



European Research on Mobile Emission Sources

ERMES Plenary Meeting *November 14th, 2017*

EMPA - Swiss Federal Laboratories for Materials Science and Technology
Ueberlandstrasse 129, 8600 Duebendorf (Switzerland)
Room AKADEMIE II

FINAL AGENDA - MINUTES of MEETING

9:30-10:00	Registration
10:00-10:10	<u>Welcome and introduction</u> – Georgios (Giorgos) Fontaras (JRC), Thomas Büttler (EMPA)
10:10-10:35	<u>WG PEMS measurements: Real Driving Emissions for Light Duty Vehicles</u> – Norbert Ligterink (TNO)
10:35-11:00	<u>WG driving behaviour</u> – Heinz Steven (HSDAC)
11:00-11:25	<u>S/I-VOC issues from vehicle emissions for SOA modelling</u> – Bertrand Bessagnet (INERIS)
11:30-11:45	<i>Coffee break</i>
11:45-12:50	WG models: Progress/status of models update <u>PHEM and PEMS data use</u> – Stefan Hausberger (TUG) <u>COPERT</u> – Leonidas Ntziachristos (LAT/EMISIA) <u>HBEFA</u> – Mario Keller (INFRAS)
12:50-13:45	<i>Lunch break</i>

13:50-14:20	VERSIT+ – Norbert Ligterink (TNO)
14:20-14:45	WG traffic activities: Projections on penetration of future technologies, including electrified vehicles – Leonidas Ntziachristos (LAT/EMISIA)
14:45-15:05	WG Remote Sensing – James Tate (University of Leeds), Harald Jenk (FOEN)
15:05-15:40	WG Non-road emissions: Update of group’s activities – Christoph Heidt (IFEU), Benedikt Notter (INFRAS)
15:40-15:55	<i>Coffee break</i>
15:55-16:25	RDE4 summary Zlatko KREGAR (DG-ENV)
16:25 -16:40	WG EFs and measurements: Ongoing and planned national measurement activities – Stefan Hausberger (TUG)
16:40 -17:00	Controversies around NOx health impact assessment – Jens Borken (IIASA)
17:00-17:25	Information from Member States : overview on national activities from funding organisations Håkan Johansson (Swedish Transport Administration) Harald Jenk (Swiss Federal Office for the Environment)
17:25-17:35	Summary and possible follow up, closure of the meeting - Giorgos Fontaras (JRC)

Minutes of the meeting

<p>Welcome and introduction</p> <p>Thomas Büttler (TB) Georgios (Giorgos) Fontaras (GF)</p>	<p>TB and GF opened the meeting. GF has taken over from Maria Cristina Galassi the ERMES group coordination responsibility at the JRC. Stressed the importance of the coordination done within ERMES and the need to continue and address the upcoming challenges.</p>
<p>WG PEMS measurements: Real Driving Emissions for Light Duty Vehicles</p> <p>Norbert Ligterink (NL)</p>	<p>The workgroup has been relatively inactive during the past year. NL, would want to mobilize more people within ERMES as he expects RDE testing to explode in the years to come. He presented a TNO developed test matrix which includes 14 tests per vehicle. In terms of NOx emissions results of recent tests show that vehicles perform well being below 80mg/km. There are certain occasions where exceedances occur. Expects to publish a first report based on tests from 18 vehicles soon. NL highlighted the problem of NH₃ emissions; sometimes people start to smell ammonia on the road. Regarding CO₂, NL stressed the significance of driving instructions and behavior, payload, cold start and ambient conditions. He suggested that the <i>ERMES group has to decide together what is "vehicle normal use" in European roads</i>. Finally NL discussed the need to characterize emissions of each vehicle independent of the test execution and boundary conditions. For this he proposed a NOx emission factor function based on vehicle velocity and tailpipe CO₂ and suggested to the group to investigate a "normalization" approach for use in large datasets.</p>
<p>WG driving behaviour</p> <p>Heinz Steven (HS)</p>	<p>HS provided an overview of the activities taken place within HBFA 4.1. The latter included: a. General review of the traffic situation scheme (addition of new speed limits for 30 and 40kph); b. Extension of traffic situations for rigid trucks and articulated trucks possibly LCVs; c. Validation of cycles per traffic situation based on cycle analysis; d. Review aggregated traffic situations.</p>
<p>S/I-VOC issues from vehicle emissions for SOA modelling</p> <p>Bertrand Bessagnet (BB)</p>	<p>The presentation of BB focused on Secondary Organic Aerosol (SOA) modelling issues and the need complete existing emission factors. There is an important contribution of SOA to PM_{2.5}. Chimere model is used for estimating SOA concentrations, discrepancies with measurements have been observed. There is an underestimation of Secondary Organic Fraction (SOF) by air quality models and PM and emission factors need to be revisited (in fact gasoline vehicles produce more aerosols than diesel ones so this is not mainly a diesel problem). PM emissions are underestimated by a factor of 2-3. Semi-volatile Organic Compounds (SOC) are partly included in current emission inventories. PM emission factor measurements focus on the organic fraction. BB was not aware if Intermediate Volatile Organic Compounds (IVOC) are captured by any measurement device. IVOC adsorbs O₂ in the atmosphere and increases in mass. BB was not aware if the IVOC is included in PM emission or VOC emission factors. They would need in air quality models to have a breakdown of VOC in SVOC (semivolatile), IVOC etc. BB mentioned that they are open for H2020 projects in the area.</p>
<p>WG models: Progress/status of models update: PHEM and PEMS data use</p> <p>Stefan Hausberger (SH)</p>	<p>SH provided a summary of the latest developments in the PHEM model. PHEM model performs now more detailed simulations of the energy losses, thermal behavior of exhaust aftertreatment system (EATS) and engine: a. added gearbox loss maps, b. additional function and conversion efficiencies in aftertreatment systems. Real test data are still used to create engine maps and EATS efficiency maps. HS highlighted the need for coordinating test campaigns in the ERMES group in this direction. Traffic situations are analyzed and supplied to PHEM for producing emission factors. The new extended emission map calculation routine covers also PEMS tests from HBEFA 3.3 and on. (50% pass car data originate from PEMS). SH intends to extend the simulation to HEV, PHEV and BEV.</p>

