Executive summary

Life Cycle Assessment – LCA of Lead-based Batteries for Vehicles

On behalf of

Association of European Automotive and Industrial Battery Manufacturers – EUROBAT
European Automobile Manufacturers Association – ACEA
Japan Automobile Manufacturers Association – JAMA
Korea Automobile Manufacturers Association – KAMA
International Lead Association - ILA

PE INTERNATIONAL
EXPERTS IN SUSTAINABILITY

Title of the Study: Life Cycle Assessment of Lead-based Batteries for Vehicles

Study commissioners:

Association of European Automotive and Industrial Battery Manufacturers – EUROBAT

European Automobile Manufacturers Association – ACEA

Japan Automobile Manufacturers Association – JAMA

Korea Automobile Manufacturers Association – KAMA

International Lead Association - ILA

April 2014

Authors:

Viviana Carrillo Usbeck

Arnav Kacker

Dr. Johannes Gediga

PE INTERNATIONAL
EXPERTS IN SUSTAINABILITY

PE INTERNATIONAL AG

Hauptstraße 111 – 113
70771 Leinfelden – Echterdingen

Phone +49 711 341817 – 0
Fax +49 711 341817 – 25

E-Mail info@pe-international.com

Internet www.pe-international.com

Executive summary

Introduction

With environmental performance now considered one of the important factors in evaluating a product, the key players in the supply chain for lead-based automotive batteries have commissioned a study to assess the impact of this product in its various applications on the environment including its Global Warming Potential.

This Life Cycle Assessment study was commissioned by EUROBAT, ILA, ACEA, JAMA and KAMA, which together represent the majority of Europe's battery and automobile manufacturers, along with Japanese and Korean automobile manufacturers and the international lead industry. PE International has therefore made a comprehensive evaluation of the three main automotive battery types from a cradle-to-grave perspective, and reported on their life cycle environmental performance.

Scope of LCA

A Life Cycle Assessment is a technique for analysing the environmental aspects and potential impacts of products by:

- Compiling an inventory of energy and material inputs and outputs (including emissions) for the product
- Identifying the potential impacts associated with the specified inventories of the product
- Evaluating the results to assess the product's overall environmental performance across different indicators

Three lead-based battery applications were chosen for consideration in this study, with the contributing industry data representing more than 90% of the production volume for those technologies in Europe:

- **Standard technology batteries**: These are flooded lead-based batteries used in conventional vehicles, for starting the internal combustion engine (ICE), lighting and ignition systems - commonly known as starting, lighting and ignition (SLI).
- **Improved technology batteries**: These are enhanced flooded (EFB) or Absorbent Glass Matt (AGM) lead-based batteries used in vehicles with a start-stop system, which allows the ICE to automatically shut down under braking and rest and then to restart.
- **Advanced technology batteries:** These are EFB or AGM lead-based batteries used in vehicles with a micro-hybrid system, which combines start-stop functionality with regenerative braking (a system to recover and restore energy from braking), and other micro-hybrid features that require higher deep-cycle resistance and charge recoverability from the battery.

The report focuses on how the environmental impact from the use of Lead-based batteries differs according to the application in which they are used. At this stage, it is not the purpose

to compare the environmental impacts of individual battery technologies (which are assumed to be comparable), and so AGM and EFB batteries are grouped together under improved and advanced technology categories.

A representative model was constructed to reproduce the material and energy flows associated with the production of the batteries. Additionally, the model also depicts the impacts associated with recycling the batteries and the environmental benefits of a 'circular economy' within the EU's lead-based battery industry.

Furthermore, the study evaluates the environmental impacts from the installation of these three battery technologies within passenger vehicles. Here, the study quantifies the reduction in Global Warming Potential across vehicle lifetime, which arises in part from installation of improved and advanced technology batteries providing start-stop and micro-hybrid functionality.

