Prospective Life Cycle Assessment of a smart battery cell

Mesquita Bordalo Da Costa, Daniele; Lavigne Philippot, Maeva; Berecibar, Maitane; Messagie, Maarten

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Based on a **prospective Life Cycle Assessment, sensors** preventing earlier degradation and failure mechanisms of battery cells can be selected

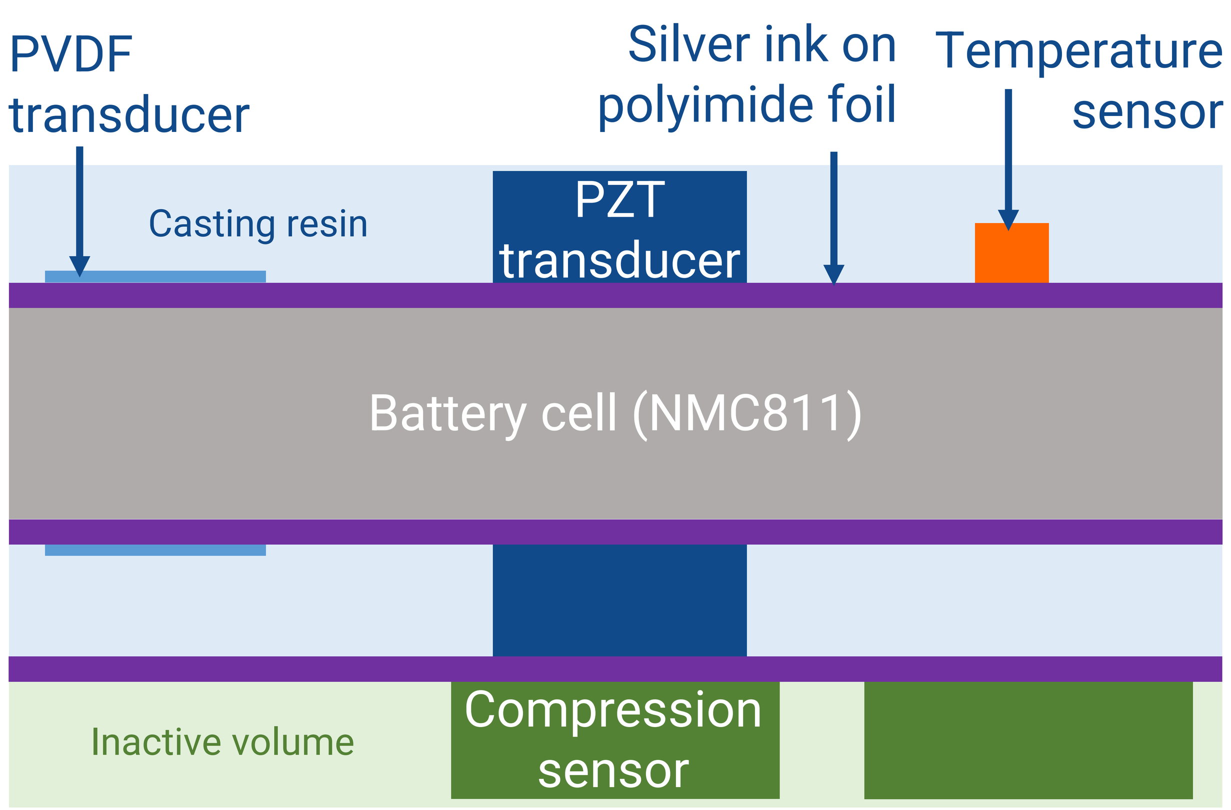
Prospective Life Cycle Assessment of a smart battery cell

Daniele Costa[1]*, Maeva Lavigne Philippot[1], Maitane Berecibar[1] and Maarten Messagie[1]

[1] EVERGi Research Group, Mobi Research Center, ETEC Department, Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussels, Belgium
* Corresponding author: daniele.costa@vub.be

Prototype smart battery cell

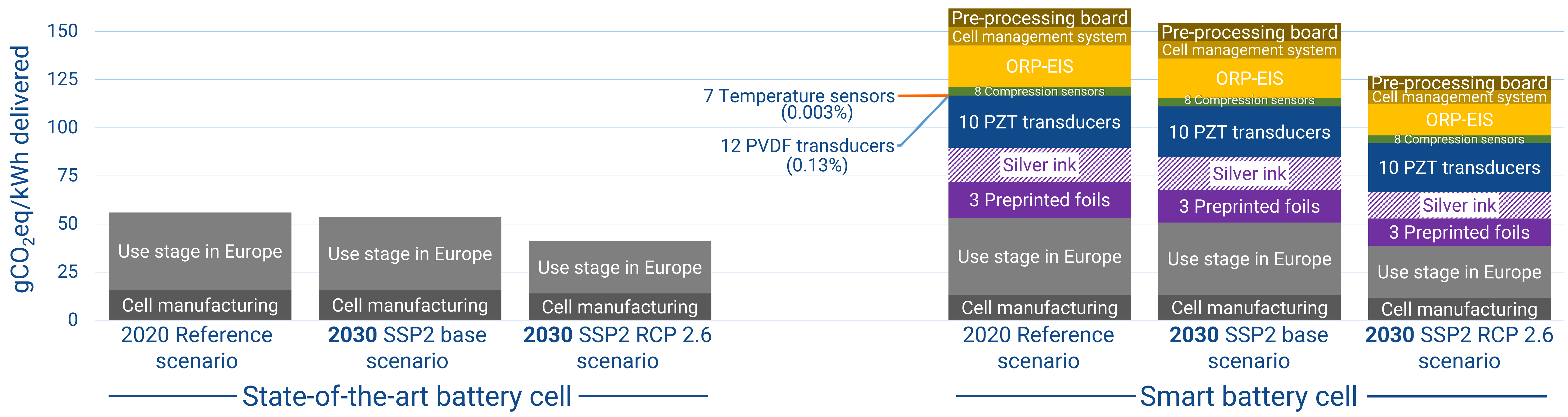
- Smart battery cell = Battery cell **+ acoustic, mechanical, and thermal sensors +** advanced impedance spectroscopy (ORP-EIS) **+** cell management system **+** pre-processing board.
- Detection of degradation and failure mechanisms via sensors and dedicated cell model.
- Comparison with a state-of-the-art battery cell.
- Assumption of a 20% longer cycle life than the state-of-the-art cell.



Legend: NMC = Lithium nickel manganese cobalt oxide, PZT = lead zirconate titanate, PVDF = polyvinylidene fluoride.

Prospective Life Cycle Assessment

- Impacts on **climate change** in 2020 and **2030.** GWP100a characterization factors with the addition of hydrogen and biogenic CO_2 uptake and release flows.
- 2 scenarios: SSP2-base (~3.5°C climate target) and SSP2- RCP 2.6 (~2°C climate target).
- Superstructure prospective database (based on ecoinvent 3.8) and the premise library.
- Functional unit = 1 kWh of delivered energy.



Take away messages & further developments

- Adding **sensors** to battery cells increase their future impact on **climate change,** even if it allows a 20% longer battery life.
- **Silver** is a major contributor, but at lab scale, the waste rate is 80% and silver manufacturing is **not directly updated in the databases**.
- **Temperature** sensors have the lowest impact among all the sensors.

1. Optimizing the manufacturing process (**economies of scale**).
2. Identifying the **necessary sensors**, based on their marginal impacts on the use phase.
3. Assessing **circularity**: the potential for **2nd life** and the **recyclability**.

Extended abstract

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