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# INCOBAT: 2nd Periodic Report Publishable Summary

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| <b>Project</b>         | INCOBAT          | <b>Project Number</b>   | 608988                 |
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## 1 Publishable Summary

In recent years, electric mobility has been promoted as the clean and cost-efficient alternative to combustion engines. Although there are already solutions on the market, mass take-up did not yet take place. There are different challenges that hinder this process from an end user point of view such as costs of the vehicle, driving range, or infrastructure support. Several of these challenges are directly connected to the battery, the central element of the full electric vehicle (FEV). The costs of the battery sum up to 40% of the total costs of a FEV, and the range of a FEV is strongly reduced in comparison to the combustion engine.

On 1st of October 2013, the research project INCOBAT started under the coordination of AVL List GmbH (Austria). The aim of INCOBAT is to provide innovative and cost efficient battery management systems for next generation HV-batteries. To that end, INCOBAT will propose a platform concept in order to achieve cost reduction, reduced complexity, increased reliability as well as flexibility and higher energy efficiency.

The consortium joins the partners AVL List GmbH, Ideas&Motion, Fraunhofer ENAS, Infineon Technologies AG and Austria AG, Impact Clean Power Technology S.A., Manz Italy Srl and Chemnitzer Werkstoffmechanik GmbH and is in the position to provide a 100% European value chain for the development of next generation HV battery management systems.

### Objectives

The main objectives of the INCOBAT project are:

- Very tight control of the cell function leading to an increase of the driving range of the FEV by 30% for current chemistry and by a factor of 10 and more by enabling the use of new cell chemistries such as LiS or even Li-air
- Radical cost reduction of battery management system – factor of 10 (at least) with respect to current solutions
- Development of modular concepts for system architecture and partitioning, safety, security, reliability as well as verification and validation, thus enabling efficient integration into different vehicle platforms.

### Approach

The INCOBAT project focuses on the following 12 technical innovations (TI) regrouped into four innovation groups (see Figure 1):

- **Customer needs and integration aspects:** ensures a correct identification of customer needs and enables an efficient integration into different platforms. This is supported by the use of mission profiles (TI-01) – in order to take into account the different driving styles of the customers, the different traffic conditions in the same scenarios and the different tracks – and by the integration into a demonstrator vehicle (TI-12)

- **Transversal innovation: consistent concept and specification:** This second group targets the optimisation of the system architecture and its consistent description over the technologies and over the system hierarchies. This aspect aims at providing a consolidated basis in order to simplify later industrialization of the proposed technologies. This includes the TI-02 “Model-based systems engineering” to improve correctness / completeness / consistency of system specification, the TI-03 “System architecture - efficient partitioning of the functionalities” for system optimization at BMS or even vehicle level and the TI-04 “Integration of multiple functionalities” to reduce the number of electronic control units (and thus related costs) in the vehicle.
- **Technology innovation: E/E control system:** This third group aims at improving the components of the E/E control system. Regarding the electronic parts, it regroups TI-05 “TriCore AURIX Platform for additional computing resources” and the TI-06 “Smart and integrated module management unit”. From the software part, this is achieved by the TI-07 “Modular SW platform” and by TI-08 “Improved BMS control algorithms”
- **Transversal innovation: improving system maturity:** This last group targets the evidences related to the trust on the technical solutions with respect to correct operation (TI-10 Design and validation plan including reliability consideration), functional safety and security (TI-09 Definition and integration of safety and security concept) as well as reliability (TI-11 Reliability and robustness validation). This group of technical innovations is an indicator for the maturity of the proposed technology and further provides information on the efforts required for proper integration and validation of the system.

