	EUROPEAN COMMISSION RESEARCH AND INNOVATION DG	Final Report

Project No: 266074

Project Acronym: SmartBatt

Project Full Name: Smart and Safe Integration of Batteries in Electric Vehicles

Final Report

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Final Report

PROJECT FINAL REPORT

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Final Report

Please note that the contents of the Final Report can be found in the attachment.

4.1 Final publishable summary report

Executive Summary

4.1.1 Executive summary

Since the successful SmartBatt-Kick-Off-Meeting (Full title: Smart and Safe Integration of Batteries in Electric Vehicles, duration: 2 years) held at the Austrian Institute of Technology (AIT) in January 2011 and during the entire project duration the communication and cooperation between partners was very well and efficient. According to the meeting plan several meetings were aligned and sequenced. To ensure quick information exchange and to keep travel costs low periodically WebEx telephone conferences (to synchronize and share action items between involved partners) were organized.

The successful project review (RV1) was held with the project officer Mr. William Bird and the entire SmartBatt consortium in February, 2012 in Bremen at Fraunhofer IFAM.
By end of May 2012 the change of Mr. William Bird as project officer for SmartBatt occurred and Mr. Robert Szczepanski was introduced as new project officer.

Main goal of the SmartBatt project was to develop an innovative multi-functional and at the same time safe lightweight construction housing for the battery system of purely electrically operated vehicles of the future. Here the battery case is no longer a separate supplement to be considered for the design of the bodywork but a fully integrated and basic structural component of the vehicle body (e.g. vehicle underbody).
The built-up of the fully functional SmartBatt prototype highlights the success of the SmartBatt project and was exhibited at the European Electric Vehicle Congress (EEVC 2012, 19th – 22nd November) in Brussels to a broad public. The Close Down Meeting was held at SP (Sweden); according to the permitted SmartBatt project prolongation of 3 months, the project was concluded successfully by end of March 2013.

Main challenges of the realized smart integration were the combination of lightweight design with a high safety level against all kinds of hazards, the optimization of functions and the intelligent design of interfaces to various on-board systems.
The consortium was well backend of 9 companies and institutes from 5 European countries with good reputation:
• AIT Mobility Austria
• AIT LKR Austria
• Axeon United Kingdom
• Fraunhofer Germany
• Impact Design Europe
• Ricardo United Kingdom
• SP Sweden
• TU Graz Austria
• VOLKSWAGEN Germany

The expertise of all partners comprised complete vehicle competence, electrics, electronics, batteries, lightweight design, engineering, materials, testing and validation.
The exploitation was not limited to the partners and results are distributed on different ways e.g. project website, papers or trainings as well as face-to-face workshops and meetings with OEMs.

Public website:
www.smartbatt.eu

Summary description of project context and objectives

4.1.2 Summary of project context and objectives

4.1.2.1 Project context

The European countries are committed to keep on reducing CO_2 emissions and slowing down the climate change. For the individual transport system, the pure electric vehicle technology powered by “green” electricity offers a great chance for an important contribution to the protection of the environment. Resulting from low energy density of batteries and the need to offer a convenient range, the battery packs of the near future will be heavy and bulky (despite the latest advances in Li-Ion cells). The project context of SmartBatt (full title: “Smart and Safe Integration of Batteries in Electric Vehicles”) is to develop and proof an innovative, multifunctional, light and safe concept of an energy storage system which is integrated in the electric car’s structure. The main challenges of this smart integration are the combination of lightweight design with a high safety level against all kinds of hazards, the optimization of functions and the intelligent design of interfaces to various on-board systems. In order to meet the various challenges, a well-balanced consortium of 9 companies and institutes from 5 European countries with good reputation was formed capable of viewing on the problem from all important sides and willing to contribute with their knowledge and capacities to the solutions for this specific topic.

Goals of the SmartBatt project and partners:
The goal of the SmartBatt project is to develop an innovative multi-functional and at the same time safe lightweight construction housing for the battery system of purely electrically operated vehicles of the future. Here the battery case is no longer a separate supplement to be considered for the design of the bodywork but a fully integrated and basic structural component of the vehicle body (e.g. vehicle underbody).
To achieve this goal multidisciplinary domains of engineering sciences (e.g. electrical engineering, chemistry, mechanics, material sciences) have to come to appliance in an interdisciplinary way.

Difference of SmartBatt compared to other battery research programs:
In purely electric driven vehicles there is a high claim to energy- and power density of the battery systems. But in foreseeable time battery and cell technology will not be so far advanced that they fulfill the wishes of the OEMs and their customers. Thus, the battery system will have the largest proportion in the total vehicle weight.
The SmartBatt project – in contrast to other battery research programs – seeks to reduce the overall weight from the battery system by an optimization of the housing structure and through intelligent vehicle integration. The objective will also be reached through innovative simulation tools and the combination of lightweight construction and new, innovative lightweight materials. A complete “tool chain” will be provided for the development of such a lightweight housing that nevertheless has to comply with highest safety standards.

4.1.2.2 Project objectives

Management (WP1)
Efficient communication and cooperation between partners were ensured during the entire project duration. Meetings were aligned and sequenced. To ensure quick information exchange and to keep travel costs low periodically WebEx telephone conferences (to synchronize and share action items between involved partners) were organized. The SmartBatt project ended successful in March 2013.

Specification analysis / requirements (WP2)
Objective(s):
"Set up of a target specification for the SmartBatt housing." In WP2 the main result shows a list of specifications and targets for the smart battery. It comprised electrical, mechanical, crash, environmental, thermal and miscellaneous requirements. These requirements were developed from an analysis of currently used standards and specifications and the knowledge of all partners.

Concepts & feasibility study (WP3)
Objective(s):
"To develop the concepts for smart battery integration. Takes inputs from WP2 (target specification) and WP4 (risk assessment). Detailed development of the proposed concept is undertaken in WP5."

Aim of this work package was to develop concepts for the smart battery integration taking inputs from WP2 (specification analysis / requirements) and WP4 (risk assessment). Rather than the planned single concept 4 concepts were under consideration. At the end of the review period the final selection was made from the results of WP4. The key milestone M3 (concept to be carried forward into WP5) has been met on 20th January 2012 and the deliverable report D3.1 (report on concepts) was completed and approved by all partner organisations on 8th February 2012.

Risk Assessment (WP4)
Objective(s):
"Describe all relevant risks that are seen on battery integration and on operating a battery in a vehicle. The view of the risks will cover the whole life cycle from assembling, handling, mounting into the vehicle, operating, maintenance and service, dismounting and recycling".
The risk classes to be considered are:
• Electrical hazards as specified in WP2 description
• Thermal
• Mechanical
• Chemical, toxicity
• Crash and dismounting after crash
• Environment
• Fire
• Abuse
In order to describe all relevant risks that are seen on battery integration and on operating a battery in a vehicle, a theoretical and an experimental approach were applied within WP4.
From the theoretical point of view a generic battery design FMEA was generated considering implications on cell, housing, hardware, software and vehicle level with inputs from every partner.
The major risks identified were:
• Water, both ingress and condensation
• Coolant leakage
• Mechanical protection against crush and crash

A testing plan has been developed based on the outcome of WP2, WP3 and the theoretical risk & failure analysis. Cells have been purchased and prepared for the tests and distributed to the testing partners and facilities booked for the tests. The following tests have been conducted:
• Thermal Shock Test
• Mechanical Shock Test
• Overcharge Test
• Nail Penetration Test
• Hard Short Circuit Test
• Thermal Stability Test

Design & Development (WP5)
Objective(s):
"Based on the results of the specification analysis and requirements study (WP2), the concept and feasibility study (WP3) and the risk assessment (WP4) a detailed design solution for the lightweight and safe battery system will be developed.
In this context, multiple aspects will be considered, which are important for function and reliability of the design".
• Material selection (metallic, non metallic (e.g. reinforced plastics), composites etc.)
• Multi-attribute optimization (weight, cost, volume, safety and reliability) with special focus on stiffness, cooling and thermal properties, fire safety, electrical safety, EMC properties, structural durability, crash worthiness and vibration behaviour
• Interfaces (electrical, thermal, mechanical)
• Applicable manufacturing techniques

In WP5 the final design for the SmartBatt demonstrator was developed and realized in CAD. With the input of WP2, WP3, and WP4 the consortium decided to use prismatic cells. The consortium worked in two subgroups – housing group and inner parts group – to finalize the WP5 in time.
The inner parts group focused on the module design and the electrical components. Solutions for modules, BMS and wiring were found.

