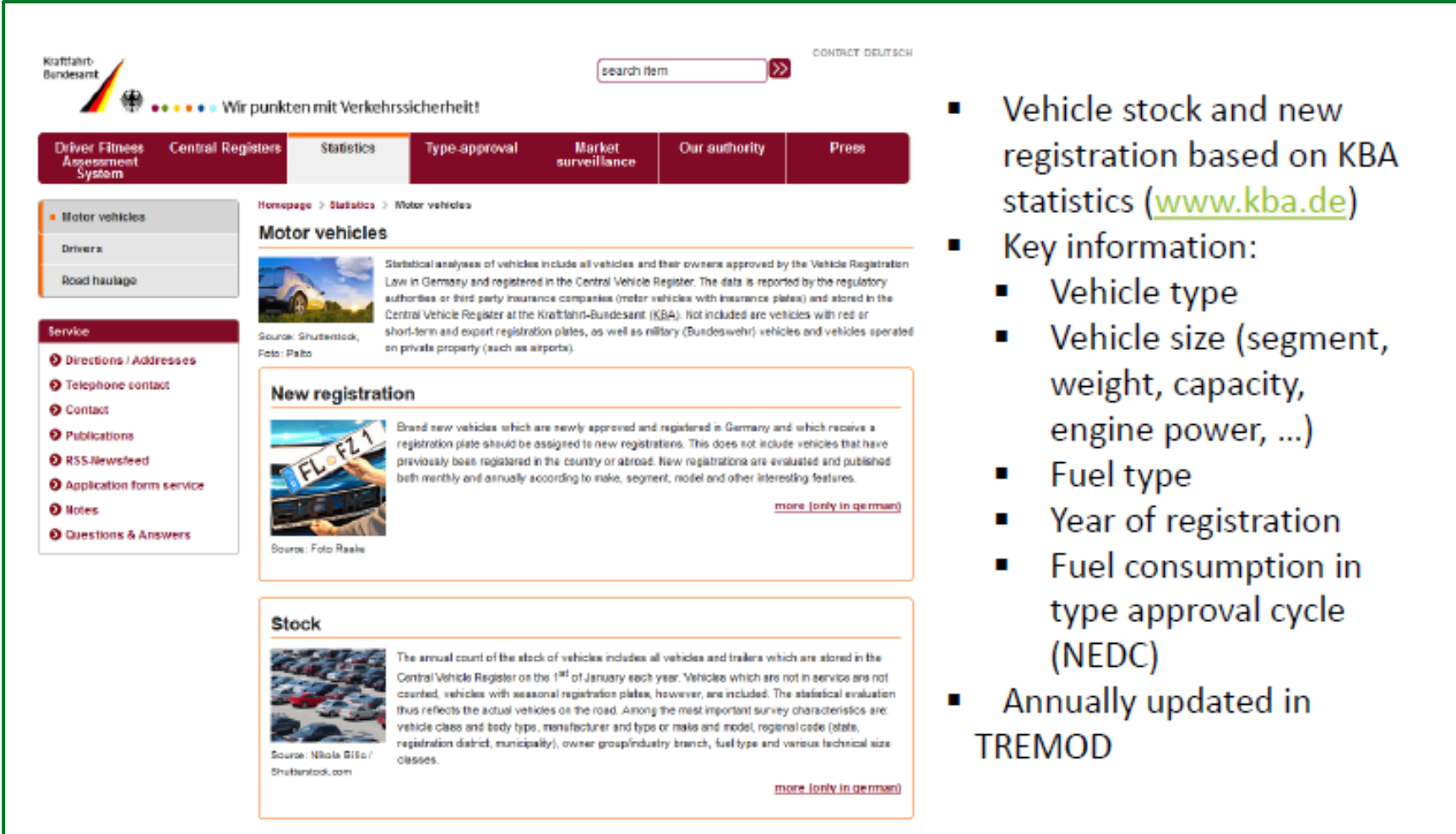
## TREMOD needs data for vehicle stock, vehicle registrations and survival curves for the fleet module



Source: IFEU 2015.

