



HAL
open science

Ecodesign of Li-ion batteries

Daniel Daniel Belchi-Lorente, Peggy Zwolinski, Guillaume Mandil

► **To cite this version:**

Daniel Daniel Belchi-Lorente, Peggy Zwolinski, Guillaume Mandil. Ecodesign of Li-ion batteries. Life Cycle Management, Aug 2015, Bordeaux, France. , 2015. hal-01219777

HAL Id: hal-01219777

<https://hal.science/hal-01219777>

Submitted on 23 Oct 2015

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.





Ecodesign of Li-ion batteries

PhD. Student: **BELCHI LORENTE**, Daniel





PhD. Director: **ZWOLINSKI**, Peggy

PhD. Supervisor: **MANDIL**, Guillaume




Current issue

-  **Resource scarcity**
Certain materials are expensive, e.g. cobalt or nickel.
-  **Demand for Li-ion battery is increasing**
Mainly due to electric vehicle applications. We need to secure supply.
-  **Absence of Li-ion recycling network**
Logistic chain is not yet developed.
-  **Recycling for economic purpose**
Recycling methods are not necessarily environmentally friendly.


Our objectives

-  **Integrated Design process**
That tool would bring together all the stakeholders' constraints, i.e. designers', manufacturers' and especially recyclers' implications along the design process.
-  **Identification of the key design parameters**
A key design parameter is a parameter used in the design process, influencing a lot the environmental impacts variations when it is subject to variations (either if they are low).
-  **Create a tool to help in the Li-ion battery ecodesign process**
It includes a model to highlight environmental hotspots of the battery lifecycle.
-  **Help to develop Li-ion recycling network in France**


Future work

-  **Procurement of end-of-life experimental data**
Primary data measured in laboratory, describing the recycling processes from our partners in LEPMI-Grenoble. These data will refine our battery model.
-  **Understanding relationship between parameters and design issues**
Some parameters (variables in the battery model) seem to have connections with other constraint levels. Specify these links is essential to develop the ecodesign tool.
-  **Make the tool accesible to everyone**
The approach must be understandable and easy to use by each stakeholder in order to implement a right Integrated Design process.

Context and state of the art

-  **Current studies are mostly based on manufacturing stages**
Few studies are focused on the battery end-of-life phase nor in the whole lifecycle. (*Dunn et al. 2012; Laboratory Argonne National et al. 2012*)
-  **Few specific databases for Li-ion batteries**
Batteries are modeled with non dedicated databases, using similar industrial activities data. It means inaccuracies of the studies. (*Ellingsen et al. 2013*)


Our work

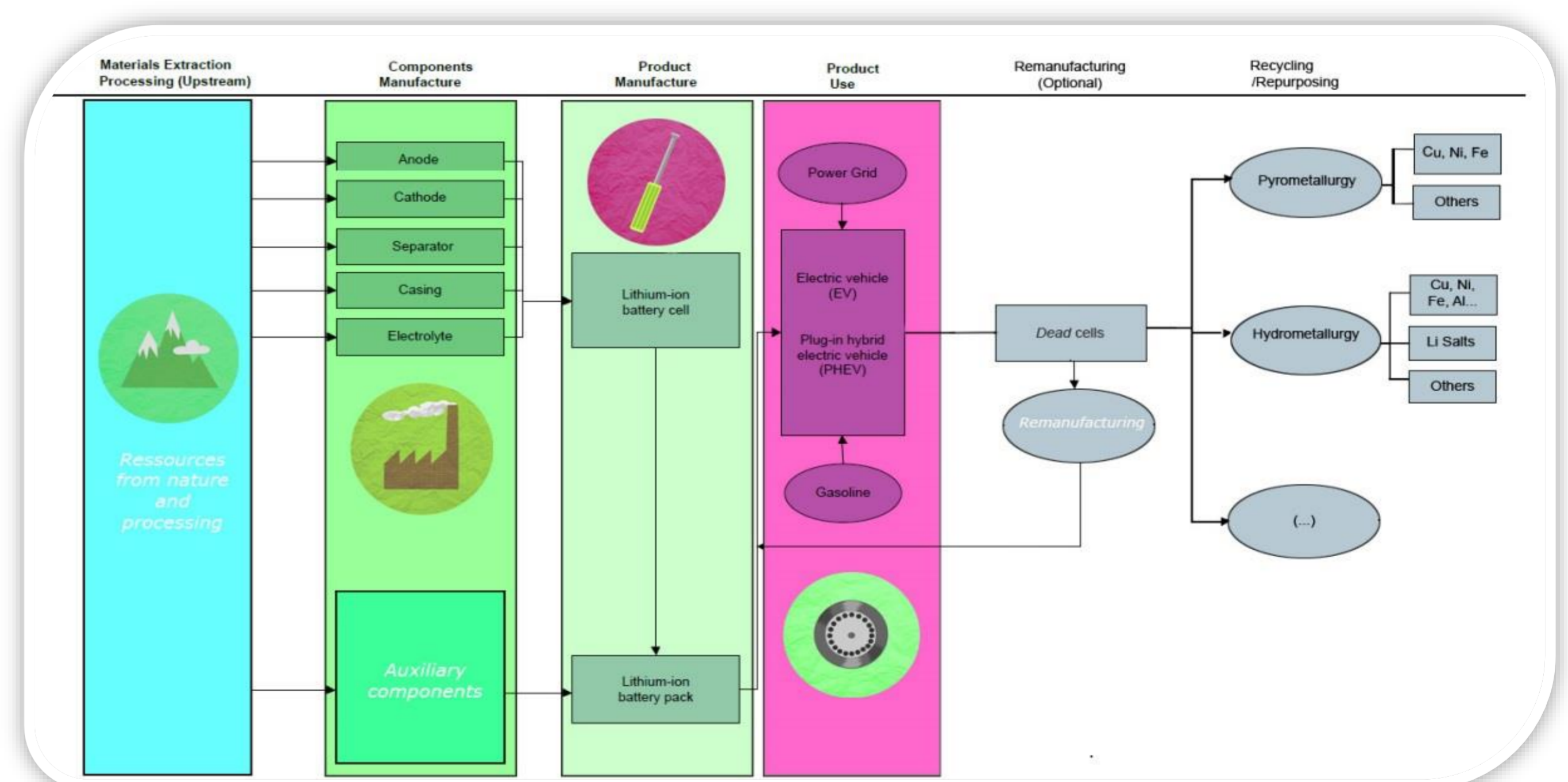
-  **LCA model of a Li-ion battery**
Parameterized and adaptable to each case study. It includes several end-of-life scenarii and battery technologies.



Li-ion battery pack

Our LCA system boundaries includes the battery auxiliary elements: passive cooling system, battery management system and the packaging.

-  **LiFePO₄ and Ni-Co-Mn batteries case study**
Batteries were modeled, analysed and environmental hotspots were highlighted. Then, we proposed some guidelines to reduce their environmental impact, for instance:
 - Use of recycled copper instead of primary copper.
 - Maximize copper recovery when recycling.
 - Reduce 'dry room' electricity consumption.
 - Use a 'greener' electricity grid during manufacturing stages.



Simplified model of Li-ion battery lifecycle

Two recycling methods were included in this case study: hydrometallurgical and direct physical recycling.