

Title: Metrology to support electromobility

Abstract

In Europe there are around 200 million cars on the road and almost all of them operate on internal combustion. Fossil fuel consumption for transport has to be reduced in order to meet the European targets for reduction in CO₂ emissions. A metrological framework for the characterisation of performance/lifetime, safety and metering of electric vehicles through development of novel measurement/modelling tools, test protocols and standards is required.

Conformity with the Work Programme

This Call for JRP's conforms to the EMRP Outline 2008, section on "Grand Challenges" related to Energy and Environment on pages 23 and 24.

Keywords

Electric vehicles, efficiency, billing, electromobility, metering, batteries, fuel cells, electrical energy

Background to the Metrological Challenges

The transport sector accounts for some 25 % of global greenhouse gas emissions, making it a key target in the world's need to reduce its dependence on oil and other fossil fuels. In response, car manufacturers are focusing intensely on developing prototype electric vehicles. China, for example, has set a target that 50 % of new vehicles on its roads should be electric by 2020. Although it is widely recognised that electric cars will only make a significant difference if they are accompanied by a move towards smart grids and cleaner electricity generation, global competition for the electric vehicle market will be intense. The speed with which car manufacturers and their suppliers are able to develop these new vehicles and bring them to market is likely to be a decisive factor. The European Commission has issued a mandate [1] to the European Standards Organisations detailing the related priorities for standardisation.

Metrology can support this development through the development of systems to accurately measure the energy flows in and out of batteries, motors and fuel cells, including the legal and data security requirements to ensure correct billing.

A major challenge is the characterisation of the battery. Proper metering the State-of-Charge and the State-of-Health is essential for ensuring reliability, especially when the battery is exchanged for recharging.

A frequency converter operates the drive between stand and a maximum speed of up to 6000 rpm. This energy flow is reversible; the motor can provide energy to the battery during braking. The determination of the efficiency of the frequency converter for the various operating points and time intervals is another key parameter.

Fuel cells offer great promise in this field but commercialisation is hampered by a number of factors such as material and processing costs, limited durability and safety considerations. The development of metrological capability to facilitate in situ measurement of critical fuel cell parameters is required both for model validation and to advance scientific understanding of the physical processes taking place. Standardised accelerated durability test methods are also needed to characterise the various degradation modes and enable fuel cell manufacturers to optimise design without the expense and delay associated with long term testing.

Scientific and Technological Objectives

Proposers should address the objectives stated below, which are based on the PRT submissions. Proposers may identify amendments to the objectives or choose to address a subset of them in order to maximise the overall impact, or address budgetary or scientific / technical constraints, but the reasons for this should be clearly stated in the JRP-Protocol.

The JRP shall focus on the traceable measurement and characterisation of energy flows in electric vehicles, including safety of the relevant systems and metering.

The specific objectives are:

1. To develop traceable measuring techniques for battery charging and discharging, suitable for billing purposes.
2. To develop methods for characterising battery performance and lifetime limiting processes, by standardising life cycle tests, diagnostic tools, test methods for State of Charge and State of Health, and validated battery models.
3. To develop the traceability required for efficiency measurements on frequency converters used in electric vehicles.
4. To develop traceable measuring techniques for the efficiency of electrical machines.
5. To develop or validate metrological methods for determining the safety, efficiency and durability of fuel cells in these applications
6. To address potential environmental stress associated with electromobility

These objectives will require large-scale approaches that are beyond the capabilities of single National Metrology Institutes and Designated Institutes. To enhance the impact of the R&D work, the involvement of the user community such as industry, and standardisation and regulatory bodies, as appropriate, is strongly recommended.

Proposers should establish the current state of the art, and explain how their proposed project goes beyond this. Particular reference should be made to any relevant projects funded by the European Green Cars Initiative [2] or Electromobility+ [3].

EURAMET expects the average size of JRPs in this call to be between 3.0 to 3.5 M€, and has defined an upper limit of 5 M€ for any project. The available budget for integral Research Excellence Grants is 30 months of effort.

Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the “end user” community. This may be through the inclusion of unfunded JRP-Partners or collaborators, or by including links to industrial/policy advisory committees, standards committees or other bodies. Evidence of support from the “end user” community (e.g. letters of support) is encouraged.

You should detail how your JRP results are going to:

- feed into the development of urgent documentary standards through appropriate standards bodies
- transfer knowledge to the automotive industry

You should detail other impacts of your proposed JRP as detailed in the document “Guide 4: Writing a Joint Research Project”

You should also detail how your approach to realising the objectives will further the aim of the EMRP to develop a coherent approach at the European level in the field of metrology and includes the best available contributions from across the metrology community. Specifically the opportunities for:

- improvement of the efficiency of use of available resources to better meet metrological needs and to assure the traceability of national standards
- the metrology capacity of Member States and countries associated with the Seventh Framework Programme whose metrology programmes are at an early stage of development to be increased
- outside researchers & research organisations other than NMIs and DIs to be involved in the work

Time-scale

The project should be of up to 3 years duration.

Additional information

The references were provided by PRT submitters; proposers should therefore establish the relevance of any references.

1. Standardization for road vehicles and associated infrastructure, CEN/CENELEC Commission Mandate M/468 <ftp://ftp.cen.eu/CEN/Sectors/List/Transport/Automobile/EVReportOctober.pdf>
2. European Green Cars Initiative PPP, <http://www.green-cars-initiative.eu>
3. Electromobility+, <http://electromobility-plus.eu/>