BATTERY INNOVATION CENTRE

VUB

Introducing self-healing functionalities for lithium ion batteries for smartphones

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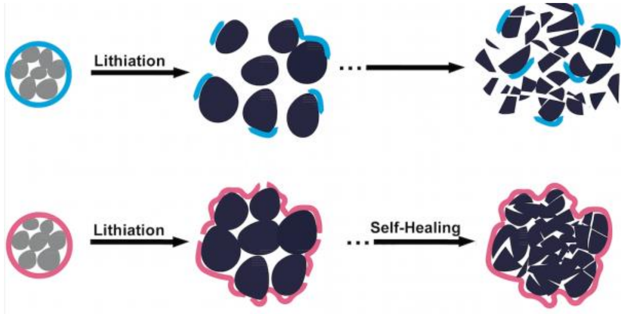
Battery Innovation Centre

Electromobility Research Centre (MOBI), Vrije Universiteit Brussel

Annual event circlemade.brussels,

23/05/2024



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BATTERY 2030+

BAT4EVER

This project is funded by the European Union

BAT4EVER – In a nutshell
Project Identity

Programme: Horizon 2020 Framework Programme

Call: Self-healing functionalities for long lasting battery cell chemistries (LC-BAT-14-2020)

Type of Action: Research and Innovation Action (RIA)

Project Title (ID): Autonomous Polymer based Self-Healing Components for high performant LIBs (957225)

Acronym: BAT4EVER

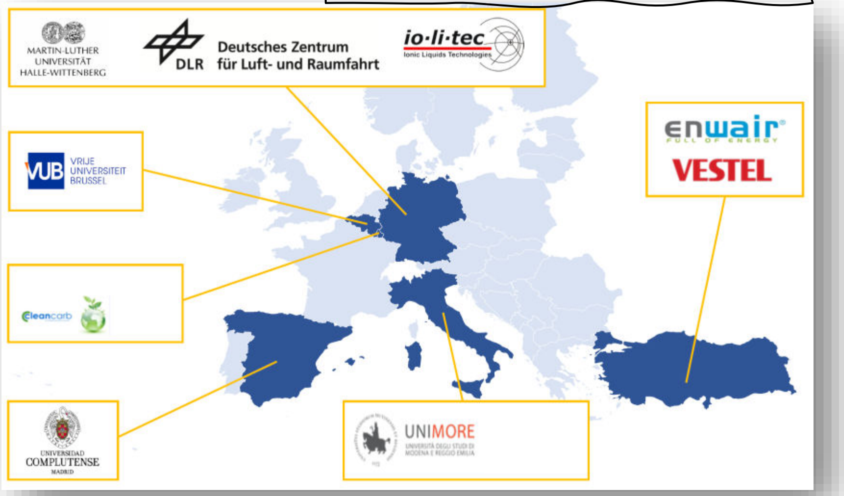
Budget: 3.2M EUR

Duration: 1st September 2020 – 29th February 2024 (42M)

Consortium: 9 beneficiaries from 6 countries
(4 universities; 1 Research Centre; 4 industry)

Coordinator: Vrije Universiteit Brussel (VUB)

