European Research Group on Mobile Emission Sources

FAIRMODE WG2 Technical Meeting

Kjeller - April 28th-29th, 2014

Presentation outline

- The ERMES Group
  - *Mission*
  - *Structure*
  - *Research coordination*
- Activities
  - *Measurements*
  - *Modelling*
- Next ERMES Meeting

The ERMES Group (1/2)

ERMES is the European network that brings together transport emission modellers and researchers, funding agencies, industry representatives and other stakeholders, to support cooperative research in the field of transport emission modeling

- *More than 50 organisations involved*
- *Participants from 23 Countries*

http://www.ermes-group.eu/

The ERMES Group (2/2)

ERMES emerged in 2009 from the collaboration of two groups engaged in emission modelling since early 2000: the DACHNLS group (headed by INFRAS and TUG) and the EEA/JRC/LAT/Emisia group, responsible for the development of the **HBEFA** and **COPERT** models respectively

- *Coordinated and partly funded by JRC since 2009*
- *Primary interface between modellers and EC*
  - Impact on European legislation (e.g. the regulations on CO2 emission performance standards (EC) 443/2009 and 510/2011, the air quality directive 2008/50/EC)
- *First focus on road transport, others to follow*

Mission

✓ to **coordinate research** and measurement programmes for the improvement of transport emission inventories in Europe

✓ to become a **permanent network** of mobile emission modellers and model users

✓ to become an international **reference point** for mobile emissions modelling and related topics in Europe

Structure of ERMES

Who... ***... does what***

Relevant DGs of EC, Industry, EEA, others (**annual plenary meeting**)

Contact Group

Review of emission factors, demands/funding for future research, reports on special topics

JRC, Member States, laboratories and national experts (**periodic meetings**)

WORKING GROUPS

Development of models, emission factors an deal with other issues identified in the ERMES Work Programme

Reduced number of experts (**frequent contacts**)

