Economic and Environmental

Assessment of Two Industrial Symbiosis Opportunities in the Copper Sector

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Introduction

Industry in general has acknowledged the need to pursue sustainability to increase its resilience. One way to do this is via Industrial Symbiosis (IS). One of the sectors with big amounts of by-products and high impact is the copper sector.

This poster aims at: showing the key results of the assessment of two IS opportunities measuring its benefits from an environmental and market perspective.

Methods

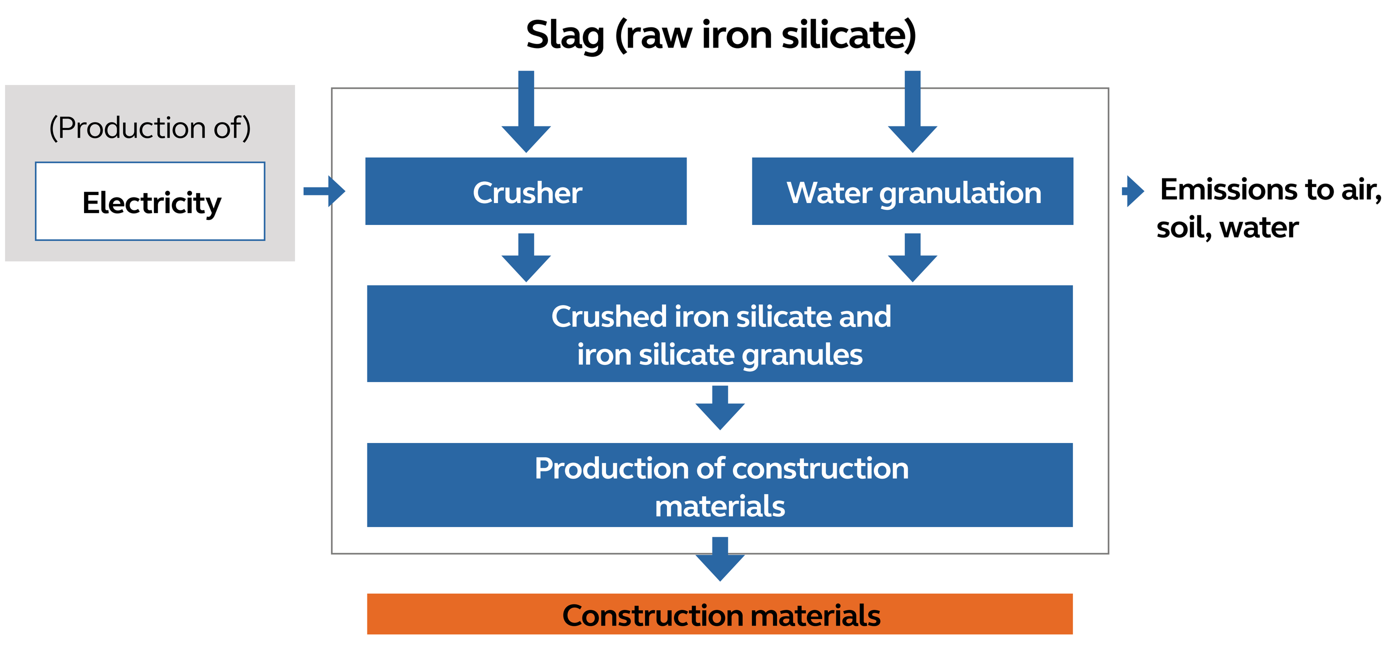
1. Life cycle assessment (LCA) following ISO 14040

