

V. Hennige (project coordinator)

GC.ICT.2011.6-8 PPP GC: ICT for fully electric vehicles

## Smart Battery Control System based on a Charge-equalization Circuit for an advanced Dual-Cell Battery for Electric Vehicles (SuperLIB)



**BOSCH**  
Invented for life



CENTRO  
RICERCHIE  
FIAT



European Batteries



Fraunhofer



Vrije Universiteit Brussel



# Objectives

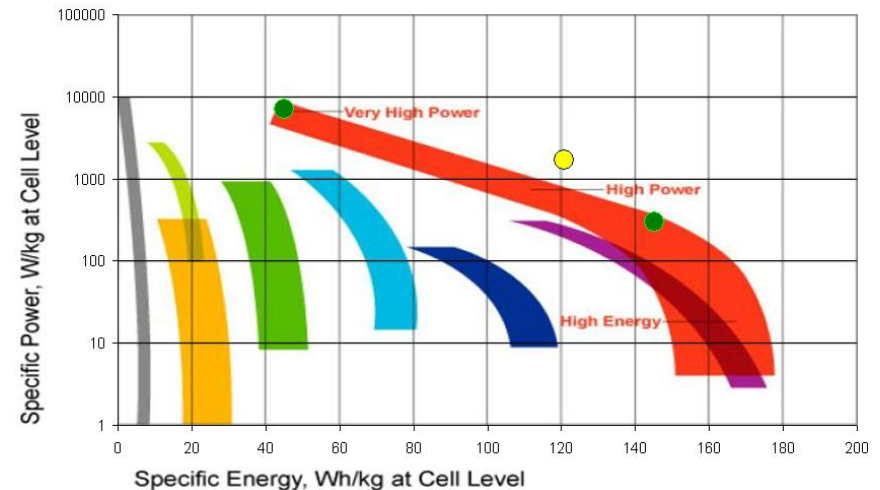


## Key Targets

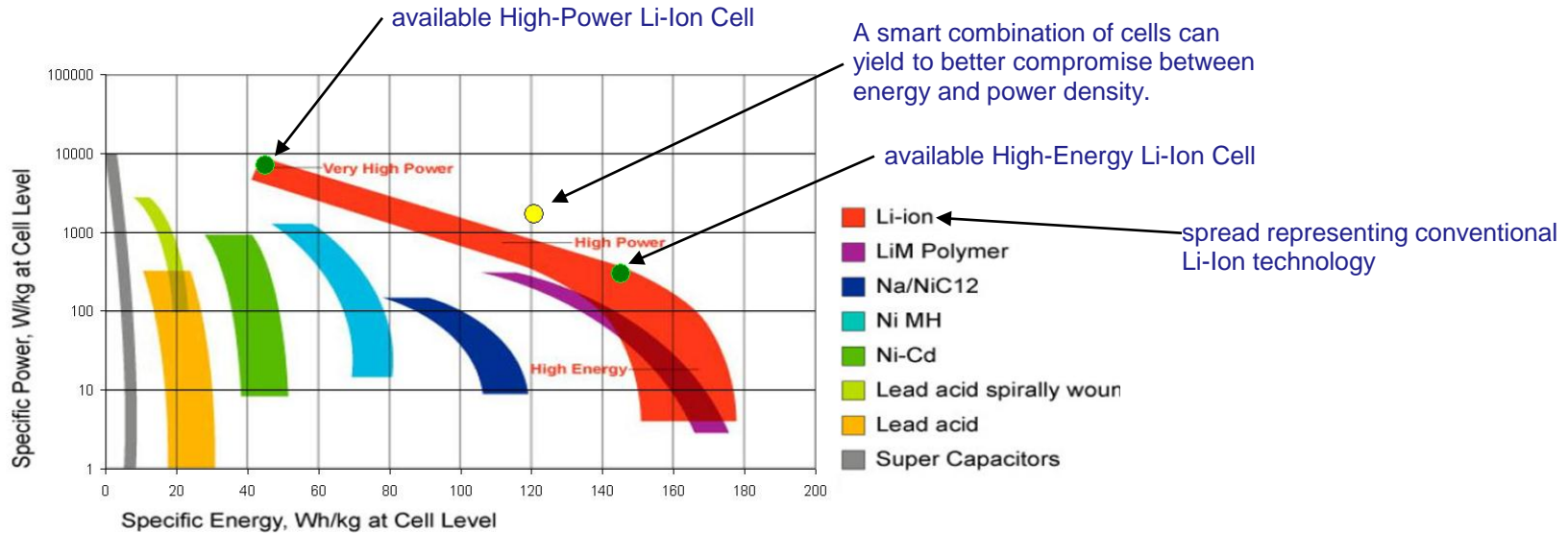
- Development of a highly integrated battery with Li-Ion High Power cells (HP cells) and Li-Ion High Energy cells (HE cells)
- Joint package, which share cooling and balancing circuit
- Extending the useable SOC range of the battery
- Smart energy distribution by advanced battery management
- Reusability of the pack in passenger EVs and light duty HEVs