## 2 Germany's tools to report transport emission inventories

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



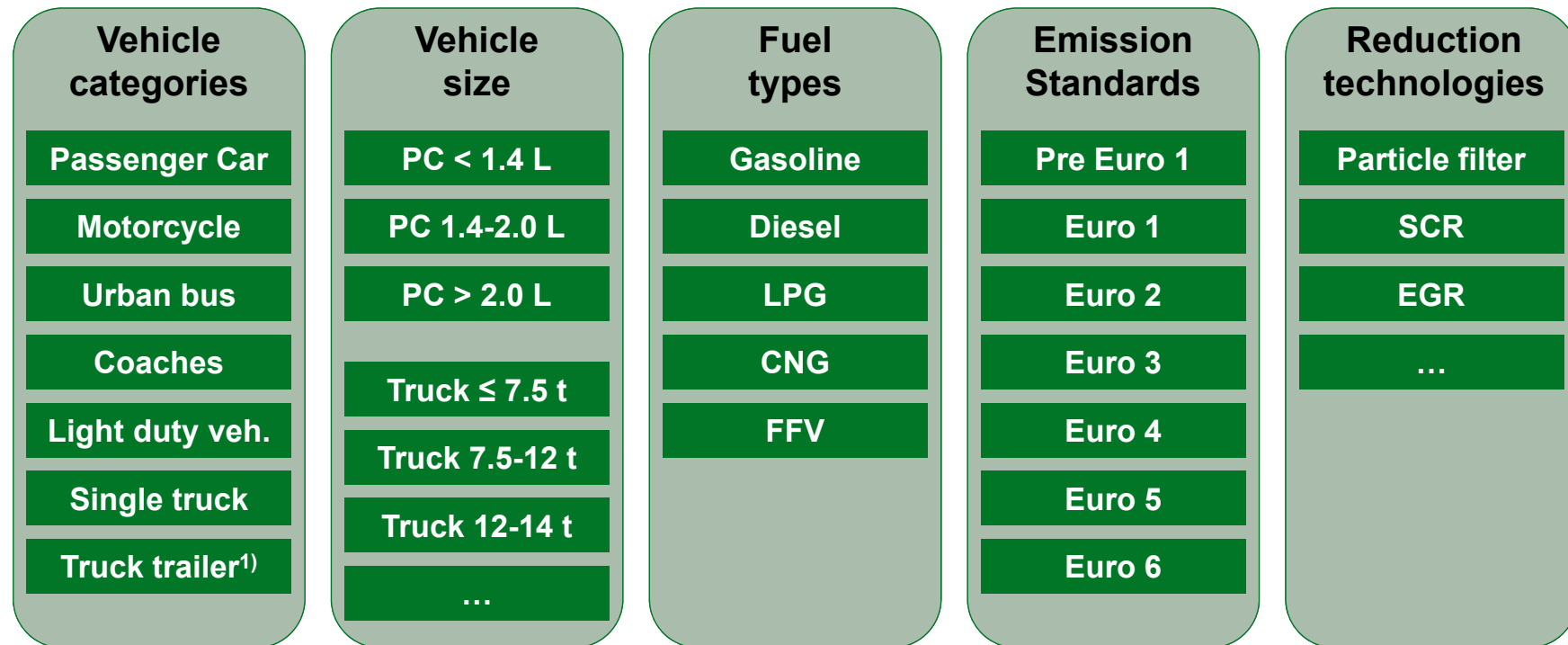
The screenshot shows the website of the Kraftfahrt-Bundesamt (KBA), the Federal Motor Transport Authority in Germany. The page is titled "Motor vehicles" under the "Statistics" section. It features a navigation menu with options like "Driver Fitness Assessment System", "Central Registers", "Statistics", "Type-approval", "Market surveillance", "Our authority", and "Press". The main content area is divided into three sections: "Motor vehicles", "New registration", and "Stock".