BAT4EVER Consortium



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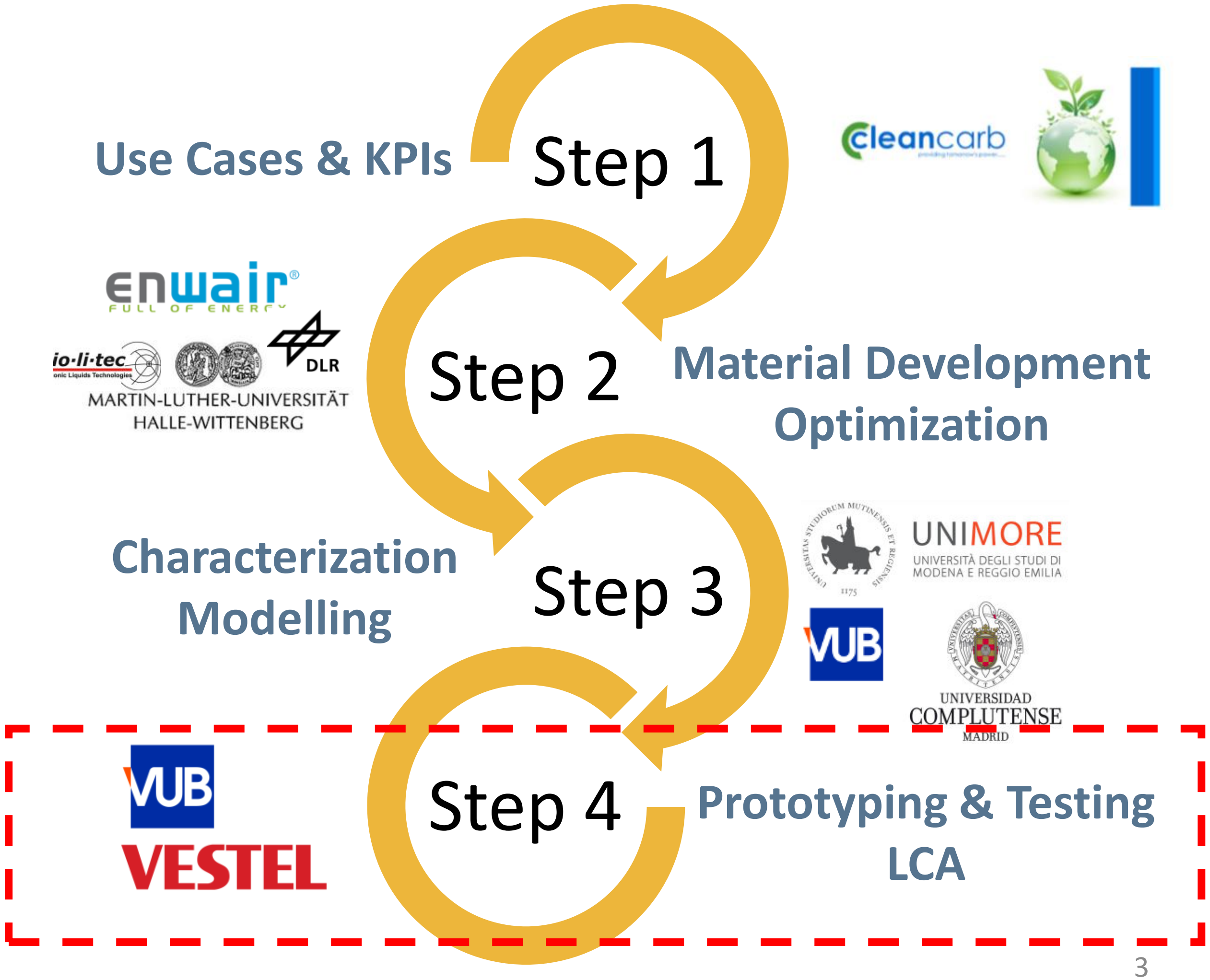
BAT4EVER – In a nutshell

Project Facts

BAT4EVER Aim & Vision

The development of substantially improved and sustainable, reliable battery cells is a must in the transition towards clean energy and clean mobility

- ✓ Self-healing functionalities through polymer binder (e.g. ionogels) surface coating to protect electrodes
- ✓ Utilization of Silicon anodes
- ✓ Oxidation resistant, high-cycle recharging and thermal activation stable core/shell NMC cathodes.
- ✓ Novel electrolytes based on polymerized ionic liquids



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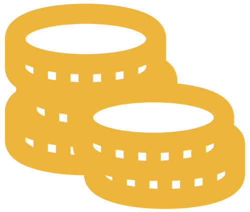
BAT4EVER Sustainability Objectives

Assess the environmental impacts of the SH battery

Assess the recyclability of the battery components



Assess the economic impacts of the SH battery

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What is LCA?

