

**Report of the 25<sup>th</sup> Session of the  
Electric Vehicles and the Environment Informal Working Group (EVE IWG)**

Location: Geneva, Switzerland  
Time / Date: 14h00 – 17h00 January 8<sup>th</sup>, 2018  
Chair: Mr. Michael Olechiw (USA)  
Vice-Chairs: Mr. Tetsuya Niikuni (Japan) [not present]  
Ms. Chen Chunmei (China) [not present]  
Secretary: Mr. Andrew Giallonardo (Canada)

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**1. Welcome, introductions (Agenda items 1 & 2)**

Mr. Mike Olechiw, the chair of the EVE IWG welcomed everyone in the room. After the introductions, Mr. Andrew Giallonardo reviewed the afternoon's agenda (Item 1) for the working group and also reviewed the 24<sup>th</sup> EVE meeting report (Item 2). The event was well attended with over 100 participants in the room from various regions and organizations. It was noted that the informal term the EVE IWG would like to use for "battery durability" is: "*in-vehicle battery durability*"

**2. Update of the Worldwide Harmonized Light vehicles Test Procedure (WLTP) (Agenda item 3)**

Mr. Matthias Nägeli provided an update about the activities of the WLTP IWG. Mr. Nägeli indicated that the EVE IWG's current planned schedule to develop a test procedure for determining the system power of electrified vehicles (EV) would meet needs of the WLTP. He also emphasized that the WLTP continues to believe that coordination between EVE IWG and WLTP IWG members will be important for this topic.

Mr. Nägeli noted that Phase II B of WLTP's mandate faces some challenges which will need more time to develop stable solutions, and EV durability is part of Phase II B. The WLTP will make a formal request to prolong the mandate, and identify which work items have the highest uncertainty. The schedule of the global technical regulation (GTR) which was approved for late 2019 is deemed still appropriate by WLTP.

On the topic of EV durability specifically, Mr. Nägeli mentioned that the, WLTP does not currently have a time schedule for this topic and may not have enough knowledge to confirm a time schedule for the topic just yet. WLTP will consider in-vehicle durability of EV batteries an open topic for the foreseeable future.

Mr. Nägeli further indicated that the WLTP continues to discuss the topic of in-vehicle durability of EV batteries, and expects to have views on the EV durability matrix (EVE-25-03-Rev2e) available for the upcoming EVE meeting in Tokyo in March 2018. The WLTP also notes that decisions about EV durability should keep in mind their impact on both current and future technologies.

Mr. Mike Olechiw asked about the relationship between EV durability and the conventional internal combustion vehicle durability, and whether the WLTP had views on whether they should be similar or if differences were acceptable to the WLTP. Mr. Nägeli indicated that the WLTP was considering this question as well, and had not yet reached consensus.

**ACTION 1:** EVE IWG and WLTP to continue close coordination to ensure that power determination test procedure meets the needs of the WLTP.

**ACTION 2:** WLTP to provide consensus version of durability matrix by March EVE meeting in Tokyo

### **3. System Power Determination (Agenda item 4)**

Mr. Andrew Giallonardo started agenda item 4 by reintroducing a presentation on behalf of Mr. Tetsuya Niikuni (vice-chair) who was unable to attend the 25<sup>th</sup> EVE meeting. Mr. Niikuni had previously presented during the 23<sup>rd</sup> EVE meeting in June (EVE-23-03e). The presentation was on the topic of “Suggestions for EVE’s forward steps on power determination of Hybrid Electric Vehicles (HEV)”. The presentation highlighted the importance of the validation testing plan and challenges associated with the target timelines of the EVE IWG. The EVE considered this presentation and indicated their intention to commit more firmly to a validation testing plan and schedule in March in Tokyo, after more progress had been made developing the draft test procedure.

There was a subsequent discussion about the ISO test procedure, which was given by Mr. Masao Kubodera. The draft procedure received 1 negative vote during the balloting process. The negative vote had been related to concerns about the correlation between TP1 and TP2,

and the ISO committee is working to resolve the concern. At this stage the EVE IWG will consider both TP1 and TP2 as potentially appropriate for use as a basis for the procedure being developed by the EVE IWG. Voting for the Draft International Standard will take place from February to April 2018 and it is expected that an international standard will be issued in June 2018.

Mr. Nägeli noted that both TP1 and TP2 should theoretically provide identical results to be acceptable. Mr. Mike Safoutin added that this is something that the EVE IWG should be considered as part of the EVE IWG's validation program. Mr. Nägeli suggested that perhaps a representative responsible for conducting the testing that informed TP2 could join a future meeting to explain the reasons for the differences between TP1 and TP2 in more detail. It was then noted that the information on the differences can be found in the JARI report, which Canada is in the process of having translated.