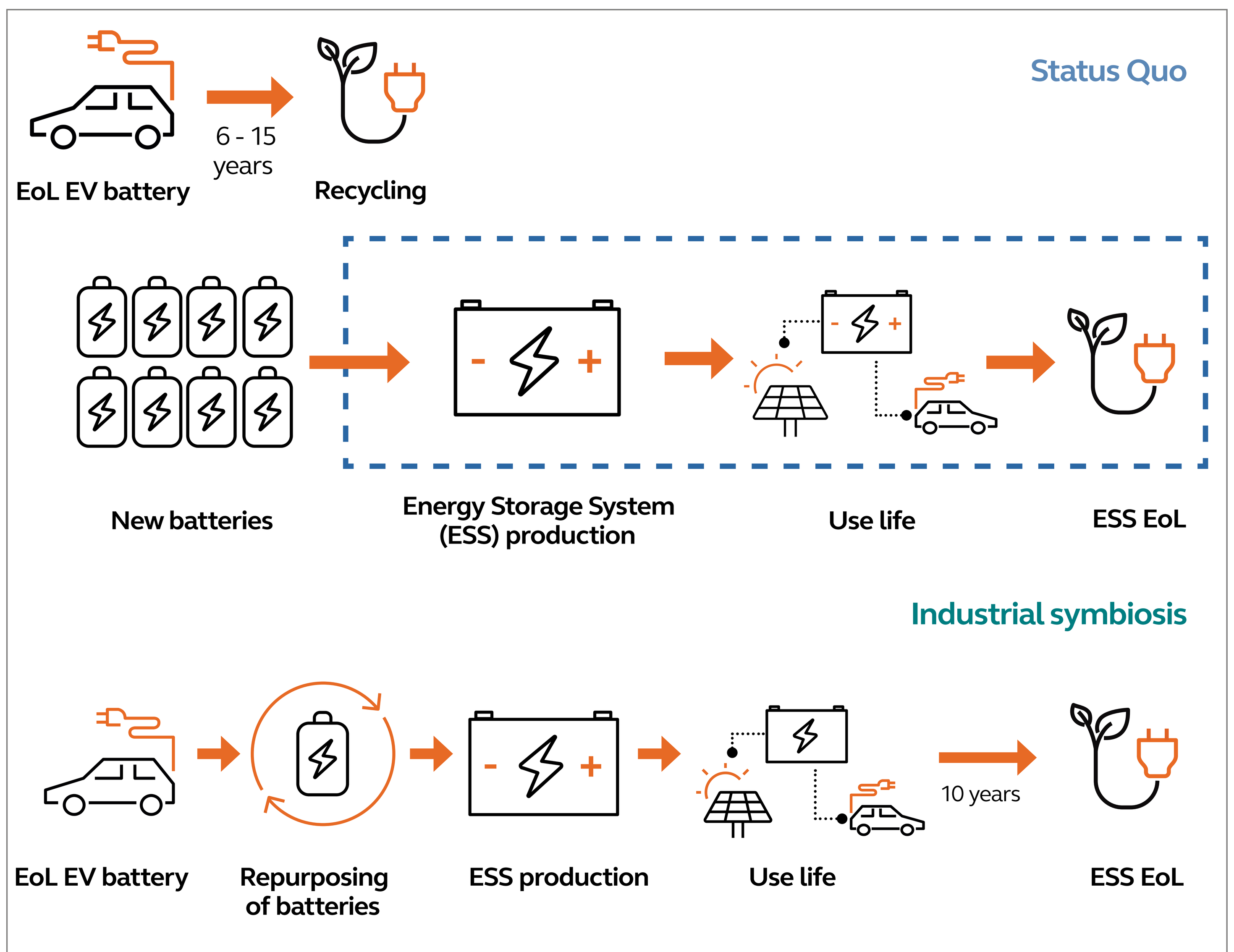
- Iron silicate, substitution in construction materials. Substitution of 1 ton of Gravel, 1 ton of Clinker, 1 ton of Concrete
- EoL EV Batteries, 1 kWh of energy stored in an energy storage system (ESS) made with either new or repurposed lithium-ion batteries used for a 10-year period

2. Comparison of costs and benefits

- For the iron silicate case (comparison of iron silicate landfilling + natural aggregate extraction vs cost of using iron silicate in concrete)
- For the end-of-life electrical vehicle (EOL EV) batteries (comparison between ESS made with new batteries and ESS made with second-life batteries)