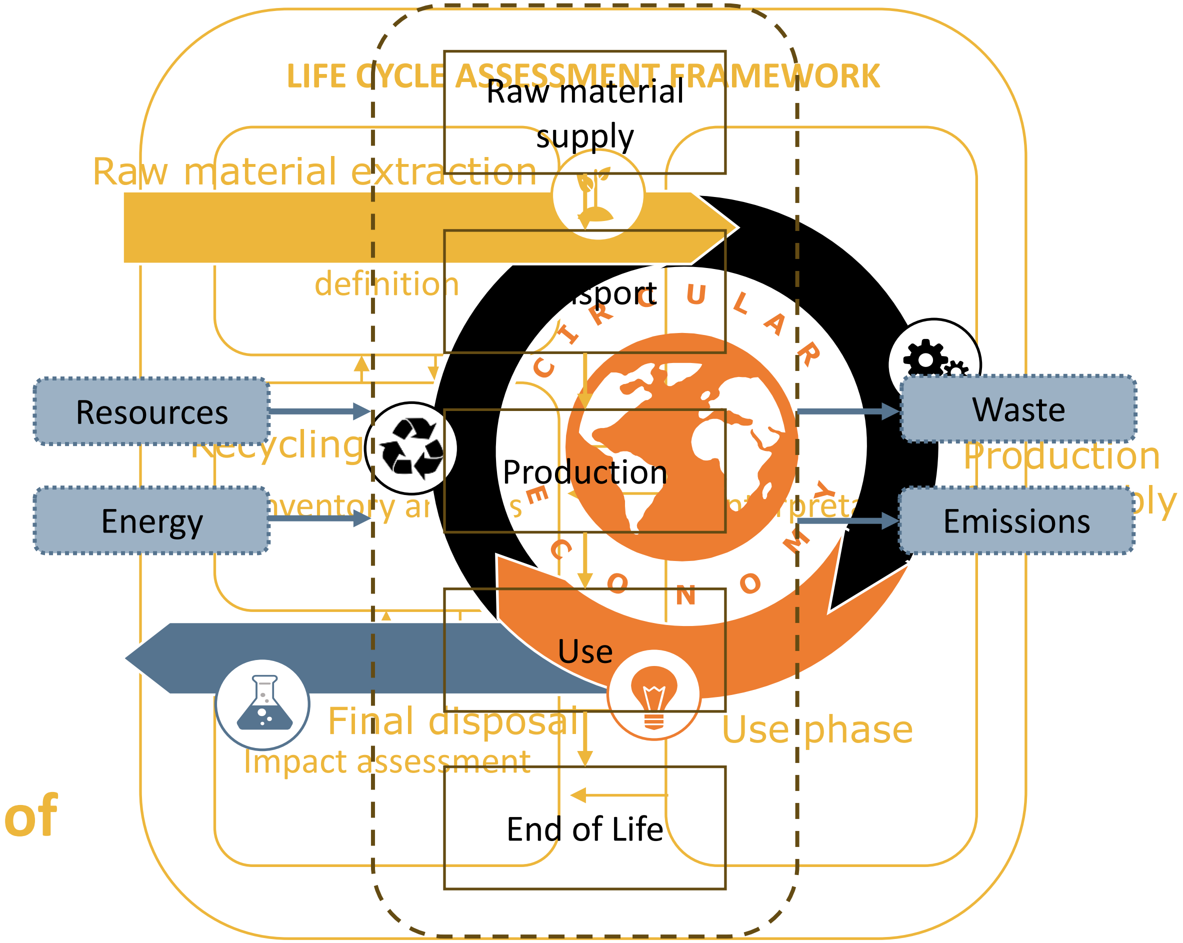
Life Cycle Assessment…

is an international method for environmental assessment

(ISO 14040/14044)

