



**Report on the
Joint EC/EPoSS/ERTRAC Expert Workshop 2010
Electric Vehicle Batteries Made in Europe**
Version 2.0, 25 June 2011

1.) Objective

On 30 November 2010 the European Commission jointly with the European Road Transport Advisory Council (ERTRAC) and the European Technology Platform on Smart Systems Integration (EPoSS) held an Expert Workshop on “Electric Vehicle Batteries Made in Europe”.

Subsequent to the previous years’ s in-depth discussion on R&D needs at all stages of the new electric vehicle battery value chain, the focus was shifted towards industrial implementation: The objective in 2010 was to understand recent advances and future perspectives in materials developments, cell technologies, system integration, production and testing methods as well as life cycle assessments for electric vehicle batteries. A particular focus was on lighthouse projects that promote manufacturing of batteries in Europe and may be part of the future implementation of the Public-Private Partnership European Green Cars Initiative. The discussions particularly considered interdependencies of production costs, materials performance, cost and supply, energy consumption, robustness and safety as well as cycle and calendar lives. The results will contribute to a European roadmap showing research, development and implementation paths for electric vehicle batteries.

The event is part of a series of workshops jointly organized by the EC and the industry which cover both technical and political issues related to the topic of electric vehicles, e.g.: “Smart Systems for the Full Electric Vehicle” (2008), “Batteries and Storage Systems for the Fully Electric Vehicle” (2009) and “Thinking Ahead the European Green Cars Initiative” (2010). The workshop was organized by the first project of the European Green Cars Initiative, the Coordination Action “Information and Communication Technologies for the Full Electric Vehicle” (ICT4FEV).

2.) Workshop Structure

The opening session of the workshop was chaired by Prof. Maria da Graça Carvalho, Member of European Parliament, who in her opening statement pointed out the expected impact of electric vehicles for competitiveness of the European industry. The following keynote speakers covered the EC’s, the Member states and the industry’s perspectives on the topic.

Dedicated sessions were held on the following themes:

Session 1: Advances in Cell Technology and Integration

Session 2: Manufacturing, Testing, and Life Cycle Assessment of Batteries

Session 3: Lighthouse Projects for EV Batteries Made in Europe

The workshop was closed by a panel discussion of EC members representing DGs RTD, Info and Enterprise.

All in all 26 dedicated speakers and chairpersons from 14 European countries discussed challenges and options for the establishment of battery manufacturing in Europe. More than 100 experts representing battery and cell manufacturers, vehicle manufacturers, suppliers, research organizations and public authorities attended the workshop.

3.) Report from the Workshop Sessions

Opening Session

As an introduction to the thematic domain of the workshop, and in order to link it to its framework in the European Green Cars Initiative, dedicated presentations were given by representatives of the European Commission.

Kate Warren from the Office of Low Emission Vehicles (United Kingdom) pointed out the fields of action of a European Member State related to electric mobility being the allocation of incentives, the creation of infrastructures and the promotion of the new industrial supply chains.

Moreover, Salman Farmanfarmaian from Zero Emission Mobility (Switzerland) in his presentation addressed “Business Scenarios for Batteries on Wheels”. Given the fact that EV batteries are expensive, depreciate quickly, suffer degradation and have an unknown residual value, he suggested to introduce a dedicated health card to assess, understand and manage the life cycle of a battery. In general, he called for more openness in the battery industry as this would lead to innovation. Furthermore, he suggested to working towards uniform test methodologies, comparative benchmarks and standards. Data from sponsored electric vehicle trials should be shared with trusted parties.

Session 1: Advances in Cell Technology and Integration

The purpose of this session was to review the state of the art and recent achievements in terms of all building blocks of an electric vehicle battery. As a first speaker, Andrea Balducci from the University of Münster (Germany) addressed “Advanced Materials for Energy Storage Systems”. In particular, a safer, greener and high performance Li-battery based on ionic liquid electrolytes and carboxymethyl cellulose (CMC) as a binder was proposed. For this system, a good cyclability, and recyclability, as well as the absence of volatile elements was emphasized. The feasibility on a pre-industrial scale has been demonstrated by the ILLIBATT project.

In her presentation about “Materials and Designs for Safe and Affordable Batteries” Anne de Guibert from Saft (France) pointed out that the use of lithium-ion chemistries in large batteries is still on a “learning curve”. In terms of performance, however, it would be the most promising system. The speaker commented in detail about methods to improve the safety of Li ion batteries, e.g. the use of gas generated by electrolyte decomposition to activate mechanical safety devices, suppression of passivation layers with high negative voltages, or new separator systems to suppress melting temperatures. According to Ms. De Guibert, organic electrolytes remain the weakest point for safety. The use of non-flammable solvents such as ionic liquids has not been successful so far.

Heiko Weller from Bosch (Germany) explained that in order to reduce the energy consumption of an electric vehicle value to 12 kWh/100 km until 2020, Bosch, i.e. SBLiMotive, is working on improving modules with intelligent Battery Management Systems (BMS) together with an optimized vehicle integration. The BMS shall ensure safe and more efficient battery operation, especially through active balancing, and also provide information for other components of the vehicle.

Strategies and devices for cell balancing were introduced in detail by Joop van Lammeren, NXP (The Netherlands). According to his presentation, cell unbalances arise from self-discharging and capacity loss, both of which increase with age, cycles, and temperature.

Balancing prevents range-decrease-over-time of the vehicle, and redistribution maximises the range of the vehicle. While resistive balancing is inefficient and fast, capacitive balancing is highly efficient, but slow. Inductive and transformer balancing/redistribution are both highly efficient and fast, but costly.