The housing group focused on the mechanical integration of the SmartBatt battery system. Innovative materials were used, for example APM hybrid sandwich material for the cover and cast aluminium for the tunnel. Functional integration helped to meet the weight and safety targets D2.1. The ratio between cell mass and the total mass is over 80%, which is well over the assumed target of 75%. A detailed list of parts and their mass is listed in D5.2. First results showed also an improved crash safety compared to the SLC.
The SmartBatt battery system can store 23 kWh of electrical energy. With a total mass of 155 kg the gravitational energy density is 148 Wh/kg on system level. The SmartBatt battery system has 85% higher energy density in comparison to state of the art vehicles like the Mitsubishi i-MiEV (80 Wh/kg) or Nissan Leaf (80 Wh/kg).

Hardware Build-up & final Validation (WP6)
Objective(s):
"Build a sufficient number of evaluation models for testing them against the different criteria's based on the requirements from WP2".
• Demonstration of the final concept for battery integration
• Validation of the battery housing to get measurable criteria's

Evaluation models for testing them against the different criteria's based on the requirements from WP2 (specification analysis / requirements) were developed and built up:
• Build up and validation of housing and cover (floor structure dummy)
• Build up and validation of battery modules
• Build up and validation of fully functional battery package
• Build up of evaluation model for validation of crash worthiness of the battery- and car structure (test-bench: parts of the housing – assembly process)
The demonstration of the final concept for battery integration was realized and presented on the EEVC 2012 in Brussels to a broad public.
Validations of the battery housing to get measurable criteria's were performed and tests relating to different safety/protection aspects were conducted:
• High voltage/current related basic safety aspects
• International Protection code (IP tests)
• Fire resistance testing in order to identify the behavior of the housing in case of external fire
• Electromagnetic compatibility test on fully functional battery package with simulated electromagnetic fields that are typical on electric vehicles, coming from high voltage and current and from fast switching devices.
• Basic functional test on fully functional battery package
• Crash and deformation test of the demonstrator (front pack) built up and equipped with used cells in order to demonstrate the battery integration

Assessment (WP7)
The objectives of this work package are to:
• Identify and assess the potential improvement of the developed technology for the electric vehicle (EV) market
• Quantify the cost benefit of the new developed technology against other commercial solutions

The work package answered the question "what were the improvements/benefits with the proposed solution?". The objectives of WP7 were to identify and assess the potential improvement of the developed technology for the electric vehicle (EV) market and to quantify the cost benefit of the new developed technology compared to other commercial solutions.
Summary:
• Weight reduction of battery housings and compensating this mass with additional battery cells will improve driving range of BEVs
• Technological edge within lightweight design (innovative materials and innovative production technologies)
• The SmartBatt concept is suitable for mass production and the cost outlook indicates potential in price reduction for cells
• Participation in standardisation committees such as ISO/TC 22/SC21 WG3 Electrically propelled vehicles, Lithium Ion traction batteries and UNECE/REESS amendment to R100 Battery Electric vehicle safety for Lithium Ion batteries

• Reviewed standardization of cells, modules, battery management system, electrical connectors and communications and battery enclosure. Existing standards partially identified

Exploitation (WP8)
The objectives of this work packages are to:
• Communicate the goals, approaches and results of the SmartBatt project to the electric vehicle (EV) community and the broader public
• Promote the results of the SmartBatt project to the automotive value chain to accelerate uptake of the innovation
• Identify framework needs in terms of regulations and standards and policy recommendations from the project results.

In WP8 the dissemination of work was performed. This was done by communicating the goals, approaches and results of the SmartBatt project to the electric vehicle (EV) community and the broader public (conferences, press releases, newspaper, homepage), secondly to promote the results of the SmartBatt project to the automotive value chain to accelerate uptake of the innovation (workshop, exhibitions and conferences). In month 4 the homepage of the project was going active and gave a short overview of the project and it is now dealing with results of WP4 and WP6.Step by Step the homepage was updated.. In May 2012 a "Battery Integration Workshop" was organized in Brussels. Consortium partners of five different EC-projects were meeting one day presenting and discussing some relevant future EV-topics. The projects were namely: SMARTBATT, ELVA, OSTLER, EASYBAT and DELIVER. 25 participants from 15 partners out of these projects joined the workshop. Five papers in different conferences were published. Up to now 9 oral presentations were held at conferences (i.e. ECCOMAS-2012 in Vienna and at the EEVC-2012 in Brussels), at workshops (fire-fighter workshop) and exhibitions.

4.1.2.3 Final results and their potential impact and use

The SmartBatt project focuses on the physical integration of heavy and bulky battery packs in the structure of pure electric and plug-in vehicles. This is relevant for such electric vehicles since it particularly focuses on the development of innovative concepts for the physical integration in the vehicle structure by considering different sometimes contradicting issues like the smart integration of the battery pack in the various on-board systems, the interfaces to electric, cooling and monitoring devices and an increased safety level regarding normal operating and abuse load cases (including electrical- or fire hazards) and an reduced mass ratio (related to the actual mass of the cells).
Final results:
• offer the technological basis for a new generation of light, safe and smart battery systems
• improve the safety of electric vehicles
• economic benefits to customers by developing an integrative battery topology system
• ensure competitiveness of Europe's engineering and automotive industry
• secure employment in the manufacturing sector by technological leadership
• provide an added value due to European R&D work through its intrinsic effectiveness synergies

Significance of cross-border cooperation for the battery research:
In order to have a real impact on the green economy, the research in the field of electric and hybrid vehicles must include all aspect of the electric vehicles technologies in close conjunction with the rest of the transport system including smart electricity grids or intelligent vehicle charging systems tailored to market needs. Another important aspect is smart electrical storage in vehicles.
Due to the cross-border cooperation of different partners, the requirement for reduction of CO2 emissions in the EU countries can be met, particularly as the individual passenger transport will grow steadily in future. The development related to e-Mobility in general and battery research specifically can give a valuable contribution for this purpose.

Description of main S & T results/foregrounds

4.1.3 Summary of main results

WP1 Management (WP1)

To guarantee that all processes (e.g. information exchange, synchronization, identifying of possible

issues and taking proper counter measurements) were working well, the consortium management stood on the top of the work plan. During the entire project duration the communication and cooperation between partners was very well and efficient. To ensure quick information exchange and to keep travel costs low periodically WebEx telephone conferences were organized. The coordinator reviewed the reports respectively the deliverables in order to verify consistency with the project tasks before submitting them to the EC.
Since the successful SmartBatt-Kick-Off-Meeting held at the Austrian Institute of Technology (AIT) in January 2011 and according to the meeting plan several meetings were aligned and sequenced.
The successful project review (RV1) was held with the project officer Mr. William Bird and the entire SmartBatt consortium in February, 2012 in Bremen at Fraunhofer IFAM.
By end of May 2012 the change of Mr. William Bird as project officer for SmartBatt occurred and Mr. Robert Szczepanski was introduced as new project officer.
The Close Down Meeting was held at SP (Sweden) and according to the permitted SmartBatt project prolongation of 3 months, the project was concluded successfully by end of March 2013.