	<p>PHEV and BEV fleet emission factors are planned for HBEFA 4.1. The intention is to use the extended SCR model to calculate also NH₃. They have already implemented SCR model with NH₃ storage that can take into account the low temperature effect. SH stressed that PEMS doesn't cover all components so chassis dyno tests are still needed for HC, CH₄, PM and other pollutants. Overall results of PHEM are in good agreement with PEMS and remote sensing data.</p>
<p>WG models: Progress/status of models update: COPERT</p> <p>Leonidas Ntziachristos (LN)</p>	<p>LN provided an overview of the COPERT model. COPERT V latest update of COPERT 85. COPERT is used in most European Countries particularly in those where not many data are available regarding the fleet and vehicle operation. COPERT offers a higher level of aggregation. Currently EMISIA are developing a new Tier 2 level where less data are really needed in order to make estimates. Their intention is to provide one update every year. A significant update that took place in the past year was the introduction of energy factors MJ/km for fuel consumption calculations. LN presented a comparison between different inventories (VERSIT+, HBEFA and COPERT). He expressed uncertainty with regards to the emission factors and the models' performance for future Euro 6 d vehicles. LN considers the current RDE procedure useful for EF production but stressed that RDA-TA are not an emission factor. LN put an international dimension to the models suggesting that conditions in countries outside Europe should not be neglected as most countries use European emission standards or some modified versions of those.</p>
<p>WG models: Progress/status of models update: HBEFA</p> <p>Mario Keller (MK)</p>	<p>The HBEFA operates as a DB for emission factors. The group aims at an update every 4-5 years. At the end of 2018 version 4 will be published. The HBEFA emission factor module is based on PHEM but uses a separate cold start correction model and the evaporative emissions model of COPERT.</p> <p>In the past year, 2 extensions to the ERMES database were materialized: a. inclusion of modal data (chassis dyno and pems), b. inclusion of data for motorcycles. The presentation of MK demonstrated the contents of the ERMES DB in terms of tests over different test conditions. There has been an increase in tests and supplied input data in the last years due to dieselgate. There is an issue because so far ERMES group have integrated the data but without characterizing them so comparison between different data sets is not straightforward. MK presented the principles for getting access to the ERMES db. For 2018 the following activities will be attempted: a. verify EF of Euro 6 / VI emission factors for PC and HD (improve temperature effects etc); b. Address methodological issues originating from new data sources; c. Address new technologies / upstream emissions; d address a series of other issues such as, EF of other vehicles, particularities (Black Carbon, PM non-exhaust) traffic activity and various HBEFA operational issues.</p>
<p>WG models: Progress/status of models update: VERSIT+</p> <p>Norbert Ligterink (NL)</p>	<p>NL presented the latest updates and on-going investigations in the Netherlands. Several test programs on Euro 6 vehicles have taken place.. A risk of elevated NH₃ emissions in the case of SCR equipped vehicles was identified. NL mentioned also issues with PM emissions, over 200 vehicle tested one OEM appeared to have serious problem with DPF durability (cracked DPF). NL presented data on LCVs showing that NO_x emissions improve with time. Suggests that the picture improves in high-sellers (LCV). They see increases in NH₃. Observed exceedances in CO emissions of small engine gasolines at high loads. HDVs are very clean in terms of NO_x. However at low speeds NO_x from HDVs increase dramatically. High NO_x emissions from trains and other transport means.</p>
<p>WG traffic activities: Projections on penetration of future technologies, including electrified vehicles</p>	<p>LN presented a study on projections of the penetration of new technologies (incl electrified vehs) in the European fleet. The starting point in this study is a complete and consistent dataset of historical data maintained by EMISIA. LN presented an outline of the EU28 passenger car stock. Their analysis didn't result in a booming market for electric vehicles. LN presented also a future penetration scenario built around Sybil model. According to their scenario in 2050 65% of the vehicles will be equipped with internal combustion engines and only 35% will be</p>