considers the entire life cycle of a product/service

is a systematic overview to avoid shifting of potential environmental burden



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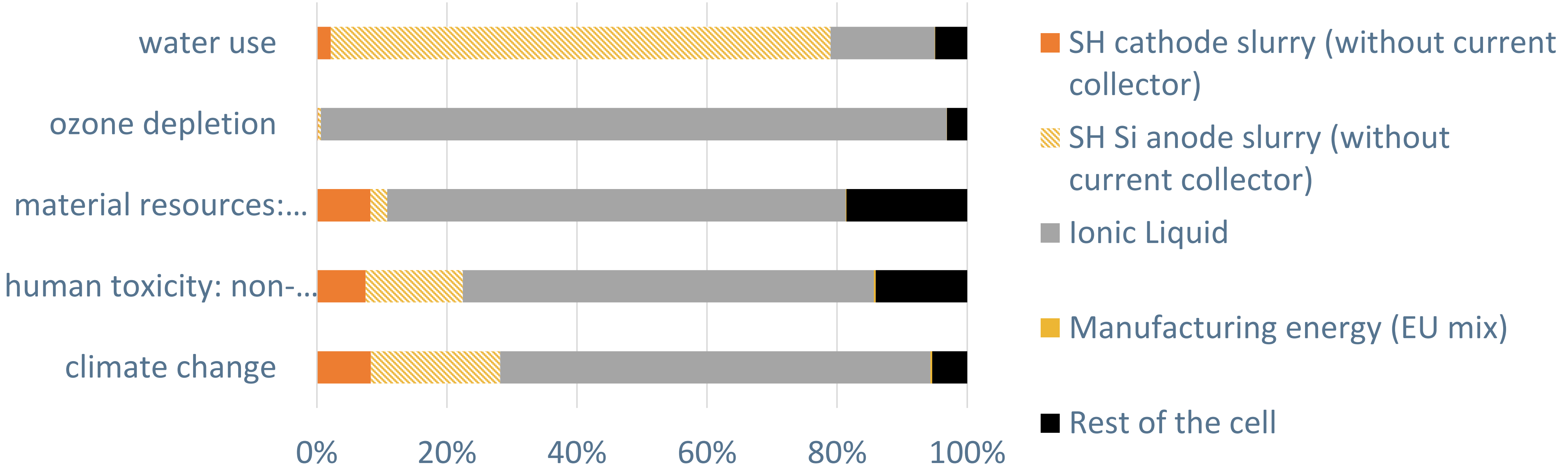
Results for the 140 mAh prototype cell

The high quantity of the ionic liquid in the 140 mAh prototype cell dominates the results



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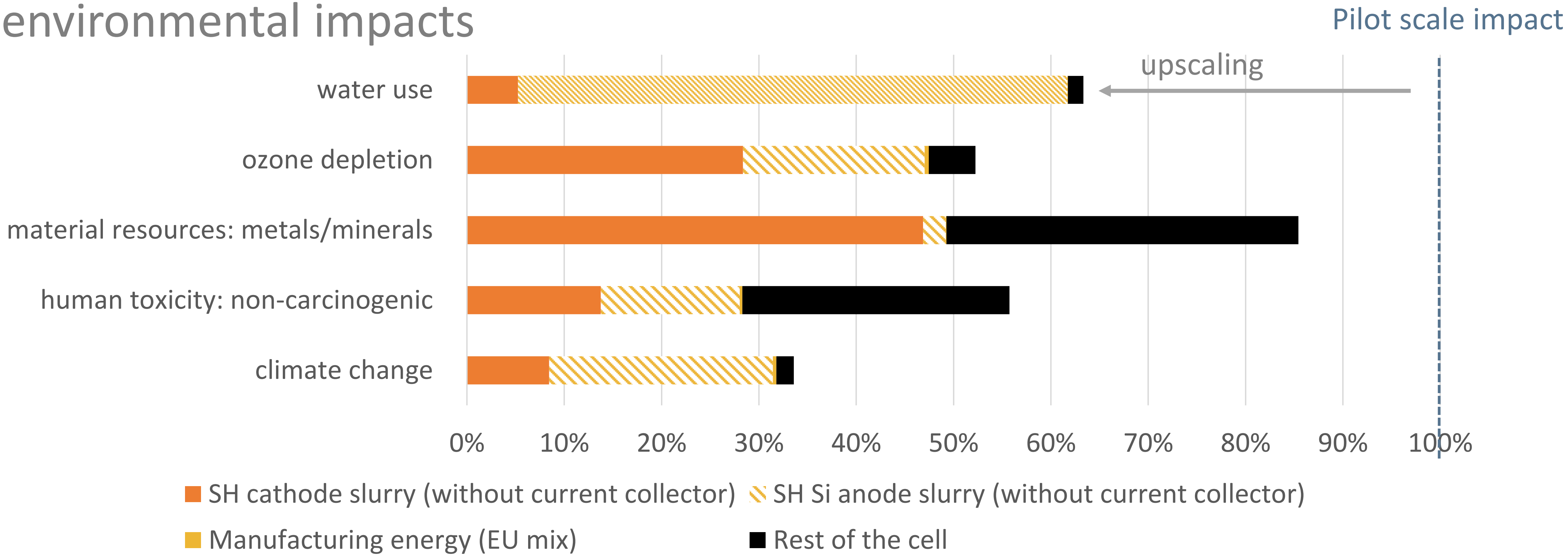
Results for the 2 Ah cell