WP2 Specification analysis / requirements

Summary:
Workpackage 2 was structured into three tasks. Task 2.1 gave an overview of current and future standards. A list of norms and requirements relevant for Smartbatt was compiled based on a review of standards and regulations worlds wide. Investigations were made in detail on: UNECE R100, UNECE R100-02, UNECE R10, ISO7010, ISO 16750, ISO 6469, ISO20653, ISO12405, IEC 60950-1, IEC 60664-1 SAE J2464, SAE J1742, SAE J1654, SAE J1673, SAE J 2929, FreedomCAR, UN Manual: UN 38.3 Transportation; FMVSS305, UL1642, UL2580, etc. In this task was the broad experience from all of the partners beneficial.
In task 2.2 the system borders in the project were defined. Here the consortium agreed on the analysis of the SmartBatt in the surrounding of the SLC reference model. By the usage of a full vehicle model boundary conditions and system borders could be derived more easily. Most important are the static and dynamic load cases which the battery needs to resist safely.
Targets that the concept needs to fulfill have been defined in task 2.3. Here the consortium agreed on seven targets in the fields of range, weight, volume, static and dynamic behavior as well as cost. Furthermore the boundary conditions investigated in the previous task have been summarized in a catalogue of requirements by means of further analyses of the SLC body.
For the SmartBatt project targets have been defined in different areas which will be described briefly in the following:
Range:
The consortium agreed on a battery system for a city EV. In this case a range of approx. 100km in the NEDC is sufficient. Considering a vehicle with approx. 1350 kg weight useable energy of 20 kWh will be provided for the battery system.
Weight:
The battery system that is going to be developed in the SmartBatt project will be characterized by lightweight design. Most of the weight of the battery system is caused by the battery cells. As this project does not focus on the battery cells but on the housing, the weight target is not favorised to be displayed as an absolute value but as the relation between housing and cells. In current battery systems, e.g. in the Nissan Leaf or in the Mitsubishi I-MIEV, the cells contribute to the system’s weight by 60%. In this project the relation should be increased to 75%.
Volume:
A volume reduction of the system is expected by the comprehension of the surrounding structure into the battery system.
Durability:
In order to make use of new weight potentials a fatigue resistance for the traction battery can be approved which is comparable to the cell life time (approx. 150.000 km). This kind of concept can be completed by spare parts which are to be replaced as well when changing the battery cells. Also a change of the complete battery at the end of the cells’ life time is possible.
Crash Safety:
As described in the previous chapter points have been defined in which the concepts can be compared with. This allows a comparison to the reference model whereas the values in these points should not be worse than those measured in the reference model, SLC.
Static Requirements:

Due to volume and weight it is recommended to integrate the traction battery into the vehicle structure in order to make use of the potentials of this structure also in the car body. In doing so the torsion should be checked and values comparable with the SLC reference model need to be generated. In doing so the torsion as well as the first natural Eigen frequency should be checked and values comparable with the SLC model should be generated.
Costs:
The cost target can be described by additional expenses per kilogramme weight reduction. In case of the implementation of traction batteries the number of required battery cells is reduced by every kilogramme saved. Considering typical values of 300 EUR per kilowatt hour saved can result in a cost target of 6 EUR per kilogramme saved at the battery. Lightweight design methods implemented that exceed this value are not recommendable from the financial point of view. Creating List of Requirements should also be mentioned as a highlight of the SmartBatt program because the very new approach of a full integrated battery in the vehicle structure must be clearly described by a list of requirements which was created within the SmartBatt consortium.

WP3 Concepts & feasibility study

Work Package 3 was largely completed in the 1st reporting period. Rather than the planned single concept, four concepts were under consideration at the end of the review period the final selection was made from the results of Work Package 4 (Safety). The deliverable document report D3.1 was completed and approved by the consortium partners.
The vehicle requirements dictate that an energy source of 20kWh is required with a continuous output of 42kW and transient (30s) capability of 70kW.
The cell selection criteria were based upon the following:
1. Cost Comparison
2. Thermal Analysis (using Ricardo development tool)
3. Safety considerations:
a. Thermal Shock
b. Overcharge
c. Nail penetration
d. Crash simulations
One candidate cell was rejected from a cost viewpoint and a second from a packaging viewpoint leaving two good candidates and a single packaging location. Input from Work Package 4 (“Safety”) and further packaging analysis eventually resulted in a single cell selection - this criterion was met by a split pack battery system (LMO-LCO prismatic cell selection) / packaging location which allowed the project to move forward to Work Package 5 for detailed design.
All partners provided major inputs to this work-package, especially Impact Design who provided significantly more than their anticipated work to ensure the pack will meet the latest crash test standards. This work demonstrated that suitable tools and processes were in place to share data (especially CAD data) between the partners to allow the required parallel working.

WP4 Risk Assessment

In order to describe all relevant risks with battery integration and operation, a theoretical- and an experimental approach was applied. Each identified risk was quantified by probability of occurrence, probability of damage and probability to detect or prevent the damage.
Theoretical risk & failure analysis
A generic battery Design-FMEA was generated considering implications on cell, housing, hardware and software and vehicle level with inputs from every partner.
The major risks identified were:
• Water, both ingress and condensation
• Coolant leakage
• Mechanical protection against crush and crash
All the major risks were associated with cell damage, which could either release harmful material or inflammable gases. This was in accordance with expectations.
Major risks identified in the Battery sections were associated with high temperature, over-current and over-voltage. They can mostly be mitigated by competent design, apart from the over-temperature conditions which occur as a result of cell malfunction caused by internal defects, which remain the most dangerous conditions identified and can only be further mitigated by restricting the extent of

their damage through careful mechanical design.
Experimental analysis
The objective was to support the theoretical risk & failure analysis with experimental data on risks in crash and other possible scenarios for two different cell types under consideration for the prototype:
1. NCM (Nickel Cobalt Manganese) pouch cell type or
2. LMO-LCO (Lithium Cobalt Manganese Spinel) prismatic cell type.
A testing plan was developed based on the outcome of WP2, WP3 and the theoretical risk & failure analysis. Cells were purchased and prepared for the tests and distributed to the testing partners and facilities booked for the tests. The following tests have been conducted:
• Thermal Shock Test
• Mechanical Shock Test
• Overcharge Test
• Nail Penetration Test
• Hard Short Circuit Test
• Thermal Stability Test
The mechanical shock testing showed no safety issues on NCM pouch cells and LMO-LCO prismatic cells. There was no reaction and all cells passed the tests.
The two tests Overcharge and Nail Penetration showed significant differences in the behaviour of the two candidate cells of type NCM (87Ah) and type LMO-LCO (4400mAh). One should however bear in mind that the overcharge current used in the test of the NCM pouch cells is very high. This demonstrates that tests procedures such as the widely used SAE J 2464 does not mimic possible situations for all kinds of cells. The design process in WP5 showed that the LMO-LCO prismatic type is the cell to use in order to be sure to meet the weight saving goal and as the safety tests here did not show any severe results for the LMO-LCO cells it was agreed to follow the LMO-LCO paths.
Summary:
A comprehensive generic battery Design-FMEA (Failure Mode and Effects Analysis) was generated (over 110 items).
Huge differences are shown between various safety test results on NCM pouch cells (87Ah) and LMO-LCO (4400mAh) prismatic cells.
Whereas NCM cells and LMO-LCO cells showed no safety issues on thermal and mechanical Shock tests, NCM types showed significant risks on Overcharge and Nail Penetration tests. This led to the decision to skip NCM pouch cell design and focus on LMO-LCO prismatic design.