3. Measuring the market size of the industrial symbiosis





Acknowledgement

The results presented were generated in view of the project "Quantifying two Industrial Symbiosis Opportunities" for the International Copper Association (ICA). The project team was composed of Arcadis and ICA, in subcontracted work was performed by Sphera. The presented work was performed by Arcadis. The report can be found here (QR):

QR code to this page:

Take home message

Main benefits of industrial symbiosis – Iron Silicate

- Environmentally speaking, the use of iron silicate as substitute of natural aggregates in in construction materials (i.e., clinker, gravel and concrete) results beneficial compared to the status quo.
- From a market and cost benefit perspective opportunities for iron silicate producers to find a market for iron silicate are on the rise.

Considerations and challenges - Iron Silicate

- Transport distances can have a negative effect on the environmental and economic feasibility of industrial symbiosis

Main benefits of industrial symbiosis – EOL EV batteries

- Environmentally more advantageous than the status quo in terms of carbon emissions and resources use (both mineral and fossil)
- From a cost-benefit perspective, the capital costs for large-scale ESS installations with repurposed batteries are lower than those of using new batteries

Considerations and challenges – EOL EV batteries

- From the battery repurposer and ESS user perspective, it is crucial that the repurposing costs + residual battery value remain lower than the cost of a new battery to ensure economic feasibility

Results: LCA Iron Silicate

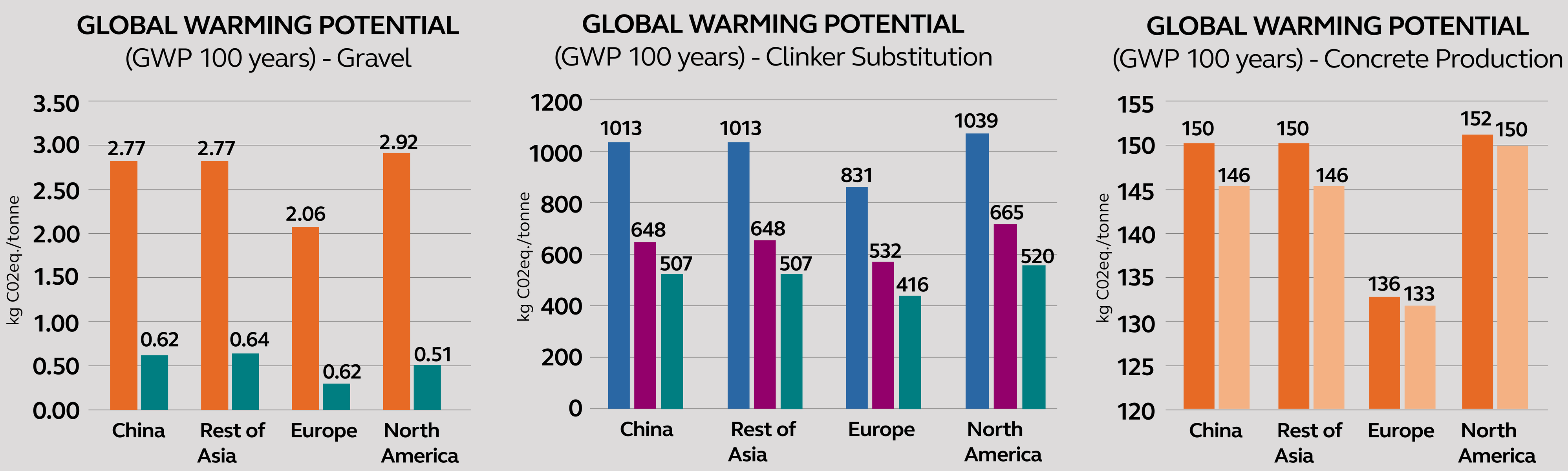


Figure 1 to 3: *The impacts associated with the production of Iron Silicate are less than half the impacts associated with the production of gravel for all regions (excluding transport distances). The impacts associated with the production of cement decrease by at least 36% when Iron Silicate is used to partially substitute the Clinker in cement. The impacts associated with the production of concrete decrease by at most 3% when Iron Silicate is used to substitute the stones in concrete production.*