## Impact

- Improved overall performance of the pack, i.e. a better compromise between power and energy density
- Increasing the lifetime significantly by reducing the impact of high currents



# Objectives



## Challenges

- Packaging of the two cells in parallel must not increase weight
- Electronic must be simple to keep costs low
- Common cooling, heating and control used by both types of cells mandatory
- Risks assessment part of the project

# Applications

1. Small EV Passenger Car
  - ↳ Electric Vehicle with Dual Battery
2. EV+RE Passenger Car
  - ↳ Electric Vehicle with Dual Battery and Range Extender
3. EV+RE Light Duty Delivery Services and Plugin and HEV Medium Duty
  - ↳ Electric Vehicle with Single or Dual Battery and Range Extender



AVL EVARE, EV with Range Extender  
(Source: AVL)



Volvo's Hybrid bus in mass production since beginning of 2010 (Source: VTA)

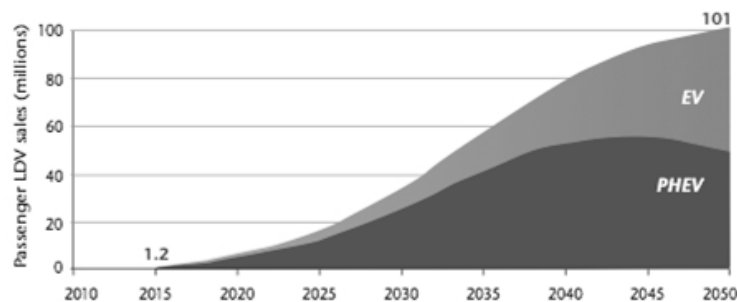
# Applications



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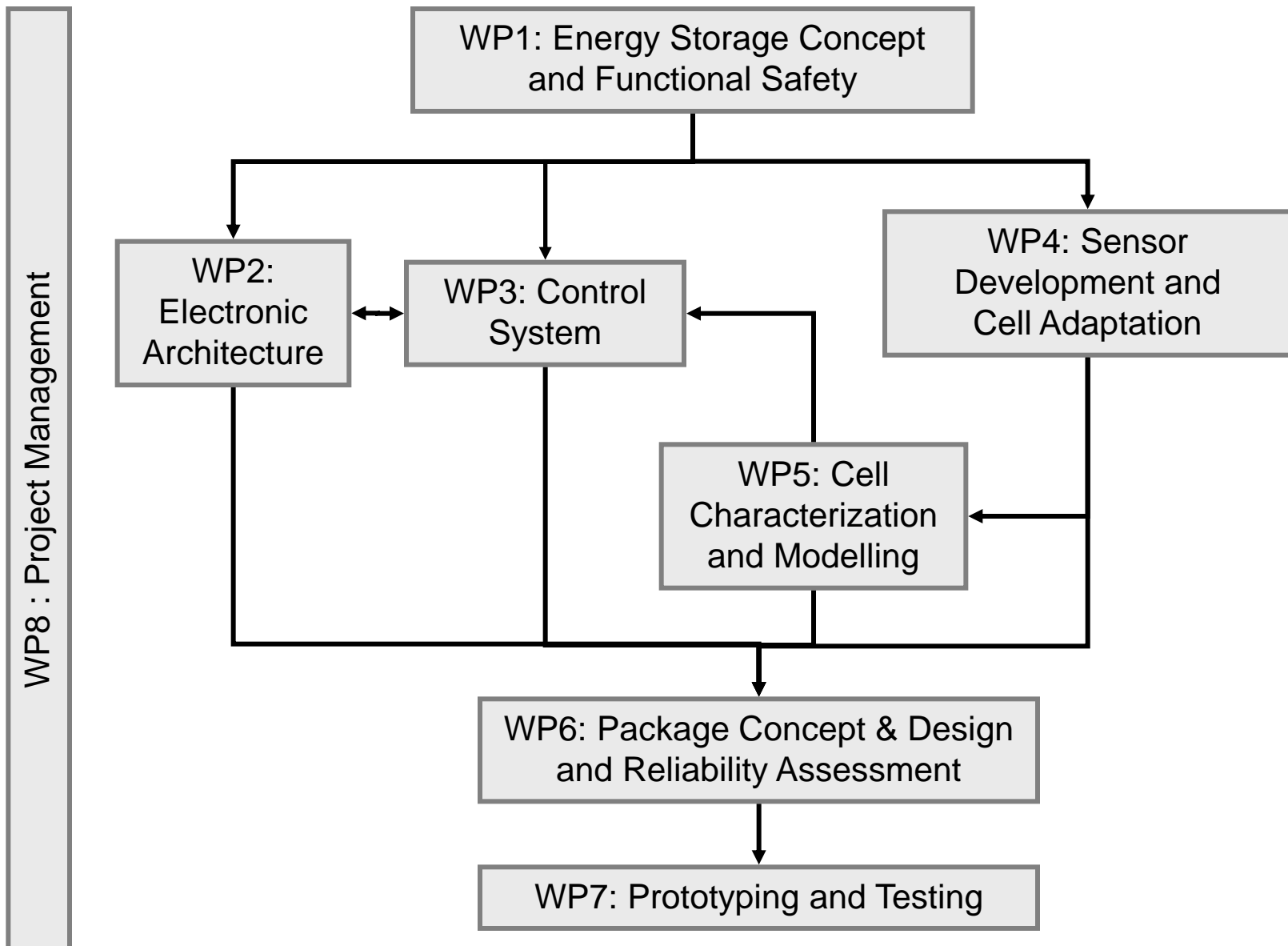


