# EUROBAT e-Mobility Battery R&D Roadmap 2030

## Battery Technology for Vehicle Applications


**Mathieu BELLE**
Saft Vehicle Business Unit
EUROBAT e-Mobility Working Group

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# LI-ION BATTERIES:
## TECHNICAL ROADMAP

- **Li-ion batteries, all chemistries together, are definitely the concept of choice to electrify vehicles, from micro-hybrid to full EV.**

- **In 2015, there are a limited number of production sites in Europe for Li-ion cells or batteries for automotive applications.**

- **Given that the global market for Li-ion batteries is in an early stage of development, it is still possible for the EU to establish a competitive advantage in the production of Li-ion battery cells and systems.**

- **Moreover, wherever cell manufacture takes place, further processes such as pack assembly or system integration can also create significant local value in Europe.**

# LI-ION BATTERIES:

## PRIORITY AREAS TO IMPROVE TECHNOLOGICAL PERFORMANCES

**Energy density**

- Development of new cathode types
- Energy density of lithium-ion cells can increase from ~170Wh/kg today to ~290Wh/kg by 2030.

**Power density**

- Especially important for plug-in hybrid (opportunity charge) and hybrid applications.
- An improvement could be achieved through optimized design & improved manufacturability

**Battery lifetime**

- Thermal management system improvements will lead to a lifetime of 10-15 years by 2030.

**Charge acceptance**

- Widely expected improvement
- Will be improved through chemistry developments and better understanding of aging processes

# LI-ION BATTERIES:

## PRIORITY AREAS TO LOWER COST

**Materials improvements**
Research into cell materials focuses on cheaper and more energetic materials resulting in further price reductions per kWh.

**Mechanical design improvements**
low-cost, low-weight solutions :

- Battery casings and management systems
- Modular concepts
- Standardization of battery sizes

**Manufacturing at scale**
Manufacturers are currently working to design simplified systems ready for large automation.

**Standardization**
Standardization of large-scale lithium-ion cell manufacturing will continue to develop over the next decade.

# LI-ION BATTERIES:

## PRIORITY AREAS TO IMPROVE SYSTEM INTEGRATION

**Standardization of interfaces**
Protocols, mechanical shape and size of the BMS is a priority in order to improve:

- overall system
- reliability and lower costs


**Improvement of thermal management**

Battery lifetime and reliability in extreme weather conditions are pending consequences of thermal management and must always be improved.

**Safety improvement in electrical components**
Electrical safety of fuses, contactors and
current sensors is important for further improving battery safety and systems reliability.

**Light weighting solutions for structural, vibration and safety improvement**
Batteries must be lighter and more stress-resistant.

# LI-ION BATTERIES:

## PRIORITY AREAS TO OPTIMISE PRODUCTION PROCESS

**Reducing energy consumption & environmental footprint**

- Energy consumption can be lowered through reducing the size of dry rooms and optimizing process steps

**Alternative processes to ink mixing and coating**

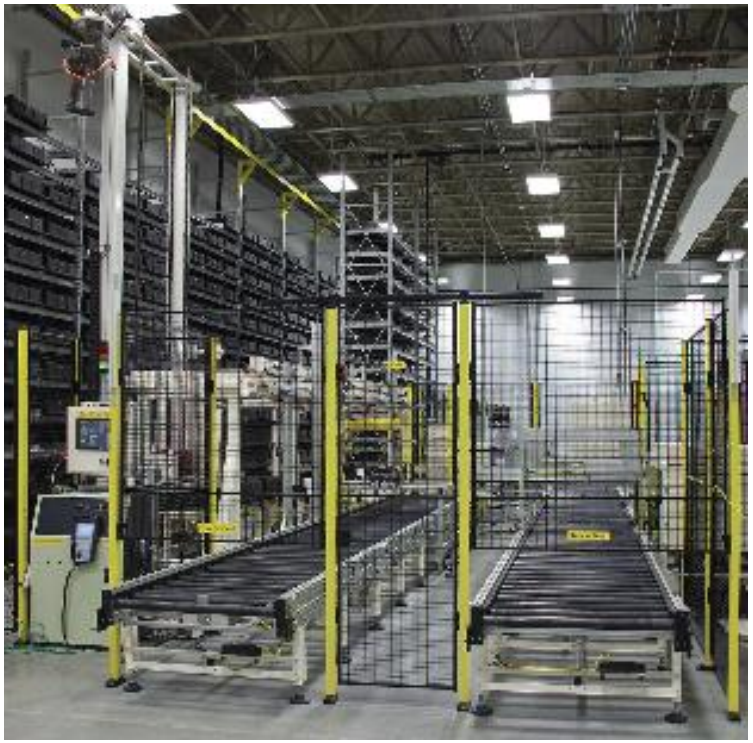
- Dry processes like extrusion, with no need to heat and cool down electrodes
- Replace organic solvent with water can be an alternative to “dry” methods

**Functional integration of manufacturing process steps**

- Automated control systems during the assembly phase will lead to significant increases in the quality and reliability of products by removing defects before assembly

**Electrical formation**

- The energy used in this process is re-injected into the grid so that consumption is reduced
- New cell material will allow batteries to work close to ambient temperatures and thus reduce the energy required



# LI-ION BATTERIES:

## PRIORITY AREAS TO OPTIMISE SAFETY PARAMETERS

**Development of high-efficiency monitoring functions**

- More accurate and reliable State-of-Charge and State-of-Health estimations (they also depend on the way the battery is used)
- Make batteries cheaper and lighter

**Cell diagnostic and supervision systems to support understanding of aging**

- Simplify the cell model
- Identify the key measures needed for reliable prediction
- Knowledge about aging of the electronic boards is also important, as any failure in level may jeopardize all efforts to make prediction more reliable

**Systems design and validation**

- Validation efforts can be reduced by improving the level of confidence in any concept used in the design


# LI-ION BATTERIES:

## PRIORITY AREAS TO DEVELOP RECYCLING PROCESSES

**Value chain principles for design for recycling and remanufacturing**

- Product recycling starts at the design stage
- Dismantling and component separation must be foreseen at this moment (replacing any component that makes a battery harder to dismantle must become a priority)
- This can be achieved by anticipation programs that will develop the concepts before they are implemented in industrial products

**Development of a use for slags containing metal phosphates**

- Industrial zero-waste recycling processes at present mainly target the recovery of nickel, cobalt and copper
- The recycling of lithium is technically and industrially feasible, but as only a small quantity is used in each battery (between 1 to 2% of total weight), this has not become economically viable yet
- Fertilizer industry or other industries can help define use of slags

# LI-ION BATTERIES:

## EUROBAT RECOMMENDATIONS

**Although the primary objectives remain increasing energy density and power density and lowering cost,**

**EUROBAT members consider that research programs into lithium-ion batteries for Micro Hybrid Vehicles, HEV, PHEV and EV must also include a focus on each of the areas identified in this chapter.**

**Only through such multifaceted improvements will lithium-ion batteries become fully market competitive,**

**While at the same time fulfilling requirements for safety and sustainability.**

# - Thank You -

For more information
Contact rschroeder@eurobat.org
and/or fgattiglio@eurobat.org