Minutes
Expert meeting on the
Development of Emission Factors for Road Transport Sector

JRC, Institute for Environment and Sustainability, Ispra, Italy
16-17 October 2008

List of Participants: for the participants please see separate file.

A technical meeting on the development of emission factors for the road transport was organized by the JRC-Ispra on the 16/17 October 2008. This meeting was the follow-up of the discussions which took place during the “Expert meeting on the Improvement of transport emission inventories” on the 19th November 2007. The meeting has been centered on technical discussion on what data exist, what are the plans, how to get appropriate funding and in general how to get ahead this research. The meeting started with detailed presentations of the different models/workgroups in the field. These presentations can now be found in the web-site of the TFEIP Transport Panel (http://transportpanel.jrc.it/expert.html).

1. PRIORITIES FOR ROAD TRANSPORT INVENTORIES

The starting point for the discussion which took place during the second day was the priority list, that resulted from the survey questionnaire disseminated to the participants of the previous “Expert meeting on the Improvement of transport emission inventories” on the 19th November 2007. The following table shows the total scores that were calculated as a weighted means of the priority (number of response of highest priority 1 is multiplied by 3, number of response of medium priority 2 is multiplied by 2,..).

<table>
<thead>
<tr>
<th>Class.</th>
<th>Theme</th>
<th>Particular Issues</th>
<th>Priority 1 (3p)</th>
<th>Priority 2 (2p)</th>
<th>Priority 3 (1p)</th>
<th>Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Uncertainty characterization and sensitivity analysis</td>
<td>Perform Monte-Carlo or similar type of statistical treatment to models to identify most important variables, give guidance on the detail required for activity data, uncertainty range of final calculation</td>
<td>12</td>
<td>6</td>
<td>0</td>
<td>48</td>
</tr>
<tr>
<td>2</td>
<td>Cold-start emissions</td>
<td>Better detail cold-start emissions, perform new measurements on new vehicle technologies, use PEMS to record cold over emissions, revise the methodology</td>
<td>11</td>
<td>7</td>
<td>1</td>
<td>48</td>
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<td>3</td>
<td>New technologies including hybrids</td>
<td>Develop emission factors, emission methodologies for new emission control technologies, such as strong hybrids, mild hybrids, SCR, GDI, Flexifuel</td>
<td>10</td>
<td>8</td>
<td></td>
<td></td>
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<tr>
<td>4</td>
<td>Biofuels and alternative fuels</td>
<td>Characterize links of vehicle technology / fuel use / blend, for example E85 effect on Euro 3 passenger cars, second generation biofuels, CNG, LPG, Biogas, Non-regulated pollutants</td>
<td>11</td>
<td>6</td>
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<td>5</td>
<td>CO2 / fuel consumption characterization</td>
<td>Develop more classes for CO2 emissions (e.g. diesel &lt;1.6 l, SUV, gasoline &lt;1.0 l, etc.), develop correction factors based on average weight / capacity, CO2 from urea consumption</td>
<td>10</td>
<td>6</td>
<td></td>
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<td>6</td>
<td>Characterization of the emission factors quality/variability</td>
<td>Assign a quality index on each emission factor (e.g. A, B, C) or a coefficient of variation value to express uncertainty, explain/discuss uncertainty, provide guidance for uncertainty of different approaches</td>
<td>9</td>
<td>7</td>
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<td>7</td>
<td>Refine activity data</td>
<td>Conduct probe surveys on vehicle utilization, better describe vehicle classification (new, second-hand, deregistered, mopeds), collect and refine already available information from transportation statistics</td>
<td>9</td>
<td>7</td>
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<td>8</td>
<td>Validate existing emission factors</td>
<td>Validate existing emission factors (mostly based on dynamometer studies) by means of tunnel or roadside concentration measurements or Portable Emission Measurement Systems (PEMS), air-quality measurements</td>
<td>9</td>
<td>6</td>
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<td>9</td>
<td>Provide methods for spatial / temporal resolution</td>
<td>Develop good-practice guidance with regard to top-down and bottom-up approaches of road transport emission inventories, develop models to support such approach, streamline average-speed and traffic situation models</td>
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<td>8</td>
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<td>10</td>
<td>Idling emissions</td>
<td>Provide idling emission factors (g/h) which may be significant for parking lots, for school busses, etc.</td>
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<td>9</td>
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<td>11</td>
<td>Provide rules/values for projections</td>
<td>Develop detailed good-practice guidance for road transport projections, produce assessments of emission factors for emerging technologies, refine methodologies for stock replacement</td>
<td>8</td>
<td>5</td>
<td></td>
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<tr>
<td>12</td>
<td>Emission corrections</td>
<td>Corrections for ambient temperature, altitude, use of auxiliaries (air-con), vehicle age</td>
<td>6</td>
<td>9</td>
<td></td>
<td></td>
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<td>13</td>
<td>Non regulated pollutants</td>
<td>Conduct studies to measure NH3, NO2/NO, NMVOC speciation, PM speciation, metals from fuel consumption, metals from lubricant, metals from attrition, ion emissions (sulfate nitrate ammonium), PAHs and POPs</td>
<td>4</td>
<td>12</td>
<td></td>
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</table>
For each theme the participants discussed on existing data and possible plans:

1. Because estimation of uncertainty is requested by law it is necessary to proceed in the fastest and cheapest way. This means using a methodology that is available and that can produce results rapidly. Separate discussion could be done for future improvement of the emission uncertainty estimation. The JRC is already funding an uncertainty study that will give results in the next 10 months.

2. The impacts of emissions during cold start are expected to become increasingly important for new engines and aftertreatment systems. The existing approaches are satisfying: the need is to complete the existing approach. A new approach for the estimation of cold start emission will be based on PEMS data. An experimental campaign is ongoing at the JRC for the measurement of the cold emission for passenger cars.

3. EMPA is revising new vehicle technologies emission factors. First results will be available for the end of 2008.

4. Biofuels and alternative fuels. Some measurements were done at the JRC, some in LAT. Information has to be collected and protocol has to be developed. For hybrid vehicle a USA study is proposed.

5. The development of more vehicle classes for CO2 emissions (e.g. diesel <1.6 l, SUV, gasoline <1.0 l, etc.) and the definition of the CO2-influencing parameters seemed to be agreed by all the participants. JRC will fund this study. Discussion has been developed on how this parameterization will be realized for different driving condition, and on the definition of correction factors.

6. The characterization of the emission factors quality/variability seems to be an important point of discussion. Participants have agreed that is mainly link to point 1. VERSIT+ is already working on this subject.

7. The improvement of activity data was skipped during this meeting, which mainly focused to the improvement of emission factors.

8. The validation of existing emission factors could be done using two approaches: using existing data or starting ad-hoc validation study. PEMS data could be used as validation data, if they are not used for the definition of emission factors themselves. The second option could be too expensive. The necessity to validate new technologies vehicle emissions (EURO5) arose during the meeting.

9. The development of good-practice guidance with regard to top-down and bottom-up approaches of road transport emission inventories was skipped during this meeting, mainly related to the improvement of emission factors.
10. **Idling emissions** could be better analyzed using instantaneous model. TNO has already developed a study for understanding from an environmental point of view, if idling is better than turn off/turn on the engine. TUG could provide information on idling for HDV.

11. The design of good-practice guidance for improvement of road transport projections was skipped during this meeting, mainly related to the improvement of emission factors.

12. **Corrections for ambient temperature, altitude, use of auxiliaries (air-con) and vehicle age** are considered an important point of discussion. There is a need of collecting data on maintenance measurements of the PC from different laboratories in order to better understand the effect of vehicle age. Norway has already done some measurement on the effect of the altitude, which could be compared to the JRC PEMS data. For the auxiliaries EMPA developed a new approach similar to ARTEMIS approach using more data, which has to be implemented in the future. It could be applied to the COPERT methodology. An important point is that during the measurements it should be recorded if the auxiliaries are on or not.

13. – 14. All the participants agree on the need of studies to measure non regulated pollutants, including NH3, NO2/NO, NMVOC speciation, PM speciation, PM number and Non-CO2 GHGs. For the moment only emission factors for the three main driving condition (urban, rural, motorway) are available. The necessity for a round robin test is clearly raised up for the preparation of a measurement protocol.