Session 2: Manufacturing, Testing, and Life Cycle Assessment of Batteries

A second session was held in order to discuss solutions for the hurdles that may hinder a mass manufacturing of electric vehicle batteries in Europe including manufacturing technologies, testing methods, standardization and life cycle assessments.

Cell Production Technologies and Perspectives on Cost versus Volume were addressed by Claudio Lanciotti from KEMET (Italy). He introduced stack winding as an innovative solution for optimizing packaging density and cost, while still providing a good manufacturing throughput. Stack winding combines the continuous manufacturing process of winding with the volumetric efficiency and energy density characteristics of stacked batteries. Further advantages are self-supporting structure, reduction of wrinkling, and enhanced safety of the pack.

Regarding Testing of Robustness, Reliability and Safety of Battery Packs, a Load Matrix was introduced by Volker Hennige, AVL (Austria) as an alternative approach for (functional) safety evaluation and improvement of batteries for electric vehicles. Battery reliability, including safety and durability is a high commercial risk, which cannot be addressed by subsidies. The load matrix integrates internal and external contributions on a common platform, is simple to implement into existing development processes and tools, has a generic methodology, and tracks and manages technical risks and safety issues.

Standardization of electric vehicle batteries was the topic of a presentation given by Alfons Westgeest, EUROBAT (Belgium), i.e. the Association of European Automotive and Industrial Battery Manufacturers. According to Mr. Westgeest, battery standards necessary for EV/HEV markets exist and/or are in a revision process and will be finalized in 2012, mostly at worldwide level (IEC/ISO), however the Start-Stop battery standardization is EU driven (pr EN50342-6). Standardization efforts must aim to be open for co-existing and complementary battery technologies.

Finally, Hans-Jörg Althaus from EMPA (Switzerland) commented on the Environmental Impact, Energy Consumption, and Life Cycle Assessment of Li ion battery production. The addition of the Li-Ion battery causes only 10-20 % of the overall environmental impact of an electric car, while the environmental impact resulting from operation is greatly reduced in an electric car. Li is a scarce material, however, recycling technologies may become feasible if production of Li batteries rises.

Session 3: Lighthouse Projects for EV Batteries Made in Europe

The third session of this workshop was dedicated to identifying fields of action which may support the competitiveness of the EV and batteries related industries in Europe. Topics discussed include resource strategies, cell manufacturing, battery production, and various energy storage applications.

In an analysis of Research Strategies for EV Batteries Patrick Kim from Renault (France) pointed out that some key materials are becoming scarce. Therefore a resource security strategy would be needed both at a national and at the company level. This includes corporate as well as government R&D to improve performance for materials efficiency, integrated downstream business concepts, stronger industry partnerships, and recycling in the framework of LCA and stocks & flows.

Technologies for the series production of large scale automotive Li ion battery cells and for their integration into battery packs were presented in much detail by Tim Schäfer, Li-Tec (Germany) and by Ralf Schmid from Continental (Germany).

Finally applications of Batteries in Transport, Consumer and Home Applications were discussed by Javier Blanco, Ikerlan (Spain), and Wolfgang Weydanz from Siemens (Germany), who emphasized that energy storage is needed to enable energy efficient operation, and may help or even solve the issue of fluctuating generation of renewable energies.

4.) Preliminary Results of the Workshop Discussions

The results of the expert discussions held at the end of each session to make recommendations for European lighthouse projects as well as of the panel discussion can be summarized as follows:

- **Smart Packaging of Battery Cells**

The need to further improve the performance of battery cells, e.g. through improved electrochemical systems including post-Lithium technologies became obvious, again. Nevertheless, the speakers and experts pointed out this work should be complemented by research and development in the domain of packaging. Smart solutions for packaging of energy storage cells into a pack are expected to lead to significant reductions of weight and cost as well as to increased safety of the battery.

- **Reliability Testing of EV Batteries**

Predicting the lifetime, reliability and residual value of an electric vehicle battery remains a major issue since the full life time performance of novel EV battery systems like those based on Li-ion cells has never been studied so far. Any test methods and simulation tools that enable a thorough understanding of the degradation processes at both cell and system levels as well as components and systems for cell balancing and performance control are thus considered a R&D topic of great importance.

- **Battery Assembly and Manufacturing Processes**

A timely ramping-up of battery manufacturing will be key for the implementation of electric mobility because an 80-90 percent cost reduction due to learning effects can be expected if manufacturing rises from today's few thousands to millions per year. The processes for cell manufacturing as well as prototyping, testing and assembly will thus be critical for the European competitiveness in the field of electric vehicle batteries. Further R&D in this domains is thus of highest priority.

- **Safety Training for Battery Staff**

The speakers covering battery assembly processes made clear that prototype and early series production is based mainly on manual labour which requires extensive trainings in terms of appropriate handling as well as chemical and electrical safety. Experiences from the series production sites may help to develop a European standard curriculum for battery staff which be needed as a training guideline for workshop personal and emergency workers.

- **Rare Materials and Recycling Strategies**

Possible limitations of lithium for advanced energy storage systems have recently been discussed in length, and will be subject to further research. Mass production of electric vehicle batteries however will also strengthen the demand for some other essential materials that are not abundant or of limited supply for European companies. The expert discussions at the workshop made clear that a dedicated project dealing with a European resource and recycling strategy for battery materials is urgently needed.

All presentations held at the workshop are available at the website of the ICT4FEV project:
www.ict4fev.eu/events/battery-workshop-2010.

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