Executive Board

Proposal of work programme, progress monitoring

Executive Board

M. Cristina Galassi

Stefan Hausberger

Mario Keller

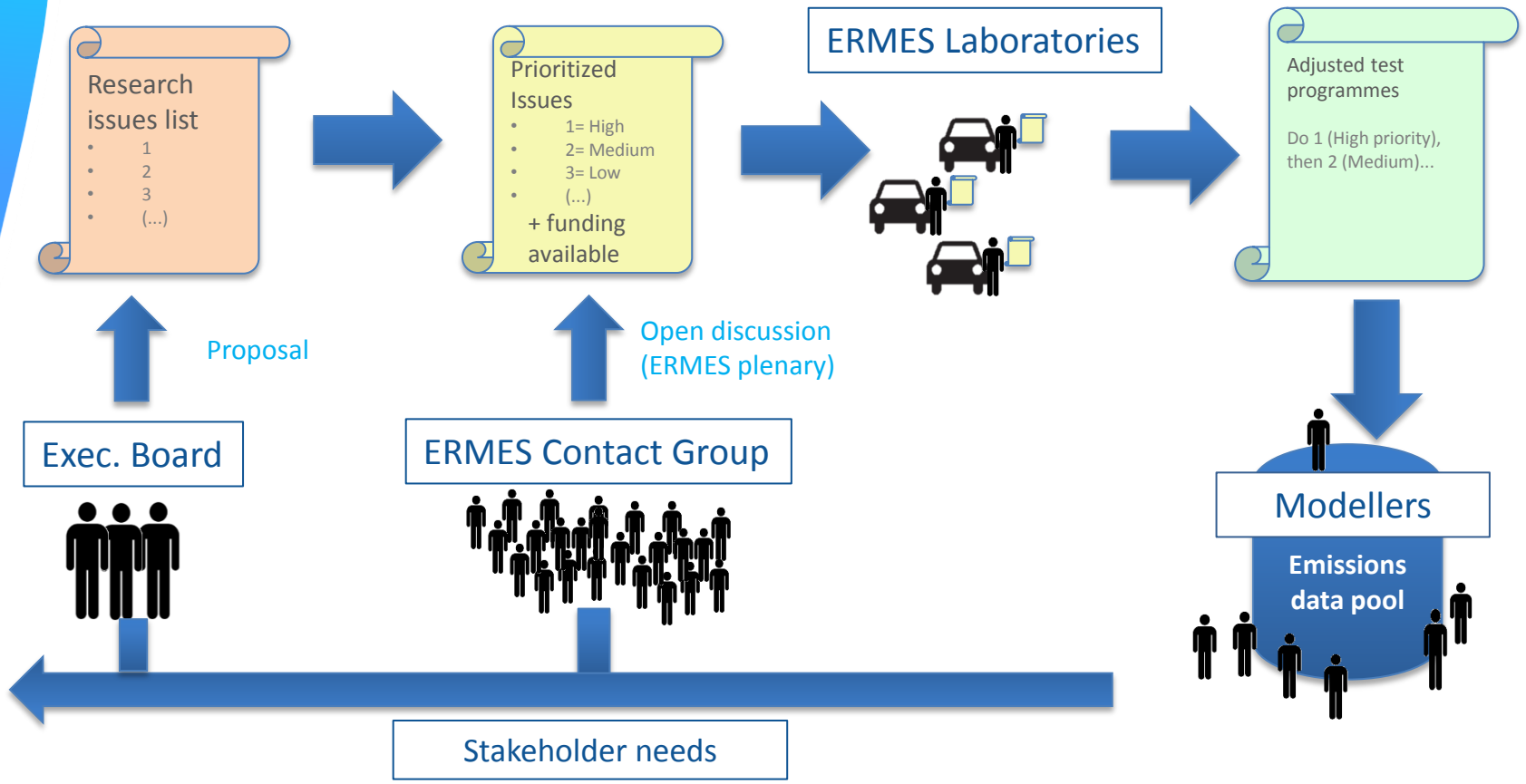
Leonidas Ntziachristos

Ake Sjodin

Norbert Ligterink

Heinz Steven

Research coordination



Work Programme 2014 (1/2)

#	Acronym	Issue	Coord.	WG
01	**DBbag**	**ERMES bag database from lab tests**	**INFRAS**	**AVL-MTC, CASANZ, EMISIA, HS-DAC, INFRAS, JRC, LAT, TUG, TNO**
02	DMpems	ERMES PEMS database	JRC	JRC
03	**EFPC**	**Emission factors for PC**	**TUG**	**BASt, IFEU, INFRAS, HS DAC, TNM, TUG**
04	**EFLCV**	**Emission factors for LCV**	**TUG**	**IFEU, INFRAS, HS DAC, TNM, TUG**
05	**EFHDV**	**Emission factors for HDV**	**TUG**	**TNM, TUG, VTT**
06	EFPTW	Emission factors for PTW	LAT	
07	**EFalt**	**Emissions from alternative fuels**	**AVL-MTC**	**AVL-MTC, SSC, VTT**
08	**EFhyb**	**Emissions and energy consumption from PC and LCV hybrids**	**EMISIA**	**EMISIA, VTT**
09	EFgdi	Emission factors from Gasoline Direct Injection	LAT	TUG

Work Programme 2014 (2/2)

#	Acronym	Issue	Coord.	WG
10	EFnonreg	Non-regulated pollutants	IFSTTAR	IFSTTAR, VTT
11	**coldP**	**Cold Start: LDV**	**EMPA**	**EMPA**
12	coldD	Cold Start: HDV and LDV diesels	TUG	TUG
13	coldPTW	Cold Start: PTW	TUG	INFRAS, JRC, TNO, LAT
15	**aux**	**Auxiliaries**	**TUG**	**TUG**
16	**insta**	**Tools for correction of instantaneous test results (testing phase)**	**TUG**	**LAT, JRC, TUG, VTT**
17	**TS**	**Traffic situations and drive cycle allocation**	**HS DAC**	**HS DAC, INFRAS, JRC, TUG, VTI, WSP**
21	dur	Durability	INFRAS	IIASA, TNO, (REMOTE SENSING GROUP)
22	**retro**	**Retrofits**	**KING´S COLLEGE**	**TNM, TUG, TUV**
24	invdata	Activity, stock data and projections	EMISIA	EMISIA, INFRAS, IVL, RICARDO, IFSTTAR

Activities

MODELLING

Vehicle simulation
Emission inventory

MEASUREMENTS

LAB tests, PEMS ,
REMOTE SENSING

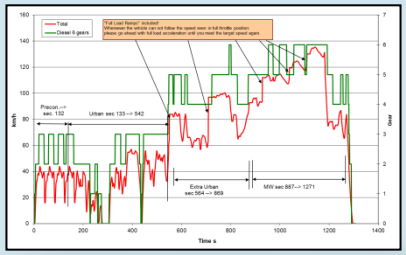
MEETINGS

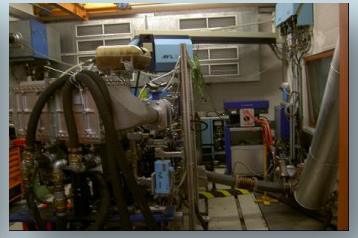
Plenary meeting
EB meetings
WG meetings

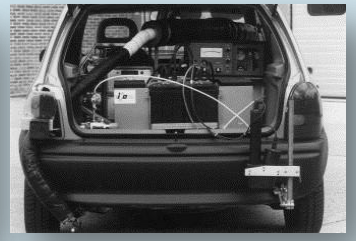
Measurements (1/5)

Harmonization and data sharing

Passenger car | Trucks | (Additional)