WP5 Design & Development

Main target of WP 5 “Design & Development” was the realization of the detailed design of the SmartBatt battery system. The result of WP 5 is a detailed description of the prototype to be build-up in WP 6 “Hardware Build-up & final Validation”.
Based on the results of WP2 “Specification analysis & requirements”, WP3 “Concepts & feasibility study” and WP4 “Risk Assessment” a detailed design solution for a lightweight and safe battery system was developed and build-up as a CAD model.
WP 5 started in month 9 and ended in month 18. CAD models of modules and pack housing as well as the mounting solution were set-up. Two concepts with different types of cells were build-up, analysed and reviewed (D5.1). The result of this analysis was the decision for the concept using prismatic cells. Overall evaluation and optimization of the design were performed by several simulation tools. Several alternative detail solutions were considered and analyzed with respect to multiple attributes like mechanical, electrical, and thermal properties, producibility and maintainability and costs.
After the decision on the used cell type the work was done in two subgroups. The so called housing group focussed on the design of the housing, regarding for example material selection, mechanical attributes, design space, integration into the body in white (BiW), and sealing. Members of this group are AIT, ID, IFAM, LBF (lead), LKR, SP, TUG and VW. The inner parts group focussed on the modules and the electrical connections. Topics were for example battery management system (BMS), HV connectors and bus bars, sensors and harness, module design, insulation, and welding techniques. To the second group belonging AIT, Axeon, LBF, Ricardo (lead), TUG and VW
Working in two subgroups enabled an intensive topic related communication between the relevant partners. A high frequency of telephone/internet conferences between the partners inside the subgroups distributed information to all partners. Problems could be discussed and solved in short time. The communication between the groups was done via the members of both groups and the WP

leader (LBF). This approach enabled the consortium to finish WP 5 in time. The optimized CAD design of the SmartBatt prototype was available in June 2012 (MS 7) and transferred to WP 6 “Hardware Build-up & final Validation”.
The SmartBatt battery system will meet the weight targets formulated in (D2.1) as well as the safety targets. The total mass of the SmartBatt battery system prototype is 155 kg. The ratio between cell mass and the total mass is over 80% , which is well over the assumed target of 75%. The SmartBatt battery system can store 23 kWh of electrical energy. On system level the gravitational energy density of the SmartBatt prototype is 148 Wh/kg, which is beyond state of the art. First results showed also an improved crash safety compared to the SLC.

WP6 Hardware Build-up & final Validation

1) Hardware Build-up
One of the main targets of WP6 (Hardware Build-up & final Validation) was the realization of the detailed design of the SmartBatt battery system. The result of WP6 is the prototype to be build-up. Base for the work of WP6 were the previous work packages WP2-WP5.
The hardware build-up comprised the validation of the housing and cover (i.e. floor structure dummy). The performed work were allocated between the partners according to their skills and documented in D6.1 (evaluation models, nature: demonstrator).
The gained results covered the
• build-up and validation of housing and cover (floor structure dummy),
• build-up and validation of battery modules,
• build-up and validation of fully functional battery package,
• build-up of evaluation model for validation of crash worthiness of the battery- and car structure (test-bench: parts of the housing – assembly process)

The complete assembled and fully functional battery SmartBatt prototype reflects the main highlight of the SmartBatt project. The exhibition of the prototype during the EEVC 2012 led to large media resonances (newspapers, radio, television).

2) Final Validation
The outcome of the final validation within WP6 is documented in in the summary of test reports (D6.2) which deals with the detailed test results conducted within the Task 6.3 – Tests. D6.2 were highly correlated on the outcomes of deliverable D6.1 (Evaluation Models) and were finally conducted after building up the housing and cover (floor structure dummy), the battery modules and the fully functional battery package.
A testing plan was developed based on the outcome and discussions after the WP6-Kick-Off meeting held in Vienna April 2012. The following tests were performed by SP, AIT Mobility and TU Graz:
• IP tests
Classification of degree of protection was performed according to ISO 20653:2006, IP6K9K for the SmartBatt battery housing prototype. As adhesive sealing material, between the top and bottom cover of the battery housing, polyurethane adhesive was used. The classification was performed for an empty battery housing prototype i.e. no batteries or electronics were present at the time of the classification. Manual service disconnect was mounted during all the time of the tests.
• Explosion tests
A worst case scenario is that one or two cells vent without any immediate ignition. If that happens then combustible gas will spread within the casing and mix with air and thus form a flammable mixture. The amount of gas in one cell is sufficient for a flammable mixture in the whole volume. In order to mitigate the consequences of this rather unlikely incident the casing was equipped with three explosion vent valves. It was tested and verified if three valves are sufficient in an explosion test.
• Fire resistance test
Fire resistance testing in order to identify the behavior of the housing in case of external fire Classification of fire resistance was determined for the SmartBatt housing prototype in accordance with the test procedure described in “Fire Resistance” of Regulation No. 100 Uniform Provisions Concerning the Approval of Vehicles with Regard to Specific Requirements for the Electric Power Train . One fire resistance test was conducted on the SmartBatt housing prototype after the ISO 20653:2006, IP6K9K testing was complete. The test was also used as validation for the simulations conducted.
• Electromagnetic compatibility test

Electromagnetic compatibility test on fully functional battery package with simulated electromagnetic fields that are typical on electric vehicles, coming from high voltage and current and from fast switching devices.
The battery pack was tested as an Electronic Sub Assembly according to UN ECE Regulation 10 Revision 4:2012. The tests covered radiated emissions (broadband and narrowband) according to CISPR25, radiated immunity according to ISO 11452-2 (ALSE) and ISO 11452-4 (BCI).
• Environmental test
The environmental test shows that the electronics have no difficulties to send out voltage information upon exposure to temperatures of -10 °C and +60 °C. The voltage read out stayed constant at 330 V throughout the whole test; at room temperature, -10 °C, +60 °C and again at room temperature. The test could not give any information about the battery packs behaviour during change of temperature since only temporary measurements (no continuous logging of data) were performed.
• Basic functional tests
Basic functional tests on fully functional battery package (shut-off at overcharge, discharge and overtemperature with functional safety device enabled) were performed.
• High voltage/current related basic safety aspects on module level
High current test/short circuit was performed according to SAE J2464.
Overcharge tests were performed according to SAE J2464:2009
Nail penetration tests (one cell inside module) were performed according to SAE J2464:2009
• High voltage/current related basic safety aspects on system level
Insulation-, dielectric strength test was performed according to ISO6469-3
• Crash and deformation test
The demonstrator was be built up and equipped with used cells in order to demonstrate the battery integration.
Within the project it was possible to build up two structures for experimental analysis in order to validate the simulation model and also to show in real conditions that the combination of different lightweight materials and crash absorbing structures can improve safety when it comes to a crash. The simulation was validated against the obtained experimental data and shows very good correlation in comparison to the test results.