Annual global EV and PHEV sales  
(Source: International Energy Agency 2009)



Volvo's Hybrid bus in mass production since beginning of 2010 (Source: VTA)

# Work Packages



# Overview of Work Packages and Tasks



Start of project

12 month

24 month

36 month

## WP1 – Energy Storage Concept incl. Functional Safety Management

- 1.1 Performance Specifications & Definition of user profiles
- 1.2 Specifications and Definitions of the dual-cell battery concept
- 1.3 Benchmarking with HE Li-ion in combination with EDLC
- 1.4 BMS Functional Safety Management

## WP2 – Electronic Architecture for Battery Management System

- 2.1 Charge equalization circuit and DC-DC link development
- 2.2 BMS Specification
- 2.3 Module Ctrl. and DC-DC Low Level SW Development
- 2.4 Module Ctrl. and DC-DC Converter Design
- 2.5 Module Ctrl. Testing and Calibration

## WP3 – Control System Solution for Battery Management

- 3.1 Interface Definition and Functional Framework
- 3.2 Control Algorithm for Smart Charge/Energy Distribution
- 3.3 Advanced Battery State Monitoring (SoC; SoH, SoF, Safety Function)
- 3.4 Function Integration

## WP4 – Sensor Development and Cell Adaptation for Dual Cell Approach

- 4.1 Cell System Specification
- 4.2 Cell production technology review & material choices
- 4.3 Cell Delivery
- 4.4 Cell Temperature Sensor

## WP5 – Cell Characterization and Modelling

- 5.1 Electrical and thermal cell characterization
- 5.2 Performing of Life Cycle Tests
- 5.3 Development of electric battery model
- 5.4 Development of thermal battery model
- 5.5 Validation of battery models

## WP6 – Package Concept & Design and Reliability Assessment

- 6.1 Concept for module layout
- 6.2 Concept of temperature conditioning
- 6.3 Detailed design of battery
- 6.4 Battery Reliability Assessment
- 6.5 Life Cycle Assessment

