

Scientific Workshop on "Closing the gap between light duty vehicle real-world CO₂ emissions and laboratory testing" (Universidade Nova, Lisbon, 7-8 June)

Venue: Sala do Senado, Rectorate Building (Reitoria) of the Universidade Nova de Lisboa, Campus de Campolide

Agenda

Monday, 6 June

Late afternoon/evening: Arrival of participants

Tuesday, 7 June

08:30 Walk from the Sana Malhoa Hotel to the university

09:00 Opening session

- Welcome by the Rector of the Universidade Nova de Lisboa Prof. António Rendas and the Dean of the Faculty of Engineering Prof. Fernando Santana
- Introduction to the European Commission's Scientific Advice Mechanism (*Henrik Wegener, Chair of the High-Level Group of Scientific Advisors*)
- Introduction to the task (*Elvira Fortunato, Deputy Chair of the High-Level Group of Scientific Advisors*)
- Introduction of the participants
- Agenda and rules of the workshop (*Johannes Klumpers, Head of Scientific Advice Mechanism Unit, European Commission*)

09:45 First session: Comparison of test procedures and cycles

Chair: Dimosthenis Trimis (Karlsruhe Institute of Technology, Germany)

Impulse presentation: Zisis Samaras (Aristotle University of Thessaloniki, Greece)

Discussants: Michel André (IFSTTAR, France), Nicolae Ispas (University of Brasov, Romania)

11:15 Coffee break

11:30 Second session: Origin, characteristics and evolution of the gap between real-world emissions and laboratory testing

Chair: Elvira Fortunato (Deputy Chair of the High-Level Group of Scientific Advisors)

Impulse presentation: Peter Mock (International Council on Clean Transportation)

Discussants: Gonçalo Gonçalves (Instituto Superior Técnico, Portugal), Christian Bach (EMPA, Switzerland)

13:00 *Lunch break*

14:00 Third session: Challenges of measuring real driving CO₂ emissions

Chair: Jan Macek (Czech Technical University in Prague)

Impulse presentation: Stéphane Rimaux and Bernard Swoboda (PSA, France)

Discussants: Federico Millo (Polytechnic University of Turin, Italy), Juhani Laurikko (VTT, Finland)

15:30 *Coffee break*

16:00 Presentation (via video link):

Measuring CO₂ emissions from light-duty vehicles: A view from the U.S.

Jeff Alson (Environmental Protection Agency, USA)

16:30 Fourth session: Strategies to close the gap for CO₂ emissions

Chair: Dame Julia Slingo (Member of the High-Level Group of Scientific Advisors)

Impulse presentation: Norbert Ligterink (TNO, The Netherlands)

Discussants: Christoph Höhmann (Daimler, Germany), Ian Skinner (Transport and Environmental Policy Research, UK)

18:00 *Break*

18:15 *Transfer from the University to the Academy of Sciences by bus*

19:00 Public event: "Introducing the Scientific Advice Mechanism" (in Portuguese)

Venue: Academia das Ciências de Lisboa, Rua da Academia das Ciências 19

- Welcome by the President of the Academy (Science Section) Prof. Carlos Salema
- Welcome by the Chair of the SAM High-Level Group Prof. Henrik C. Wegener
- Scientific Advice and Ethics in the European Context
(Prof. Maria da Graça Carvalho, Scientific Advice Mechanism Unit, European Commission, Fellow of the Academy of Sciences of Lisbon and the Portuguese Academy of Engineering)
- The High-Level Group of Scientific Advisors
(Elvira Fortunato, Deputy Chair of the High-Level Group of Scientific Advisors and Fellow of the Portuguese Academy of Engineering)
- Questions & Answers

20:15 *Transfer from the Academy to the dinner by bus*

20:30 Dinner

Venue: Restaurante da Ordem dos Engenheiros, Avenida António Augusto de Aguiar 3, 6th floor

Dinner speeches:

- The role of CO₂ from transport in the urban context
(Tiago Farias, Instituto Superior Técnico, Portugal)
- The role of CO₂ from transport in the global climate context
(Dame Julia Slingo, MetOffice, UK)

