Briefing: Non-Exhaust Emissions of Electric Cars

Brussels, 6 June 2016

Electro-mobility offers an unequalled solution to make Europe's transport clean, low carbon, quiet, more efficient and less dependent on imported energy. Electric vehicles (EVs) produce no exhaust emissions and offer a sustainable solution to help tackle climate change. More specifically, the electrification of surface transport will enable Member States to meet their greenhouse gas emission reduction targets for 2030.

Nevertheless, various media throughout Europe have recently published articles referring to the Timmers and Achten[1] study stating that electric cars would emit more non-exhaust particulate matters (PM) than traditional internal combustion engine (ICE) cars: "*total PM_{10} emissions from EVs were found to be equal to those of modern ICEVs whilst $PM_{2.5}$ emissions were only 1-3% lower.*"[2]

The Platform for Electro-Mobility, an alliance of 21 organisations and companies from across industries and transport modes, would like to respond to these findings, since they do not hold true if put into perspective. The Platform does, however, agree with the study's overall finding that "*Future policy should consequently focus on setting standards for non-exhaust emissions and encouraging weight reduction of all vehicles to significantly reduce PM emissions from traffic*."

This briefing explains how electric vehicles, and the electrification of transport as a whole, make transport cleaner and more sustainable.

1. Electric vehicles do not emit exhaust particular matter (PM)

The study of Timmers and Achten suggests that "*electric vehicles may not reduce levels of PM as much as expected because of their relatively high weight.*" This finding needs to be read in a broader perspective. ICE vehicles produce both exhaust and non-exhaust emissions: CO_2,

[1] Timmers, V., & Achten, P., (2016). Non-exhaust PM emissions from electric vehicles. *Atmospheric Environment*,*134* (6), 10-17. doi: 10.1016/j.atmosenv.2016.03.017

[2] Although using the term 'electric vehicle', the study's comparative analysis focuses on passenger cars, for this reason, most of the evidence of this briefing is focused on passenger cars. The Platform for Electro-mobility, however, shows that the benefits of electrification mentioned are valid for all road vehicles, including light electric vehicles, cars, vans and trucks.

NO_x and PM. EVs do not produce exhaust emissions and consequently cause less pollution in general.

According to a case study performed by Aria Technologies[3] on the city of Rome, a 20% shift of the fleet to electro-mobility would significantly reduce the exposure of the population to emissions in general. More specifically, the level of PM_{10} would decrease by up to 30%, NO_x by up to 45%. The conclusions of this study clearly state the positive impact of EVs on air quality.

When discussing environmental impact of vehicles (electric or ICE), it is crucial to take into account the **full life cycle** of a vehicle (LCA). MOBI, the Mobility, Logistics and Automotive Technology Research Centre of Brussels University (VUB) has developed a life-cycle model that takes into account all vehicle emissions and thus allows for the objective comparison of different fuel technologies.

MOBI's models show that the majority of pollutants, specifically PM, come from exhaust systems as a result of the combustion process. In a Well-to-Wheels perspective, electric cars emit twenty times less NO_x and four times less PM than ICE cars[4]. If EVs were to use sustainable electricity, as is already the case in some countries such as Norway, CO_2 emissions could be further reduced by a factor of 15[5]. LCA evidence suggests that electrification of vehicles is one of the major solutions for the pollution problem caused by ICE vehicles.

2. Both ICE and EV emit non-exhaust pollution due to braking

Both EVs and ICE vehicles cause non-exhaust PM pollution. This is caused by braking and tyre wear and can contribute to respiratory diseases and cancer. The Timmers and Achten study rightfully concludes: "*Future policy should consequently focus on setting standards for non-exhaust emissions and encouraging weight reduction of all vehicles to significantly reduce PM emissions from traffic*."

It is important to take into account that no homologated assessment of non-exhaust emissions from vehicles tyres is available yet. The global standardisation body UNECE has recognized this lack and is preparing a standardised testing and measurement method.