## WP8 – Project Management

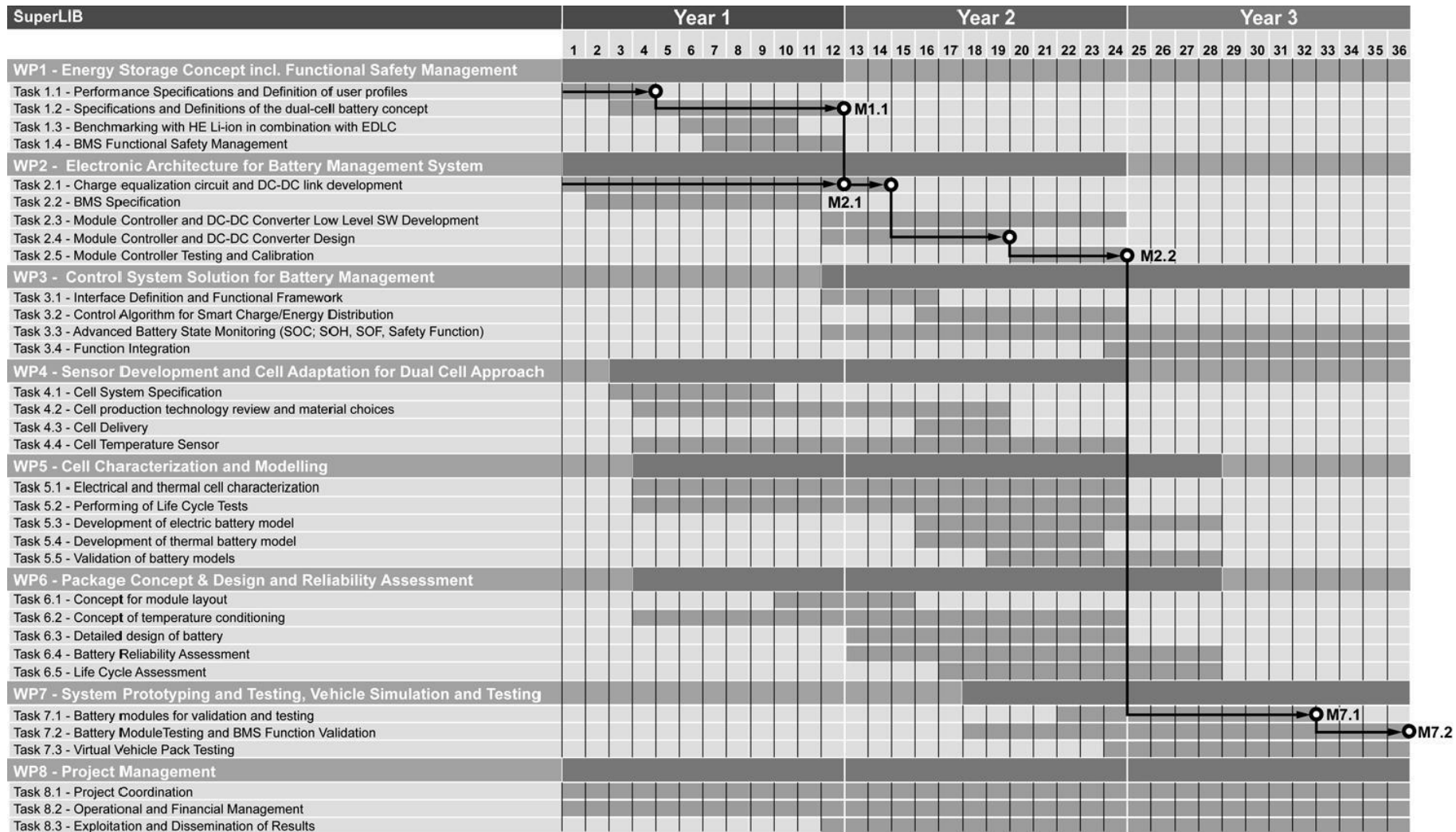
- 8.1 Project Coordination
- 8.2 Operational and Financial Management
- 8.3 Exploitation and Dissemination of Results

## WP7 – System Prototyping and Testing, Vehicle Simulation and Testing

- 7.1 Battery Modules for Validation and Testing
- 7.2 Battery Module Testing and BMS Function Validation
- 7.3 Virtual Vehicle Pack Testing



# Critical Path





# Partners



AVL List, Austria

Control System Solutions for BMS



Robert Bosch, Germany

Package Concept and Design



Centro Ricerche Fiat, Italy

Prototyping and Testing



European Batteries, Finland

Lilon Cell Adaptation



Fraunhofer, Germany

Temperature Sensor Development



IFP Energies Nouvelles, France

Electronics, Characterization and Thermal Modeling



Valeo, France

Electronic Architecture for BMS



Volvo Technology, Sweden

Concept Validation and LCA



Vrije Universiteit Brussel, Belgium

Cell Characterization, Modeling, LCA



K&S Projektmanagement, Germany

Project Management

# Contact



Dr. Volker Hennige  
Global Battery Competence Team  
AVL List, Austria, 8020 Graz

Telephone: +49 316 787 4947  
Email: volker.hennige@avl.com

