Uneven Transitions: Environmental and Spatial Consequences of the Economic Security in the Aluminium Industry. â€œSpecial Session: Sustainable Strategies for Reducing COâ‚‚ and Non-COâ‚‚ Greenhouse Gas Emissionsâ€•

Topic: Sustainable Strategies for Reducing COâ‚‚ and non-COâ‚‚ Greenhouse Gas Emissions (II)
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This paper examines the environmental, economic, and spatial implications of the EUâ€™s strategy to enhance economic security through the revitalisation of domestic mining capacities and the reshoring of aluminium related production. In a context of growing geopolitical tensions, supply chain fragilities, and rising global demand for critical raw materials, the EU has adopted a more assertive approach to securing inputs essential for the green and digital transitions. Aluminium, and its precursor bauxite, are central to this agenda due to their role in infrastructure, mobility, renewable energy technologies, and industrial competitiveness. However, European aluminium value chains remain highly dependent on external suppliers: nearly 90% of bauxite imports come from outside the EU, with very limited domestic substitutability. This dependence exposes the EU to geopolitical shocks, trade restrictions, price volatility, and environmental and social risks embedded in foreign supply chains.

The study offers one of the first quantitative assessments of the uneven economic, environmental, and spatial consequences of revitalising the aluminium value chain in Europe. It focuses on a scenario in which the EU seeks strategic autonomy through reactivating bauxite mining, increasing European primary aluminium production, and expanding recycling pathways. Using an EXIOBASE 3.8.2 multiregional inputâ€“output (MRIO) framework, the study compares two scenarios: one in which rising demand is met through current import patterns, and another where all incremental demand is fulfilled through European production.

To operationalise the reshoring scenario, the analysis constructs an inventory of European bauxite deposits using the EGDI and RMIS databases, classifying them by size and extractive potential. Slovenia, Austria, Spain, and Romania emerge as the key regions with significant geological resources. The model integrates assumptions about sectoral price differences, substitutability between imported and domestic products, a 4% annual demand growth over two years, and the distribution of impacts across sectors and regions.

Results reveal notable contrasts between the two scenarios. Meeting increasing demand through current imports raises global emissions by 4,320 ktCOâ‚‚, creates 219,000 jobs worldwide, and generates â‚¬5.35 billion in value added. Reshoring production reduces global emissions to 4,080 ktCOâ‚‚ and increases value added to â‚¬5.93 billion, although global employment falls to 198,000 jobs. These differences reflect Europeâ€™s lower emissions intensity in aluminium production, its higher labour productivity, and higher price levels compared with suppliers such as Guinea, India, Brazil, and China.

Spatially, reshoring shifts most environmental and economic impacts from third countries to Europe, but the pattern is markedly uneven. In mining, Slovenia becomes the main producer, generating the largest increases in emissions, employment, and value added due to its numerous documented deposits. In aluminium production, Germany, Spain, Greece, Poland, and Sweden show the highest rises in environmental impacts, while employment gains are concentrated in Poland and Slovakia. Value added increases most in Germany and France, reflecting their stronger industrial structures and higher domestic intensities. The reprocessing sector shows fewer differences between scenarios because of its existing strong presence in Europe, though reshoring still reduces global emissions and boosts European economic benefits.

The study also highlights broader structural effects along the aluminium value chain. Increased domestic production stimulates indirect employment and value added across Europe, amplifying the economic benefits beyond directly affected industries. Domestic emissions also rise, but their scale

remains negligible relative to total EU emissions (below 0.05%).
Overall, the findings underline the strategic trade offs in the EUâ€™s pursuit of economic security through reshoring. While revitalising domestic aluminium production can strengthen supply chain resilience, reduce exposure to external shocks, and increase European value added, it may intensify regional inequalities, increase local environmental pressures, and reduce global employmentâ€”particularly in lower income supplier countries. A balanced industrial strategy, supported by coordinated regional development, targeted investment in mining and processing capacities, and enhanced circular economy initiativesâ€”especially recyclingâ€”will be essential to ensure that reshoring contributes both to European competitiveness and to more sustainable global value chain governance.