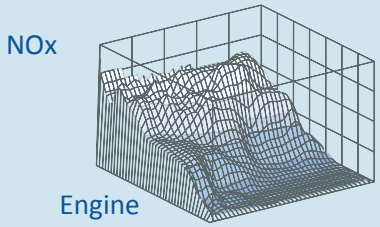






(Real world) driving cycles | **Roller test bench** | **Engine test bed** | **On-Board measurements**

ERMES work aims at harmonizing the measurement procedure across labs and sharing data in a common format

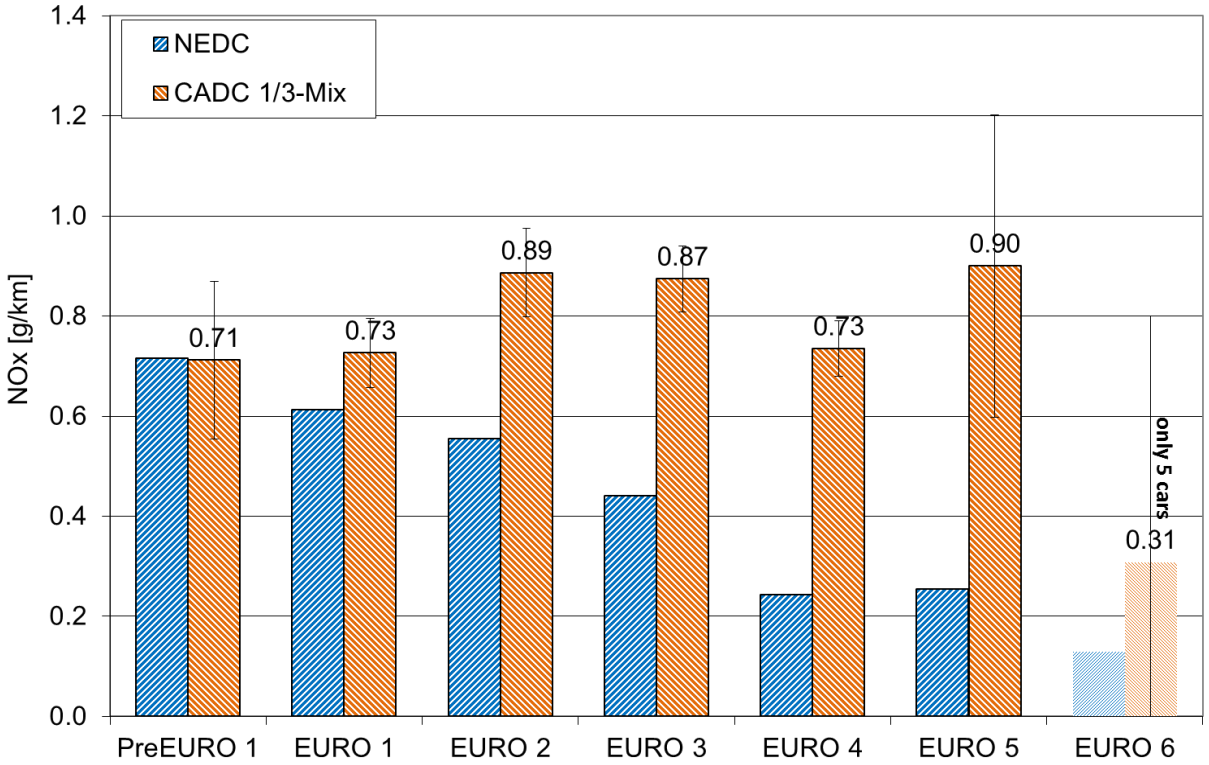


Engine maps

Source: INFRAS

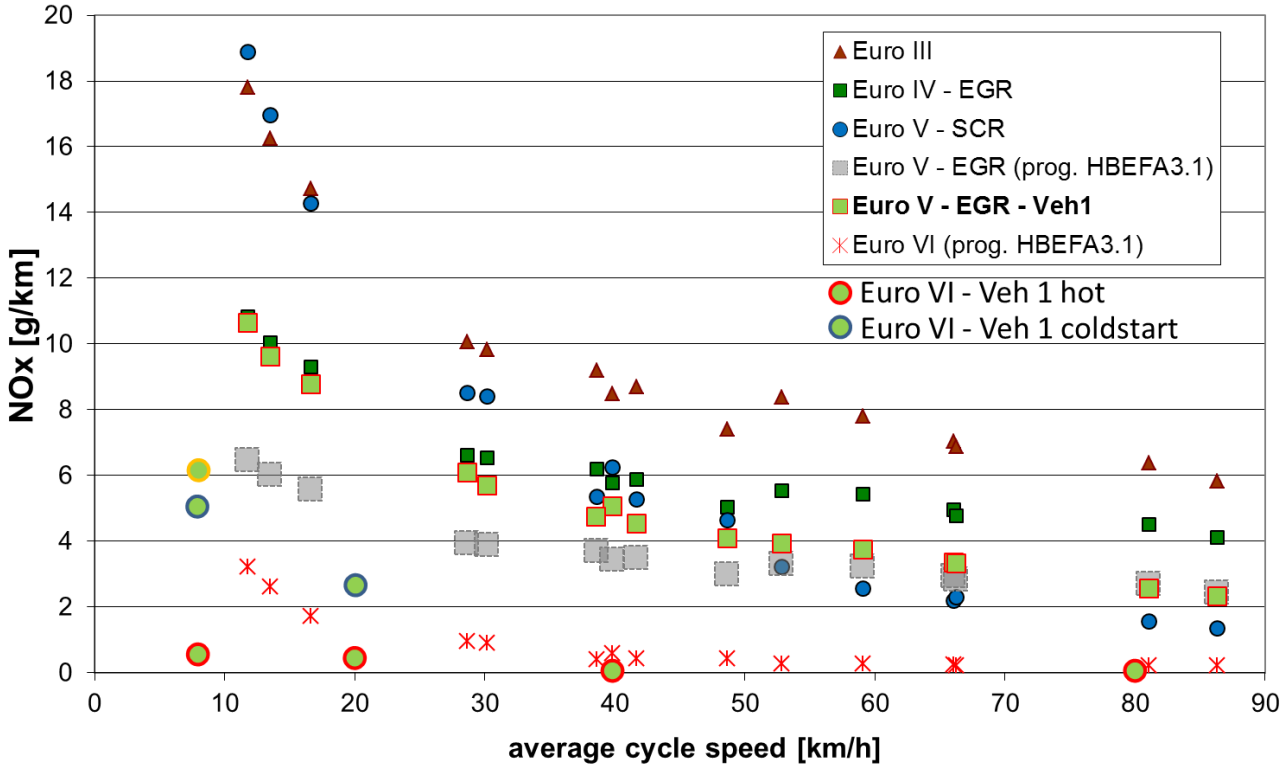
Measurements (2/5)

Emission factors from LDV



Measurements (3/5)