[3] Aria Technologies 2013
[4] Calculation for Belgium, http://mobi.vub.ac.be/mobi/news/electric-driving-sparking-your-interest/
[5] http://mobi.vub.ac.be/mobi/news/electric-driving-sparking-your-interest/

The most effective way to reduce non-exhaust pollution from all cars would be to set PM standards for tyres, based on tyre abrasion, durability and/or mileage. Better quality tyres will allow all vehicles to emit less pollutants. Already today most EVs are equipped with low rolling resistance tyres, which produce less emissions from wear.

Timmers and Achten argue that the main cause of electric car's PM emissions is their higher weight. Today, electric vehicles are effectively heavier than their ICE counterparts. However, in the medium term, electric cars' weight will decrease, resulting in a further reduction of non-exhaust pollution. The expectations of considerable weight reduction are based on rapid improvement in battery density[6]. While Lithium-ion batteries' energy density at a cell level currently varies from 120 to 170 Wh/kg, European battery manufacturers expect 290 Wh/kg by 2030, currently.[7] FP7 and Horizon2020 programs include research and innovation focused on battery technological advancement.[8]

The Timmers and Achten study identifies braking as the most important source of non-exhaust emissions across vehicles. All electric as well as hybrid vehicles are equipped with regenerative braking, a more efficient braking technology, which uses the inertia force to recharge the battery of the vehicle while driving. Regenerative braking directly reduces wear of the brakes and related PM emissions. For the Renault electric vehicle ZOE, the regenerative braking reduces brake pad wear by 25 to 50%[9].

Furthermore, the assessment of emissions resulting from braking is highly dependent on external factors such as driving conditions and the state of the road. These factors have an impact on the reliability of any emission measurements. The EU Joint Research Centre has stated that, to date, no testing protocol is available yet

According to a recent study by Neuman et al. (2015)[10], electric car drivers have a much better eco-driving behaviour then ICE car drivers. This appeared from a longitudinal field study with 40 participants. The study was aimed at examining which eco-driving strategies users knew before and after driving an EV for 3 months. Eco-driving can bring real environmental benefits

[6] http://www.nature.com/nclimate/journal/v5/n4/full/nclimate2564.html
[7] EUROBAT, "*Eurobat E-mobility battery R&D roadmap 2030*", http://www.eurobat.org/sites/default/files/eurobat_emobility_roadmap_lores_2.pdf
[8] Example of FP7 funded program: www.batteries2020.eu
[9] This refers to brake pad reduction compared with the same braking patterns of EV car.
[10] Isabel Neumann*, Thomas Franke, Peter Cocron, Franziska Bühler, and Josef F. Krems (2015), Technische Universität Chemnitz, https://www.tu-chemnitz.de/hsw/psychologie/professuren/allpsy1/pdf/Neumann%20et%20al_2015_BEV%20EcoDriving.pdf

as shown by an Ertico study[11], which states an average of 13% CO^2 reduction, depending on the drivers' behaviour.

Conclusion:

Based on the above arguments, the Platform for Electro-Mobility stresses that, from a Well-to-Wheel perspective, the use of electric vehicles instead of ICE cars, especially if operated on sustainable electricity, reduces exhaust emissions (in particular CO_2, NO_x) and therefore air pollution in a very significant way. The Platform recognises that emissions from tyres and braking are indeed an issue that needs to be tackled. This, however, applies to all types of vehicles, not only EVs. Platform Members agree that standards for non-exhaust emissions must be set and that vehicle weight reduction must be encouraged to significantly reduce PM emissions. In a Well-to-Wheel perspective, electric vehicles, in the context of the wider electrification of transport, offer a very effective solution to making transport cleaner and more sustainable.

Overall, electric vehicles are only part of the solution to decarbonise transport. The vision of the Platform for Electro-Mobility is a sustainable, multimodal transport system in which people and goods are predominantly moved across land in Europe using sustainable electricity.

Note to Editors:

The Platform for Electro-Mobility (www.platformelectromobility.eu) is a European alliance of over 20 producers, infrastructure managers, operators, transport users, cities and civil society organisations from across industries and transport modes. The Platform advocates the acceleration of electrification of all modes of transport, focusing on its numerous benefits, such as emission reduction, efficiency gains, support for technological innovation, jobs and growth through value creation in Europe as well as reducing Europe's energy dependence from fossil fuel imports.

[11] Ertico (2015) « ITS for reducing CO^2 emissions related to the usage of cars ».

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