Upscaling the production to a gigafactory (36 GWh) decrease the environmental impacts



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Focus on recycling

Hydrometallurgical process with a solvent extraction step after shredding to recover ionic liquid

95 % recovery rate

Recovery rate Ni, Co, Mn 98%

Recovery rate Cu, Al, Li 90%

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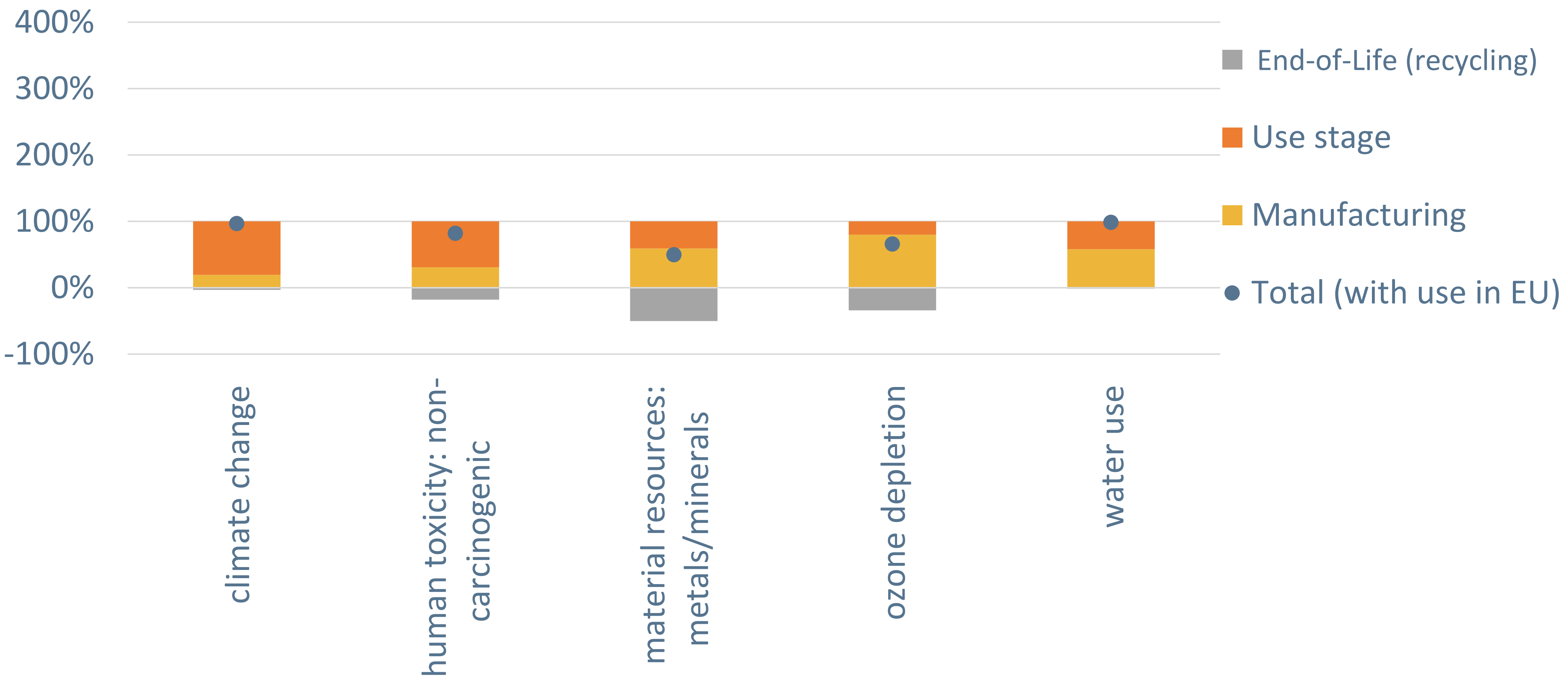
Recycling lowers the impact on human toxicity, material resources, and ozone depletion



