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Life Cycle Assessment for the electric steelmaking route in the ALCHIMIA project

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The European project ALCHIMIA "Data and decentralized Artificial intelligence for a competitive and green European metallurgy industry"(GA No 101070046) gathers academic and industrial partners in the steelmaking sector to optimize steel scrap use in the Electric Arc Furnaces (EAF) and the Ladle Furnace (LF) operation. The project aims to develop a Federated Learning informatic architecture integrating computational models based on data science.

Within this framework the Life Cycle Assessment (LCA) methodology serves two key roles:

• Establishing a baseline eco-profile for three CELSA Group steelmaking facilities (called Factory 1; Factory 2, and Factory 3). A cast-iron production plant (Fonderia di Torbole, FdT) was also assessed, but is beyond the scope of this contribution.

• Providing environmental impact factors for a multi-objective economic and environmental optimization model to reduce costs and impacts compared to the baseline.

A primary data collection campaign, conducted with CELSA process engineers, enabled the development of Life Cycle Inventories (LCIs) for EAF and LF operations. These data regard the consumption of materials and energy and the production of waste and pollutants. Since the focus of the project is on steel scraps, detailed data about the amount and composition of the scraps have been collected.

The baseline model has been firstly used to identify the major environmental hotspots of the processes. In particular, the results show that the use of ferroalloys, and more in general of tapping additions, represents the main contributor to the environmental impact of the steelmaking plants. Moreover, electricity consumption turns out as another major environmental hotspot. The environmental burdens associated with direct emissions, waste management, water consumption are also accounted for. Developing an optimization model is the focus of ALCHIMIA's second phase, currently underway. Once finalized, results will be compared to the baseline to quantify the potential environmental benefits of optimization.

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