22:45 Transfer from the dinner to the Sana Malhoa Hotel by bus

Wednesday, 8 June

08:30 Walk from the Sana Malhoa Hotel to the university

09:00 Fifth session: Options for policy action and way forward

Chair: Henrik Wegener (Chair of the High-Level Group of Scientific Advisors)

Impulse presentation: Georgios Fontaras (Joint Research Centre, European Commission)

Discussants: Athanasios Konstantopoulos (CERTH, Greece), Cinzia Pastorello (European Environment Agency)

10:30 Coffee break

11:00 Final discussion and wrap-up

Chair: Elvira Fortunato (Deputy Chair of the High-Level Group of Scientific Advisors)

12:00 Departure of participants

Session descriptions

First session: Comparison of test procedures and cycles

Objective of the session:

The objective of this session is to give an overview of the test procedures and cycles used in Europe and in other parts of the world, such as the US and Asia. The different methodologies used in NEDC and WLTP should be highlighted, including remaining shortcomings of the WLTP. The application of the WLTP to hybrid vehicles and vehicles using alternative fuels may also be discussed.

Background:

The new Worldwide harmonized Light vehicles Test Procedures (WLTP), as agreed in the framework of UNECE and requested by Regulation 333/2014 on CO₂ emissions from cars, will bring significant improvements with respect to the current regulatory European test cycle (New European Driving Cycle NEDC). It will therefore provide more realistic values for fuel consumption and CO₂ emissions. The new test procedure should ensure that the measurements better reflect emissions in real driving conditions and that there is less flexibility in carrying out the tests. It is expected that WLTP will be applied in the EU soon (2017/18).

Key questions:

- What is the European and world-wide scientific basis for improving the measurement of light vehicle CO₂ emissions and fuel consumption in order to produce values closer to average real-world data?
- Which are the expectations about the new WLTP in terms of strengths and weaknesses, also in terms of reliability, and what additional measures would be needed in order to produce values closer to average real-world data?
- Which are the differences between the WLTP and test cycles used in America and Asia regarding CO₂ emission measurements and the related gaps between laboratory and real drive emissions? How do regulatory authorities in America and Asia tackle the problem?

Choreography of the session:

Zissis Samaras (Aristotle University of Thessaloniki, Greece) will give an impulse presentation (20-25 minutes), followed by interventions (5 minutes each) of the discussants Michel André (IFSTTAR, France) and Nicolae Ispas (University of Brasov, Romania). This will be followed by a free discussion involving all the participants. The session will be chaired by Dimosthenis Trimis (Karlsruhe Institute of Technology, Germany).

Second session: Origin, characteristics and evolution of the gap between real-world emissions and laboratory testing

Objective of the session:

The objective of this session is to discuss the origin, characteristics and evolution of the gap between laboratory measurements and real-world emissions. The origin of the gap and the division into its possible root causes as well as its evolution over time should be discussed. The effect of conditions such as test conditions, vehicle characteristics, driving behaviour, weather, traffic, and road morphology should be analysed.

Background:

The gap between the manufacturers' type-approval CO₂ emissions and the real emissions was identified already in 2005. Several researchers have tried to quantify the gap since then based on various approaches (emissions inventories, vehicle simulations, fuel sales based estimations). A common finding in several research works is that, in Europe, the gap has increased from year to year, with an accelerated widening of the gap following the adoption of the current CO₂ emission limits at EU level ten years ago.

The WLTP is, according to the literature, the most robust CO₂ emission test cycle currently achievable considering technical, economic and political constraints. The gap will be reduced by the WLTP, but will not disappear. For instance, some emission-relevant factors – such as the use of air conditioning systems – are not reflected in the WLTP either. Also environmental conditions vary considerably across Europe and the question is how to account for these (the US EPA is using correction factors to reflect these).

Key questions:

- What is the existing gap (average) in CO₂ measurements between laboratory-based type approval tests and real on-road emissions?
- What is the origin of the gap and how did it develop over time?
- What is the expected gap in CO₂ (average) emissions vs. real data under the WLTP?
- What is the expected evolution over time taking into account possible test cycle flexibilities, in-use factors, etc...?

Choreography of the session:

Peter Mock (International Council on Clean Transportation) will give an impulse presentation (20-25 minutes), followed by the interventions (5 minutes each) of the discussants Gonçalo Gonçalves (Instituto Superior Técnico, Portugal) and Christian Bach (EMPA, Switzerland). This will be followed by a free discussion involving all the participants. The session will be chaired by Elvira Fortunato (Co-Chair of the High-Level Group of Scientific Advisors).