14. Estimate share of ultra-emitters by remote-sensing, provide emission factors for ultra-emitters, estimate the effect of OBD

### 2. OTHER IMPORTANT ISSUES

During the discussion, the importance of the use of a collective approach is raised up by several participants. Several points had to be discuss in order to develop this collective approach:

a) **Driving cycle:** in order to have comparable measurements which can be used for different model the best driving cycles have to be defined. Some participants pointed out the importance of the definition of *traffic situations (TS)* for the whole of Europe and of the creation of a new set of driving cycles to be used in the chassis dynamometer testing. DACH will produce a new set of 250 traffic situation for the end of this year. For this aim the preparation of the format for collecting the driving cycle dataset is crucial. Some others participants point out that having a lot of driving cycles could have negative impact for the emission inventory development (how to chose driving cycle for representing the real situation) and how this dataset could be used in an aggregated model.

b) **Common measurement program.** First step is the creation of a common database of the cars already tested, for ongoing measurements or foreseen measurements in all Europe (cycle: NUDC, and real world cycle). Comparison has then to be done with sale statistics in order to understand where measurements are required. A common format for both BAG data and Instantaneous data has to be used. Moreover, for the
latter point a protocol for a common method for delay correction has to be specified. This would require a lot of work and, consequently, funding is required. Information related to the fuel used during the measurements has to be collected in the database. The access to this DB has to be further discussed.

c) **Link between GIS and road network.** It is fundamental for the use of EMS data having not only geographical information, but also traffic situation (level of service - congested, free-flow) and gradient. Equip the vehicles with a camera could be a solution, but too expensive.

d) **NRMM.** JRC is starting a measurement campaign for NRMM emissions. Some other measurements are available from German study aimed to estimate emission from German highway, where the 40/50% of the HDV are euro V.

e) **Evaporative emission:** a need of an evaporative emission protocol is underlined. However, the JRC together with the LAT have already produced a new evaporative emissions methodology, which could also be used by LAT.

3. **LIST of ACTIONS**
1. **Mario Keller:** JRC to be invited to the next DACH meeting in the Netherlands, 27-28 October. **(DONE)**
2. **DACH:** A new name for the group should be sought for the new wider participation
3. **JRC** to coordinate the collection of tests (either done or future, with NEDC, CADC or other cycles) for LDV and evaporative emissions. **TUG** to send the format used for HD data to JRC. The list shall be ready at the beginning of next year in order to plan the activity for next year
4. **DACH:** to work on the correction of modal data, time alignment
5. **JRC/LAT** to provide results of uncertainty study to the DACH group **(UNDERWAY)**
6. **LAT** will provide the USA document on the requirement for hybrid car measurements to the expert group
7. **LAT** will collect data on degradation of PC from different laboratories.
8. **AVL/MTC** will provide reference for the definition of the effect of altitude on emission factors **(DONE)**
9. **JRC** will check for the possibility of funding round robin tests on instantaneous data, non regulated pollutants and particulate number.
10. **TUG** to provide idling emissions from PHEM model.
11. **EMPA:** To send new methodology for air conditioning data to group
4. **Other relevant list of actions from DACH meeting**

1. **LAT** to provide explanation on what the N2O model was based upon and when they included these module in COPERT (i.e. which version) (UNDERWAY)

2. **JRC** to ask permission from PMP, prepare and sent the PMP data to EMPA, INFRAS and TUG. JRC to take the lead on the development of emission factors for PM numbers (ONGOING)

3. **JRC** to check if we can get our own coast/down data to be compared with those of the manufacturers

4. **JRC**: Send road tire and brake wear TFEIP chapter to the whole group

5. **JRC**: To check the possibilities of funding some methodological developments (DONE)

6. **JRC**: prepare example of collaboration agreement between JRC and DACH/LAT for the next meeting

7. **JRC**: Next plenary meeting for accepting the new HBEFA to be held 1-2 April in Ispra, hosted by the JRC

8. **DACH**: to include both LAT and JRC to all future communications and meetings