- Motor vehicles:** A section with a sub-header "Motor vehicles" and a description: "Statistical analyses of vehicles include all vehicles and their owners approved by the Vehicle Registration Law in Germany and registered in the Central Vehicle Register. The data is reported by the regulatory authorities or third party insurance companies (motor vehicles with insurance plates) and stored in the Central Vehicle Register at the Kraftfahrt-Bundesamt (KBA). Not included are vehicles with red or short-term and export registration plates, as well as military (Bundeswehr) vehicles and vehicles operated on private property (such as airports)." Source: Shutterstock, Foto: Pixto.
- New registration:** A section with a sub-header "New registration" and a description: "Brand new vehicles which are newly approved and registered in Germany and which receive a registration plate should be assigned to new registrations. This does not include vehicles that have previously been registered in the country or abroad. New registrations are evaluated and published both monthly and annually according to make, segment, model and other interesting features." Source: Foto Raabe. A link "more (only in german)" is provided.
- Stock:** A section with a sub-header "Stock" and a description: "The annual count of the stock of vehicles includes all vehicles and trailers which are stored in the Central Vehicle Register on the 1<sup>st</sup> of January each year. Vehicles which are not in service are not counted, vehicles with seasonal registration plates, however, are included. The statistical evaluation thus reflects the actual vehicles on the road. Among the most important survey characteristics are: vehicle class and body type, manufacturer and type or make and model, regional code (state, registration district, municipality), owner group/industry branch, fuel type and various technical size characteristics." Source: Nikola Bilo / Shutterstock.com. A link "more (only in german)" is provided.

- Vehicle stock and new registration based on KBA statistics ([www.kba.de](http://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



