Future environmental impacts of metals: findings from integrated scenario assessment with prospective LCA

Harpprecht, C.I.

Propositions

Stellingen

accompanying the thesis

Future Environmental Impacts of Metals

Findings from Integrated Scenario Assessment with Prospective LCA

1. Life cycle GHG emissions of metal production on a per-kilogram-basis may be lowered in the future for many metals. Key levers are a greener electricity supply, increased recycling shares, and switching to novel, decarbonized production technologies. For steel production, GHG emissions are most effectively reduced with electrified or hydrogen-based production technologies (Chapters 2-5).
2. The effect of declining mined ore grades, as expected for copper, nickel, ferronickel, zinc, and lead, can largely be compensated by other improvements, e.g., a greener electricity supply and increased recycling shares (Chapter 3).
3. Emission reductions per kilogram of metal produced may be insufficient to fully compensate for the effect of growing global metal demand. As a result, demand-related impacts are still likely to rise for many metals across several impact categories (Chapters 2 & 5).
4. Even under the most optimistic decarbonization scenarios, it will be particularly challenging for the iron and steel industry to meet climate targets, as it may require disproportionately large shares of the remaining carbon budgets by 2060—both at a global and national level, e.g., in Germany (Chapters 4-5).
5. Decarbonization measures are imperative to reduce climate change impacts of steel production. They may, however, shift burdens to certain impact categories, such as ionizing radiation, metal depletion or land use, which are largely—though not solely—caused by higher electricity requirements for future electrified steel production (Chapter 5).
6. The background system matters (Chapters 2, 3, 5; Mendoza-Beltran et al., 2018).
7. The future environmental impacts of metals are so far insufficiently addressed by existing research. In particular, there is a lack of knowledge on future impacts beyond climate change and on impacts at a global scale, i.e., accounting for future global metal demand. (Chapter 2; Watari et al., 2021).
8. The ultimate magnitude of future impacts of metals is uncertain, as impacts are highly influenced by scenario assumptions, narratives, and research scopes (Chapters 2-5; Watari et al. 2021).

9. The field of (prospective) LCA faces the big challenge of insufficient publication of (scenario) data and non-transparent reporting (Chapter 2; Bisinella et al., 2021).
10. Demand is a key driver of future environmental impacts. While we can try to identify technological solutions to reduce emissions of production, demand-side measures will also be necessary.
11. The more I learn, the more I realize how much I don't know. (Albert Einstein)

Carina Harpprecht

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