Market and cost analysis

1. The demand for natural aggregates was ~3 bn tons in 2018 and expected to grow slightly to around 3.2 bn tons in 2025
2. A detailed cost-benefit analysis needs to be done on a company-by-company basis to conclude on feasibility
3. Trends make industrial symbiosis ever more feasible, as the costs linked to not doing it are on the rise

LCA EOL EV batteries

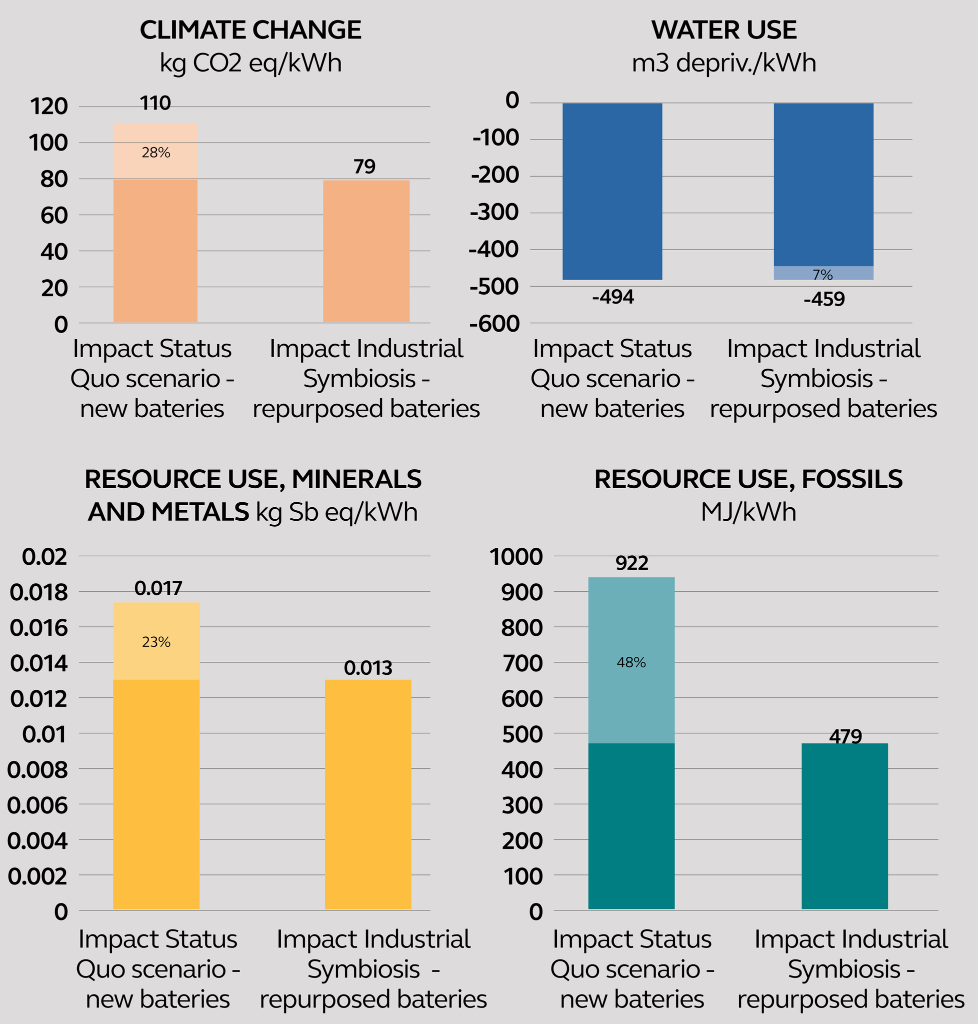


Figure 4 to 7: *The industrial symbiosis scenario scores better in the impact categories climate change, resource use, fossils, and resource use, minerals and metals. The status quo scores better in water use by a small margin, this is due to a double presence of the recycling stage (one after the EOL of the EV and one after the EOL of batteries in an ESS.*