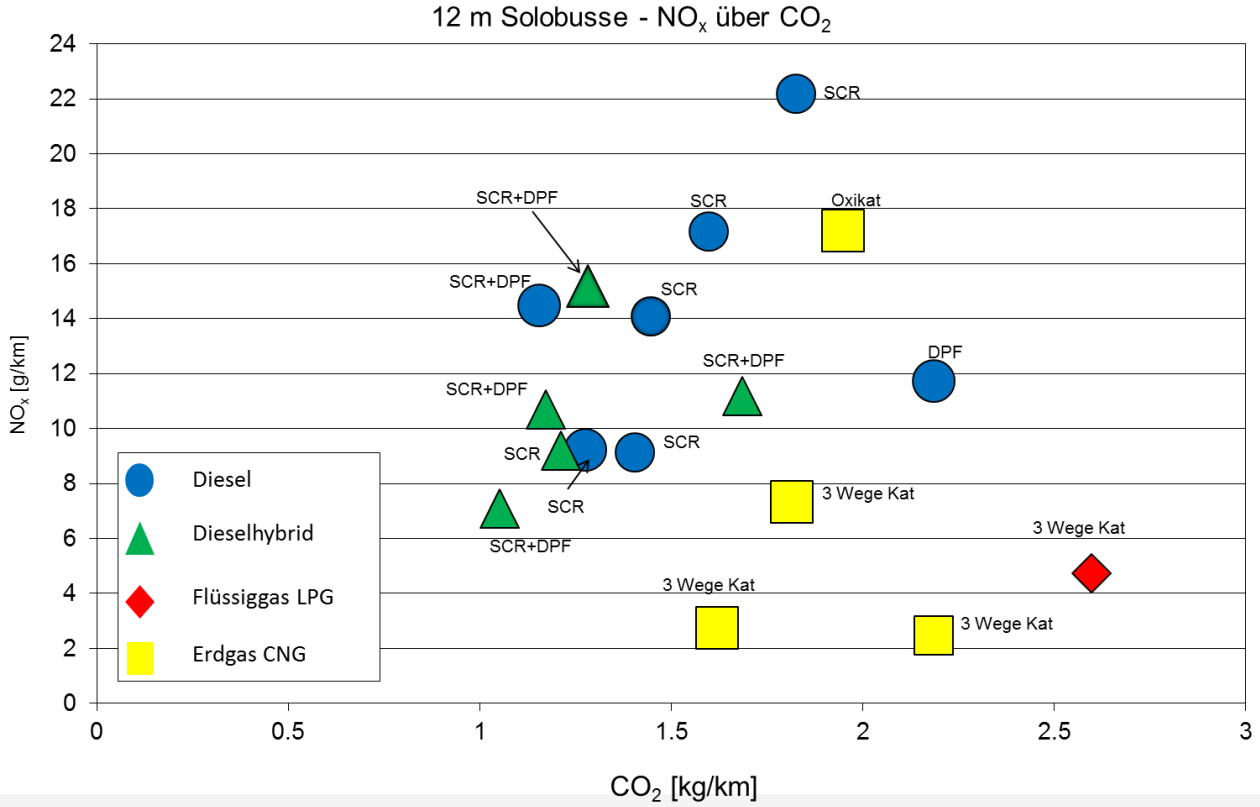
Emission factors from HDV



Source: Technical University of Graz

Measurements (4/5)

Emission factors from busses

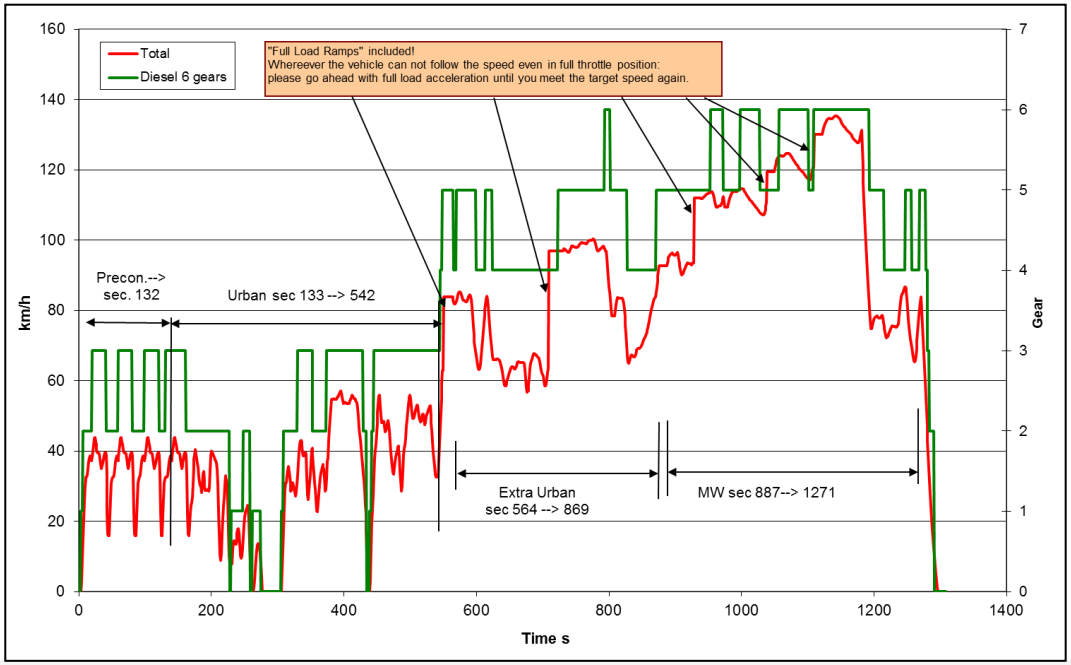


Source: Technical University of Graz

Measurements (5/5)

ERMES test cycle: a modelling cycle