Third session: Challenges of measuring real driving CO₂ emissions

Objective of the session:

The objective of this session is to discuss the challenges of measuring real driving emissions (RDE). The concept is: rather than putting the vehicle in a laboratory, the laboratory can be put into the vehicle, e.g. using Portable Emission Measurement Systems (PEMS). During the session the strengths and limitations of RDE for CO₂ should be discussed. The following aspects should be considered:

- RDE for market surveillance and as low-cost verification procedure
- Adaptations needed to use RDE as CO₂ certification procedure
- Elements of RDE test procedures to be used to design on-road CO₂ emissions tests
- Use of RDE tests to re-construct average driving patterns and CO₂ emissions
- RDE being used as a data source for CO₂ modelling
- Differences between the various methods to analyse PEMS data (e.g. EMROAD/JRC, CLEAR/TU Graz, VESBIN/TNO)

Background:

RDE methodologies are under development for NO_x and particle measurements, e.g. using Portable Emission Measurement Systems (PEMS). It is expected that RDE will also provide some first-order estimate of real-world CO₂ emissions. However, due to the variation of the results obtained with the PEMS trips and in order to use these results for regulatory purposes, a large sample of such trips might be required. Several authors claim that this big sampling cannot be done with PEMS equipment due to the massive testing effort. It is important to remind that regulation treats CO₂ emissions differently than NO_x and particle emissions (targets for car fleets versus targets for individual vehicles). In this context overall policy goals for the decarbonisation of transport come into play.

Key questions:

- How can (or cannot) the real driving emissions (RDE) approach adopted for regulated pollutants be useful to reduce the gap in the case of CO₂ emissions?
- Are there assessment methods able to normalize data from PEMS trips without jeopardizing the effectiveness in detecting RDE performance?
- What are the scientific reasons to support (or not) the introduction of an RDE approach in the post-2020 emissions package for CO₂?

Choreography of the session:

Stéphane Rimaux and Bernard Swoboda (PSA, France) will give an impulse presentation (20-25 minutes), followed by the interventions (5 minutes each) of the discussants Federico Millo (Polytechnic University of Turin, Italy) and Juhani Laurikko (VTT, Finland). This will be followed by a free discussion involving all the participants. The session will be chaired by Jan Macek (Czech Technical University in Prague).

Fourth session: Strategies to close the gap for CO₂ emissions

Objective of the session:

The objective of this session is to discuss strategies to close the gap between measured and declared CO₂ emissions and real CO₂ emissions. There are several papers in the open literature pointing out remedies to lower this gap (e.g. use of data from PEMS trips in combination with modelling; introduction of "not-to-exceed" (NTE) concepts; use of real fuel consumption as an indicator of real emissions). The comparison of the different methods should be the basis of the discussion in this session.

Background:

The WLTP represents a considerable step forward in addressing the problem of the gap. Whether it will suffice alone or additional measures are necessary is difficult to be assessed before its actual introduction. The open literature presents already mechanisms to monitor the evolution of the gap and remedies to lower that gap. For instance, fuel consumption meters could constitute part of the solution because monitoring the fuel consumption of a vehicle over its lifetime could provide a good proxy for its CO₂ emissions. Information on the fuel consumption of individual vehicle types, together with the mileage driven, could be regularly and systematically read out for the entire fleet. However, even if anonymised, this may raise concerns in other areas such as privacy and cybersecurity.

Key questions:

- What are the possible solutions to reduce the gap under WLTP and beyond (e.g. introduction of a "not to exceed" limit)?
- How can the CO₂ measurements gained with the RDE procedure in combination with modelling approaches be useful to reduce the gap?
- What are the possibilities from a scientific point of view to use fuel consumption as an indicator of real emissions and which are the challenges of this approach?
- Which other aspects (e.g. acceptance by consumers) need to be considered?

Choreography of the session:

Norbert Ligterink (TNO, The Netherlands) will give an impulse presentation (20-25 minutes), followed by the interventions (5 minutes each) of the discussants Christoph Höhmann (Daimler, Germany) and Ian Skinner (Transport and Environmental Policy Research, UK). This will be followed by a free discussion involving all the participants. The session will be chaired by Dame Julia Slingo (Member of the High-Level Group of Scientific Advisors).