During a discussion about the availability of resources to conduct validation testing, Ms. Elena Paffumi confirmed the Joint Research Centre's (JRC) availability to contribute JRC test facilities. Ms. Annika Ahlberg-Tidblad said OICA (Organisation Internationale des Constructeurs d'Automobiles) is positive in its position of supporting this work but OICA lacks a common budget and is exploring ways to support this project, including possibly providing vehicles to JRC for testing.

It was noted by some participants that previous round robin testing for WLTP verified the suitability of the regulatory text and helped to close loopholes. The EVE IWG noted that planning is important for round robin testing but intercontinental sharing of test specimens is unlikely to be necessary.

Following this discussion, Mr. Mike Safoutin, who is chair of the power determination drafting group mentioned that individuals who would like to join can contact him ([safoutin.mike@epa.gov](mailto:safoutin.mike@epa.gov)). He then led a discussion of the achievements of the drafting group. The system power determination GTR drafting group has held two meetings to date, with an early draft of the GTR following the UN style guidelines. Much of the draft regulation includes information from an advanced copy of the ISO procedure which was previously converted into a word document for use by the group in drafting the GTR. Thus far the drafting group has focused on identifying optional pathways or loopholes in the reformatted version of the ISO procedure that would not be acceptable for a GTR. A share point site was also established to

work with members on the GTR along with the terms of reference (protocols for tracking input, making revisions, taking expert input, etc.).

Some technical considerations have already been identified, including selection of a charge depleting vs charge sustaining mode for plug-in hybrid electric vehicles (PHEV) and methods to find maximum load collective and max power. The candidate testing method is not being considered at this time, but could be considered at a later time. The drafting group has also noted that a decision will need to be taken on the appropriate warm-up and state of charge (SOC) for different vehicle architectures. Some felt that max SOC may be the best point, but this was not a consensus view among the group.

There was a question from the EVE group on the role of the drafting group to resolve technical issues or to draft modified text, and Japan expressed interest in wanting to contribute to the drafting team. Mr. Mike Safoutin noted his view that for now the drafting group will identify technical issues so that they can then be brought forward to the full EVE IWG.

China participated in the meeting via teleconference, and indicated that they appreciate the work of the EVE IWG and indicated their interest want to participate in the drafting group and possibly on the validation testing.

ACTION 3: Japan to consider nominating a volunteer to join the drafting group and to contact Mr. Mike Safoutin with questions.

ACTION 4: EVE IWG Secretary and China to communicate regarding participation in the drafting group and validation testing program.

#### **4. Method of stating energy consumption update (Agenda item 5)**

Mr. Andrew Giallonardo reviewed a short presentation on the EVE-IWG's work on a method of stating energy consumption of electrified vehicles (EVE-25-04e). Mr. Giallonardo had presented on this work to the Group of Experts on Energy Efficiency (GEEE) on November 1st, 2017. The presentation was received well by the GEEE, and they conceptually agreed that work on a method of stating energy consumption could be led by the GEEE, given the impact that emissions from electricity generation have on the environmental impact of EVs. The EVE-IWG continues to be willing to support the GEEE with information related to EV performance, at the discretion of the GEEE.

## **5. Update from OICA on position regarding in-vehicle durability of EV batteries (Agenda item 6)**

Document EVE-25-08e was presented regarding agenda item 6 on OICA's position on modelling battery durability in electrified vehicles. OICA representatives noted that EV owners are already provided with warranty from the manufacturer. OICA has stated that cannot accept a test procedure or requirements which manipulate the battery system, such as early proposals to consider a test procedure with an artificially aged battery. OICA also stated that they felt that existing methods/models to simulate EV battery life are too simple to provide an accurate forecast simulation of vehicle performance in real life.

A discussion of modelling and simulations followed. It was discussed that field simulations of vehicle performance are still being verified against real customer usage and that the technology is changing rapidly. OICA recommended that if regulators required some kind of deterioration consideration for EVs in the future, a method which assigns a default deterioration factor (DF) would be the most suitable option at the moment. Mr. Andrew Giallonardo asked if default DF's should be identified using simulation or some other method. Mr. Norbert Klein responded that suitable DFs cannot be identified at the moment and future DFs should be based on experience where possible.

Ms. Annika Ahlberg-Tidblad commented that deterioration simulation modeling would be very challenging, because any model would need to be both very generic to allow for all possible use cases and very specific to consider many particular battery chemistries. She also noted that the generic models require a lot of assumptions, but specific models require a lot of detailed/specific parameters.