WP7 Assessment

WP7 answered the question “what were the improvements/benefits with the proposed solution?”
WP7 started in month 18 and ended in month 23. However, some work within task 7.3 was conducted earlier due to when suitable standardisation work has been running.
The objectives of WP7 were to:
• Identify and assess the potential improvement of the developed technology for the electric vehicle (EV) market
• Quantify the cost benefit of the new developed technology against other commercial solutions
WP7 was divided into four tasks;
Task 7.1” Effect of weight optimized energy storage system”
Two vehicle simulation scenarios were investigated in. The first was an analysis regarding the improvements in energy consumption due to less weight of the battery system. The second was an analysis on driving range improvements due to more battery capacity. Three different vehicle types were compared in standardized driving cycles and performance tests. Three different driving cycles were simulated (NEDC, FTP 72 and Artemis cycle) and energy consumption and driving range were analysed. The biggest effect on the driving range can be achieved by increasing the battery capacity while maintaining the overall vehicle mass.
Task 7.2 “Cost saving of an energy optimized energy system”
An important point in SmartBatt is the capability of a mass production ready structure. The prototype of the SmartBatt does not achieve this objective yet, but within the scope of this research project that is acceptable. Reasons for this status are innovative materials and production technologies which will finally enable the technological edge in lightweight design of the SmartBatt.
The concept is very suitable for a use in mass production since the assembly takes place from below and also it offers a mounting process like for combustion engine vehicles. An outlook about the cell cost for the next years was also given within the scope of the project. In order to bring a product to market which is suitable for mass production all components need to be produced in a cost-optimized way. An analysis was done that consider different series volumes.
Task 7.3 “SmartBatt impact of standardisation”

Standardization concerning electric vehicles is performed within ISO/TC 22/SC21 and IEC/TC 69. ISO deals with anything related to the vehicle while IEC deals with all the rest. Work on charging is done in cooperation between ISO and IEC according to a special agreement. The ISO and IEC standards are then usually adopted as EN standards. SP followed the work in several standardisation committees during the SmartBatt project. Due to the time frame for the development of applicable standards the work in this task had to be started a bit earlier than anticipated. In addition, one committee received so many comments to the suggested standard, so they took a decision in their august meeting not to accept any further comments on the standard. This means that the experiences gained during WP6 testing could not be conveyed as official comments. Other important recent development is the development of legal requirements that has taken place within UNECE/REESS there an amendment to R100 Battery Electric vehicle safety for Lithium Ion batteries has been developed and was adopted. The development took place mainly during 2011.
Task 7.4 “SmartBatt impact of easy replaceable energy storage system”
The development of the standardization of cells, modules, battery management system, electrical connectors and communications, and battery enclosure were reviewed. Existing standards were partially identified. Recommendations from battery standards organisations were highlighted. To standardize each component in the battery system still needs a long way to go. Therefore the easy replaceable energy storage system is unlikely to happen in the near future. There’s hardly any standardization work on the other components of the battery pack system. However there are some recommendations directing the future work. For example, the German Association of the Automotive Industry (VDA) has made some headway toward standardizing the overall dimensions of lithium-ion cells. Potential cost saving assuming certain level standards established up to 2030 has been studied. By 2020, a medium size car can be fitted with a 200kg pack, delivering 30kWh of energy, with a range of 250km, an expected lifetime of 12 years, for a total cost of $9620. By 2030, the same pack could weigh 165kg and cost $6400. Despite performance improvements by 2030, it is not expected that BEVs will deliver range equivalence to IC cars, because of weight limitations. The overall cost reductions arise from multiple sources, the ca. 70% reduction in pack costs predicted by 2030 arises primarily through the improvement in material properties delivering higher energy densities, and the scaling up of production of large cell packs. Safety implications and warranty issues were also addressed. The standardization and world-wide volume production will certainly drive the safety improvement and the improvement of the other parts of the system. However, the main concerns for the safety are still the cell. Warranty is not only about safety issues, but also about performance. The cell manufacturers would not warranty the battery pack if the cells are not all theirs.

WP8 Exploitation

The objectives of this work packages are to communicate the goals, approaches and results of the SmartBatt project to the electric vehicle (EV) community and the broader public (conferences, press releases, newspaper, homepage), secondly to promote the results of the SmartBatt project to the automotive value chain to accelerate uptake of the innovation (workshop, exhibitions and conferences). At least identify framework needs in terms of regulations and standards and policy recommendations from the project results (working groups for standardisation).
In month 4 the homepage of the project was going active and gave an overview of the project. But as there was a lot of research going on it needed some time to step by step updating the homepage. In May 2012 a “Battery Integration Workshop” was organized in Brussels. Consortium partners of five different EC-projects were meeting one day presenting and discussing some relevant future EV-topics. The projects were namely: ELVA, OSTLER, EASYBAT, DELIVER and SMARTBATT. 25 participants from 15 partners out of these projects joined the workshop. Five papers in different conferences were published. Up to now 9 oral presentations were held at conferences (i.e. ECCOMAS-2012 in Vienna and at the EEVC-2012 in Brussels), at workshops (fire-fighter workshop) and exhibitions.
SP has followed the work in ISO/TC 22/SC21 WG3 Electrically propelled vehicles, Lithium Ion traction batteries. In particular SP supplied comments to the CD ballot taking place March - June 2012 and made a presentation about the fire resistance tests to be included in the standard ISO 12405-3 at the ISO/TC 22 SC21 WG3 meeting in Berlin in February 2012. At that meeting SP also supplied several other comments on the working document of the standard. Another example of important recent development is the development of legal requirements that has taken place within UNECE/REESS there an amendment to R100 Battery Electric vehicle safety for Lithium Ion batteries has been developed. The amendment has been approved and is interim from 1st of march

2013 and will probably come into force March 2014.

Potential impact and main dissemination activities and exploitation results

4.1.4 Description of the potential impact

The 'European Green Cars Initiative' addresses three major research and development avenues within its RTD pillar, namely research for heavy duty vehicles based on internal combustion engines, research on electric and hybrid vehicles and research for logistics and co-modality.
In order to have a real impact on the green economy, the research in the field of electric and hybrid vehicles must include all aspect of the electric vehicles technologies in close conjunction with the rest of the transport system including smart electricity grids or intelligent vehicle charging systems tailored to market needs. Another important aspect is the smart electrical storage in vehicles.
Topics addressed
The SmartBatt project focuses on the physical integration of heavy and bulky battery packs in the structure of pure electric and plug-in vehicles. This is relevant for such electric vehicles since it particularly focuses on the development of innovative concepts for the physical integration in the vehicle structure by considering different (sometimes contradicting) issues like the integrating of the battery pack in the various on-board systems in a smart way, the interfaces to electric, cooling and monitoring devices, an increased safety level regarding usage and misusage load cases (including electrical or fire hazards) and an reduced mass ratio (related to the actual mass of the cells).
Short, medium and long term impact of SmartBatt
The outcome of the project is of very high importance to the wide acceptance of a pure electric and plug-in hybrid vehicles by buyers and drivers and has a very high relation to the success of nearby commercialization as a single hazardous event may destroy the safety reputation of the whole e-vehicle concept planned to be a great key factor in reducing the CO2 emissions of the individual transport systems (Remark: the first generation of LPG fueled cars were not allowed to park these vehicle in underground car parking order to avoid danger of fire or explosion) Therefore, novel reliable and safe high-performance battery pack systems represents one of the most important strategic technologies besides the cells with high energy density itself.
The specific impact of SmartBatt is to provide technology and expertise to enable optimized packaging of batteries within an electric vehicle. By generating such a safe and "green" offer to the vehicle customers, the ecologic impact to Europe's emission reduction programme is given. Besides the environmental effects, this is regarded as an important contribution to quality of life and health. Since the results of this project will strengthen the competitiveness and sustainability of European companies in the automotive sector in the global market, a positive economic impact of SmartBatt for the automotive OEMs and their suppliers (especially SMEs) will be of strategic interest to the EC. By maintaining and improving the technological competitiveness of the European car industry especially with respect to the pure electric vehicle systems, further employment is secured in Europe.