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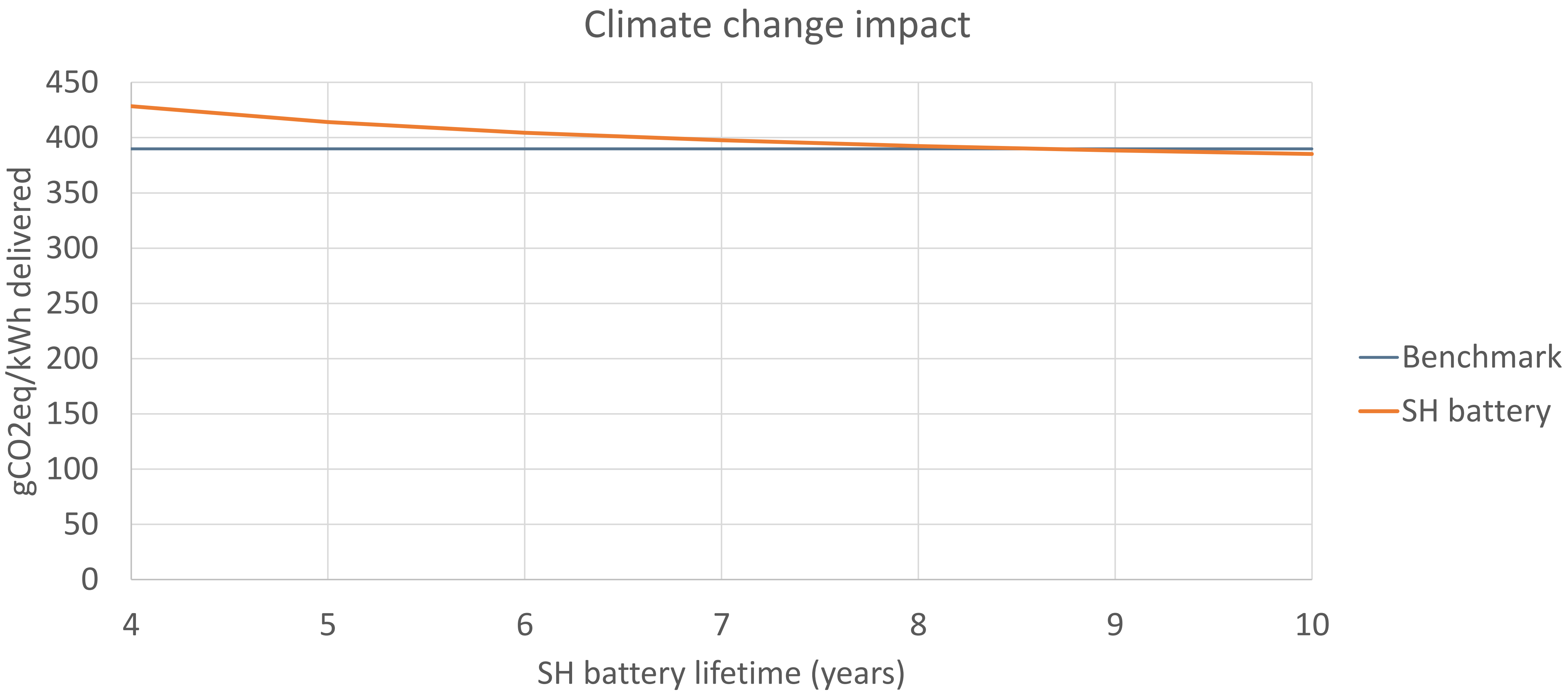
Comparison with benchmark