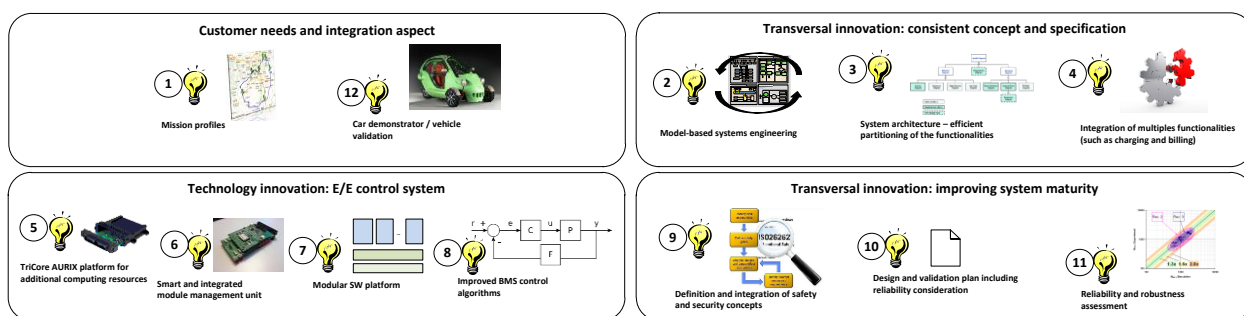


Figure 1: INCOBAT technical innovations

### Achievements to date

The second project period was focused on the milestone MS3: Lab Demonstration with beta sample. Main project efforts were allocated to WP2 (control strategy and SW) and WP3 (Battery Management Technology and Hardware), as well as the efficient and consistent specification handover to WP1 (System Design for Energy Efficiency) and the preliminary integration and verification (WP4) and preliminary platform evaluation (WP5) for selected components. Following specific outcomes shall be highlighted

- Completion of system architecture specification with SysML. This description comprises main battery targets as well as functional and logical architecture
- Development of methods and tool prototype to automatically transfer SW architecture information (AUTOSAR aligned) from authoring tool for Systems Engineering to SW engineering. This covers especially SW component, task information (operating system), basic SW, HW-SW interface.
- Development of combined methods for safety, security and serviceability analysis, in order to improve and homogenize identification of dependability targets
- Finalization of battery module demonstrator hardware assembly
- Finalization of local monitoring unit chip and board
- Execution of reliability analysis of the local monitoring unit
- Major advance regarding EIS – both from electronic HW (dedicated PCB) and SW point of view
- Preparation of HW battery module
- Preparation of vehicle demonstrator

Important to mention as well are the dissemination activities with 16 peer-reviewed publications, 4 poster presentations, and 2 newsletters as well as a dedicated cluster workshop to exchange information between related projects.

### **Impact/expected impact**

Over the years the E/E systems have steadily increased their value on the vehicle: the current estimate accounts for almost 30% of the entire vehicle costs. A foresight of the market in the next years shows the x-EV will exceed 10% of the total market share in 2020, leading the value of the semiconductor per car around 700 USD in 2020 (it was ~320 in 2008) with more than 5 million electrical vehicles. INCOBAT project targets to strengthen the European position in the worldwide market helping Europe in keeping the necessary know-how and in seizing the opportunities of the market by providing new and innovative platforms and solutions for the industrializations of the electrical vehicles, while curtailing the costs and improving the performances. Impacts of the INCOBAT project on the market position of Europe and on the objectives of the work program are the following:

- Improved energy efficiency and extended driving range of the FEV
- Increased performance and reduced costs of the electronic components and the overall FEV produced in Europe.
- Significant improvement of FEVs' safety and comfort
- Strengthened global competitiveness of the European automobile, ICT and battery sectors; market penetration of key components of FEVs.

**Project Consortium:**

| <b>Partner</b>  | <b>Country</b> |
|---|----------------|
| AVL List GmbH   | Austria        |
| Ideas&Motion  | Italy          |
| Fraunhofergesellschaft zur Förderung der angewandten Forschung E.V. | Germany        |
| Infineon Technologies Austria AG                                    | Austria        |
| Infineon Technologies AG  | Germany        |
| Impact Clean Power Technology S.A.                                  | PL             |
| MANZ Italy SRL  | Italy          |
| Chemnitzer Werkstoffmechanik GmbH                                   | Germany        |

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