In a wider view, the gained results of the SmartBatt project
• offers the technological basis for a new generation of light, safe and smart battery pack systems
• improves the safety of pure electric vehicles
• brings economic benefits to customer by developing an open battery topology to select the battery from several battery manufactures
• ensures competitiveness of Europeans' engineering and automotive industry
• secures employment in the manufacturing sector by technological leadership
• promotes cooperation between researchers and industry, with an industrial share of 50%
• promotes cooperation between large competing companies, especially between Volkswagen
• provides an added value due to European R&D work through its intrinsic effectiveness synergies

The benefit for the European industries, especially for the participating industrial partners, can be summarized as follows:
• experience with innovative concepts regarding smart battery pack integration
• topical knowledge about forms of possible hazards of HV packs
• design notes for safe and light-weight housing and mounting solutions considering all relevant attributes, e.g. crashworthiness, structural durability, vibration behavior, fire resistance, maintenance aspects
• a tool chain to be applied to the specific battery integration for a specific vehicle
• open battery topology to select the battery from several battery manufactures

• recommendations regarding efficient monitoring systems

The complexity in the project tasks required a concerted research and development approach in smart integration on European level, in which the knowledge of different experts needs to be combined, i.e. concerning:
• vehicle-package interfaces
• monitoring devices and data exchange
• thermal loading
• mechanical loading
• safety issues
• manufacturing issues
• lightweight design
• material properties
• testing of new concepts

European context

The European context of SmartBatt is twofold – on the one hand related to the European automotive OEM & supplier industry an on the other hand concerning the greenhouse gas emissions.
The European scope of this project was necessary since the respective industries operate on a global framework and are competing against non-European companies. A European project was needed since countries at the national level lack sufficient critical mass to achieve the targets.
Standardization on a European level is only possible if relevant players cooperate in alignment.
In the SmartBatt project group a major European automotive OEMs was participating together with other companies and research institutes, which are also European leaders in their particular field of expertise in the relevant thematic fields like light weight design, crashworthiness, testing against hazards, materials or electric storage.
The broad replacement of internal combustion engine (ICE) vehicles with fully electric vehicles consuming “green” electricity will have a major impact on the sources of EU greenhouse gas emissions since transport in general contributes with 21%.

Global context

In the global context, the outcome of SmartBatt can be the key to future safe and economic usage of fully electric vehicles which will to contribute to global emission reduction which is an important action to stop global warming from reaching dangerous levels.
Further, global standardisation is necessary to promulgate European products in a global level. Participation of SmartBatt Partners in standardisation activities globally (e.g., ISO and UN ECE, FKM – Forschungskuratorium Maschinenbau (Fraunhofer LBF), NEP – Nationale Entwicklungsplattform Elektromobilität (Fraunhofer), UK's Automotive Technology Council (Axeon)) will foster global acceptance of European products and ensure that European standardisation (CEN) is in alignment with similar global activities.

Dissemination of knowledge within the consortium

Due to the fact that the performance of the SmartBatt work plan required an intensive collaboration of the project partners, an efficient and extensive knowledge exchange was essential for the project success. Therefore different management tools were applied to ensure this information and knowledge exchange.
• For a fast start-up, an introduction of the different competences, research areas and involved research staff as well as for development of cooperation and communication rules a kick-off meeting was organised by the coordinator. In this way the project was launched effectively and clear communication patterns were established.
• For data and document exchange a project server and project website was implemented allowing easy handling and sharing of simulation and testing data, results, reports and further documents.
• For documentation of the developed knowledge the reports were used. Furthermore internal workshop were organised twice a year by the coordinator to present and discuss the latest results, their impacts and follow-ups. All reports are available on the project sharepoint (restricted area only for project partners).

Dissemination of knowledge beyond the consortium

Dissemination of developed knowledge beyond the consortium is a key issue to improve knowledge and to support the development of electric vehicles in a broad sense. Therefore work package 8 covered the dissemination part. The dissemination covered the following issues:
• Dissemination on scientific level: the academia and research partners (e.g. AIT, Fraunhofer, SP,

TUG, and Ricardo) took part at national and international conferences and presented and discussed the results with the related scientific forum. In addition, project knowledge was disseminated by writing scientific publications that have a high reputation or by writing for project-field-related magazines.
• Integration of know-how into other projects: the project partners applied and communicated the developed knowledge in related projects and by that contributed to an extension and application of the developed knowledge especially. The partners disseminated their knowledge within their different scientific and industrial networks and by that improve and further develop the knowledge in related technologies.
The technical coordinator established and maintained a project website with a public. The public website is used to provide information on the research results on a general level. Special emphasis will be given to increase awareness of the safety issues of batteries for electric vehicles and its handling by providing adequate information on the website.

Exploitation
The strong industrial group guarantees efficient exploitation of the results. Forms of exploitation cover:
• Offering of adequate services to all customers (mainly testing)
• Using the new results by manufacturers, suppliers and engineering companies
• Improved attractiveness of applied research entities
• Improved standardization of battery pack production

The partners anticipate that the direct (to the partners) total value of the exploitation will exceed €30M over the next 10 years, while the cost savings achieved will save the industry > €1B over the same time period.
Impacts: Efficient development processes for battery integration solutions, suitable design solution for detail problems, evaluation of standardization potentials, multi-domain analysis: Holistic optimization of the battery integration system.

Address of project public website and relevant contact details

www.smartbatt.eu

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4.2 Use and dissemination of foreground

Section A (public)

Publications (peer reviewed)

LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES										
No.	Title / DOI	Main author	Title of the periodical or the series	Number, date or frequency	Publisher	Place of publication	Date of publication	Relevant pages	Permanent identifiers (if applicable)	Is open access provided to this publication ?

LIST OF DISSEMINATION ACTIVITIES								
No.	Type of activities	Main Leader	Title	Date	Place	Type of audience	Size of audience	Countries addressed
1	Publication	FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V	Applications of aluminium hybrid foam sandwiches in battery housings for electric vehicles	23/06/2013	International Conference on Porous Metals & Metallic Foams technology (Metfoam), North Carolina, USA	Scientific community (higher education, Research) - Industry		International
2	Publication	FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V	With system integration and lightweight design to highest energy densities	18/06/2013	17th International Forum on Advanced Microsystems for Automotive Applications (AMAA) Berlin, Germany	Scientific community (higher education, Research) - Industry		International
3	Publication	SP SVERIGES TEKNISKA FORSKNINGSINSTITUT AB	"Evaluating EV Batteries"	20/03/2013	Electronic Environment, Stockholm, Sweden	Scientific community (higher education, Research)	80	Sweden
4	Publication	RICARDO UK LIMITED	An Approach to Cell Selection to Optimise Battery Pack Size and Mass for Small Battery EVs	19/11/2012	European Electric Vehicle Congress (EEVC 2012), Brussels, Belgium	Scientific community (higher education, Research) - Industry	400	International
5	Publication	TECHNISCHE UNIVERSITAET GRAZ	Structural analysis of a Body in White for battery integration using Finite Element and Macro Elemen	10/09/2012	European Congress on Computational Methods in Applied Sciences &Engineering (ECCOMAS) Vienna,Austria	Scientific community (higher education, Research) - Industry		International
6	Presentations	SP SVERIGES TEKNISKA FORSKNINGSINSTITUT AB	Presentation by Dr. Karin Davidsson: "Evaluating EV Batteries"	20/03/2013	Electronic Environment, Stockholm, Sweden	Scientific community (higher education, Research)	80	Sweden
7	Presentations	FRAUNHOFER-GESELLSCHAFT ZUR	F. Baumeister: "Applications of	23/06/2013	International Conference on	Scientific community (higher		International

		FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V	aluminium hybrid foam sandwiches in battery housings for EVs"		Porous Metals & Metallic Foams technology (Metfoam), North Carolina, USA	education, Research) - Industry		
8	Presentations	AIT Austrian Institute of Technology GmbH	H.Kapeller: "An Approach to Cell Selection to Optimise Battery Pack Size&Mass for Small Battery EVs"	19/11/2012	European Electric Vehicle Congress (EEVC 2012), Brussels, Belgium	Scientific community (higher education, Research) - Industry	400	International
9	Presentations	AIT Austrian Institute of Technology GmbH	H. Lacher: Presentation of the SmartBatt project	12/12/2012	eco-Mobility 2012, 7th A3PS International Conference 2012, Vienna, Austria	Scientific community (higher education, Research) - Industry		International
10	Presentations	VOLKSWAGEN AG	M. Kurz: Presentation of the SmartBatt project	24/09/2012	European Automotive Research Partners Association (EARPA) Safety Workshop 2012, Aachen, Germany	Scientific community (higher education, Research) - Industry		Europe
11	Presentations	LKR LEICHTMETALL KOMPETENZZENTRUM RANSHOFEN GMBH	R. Gradinger: Presentation of the SmartBatt project	11/07/2012	European Green Cars Initiative, Projects Clustering Event, Brussels, Belgium	Scientific community (higher education, Research) - Industry		Europe
12	Presentations	FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V	Application of aluminium-polymer hybrid foam sandwiches in battery housings for electric vehicles	03/09/2013	Eurolightmat 2013, Bremen, Germany (presentation by E.M. Hirtz, J. Baumeister, J. Weise, K. Höhne)	Scientific community (higher education, Research) - Industry		International
13	Presentations	AIT Austrian Institute of Technology GmbH	H. Kapeller: Presentation of the SmartBatt project "Multifunktionales und sicheres Leichtbaugehäuse"	19/06/2013	SafeEmobility 2013, Karlsruhe, Germany	Scientific community (higher education, Research) - Industry		Germany
14	Workshops	TECHNISCHE UNIVERSITAET GRAZ	Recommendations for Rescue Teams (Deliverable 8.2,	18/09/2012	Eisenstadt, Austria (held by P. Luttenberger - TU	Civil society	50	Austria

			SmartBatt)		Graz, R. Permann - AIT, Lars Hoffmann - SP)			
15	Workshops	TECHNISCHE UNIVERSITAET GRAZ	Battery Integration Workshop: Smartbatt Presentation (structure, desgin, cell selection)	31/05/2012	Workshop with Consortia from: ELVA, OSTLER, EASYBAT, DELIVER and SMARTBATT, Brussels, Belgium	Scientific community (higher education, Research)	25	Europe
16	Exhibitions	AIT Austrian Institute of Technology GmbH	Exhibition of the fully functional SmartBatt prototype on the EEVC 2012	19/11/2012	European Electric Vehicle Congress (EEVC 2012), Brussels, Belgium	Scientific community (higher education, Research) - Industry	400	International
17	Flyers	AIT Austrian Institute of Technology GmbH	Die leichte Zukunft der Elektromobilität (Page14, 15, 16, 17)	01/11/2012	http://www.ait.ac.at/fileadmin/cmc/downloads/Magazine/Neu/Tomorrow_Today_November_2012.pdf,	Scientific community (higher education, Research) - Industry		Austria
18	Flyers	AIT Austrian Institute of Technology GmbH	Smart and Safe Integration of Batteries into EVs - Lightweight and Safe Battery Integration	19/11/2012	European Electric Vehicle Congress (EEVC 2012), A3PS, ECGI, etc.	Scientific community (higher education, Research) - Industry - Civil society		Europe
19	Posters	AIT Austrian Institute of Technology GmbH	H. Lacher & H. Kapeller: Poster presentation "Smart and Safe Integration of Batteries into EVs"	10/04/2013	EC/European Green Cars Initiative PPP Workshop on EV Batteries, Brussels, Belgium	Scientific community (higher education, Research) - Industry - Policy makers		Europe, International
20	Posters	FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V	F. Baumeister: Poster and exhibition booth at the fair "Aluminium 2012"	09/11/2012	Aluminium 2012, Düsseldorf, Germany	Scientific community (higher education, Research) - Industry		International
21	Press releases	AIT Austrian Institute of Technology GmbH	Forschung: Batteriepackage-Abspeckkur für das E-Auto	19/11/2012	http://www.ait.ac.at/fileadmin/cmc/downloads/PAs/2012/AIT_2012_SmartBatt_final.pdf	Scientific community (higher education, Research) - Industry		Austria, International

22	Press releases	RICARDO UK LIMITED	Optimizing future battery pack technology for small electric vehicles	19/11/2012	http://www.ricardo.com/en-GB/News--Media/Press-releases/News-releases1/2012/	Scientific community (higher education, Research) - Industry		UK, International
23	Press releases	AIT Austrian Institute of Technology GmbH	Das EU-Projekt zur smarten und sicheren Integration von Batterien in Elektrofahrzeugen.	06/05/2011	http://www.ait.ac.at/fileadmin/cmc/downloads/PAs/2011/AIT_2011_SmartBatt.pdf	Scientific community (higher education, Research) - Industry		Austria
24	Articles published in the popular press	AIT Austrian Institute of Technology GmbH	Superbatterie macht E-Fahrzeuge leichter!	04/12/2012	Kronen Zeitung (Printmedium, Newspaper), page 18.	Civil society	487000	Lower Austria, Vienna
25	Articles published in the popular press	AIT Austrian Institute of Technology GmbH	e&i, Science News: "Die leichte Zukunft der Elektromobilität""	01/01/2012	Autrian magazine: e&i, elektrotechnik und informationstechnik, page a26.	Scientific community (higher education, Research) - Industry		Austria
26	TV clips	AIT Austrian Institute of Technology GmbH	ORF Niederösterreich (TV-Interview)	03/01/2013	http://youtu.be/V56JTB19uEQ	Civil society - Medias	150000	Lower Austria, Vienna
27	Videos	FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V	SmartBatt: Innovatives Batteriesystems für Elektrofahrzeuge - 20 % leichter	13/12/2012	Fraunhofer Youtube Channel: http://www.youtube.com/watch?v=iaxs6SrYWTg	Scientific community (higher education, Research) - Industry		Germany, International
28	Interviews	AIT Austrian Institute of Technology GmbH	Physics Today magazine story on electric vehicle batteries (interviewed person: H. Kapeller)	23/04/2013	Telephone interview about SmartBatt with Journalist from Physics Today magazine.	Scientific community (higher education, Research) - Industry		USA, International
29	Interviews	AIT Austrian Institute of Technology GmbH	OE2 Radio NOE Journal (Radiointerview)	02/01/2013	Radiointerview - Newsflash	Civil society	561000	Lower Austria, Vienna
30	Interviews	AIT Austrian Institute of Technology GmbH	Radio 88.6 (Radiointerview)	04/12/2012	Radiointerview - Newsflash	Civil society	153000	Lower Austria, Vienna
31	Interviews	AIT Austrian	Interview about	15/11/2011	Austrian magazine	Scientific		Austria

		Institute of Technology GmbH	SmartBatt project for magazine "Umweltjournal" (interviewed person: H. Kapeller)		"Umweltjournal"	community (higher education, Research) - Industry		
32	Web sites/Applications	AIT Austrian Institute of Technology GmbH	E-Autos: Forscher entwickeln Superbatterie, online - 02.01.2013	02/01/2013	ORF Website, www.text.orf.at	Civil society		Austria
33	Web sites/Applications	SP SVERIGES TEKNISKA FORSKNINGSINSTITUT AB	Transport - SmartBatt, 2011-2012 Smart and Safe Integration of Batteries in Electric Vehicles	01/01/2012	http://www.sp.se/en/index/research/eu-project/FP7/smartbatt/Sidor/default.aspx	Scientific community (higher education, Research) - Industry		Sweden, International
34	Web sites/Applications	AIT Austrian Institute of Technology GmbH	Wide media resonance in the world wide web: articles referring to the SmartBatt project.	25/05/2013	See uploaded list of publications, dealing with most important 19 web-adresses.	Scientific community (higher education, Research) - Industry - Civil society		Internet

Section B (Confidential or public: confidential information marked clearly)

LIST OF APPLICATIONS FOR PATENTS, TRADEMARKS, REGISTERED DESIGNS,UTILITY MODELS, ETC.					
Type of IP Rights	Confidential	Foreseen embargo date dd/mm/yyyy	Application reference(s) (e.g. EP123456)	Subject or title of application	Applicant(s) (as on the application)

OVERVIEW TABLE WITH EXPLOITABLE FOREGROUND								
Type of Exploitable Foreground	Description of Exploitable Foreground	Confidential	Foreseen embargo date dd/mm/yyyy	Exploitable product(s) or measure(s)	Sector(s) of application	Timetable for commercial use or any other use	Patents or other IPR exploitation (licences)	Owner and Other Beneficiary(s) involved

ADDITIONAL TEMPLATE B2: OVERVIEW TABLE WITH EXPLOITABLE FOREGROUND	
Description of Exploitable Foreground	Explain of the Exploitable Foreground

4.3 Report on societal implications

B. Ethics

1. Did your project undergo an Ethics Review (and/or Screening)?	No
If Yes: have you described the progress of compliance with the relevant Ethics Review/Screening Requirements in the frame of the periodic/final reports?	