Leonidas Ntziachristos (LN)	PHEV and EVs (taking into account all road vehicles). Adapting the scenario in order to fit the Commission's white paper they suggest that in order to meet Europe's targets one would need to reduce both transport activity & stock.
WG Remote Sensing James Tate (JT)	JT summarized the work of the working group on remote sensing. Participating labs have pooled together their measurements on remote sensing, establishing the ERMES remote sensing database. Close to 10 ⁶ remote sensing tests were conducted covering different fleets, vehicle ages, Euro standards and a wide range of driving conditions. Right now there are approximately 446000 DB records for pass cars. The WG compared remote sensing data with PEMS. Good correlation of remote sensing results vs PEMS test results. Looking for ways to finance on-going remote sensing DB.
WG Non-road emissions: Update of group's activities Benedikt Notter (BN) Christoph Heidt (CH)	BN opened the session. The WG first met on 13/11/2017 and initiated the WGs contacts and networking activity. Main activity of the WG is to further investigate load factors. INFRAS and IFEU launched a survey on the existing load factors. BN presented results for the Load Factors of Non Road Mobile Machinery (NRMM). He noted problems in differentiation; countries don't differentiate power class, types, use etc for NRMM. CH presented a qualitative analysis of the uncertainty sources and compared model vs real world emissions for PM and NOx. The model exhibits good capacity to capture the trends in emissions, limited offsets observed with regards to the absolute values (comparing EFs to test data). The current database is not large enough (more data needed). The availability of DPFs on NRMM seems critical; stricter emission limits are probably required. The WG discussed options for the intensification of collaboration on 13/11/2017, which will be further pursued in 2018.
RDE4 summary Zlatko Kregar (ZK)	ZK went through the RDE timeline (RDE1 to RDE4). The RDE4 is close to finalization, publication in OJEU 2nd quarter 2018. Main topics of upcoming RDE4 are: a. 3rd party testing; b. type approval issues related to multi stage LCVs; c. special purpose vehicles and d. various, other open issues. ZK presented reviews on more representative methods for testing hybrid vehicles, reviews of data evaluation methods, uncertainty margin for NOx (CF=1 + margin of equipment). ZK described a new in service conformity (ISC) test procedure. This ISC procedure introduces the concept of third party testing. Independent testers are going to use accredited labs. ZK described the new outlier treatment and acceptance procedure for vehicles up to 100 000km. ZK Concluded with a discussion on the PEMS tests and their comparability.
WG EFs and measurements: Ongoing and planned national measurement activities Stefan Hausberger (SH)	SH Described data collection activities of the WG. The WG drafted an overview of different tests executed by different labs in Europe and collected tests on 238 passenger cars, 31 LCVs, 92HDVs, 104 2-wheelers. Due to dieselgate more tests have been performed than in the past.. They have a clear lack of Euro 6 gasoline GDI. He pointed out that future tests should take into consideration what has already been tested. The WG will be trying to fill in the gaps in vehicle models so that they have a uniform representation of the fleet. About 25 tests from Heavy Duty Vehicles were collected and 58 tests for 2 wheelers (across different emission standards). SH identified a need for NH3 (from both and diesels) N ₂ O (diesel) emissions data.
Controversies around NOx health impact assessment Jens Borken (JB)	JB presented a summary of studies on premature deaths due to the NOx emissions scandal. He emphasized on the uncertainties resulting from health risk functions and PM formation calculation. JB suggested additive effect of NO ₂ based on the findings of IIASA's studies and raised the question whether NOx induced PM are equally dangerous as PM?
Information from	HJO presented some details of the New Climate Act decided by the Swedish parliament. In 2045 Sweden is to have no net emissions of GHG. Emissions from