- Produces instantaneous engine data useful for engine mapping (better coverage of operating points than NEDC)
- Allows flexible planning for laboratories thanks to its short duration (~24 min)



Modelling (1/3)

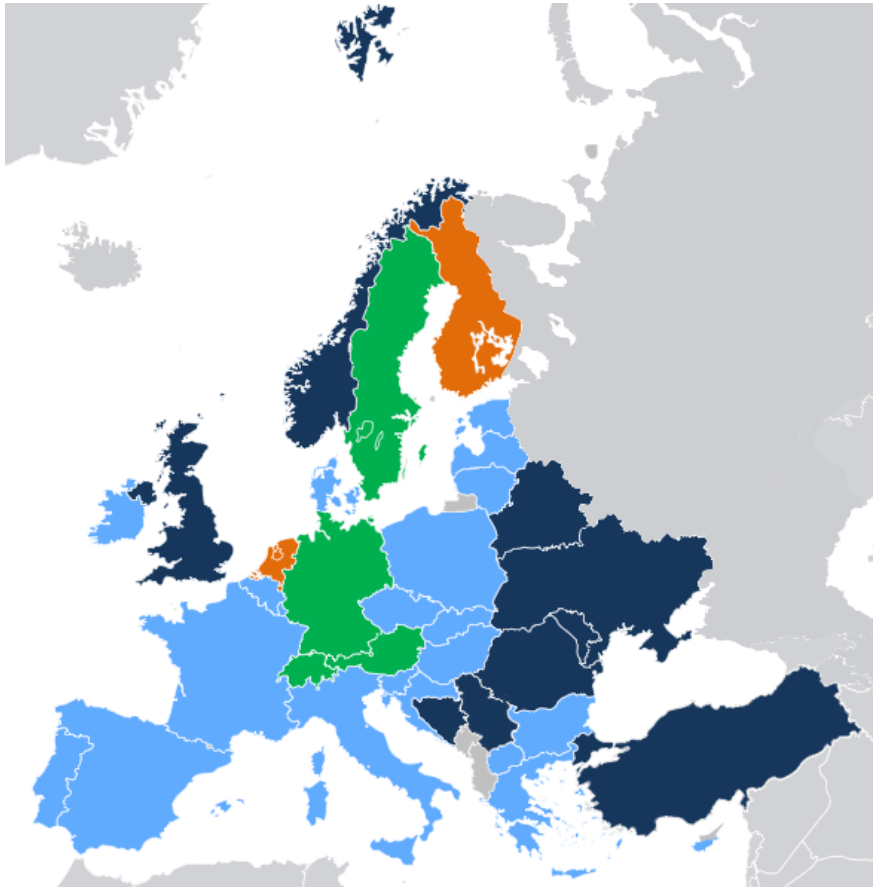
ERMES oversees the development of the leading vehicle emission models in Europe such as:

- ***COPERT***: main road transport emissions model of the EMEP/EEA Atmospheric Emissions Inventory Guidebook, used by several MS in official reporting of national emission inventories

- ***HBEFA***: Model of choice in DACH-S group of countries. Developed by TU Graz and INFRAS

- ***VERSIT+***: Model of choice in NL. Developed by TNO

Modelling (2/3)



COPERT
HBEFA
Own model
COPERT-based

Emission models usage in Europe

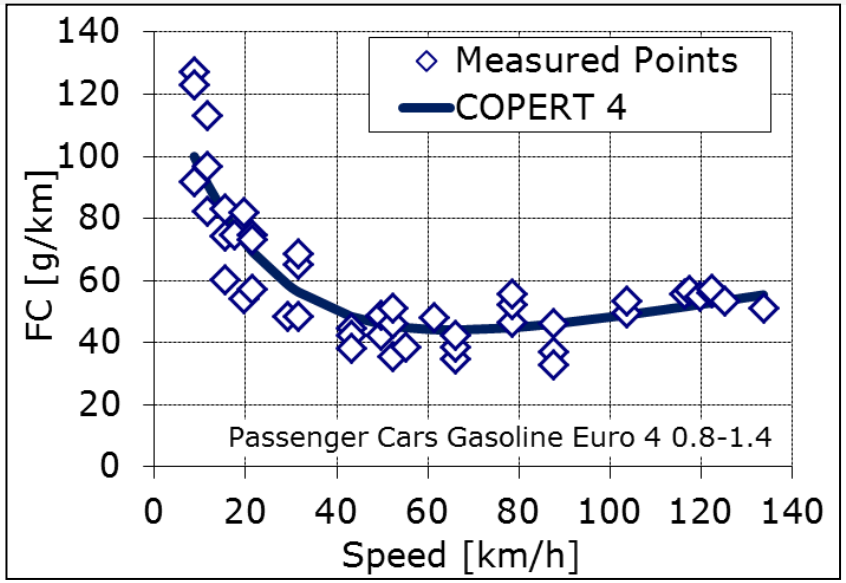
Modelling (3/3)

	COPERT 4	HBEFA 3.1	VERSIT +	NEMO	PHEM
Geographical scale	Broad	From street level up	From street level up	From street level up	Single vehicle to street level
Emission factors	Based on average speed	Based on traffic situations	Based on traffic situations (road types, speed limits, degrees of congestion)	Based on calculation of driving resistance for avg. traffic situations	Based on instantaneous vehicle speed trajectories and engine emission maps
Pollutants	Regulated + CO_2, FC, CH_4, N_2O, NH_3, SO_2, heavy metals, PAHs, POPs, NMVOC speciation	Regulated + CO_2, FC, NO_2, CH_4, N_2O, NH_3, SO_2 and PN	Regulated, CO_2, NO_2, PM2.5, EC, PAH, PM wear (tyre, brake, road surface)	Regulated + CO_2, FC, NO_2, CO_2 and PN	Regulated + CO_2, FC, NO_2, CO_2 and PN
Typical applications	Large scale inventories and assessment of measures	Inventories, assessment of measures (large and medium scale)	Inventories, assessment of measures (large and medium scale)	Inventories, assessment of measures (based on road networks)	Calculation of emission factors for various traffic situations, driving styles, and vehicle technologies