Main findings

- **Production** – Battery manufacturing and assembly processes as such do not play a dominant role in the studied environmental impacts of lead-based batteries. The study concludes that the material production of lead contributes most dominantly to the studied environmental impacts from battery production.

- **Use** - Improved and Advanced technology batteries use more lead, however this is more than offset by the savings that they enable in Global Warming Potential when installed in passenger vehicles. These batteries are integral parts of start-stop and micro-hybrid engine systems which have lower fuel-consumption than regular engines. Over the lifetime of the vehicle, using these systems and batteries results in emission savings of between 700-1600 kg CO_2 eqv. If the total system benefit is allocated to the batteries.

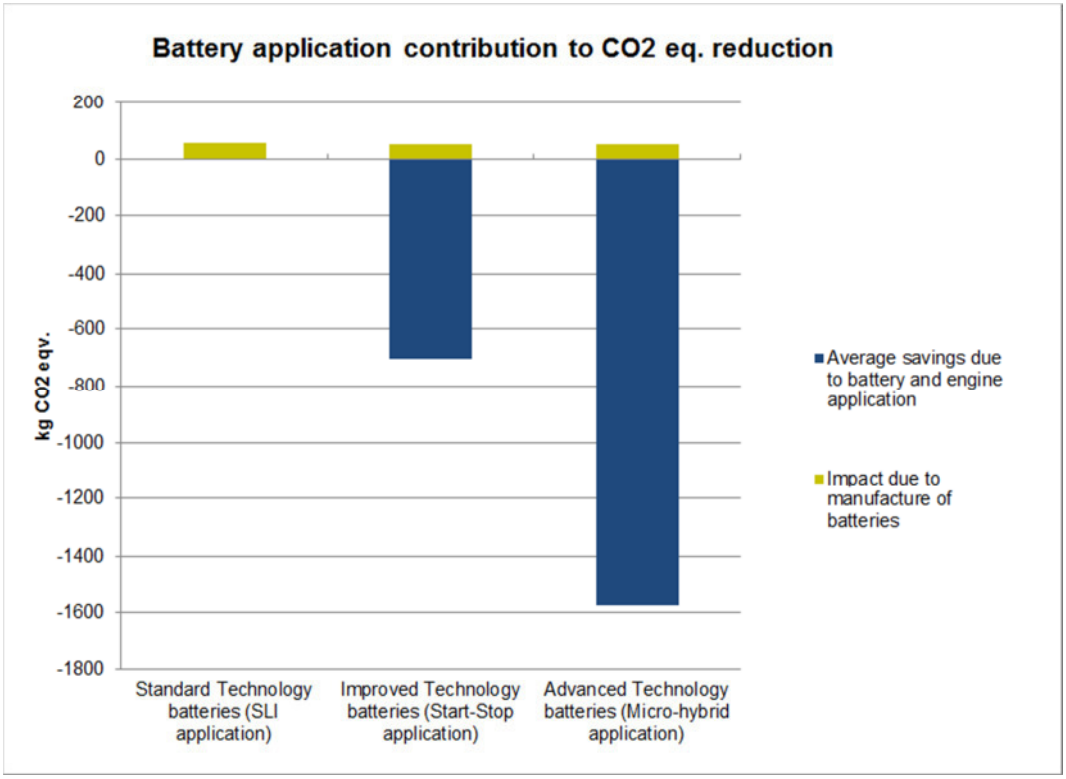

Figure 0-1: Net impacts and savings associated with batteries required over 1 vehicle's-lifetime

- **End-of-Life** - Within the EU, close to 100% of lead-based batteries are taken back and recycled in a closed loop system - a rate of recycling higher than any other mass consumer product. From an end-of-life perspective, the study finds that these sophisticated take-back and recycling schemes, as set up by the European lead-based battery industry, dramatically reduce the need for the production of additional primary lead – the most dominant source of environmental impact in the life cycle of the product

To affirm the ISO 14040/44 conformity of the study, a critical review was carried out, as specified in the Goal and Scope sections of the report.