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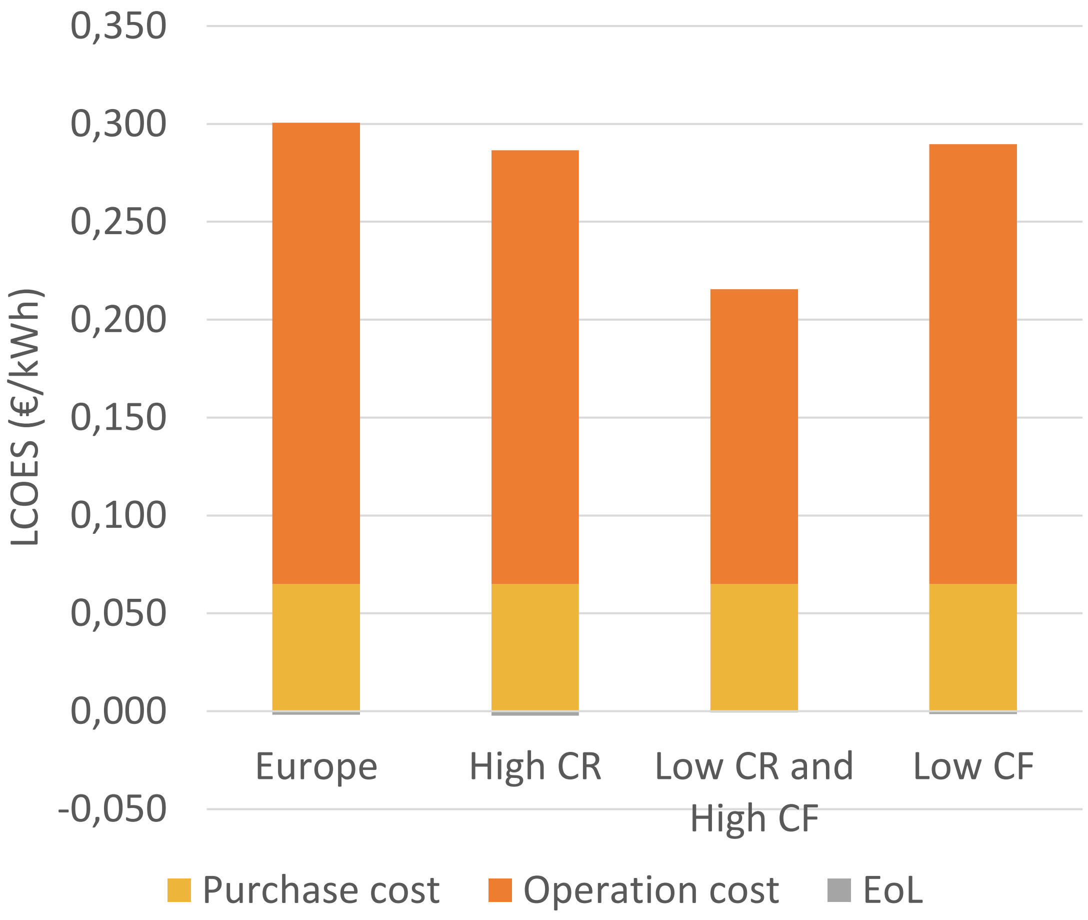
Economic performance

- Costs of the active materials assessed → the SH polymer is responsible for 42 to 43% of the costs of the cell manufacturing (depending on the factory location)
- Levelized cost of energy storage (LCOES) → most of the LCOES originates from the use stage



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Conclusion

Results:

- On prototype level, high quantity of ionic liquid distorts the results
- Upscaling to GWh factory scale decreased the environmental impacts up to 65%
- The ionic liquid can be recycled with a 95% recovery rate, hence reducing the impacts on human toxicity, resource depletion and ozone depletion
- When the lifetime of the battery can be extended to 9 years, the self-healing batteries outperform benchmark batteries
- The SH polymer contributes up to 43% of the manufacturing costs. However, the operation phase is more important for the LCOES

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What's next?

phoenix

Scan me!

Building more reliable and performant batteries by embedding sensors and self-healing functionalities to detect degradation and repair damage via advanced Battery Management System

- Development and implementation of magnetic, thermal and pressure triggering
- Design and implement the mechanical, electrical, thermal and gas sensors
- Demonstration of Gen 3b and 4a batteries with increased anode capacity and excellent capacity retention after numerous cycles
- The demonstrator pouch cell shows significant capacity retention after multiple cycles at a moderate charging rate
- Develop a fully integrated BMS
- Lower the specific costs of the self-healing battery compared to the reference battery
- Achieve a high recycling efficiency that demonstrates the recyclability of self-healing components
- Prospective Life Cycle Assessment of future batteries

Phoenix Smart Batteries

@PhoenixSmartBat

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