There was some further discussion amongst the group about whether durability needed to be assessed for consumer protection and/or consumer information purposes. The group agreed that the EVE IWG was focused on whether durability requirements are appropriate in the context of certification, though recognizing that some jurisdictions may feel durability information should be a part of consumer information/vehicle labelling requirements. Several manufacturers felt that consumer information on durability should be provided by the manufacturer, since the manufacturer controls the design of the battery life management system.

## **6. Presentation on in-vehicle durability modeling of electrified vehicle batteries and durability matrix (Agenda item 7)**

Mr. Michele de Gennaro presented an update to a presentation previously shared during the 24<sup>th</sup> EVE meeting in Vienna. The initial presentation outlined battery ageing models from literature, highlighted various battery ageing mechanisms and described the integration of these ageing models with the EU's Technology and Mobility Assessment (TEMA)<sup>1</sup> platform. The literature models had only been validated through cell level testing. Mr. de Gennaro presented some high level results simulating electric vehicle performance, and compared these results with EV lifetime performance testing data provided by Canada. The forecast deterioration using the TEMA platform and measured deterioration using real-world test data showed good agreement. The ability to relate deterioration of cell level performance characteristics (which are well understood) with pack level performance characteristics (which can be much more difficult to predict) is one of the key results of this work.

Ms. Ahlberg-Tidblad asked about the confidence in the methods and models. Mr. de Gennaro indicated that he is confident in the model predictions because activity levels are within the bounds of validity of the cell level models that were used. The model seems to do a good job scaling up cell level performance to pack level performance given the good agreement between the modeled and test data. However, the model can only be effective if equations accurately describing cell performance, driving data, pack design, etc. are available for all relevant vehicle architectures, battery chemistries and usage cases. Figure 1 below outlines the model logic passes.

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<sup>1</sup> Technology and Mobility Assessment Platform:  
<https://www.sciencedirect.com/science/article/pii/S2214579615300319>

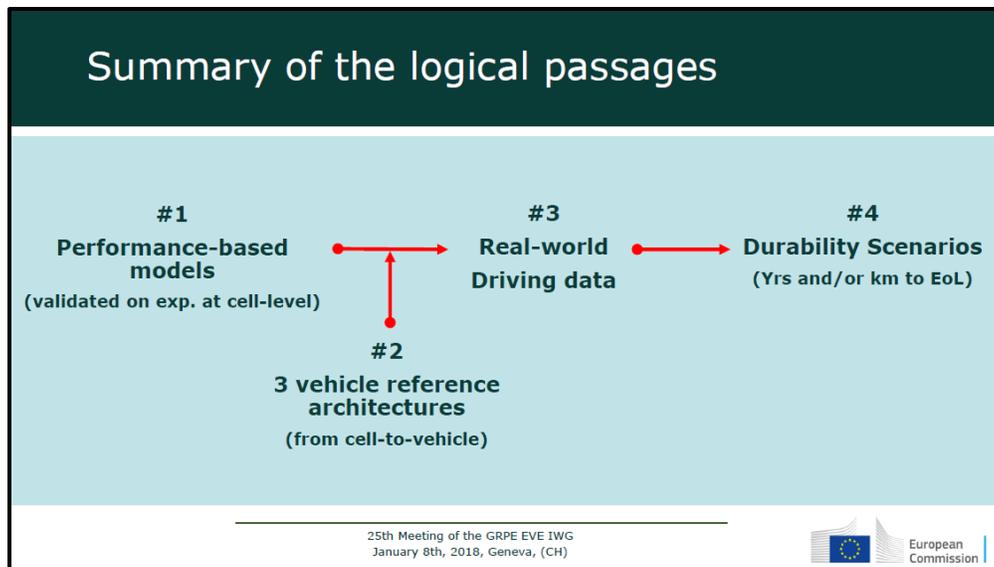


Figure 1: Slide #9 of document EVE-25-06e

There was some conversation about how the model could be adjusted to compare with validation testing from a specific vehicle. Mr. de Gennaro responded that one would need to derive the performance model for the cell level using cell cycling equipment for specific chemistry of that cell. Cell level equations would be combined with information on vehicle architecture and driving behavior to assess durability.

One group member asked if the model was capable of simulating variable driving data. Mr. de Gennaro responded that the current forecasts use anonymized usage statistics and that any driving data can be programmed into the model. Mr. de Gennaro's personal impression is that current chemistries in the model seem to age more quickly early in their life and then plateau later in their life.