### Abbreviations:

PC = Passenger car

LPG = Liquefied Petroleum Gas

CNG = Compressed Natural

Gas

<sup>1)</sup> Including articulated vehicles

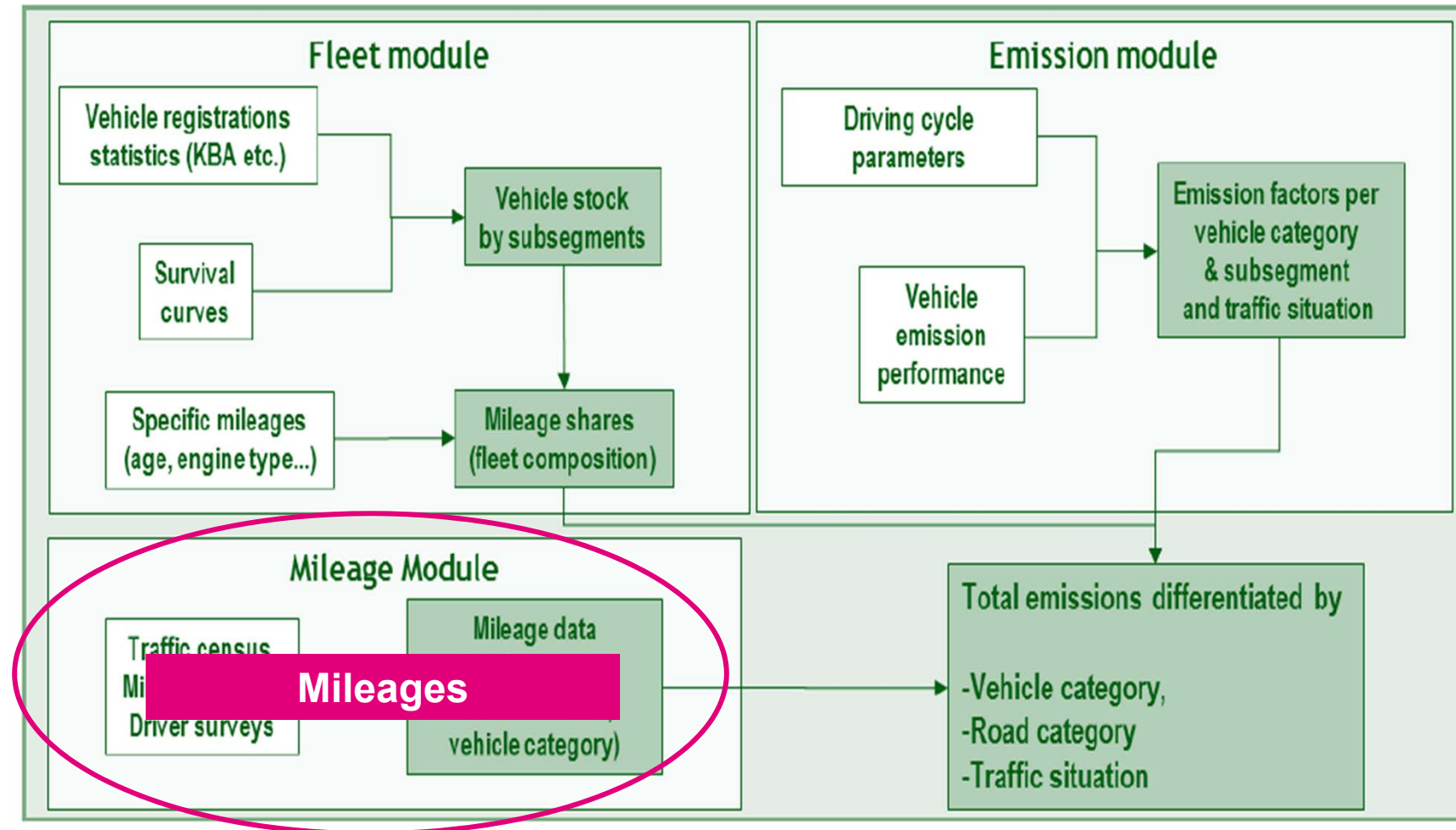
FFV = Flexible Fuel Vehicles

SCR = Selective Catalytic Reduction

EGR = Exhaust Gas Recirculation

2 Germany's tools to report transport emission inventories

## TREMOD needs total mileages of the vehicles for the mileage module



Source: IFEU 2015.

2 Germany's tools to report transport emission inventories

## 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](http://www.bast.de)

Source: IFEU)

