

## **Circularity Reinforcement of Critical Raw Materials in Europe: An Input-Output Analysis for the Case of Niobium**

Topic: Input-output and the network theory I (Chair: Keisuke Nansai, National Institute for Environmental Studies of Japan)

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European Commission (EC) attributes utmost attention to Critical Raw Materials (CRMs) as the related reserves rapidly exhaust and the recyclability rates are low. Hence, implementation of Circular Economy (CE) for CRMs plays a significant role for a sustainable European industry. Niobium is one of the most rare CRMs whose reserves are dominantly in Brazil and its circularity is below 1%. Being used in production of steel, superalloys, and superconducting magnets, scarcity of niobium threatens the future of multiple industries such as aerospace, information-technologies, and construction.

The main research question of this study is: “To what extent does the implementation of a CE strategy impact niobium’s criticality for Europe as well as the generation of waste and emissions along the niobium supply chain?” Three circular scenarios based on potential future technological developments, governmental policies, and resource use pathways for niobium are investigated. The global niobium supply chain is analyzed by an Enterprise Input-Output (EIO) model and the supply risk is calculated for each scenario in accordance with the EC’s criticality assessment framework. The study is novel as the first article proposing multiple CE solutions to tackle niobium’s criticality by using an EIO model.

The results show that urban mining as a CE strategy is a viable solution to reduce niobium’s criticality and to mitigate its supply chain’s negative impact on the environment. A higher recycling input rate or a mix of recycling and substitution strategies is necessary to reach below the criticality threshold of 1 and offset niobium’s criticality. Accordingly, Europe would prevent a shortage of supply by becoming less dependent on Brazil, however, joint efforts of academia, politics and the economic actors are needed.