<p>Member States : overview on national activities from funding organisations</p> <p>Håkan Johansson (HJO) Harald Jenk (HJE)</p>	<p>domestic transport are to be reduced by at least 70% in 2030 compared to 2010 (voted with a 85% parliamentary majority). They foresee 3 ways to decrease the GHG emissions a. transport efficient society; b. improved energy efficiency, c. shift to renewable energy. Sweden has a strategic plan for the transformation of the transport sector. HJO doesn't think that the latest proposal of the Commission on the post 2020 target is going to be a driver for lower CO2 emissions. Sweden has established the S-ERMES group to act as a mirror of ERMES in Sweden. They established a Swedish in Service Conformity program.</p> <p>HJE presented a series of activities supported by the Swiss Federal Office for the Environment including work on HBEFA, emissions measurement program, emission measurement program for 2-wheelers, pooling and sharing of remote sensing data and evaluation of a remote sensing tool.</p>
<p>Summary & Possible follow up</p> <p>Giorgos Fontaras (GF)</p>	<p>GF made a brief summary of the meeting. The ERMES group is really gaining momentum. Several challenges for the coming years have been identified. During the meeting several members of ERMES expressed the interest and willingness to participate in upcoming Horizon 2020 calls under the ERMES umbrella. Some initiatives are already formulating in the field of Remote Sensing. The ERMES board will further discuss the possibility for participating in one of the H2020 calls.</p> <p>Possible topics for further research and investigation by ERMES group based on the discussions:</p> <ul style="list-style-type: none"> ● Emissions from LDVs and Emission Factors <ul style="list-style-type: none"> ○ Expansion of ERMES db / verification of existing EFs for Euro6/VI vehicles ○ Definition of average driver behavior and vehicle use in Europe and potentially geographical sub-regions of Europe ○ Coordination of experimental tests so that a wider sample of vehicles is covered under different operating conditions ○ Collect data for Euro 6 gasoline GDI vehicles to complement apparent gaps in the ERMES db ○ Collect data for additional pollutants eg NH₃ and N₂O ○ Investigate how to complement emissions inventories with IVOC EFs. ○ Method for identifying IVOC by volatility bin for modern EU vehicles. ● Models, Inventories and data use <ul style="list-style-type: none"> ○ Definition of new normalized¹ NO_x emission factor functions as a function of vehicle speed, CO₂ or other variables for application in VERSIT+ and other models ○ Comparison of the extended PHEM engine-EATS simulation approach to a wider range of datasets further development of the method. ○ Possible cross-model comparison between the different emission inventories (COPERT, HBEFA, VERSIT+) with focus on Euro 6 / Euro VI technology. ○ Consider needs for Emissions' inventorying outside European countries, expand the ERMES db accordingly ○ Harmonization of inventorying techniques particularly for cases where limited information is available. ○ Possible development for a common methodology based on

¹ Note by GF: Not to be confused with the emissions normalization method investigated by the European Commission at the time of the meeting for the needs of RDE testing which was based on the CO₂ emitted over the WLTP sub-phases and accepted as a "reference" condition.

	<ul style="list-style-type: none">ERMES data and experience for countries outside Europe<ul style="list-style-type: none">○ Address the open HBEFA methodological issues○ Expand the remote sensing database, derive emission factors and compare to laboratory/RDE ones ● Traffic projections and future technologies<ul style="list-style-type: none">○ Refine assumptions around fleet composition and technology penetration rates - link to market data○ Expand the analysis on transport activity evolution○ Other ● Non road Emissions<ul style="list-style-type: none">○ Collect additional data on emissions and consolidate information on load factors of NRMM○ Propose a possible harmonized approach for data collection and differentiation ● Non-Exhaust Emissions<ul style="list-style-type: none">○ Create a sub-group on Non-Exhaust emissions, possibly to be coordinated by the JRC
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