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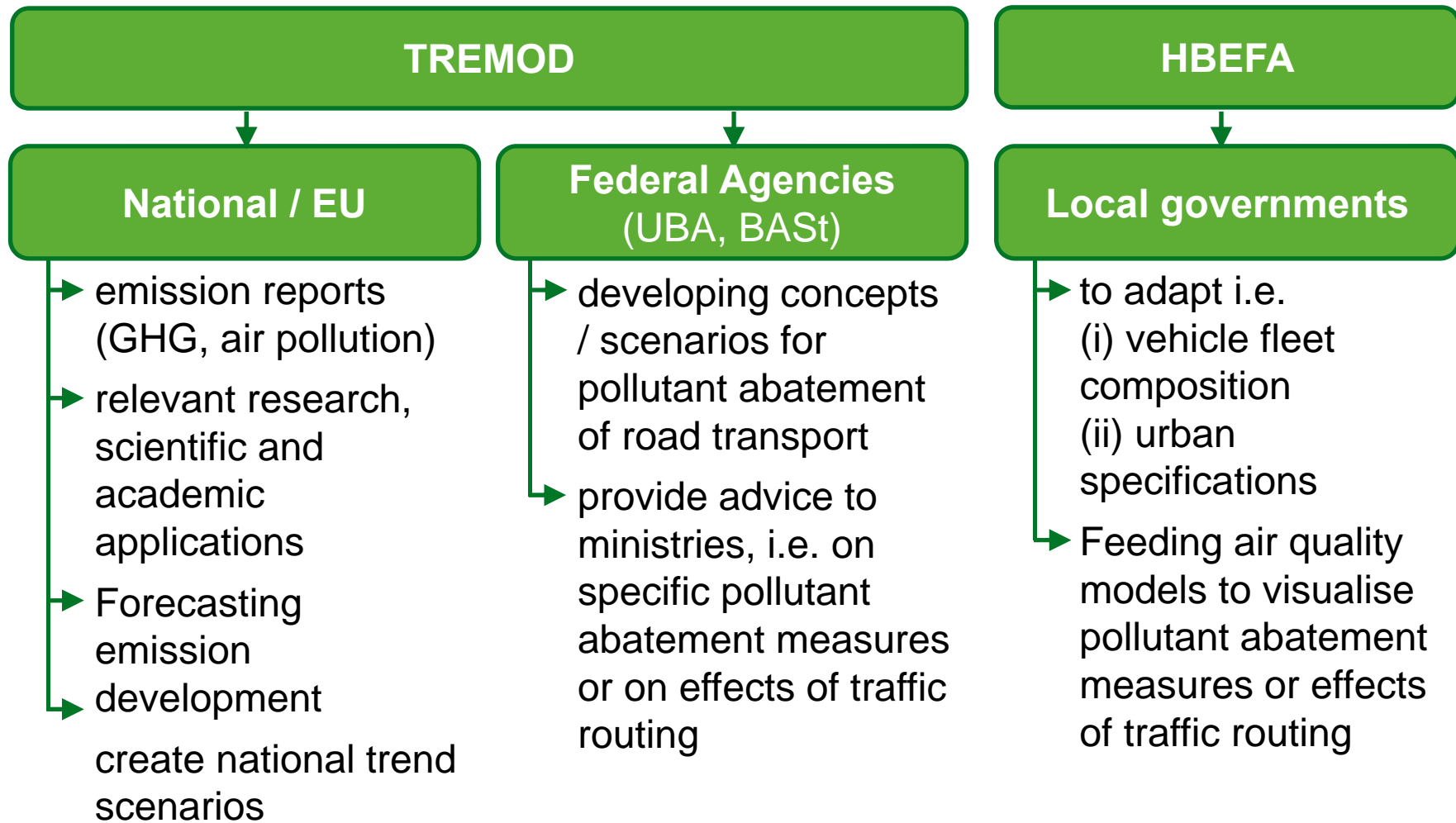
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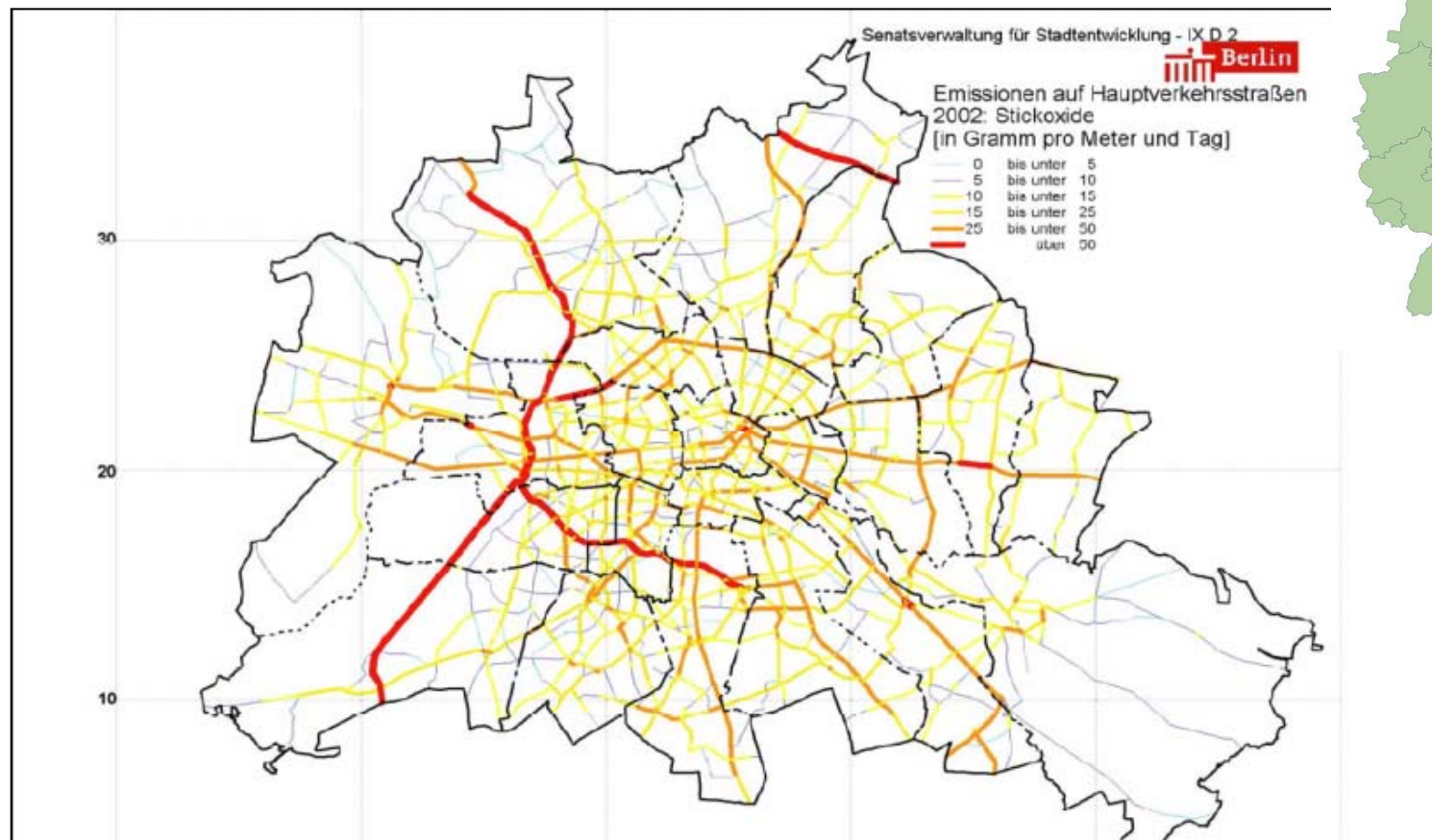
## Application areas of transport emission inventories