The models are currently based on Italian driving data from select provinces, but more driving data is being added from other areas such as Paris. Ms. Ahlberg-Tidblad noted that the group may need to consider the second and third life of vehicles with second and third owners. Mr. Giallonardo noted that the goal of this work is to determine whether a parametrized model can predict vehicle life in specific cases, the group can then progress to seeing whether a parametrized model is suitable as a more general tool for predicting in-vehicle durability for EV batteries. Mr. Safoutin noted the significant progress to date, and further noted that the EVE IWG may arrive at a point in the future where the EVE IWG could engage third parties who could input their own data into the models. Mr. de Gennaro noted that all of the models are open and that the third parties could provide their data to run the model and obtain their own

results. The JRC would also be willing to provide assistance implementing 3<sup>rd</sup> party data into the TEMA platform, if desired by 3<sup>rd</sup> parties.

Mr. de Gennaro also noted that efforts would be made to publish the research findings in a peer-reviewed scientific journal.

## **7. Meeting conclusion**

The schedule of the next meetings in Tokyo, Geneva and Ottawa were discussed. The Tokyo meeting is expected to happen on March 27<sup>th</sup>- March 28<sup>th</sup>, while the Geneva and Ottawa EVE IWG meetings will occur in June and October respectively. The official dates of these events will be confirmed in the future in consultation with members of the EVE IWG. Future actions around meeting logistics were also discussed. Mike Olechiw, the EVE IWG chair, thanked all who attended and expressed appreciation to all members for their continued support and engagement.

## **8. Summary of Action Items**

Action items from the 25<sup>th</sup> meeting of the EVE IWG are listed below. Additionally, outstanding items from the 24<sup>th</sup> meeting of the EVE IWG are included in Table 1. Action numbers remain the same as those in document EVE-24-14e. Work developing the regulatory text of the power determination GTR will continue over the coming months, and work related to in-vehicle durability of EV batteries, modeling and testing will continue.

**ACTION 1:** EVE IWG and WLTP to continue close coordination to ensure that power determination test procedure meets the needs of the WLTP.

**ACTION 2:** WLTP to provide consensus version of durability matrix by March EVE meeting in Tokyo

**ACTION 3:** Japan to consider nominating a volunteer to join the drafting group and to contact Mr. Mike Safoutin with questions.

**ACTION 4:** EVE IWG Secretary and China to communicate regarding participation in the drafting group and validation testing program.

Table 1: Outstanding Action Items from 24<sup>th</sup> Meeting of EVE IWG

<b>Action #</b>	<b>Category</b>	<b>Action to be pursued by:</b>	<b>Action</b>	<b>Next Steps</b>
1	In-vehicle Durability for EV batteries	Ms. Elena Paffumi	To raise whether Commission has views on durability requirement out to 160,000 km.	Awaiting Commission Feedback
3	In-vehicle Durability for EV batteries	Ms. Martha Christenson	To be prepared to share updated durability test results at EVE March meeting	Next test data to be presented in June or October 2018
4	In-vehicle Durability for EV batteries	Mr. Tetsuya NIIKUNI	Mr. Tetsuya Niiikuni to look at data/methodologies for air pollutant durability for conventional vehicles in Japan, and whether Japan would prefer conventional and electrified vehicles to have similar durability requirements.	Still under consideration by Japan
5	In-vehicle Durability for EV batteries	U.S. EPA	U.S. EPA to review in-use data for HEV and PHEV vehicles for air pollutant durability requirements.	Still under review by U.S. EPA
6	In-vehicle Durability for EV batteries	WLTP Durability Group	Review status report and modelling information for JRC.	Feedback not yet received from WLTP Durability Sub group
9	In-vehicle Durability for EV batteries	Mr. Matthias Nägeli	To have GTR references to definitions of durability terms.	To be determined
10	System Power Determination	Japan	To check reports to find out if they identify the sources of test-to-test variation for TP2.	
13	System Power Determination	Mr. Andrew Giallonardo	Ask WP.29 secretariat if ISO draft procedure can be shared more broadly.	
21	System Power Determination	Mr. Matthias Nägeli and Ms. Annika Ahlberg-Tidblad	Mr. Nägeli & Ms. Ahlberg-Tidblad (OICA) to ask about providing vehicles, and ideally instrumented vehicles for EPA and/or JRC to test.	Still under consideration by OICA
27	System Power Determination	GTR Drafting group	Drafting group to develop a standalone document and prepare information so that GRPE can take decision on whether new GTR vs amendment to GTR No. 15 makes more sense.	Still under development