COPERT Approach

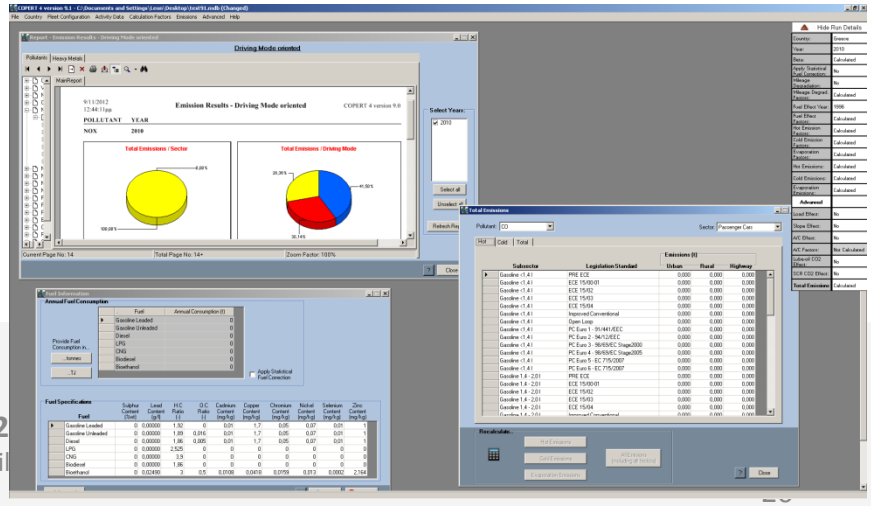
Emission factors from interpolation of measurements as a function of average speed

- Straightforward and easy to obtain at national level
- Lacks sensitivity as temporal/spatial resolution increase



- The methodology is describe in the EEA emission guidebook
- A single free software package is available at www.emisia.com

Source: LAT



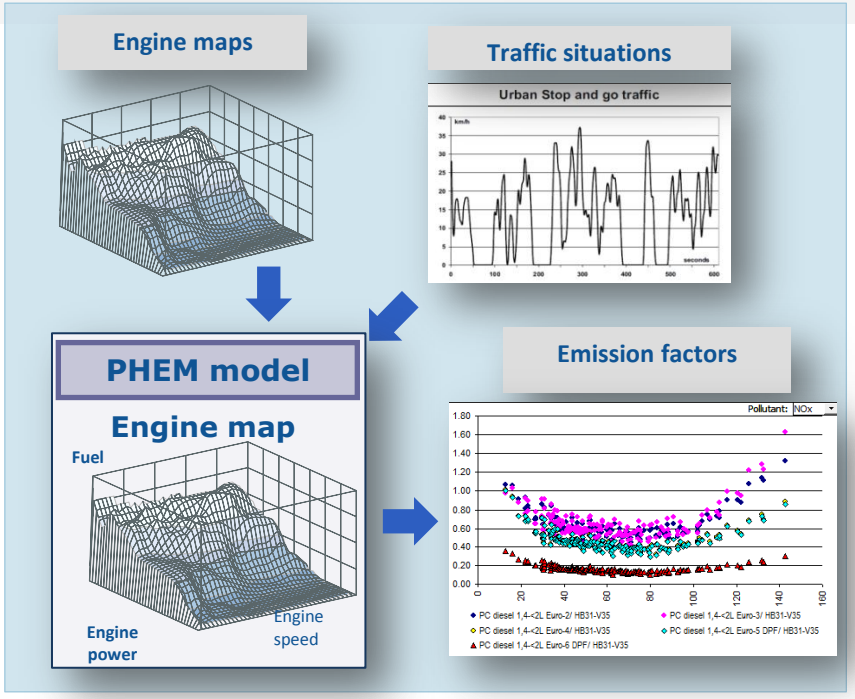
HBEFA Approach

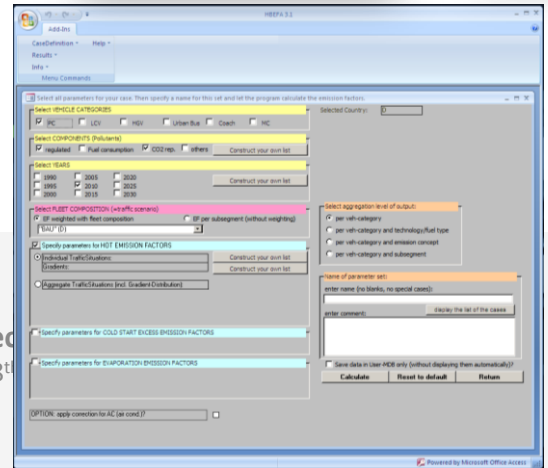
Emission factors are the weighted average of the PHEM model results

- PHEM is calibrated on vehicle measurements
- PHEM runs for 276 individual traffic situations classified by: **road type; level of service; speed limit.**

- The Software is available at www.hbefa.net
- Software database allows selection of emission factors