2. Please indicate whether your project involved any of the following issues :	
RESEARCH ON HUMANS	
Did the project involve children?	No
Did the project involve patients?	No
Did the project involve persons not able to consent?	No
Did the project involve adult healthy volunteers?	No
Did the project involve Human genetic material?	No
Did the project involve Human biological samples?	No
Did the project involve Human data collection?	No
RESEARCH ON HUMAN EMBRYO/FOETUS	
Did the project involve Human Embryos?	No
Did the project involve Human Foetal Tissue / Cells?	No
Did the project involve Human Embryonic Stem Cells (hESCs)?	No
Did the project on human Embryonic Stem Cells involve cells in culture?	No
Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos?	No
PRIVACY	
Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	No
Did the project involve tracking the location or observation of people?	No
RESEARCH ON ANIMALS	

Did the project involve research on animals?	No
Were those animals transgenic small laboratory animals?	
Were those animals transgenic farm animals?	
Were those animals cloned farm animals?	
Were those animals non-human primates?	

RESEARCH INVOLVING DEVELOPING COUNTRIES

Did the project involve the use of local resources (genetic, animal, plant etc)?	No
Was the project of benefit to local community (capacity building, access to healthcare, education etc)?	No

DUAL USE

Research having direct military use	No
Research having potential for terrorist abuse	No

C. Workforce Statistics

3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).

Type of Position	Number of Women	Number of Men
Scientific Coordinator	1	1
Work package leaders	3	5
Experienced researchers (i.e. PhD holders)	3	6
PhD student	0	0
Other	2	10

4. How many additional researchers (in companies and universities) were recruited specifically for this project?	0
Of which, indicate the number of men:	0

D. Gender Aspects

5. Did you carry out specific Gender Equality Actions under the project ?	No

6. Which of the following actions did you carry out and how effective were they?	
Design and implement an equal opportunity policy	Not Applicable
Set targets to achieve a gender balance in the workforce	Not Applicable
Organise conferences and workshops on gender	Not Applicable
Actions to improve work-life balance	Not Applicable
Other:	

7. Was there a gender dimension associated with the research content - i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?	No
If yes, please specify:	

E. Synergies with Science Education

8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?	No
If yes, please specify:	

9. Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?	Yes

F. Interdisciplinarity

10. Which disciplines (see list below) are involved in your project?	
Main discipline:	
Associated discipline:	2.2 Electrical engineering, electronics [electrical engineering, electronics, communication engineering and systems, computer engineering (hardware only) and other allied subjects]
Associated discipline:	2.3 Other engineering sciences (such as chemical, aeronautical and space, mechanical, metallurgical and materials engineering, and their specialised subdivisions; forest products; applied sciences such as geodesy, industrial chemistry, etc.; the science and technology of food production;

	specialised technologies of interdisciplinary fields, e.g. systems analysis, metallurgy, mining, textile technology and other applied subjects)

G. Engaging with Civil society and policy makers

11a. Did your project engage with societal actors beyond the research community? (if 'No', go to Question 14)	No
11b. If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?	
11c. In doing so, did your project involve actors whose role is mainly to organise the dialogue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)?	
12. Did you engage with government / public bodies or policy makers (including international organisations)	
13a. Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?	

H. Use and dissemination

14. How many Articles were published/accepted for publication in peer-reviewed journals?	0
To how many of these is open access provided?	0
How many of these are published in open access journals?	0
How many of these are published in open repositories?	0
To how many of these is open access not provided?	0
Please check all applicable reasons for not providing open access:	
publisher's licensing agreement would not permit publishing in a repository	No
no suitable repository available	No
no suitable open access journal available	No
no funds available to publish in an open access journal	No
lack of time and resources	No
lack of information on open access	No

If other - please specify	
15. How many new patent applications ('priority filings') have been made? ("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).	0

16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).	
Trademark	0
Registered design	0
Other	0

17. How many spin-off companies were created / are planned as a direct result of the project?	0
Indicate the approximate number of additional jobs in these companies:	0

18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:	Difficult to estimate / not possible to quantify,

19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (FTE = one person working fulltime for a year) jobs:	0Difficult to estimate / not possible to quantify

I. Media and Communication to the general public

20. As part of the project, were any of the beneficiaries professionals in communication or media relations?	No

21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?	No

22. Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?	
Press Release	Yes
Media briefing	No
TV coverage / report	Yes
Radio coverage / report	Yes
Brochures /posters / flyers	Yes
DVD /Film /Multimedia	Yes

Coverage in specialist press	Yes
Coverage in general (non-specialist) press	Yes
Coverage in national press	Yes
Coverage in international press	No
Website for the general public / internet	Yes
Event targeting general public (festival, conference, exhibition, science café)	Yes

23. In which languages are the information products for the general public produced?	
Language of the coordinator	Yes
Other language(s)	No
English	Yes

Attachments	Final publishable summary report SmartBatt.pdf, Recommendations for Rescue Teams.pdf, Flyer_SmartBatt_A5_folder.pdf, Poster Aluminium 2012 Pulvertechnologie2-smartbatt.pdf, AIT Mobility_Pressreview_SmartBatt.pdf, ORF_TVthek_Niederösterreich heute - 02.01.2013 1900 Uhr.wmv, SmartBatt_list of publications.pdf, SmartBatt_EGCI_WS2013_Poster_A1.pdf, 20121204_88.6_18.37_aircheck.wma, 20130102_oe2_radop-noe_journal_8.00_ait.mp3, 03SmartBatt_ComparisonCrash_VehicleModel_vs_TestBenchMo 02SmartBatt_Assembly.wmv, 01Mechanical-shock-testing.avi, 09SmartBatt_team.pdf, 08SmartBatt_prototype_d.pdf, 07SmartBatt_prototype_c.pdf, 06SmartBatt_prototype_b.pdf, 05SmartBatt_prototype_a.pdf, 04SmartBatt_BMS.pdf, 03SmartBatt_front.pdf, 02SmartBatt_toolchain.pdf, 01SmartBatt_roadmap.pdf, SmartBatt_logo_FINAL_cmyk.pdf, SmartBatt_contact names.pdf
Grant Agreement number:	266074
Project acronym:	SmartBatt
Project title:	Smart and Safe Integration of Batteries in Electric Vehicles
Funding Scheme:	FP7-CP-FP
Project starting date:	01/01/2011
Project end date:	31/03/2013
Name of the scientific representative of the project's coordinator and organisation:	Mr. Hansjoerg Kapeller AIT Austrian Institute of Technology GmbH
Name	
Date	

This declaration was visaed electronically by Hansjörg KAPELLER (ECAS user name nkapelha) on