### 3 Application areas

## Application areas – example: Local Authorities

### Berlin: NO<sub>x</sub> emissions



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## Outlook

- Maintain cooperation across authorities and countries to
  - a) increases the number of data hence improves the reliability of emission factors
  - b) enables the coverage of a wider range of measurements
- Maintain data quality standard by
  - a) unified measurement criteria, i.e using standard catalogue on data collection or measurement parameters
  - b) data processing
- Software and data maintenance should always be considered crucial

## Challenges

- Incorporate new measurement techniques, i.e. PEMS and Remote Sensing
- Current focus: (i) updating fuel consumption by realistic values
  - (ii) identify benefits and limitations of Remote Sensing for HBEFA

# Thank you for your attention!

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Section

“Pollution Abatement and Energy Saving in Transport”

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## Authorities teamwork for GHG emission report

- Germany reports emissions of GHGs (direct and indirect GHG) within the scope of United Nations Framework Convention on Climate Change and the Kyoto Protocol
- The UNFCCC Reporting Guidelines and the Kyoto Protocol demands the determination of institutional arrangements for GHG emission reporting in each country (in Germany it is done by an “Agreement by State Secretaries on the National System”)  
=> this determines BMUB (Ministry of Environment) to be in authority and the German Environment Agency as requested Single National Entity
- Various departments within UBA gather data to their topics, i.e. emissions from transport sector (in-house directive)
- All federal authorities are obligated to cooperate to fulfil legal tasks on a national level as e.g. emission report (German government’s rules of procedure)

Because HBEFA and TREMOD are crucial to calculate emissions in the transport sector as part of the national emission report the authorities of the ministry of transport are obligated to deliver required data.