Fifth session: Options for policy action and way forward

Objective of the session:

The objective of this session is to discuss options for policy-makers and the way forward. This section will constitute an opportunity to discuss innovative elements that may be considered in the methodologies and introduced in post-2020 European policies to reduce the gap between measured and declared CO₂ emissions and real CO₂ emissions.

Background:

The European Commission announced on 27 January 2016 a major overhaul of the so-called EU type approval framework (see http://europa.eu/rapid/press-release_IP-16-167_en.htm). The draft Regulation has been sent to the European Parliament and Council for adoption. Under current rules, national authorities are solely responsible for certifying that a vehicle meets all requirements to be placed on the market and for policing manufacturers' compliance with EU law. According to the proposed legislation, the Commission will be able to carry out ex-post verification testing and, if needed, initiate recalls. The Commission will also develop common compliance verification strategies with Member States and organise joint audits of technical services and peer reviews of type-approval authorities. However, the question remains how to design post-2020 policies in the field of CO₂ emissions from light-duty vehicles, also in view of the EU's climate change commitments.

Key questions:

- From a scientific point of view, which policy options can be developed to address the problem of closing the gap between light-duty vehicle real-world CO₂ emissions and laboratory testing?
- How can new technologies and methodologies help to tackle the issue, for instance wireless communications, big data approaches and the modelling of complex systems?
- Which approaches discussed at the workshop are the most promising ones?

Choreography of the session:

Georgios Fontaras (Joint Research Centre, European Commission) will give an impulse presentation (20-25 minutes), followed by the interventions (5 minutes each) of the discussants Athanasios Konstantopoulos (CERTH, Greece) and Cinzia Pastorello (European Environment Agency). This will be followed by a free discussion involving all the participants. The session will be chaired by Henrik Wegener (Chair of the High-Level Group of Scientific Advisors).

List of participants

SAM High-Level Group:

Elvira Fortunato (Universidade Nova de Lisboa, Portugal)

Dame Julia Slingo (MetOffice, UK)

Henrik Wegener (Technical University of Denmark)

SAM Secretariat:

Johannes Klumpers (DG Research and Innovation, European Commission)

José Jiménez Mingo (DG Research and Innovation, European Commission)

Maria da Graça Carvalho (DG Research and Innovation, European Commission)

Jan Marco Müller (DG Research and Innovation, European Commission)

Experts:

Jeff Alson (Environmental Protection Agency, USA) – **via video link**

Michel André (IFSTTAR, France)

Christian Bach (EMPA, Switzerland)

Georgios Fontaras (Joint Research Centre, European Commission)

Gonçalo Gonçalves (Instituto Superior Técnico, Portugal)

Christoph Höhmann (Daimler, Germany)

Nicolae Ispas (University of Brasov, Romania)

Athanasios Konstantopoulos (CERTH, Greece)

Juhani Laurikko (VTT, Finland)

Norbert Ligterink (TNO, The Netherlands)

Jan Macek (Czech Technical University in Prague, Czechia)

Federico Millo (Polytechnic University of Turin, Italy)

Peter Mock (International Council on Clean Transportation)

Cinzia Pastorello (European Environment Agency)

Stéphane Rimaux and Bernard Swoboda (PSA, France)

Zissis Samaras (Aristotle University of Thessaloniki, Greece)

Ian Skinner (Transport and Environmental Policy Research, UK)

Dimosthenis Trimis (Karlsruhe Institute of Technology, Germany)

Observers:

Cosmin Codrea (DG Climate Action, European Commission) – first day only

Alessandro Marotta (DG Internal Market, Industry, Entrepreneurship and SMEs, European Commission)

Patrícia Baptista (Instituto Superior Técnico, Portugal)

Sara Tomé (Instituto Superior Técnico, Portugal)

Local participants to parts of the meeting:

António Rendas (Rector of the Universidade Nova de Lisboa, Portugal)

Fernando Santana (Dean of the Faculty of Engineering of the Universidade de Lisboa, Portugal)

Tiago Farias (Instituto Superior Técnico, Portugal)