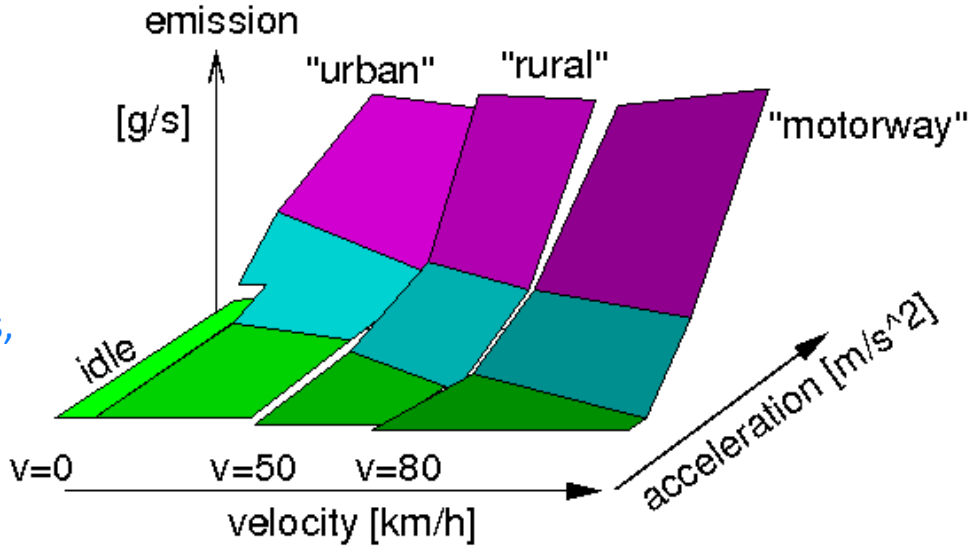
Source: INFRAS





VERSIT+ Approach

- Velocity-and-acceleration based
- Statistical analyses:
  - sufficient data per vehicle
  - sufficient vehicles per category
  - no reliance on engine maps, etc.: data focussed
- Shift towards on-road testing (PEMS) is in progress
  - Euro-V HD emission factors based on PEMS since 2010
- 10+1 parameters per vehicle category (1 for cold start)
  - 20 parameters for heavy duty (to cover payload)



- Emission factors published for national usage, changes reported annually on March 14th

Next ERMES Meeting

ERMES Plenary Meeting

September 17th, 2014
Graz, Austria

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Jointly organized with

TAP2014 Conference

20th International Transport and Air Pollution Conference 2014

September 18th-19th, 2014
Graz, Austria

http://www.tapconference.org/

Join ERMES!

Following its mission, ERMES is an ***OPEN NETWORK*** and anyone is welcome to sign up for the Contact Group

http://www.ermes-group.eu/web/contacts

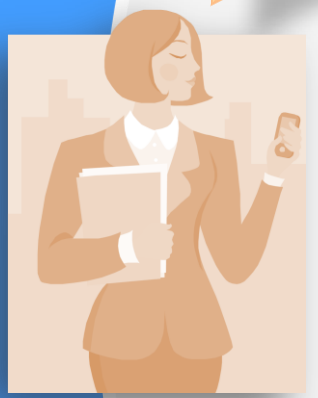
Thank you
for your attention!

www.ermes-group.eu

Comparison of road traffic emission models in Madrid (Spain)

R. Borge at al., Atmospheric Environment 62 (2012) 461, 471

Independent study – not coordinated by ERMES – on two of the ERMES models



proaches to estimate road traffic emissions in Madrid (Spain): the lculate Emissions from Road Transport (COPERT4 v.8.1) and the for Road Transport (HBEFA v.3.1), representative of the 'average-' model types respectively. The input information (e.g. fleet tres travelled, traffic intensity, road type, etc.) was provided by the the Madrid City Council along with observations from field campaigns. puted for nearly 15 000 road segments distributed in 9 management areas covering the Madrid city and surroundings. Total annual NO_X emissions predicted by HBEFA were a 21% higher than those of COPERT. The discrepancies for NO_2 were lower (13%) since resulting average NO_2/NO_X ratios are lower for HBEFA. The larger differences are related to diesel vehicle emissions under "stop & go" traffic conditions, very common in distributor/secondary roads of the Madrid metropolitan area.

In order to understand the representativeness of these results, the resulting emissions were integrated in an urban scale inventory used to drive mesoscale air quality simulations with the Community Multiscale Air Quality (CMAQ) modelling system (1 km^2 resolution). Modelled NO_2 concentrations were compared with observations through a series of statistics. Although there are no remarkable differences between both model runs, the results suggest that HBEFA may overestimate traffic emissions. However, the results are strongly influenced by methodological issues and limitations of the traffic model. This study was useful to provide a first alternative estimate to the official emission inventory in Madrid and to identify the main features of the traffic model that should be improved to support the application of an emission system based on "real world" emission factors.