Market and cost analysis

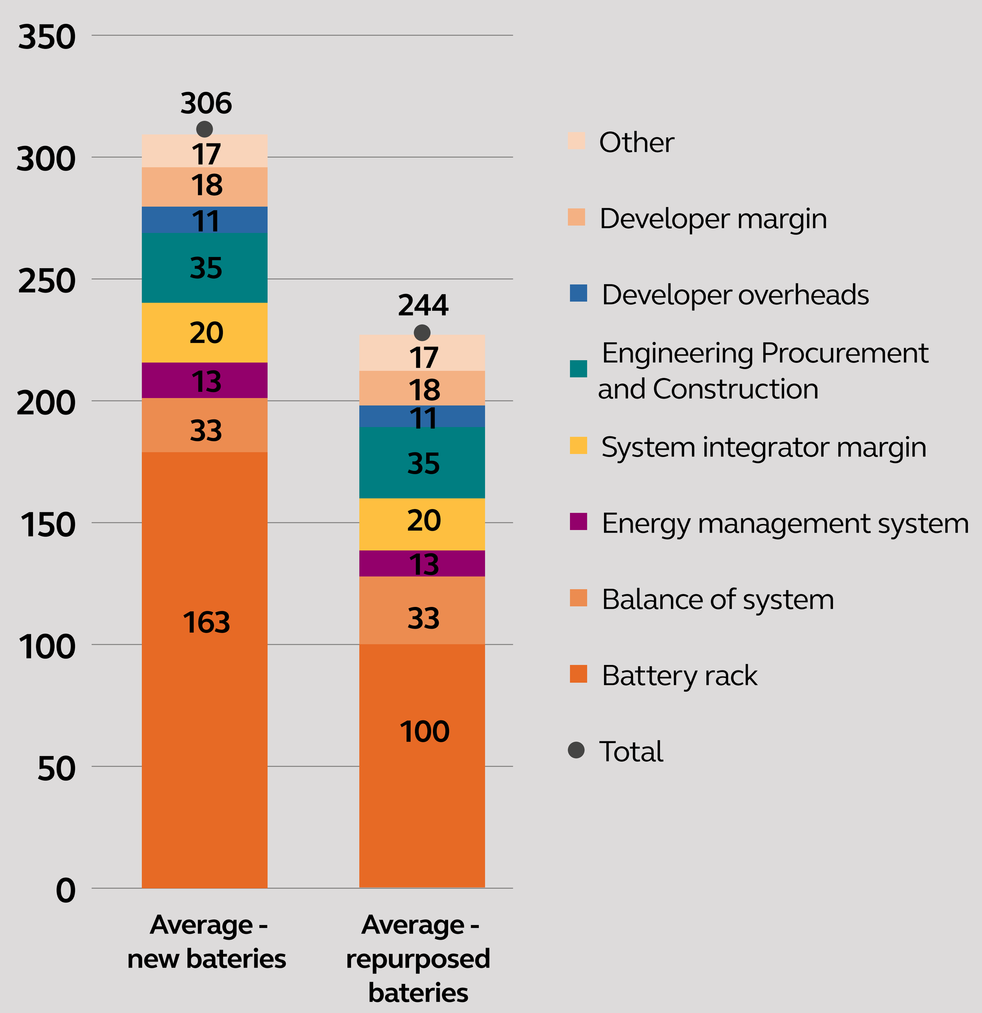


Figure 8: *The capital costs of a large-scale ESS installation is ~306 (new batteries) vs 244 USD/kWh (with repurposed batteries), making the cost of an ESS installation with repurposed batteries lower than that with new batteries.*

1. From a cost analysis perspective, More than 50% of the costs are due to the battery. Therefore, if the cost of repurposed batteries remain below the cost of a new battery the opportunity would be feasible.
2. However, projections indicate a downward trend in Li-ion battery prices, therefore, battery repurposing cost should remain lower than the costs of new batteries so that the opportunity remains feasible.