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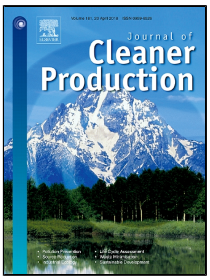

Challenges of digitalizing the circular economy: Assessment of the state-of-the-art of metallurgical carrier metal platform for lead and its associated technology elements

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Challenges of digitalizing the circular economy: Assessment of the state-of-the-art of metallurgical carrier metal platform for lead and its associated technology elements

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ABSTRACT
The circular economy (CE) paradigm in its broadest sense is key to our survival as a species. Due to this critical importance, understanding its fundamental limitations is thus of significant importance. Especially understanding the losses to Nature are key as these represent the true limitation to circularity. This requires at the minimum an understanding of the thermodynamics and entropy of the losses. Most CE work as well as the many depictions to date neglect to address this in detail, the many losses are brushed aside. Many texts in CE do not use the words entropy, thermodynamics, mass and heat transfer, technology etc. which all ultimately fundamentally affect both the circularity as well as economic viability of the system. Using lead as carrier for the narrative of this paper, the state-of-the art from technology to the thermodynamics as well as heat and mass transfer, product design, modularity, environmental impact, system simulation etc. will be critically discussed. This will reveal what key knowledge and data is presently missing to achieve the economically viable circularity of materials and products. This paper identifies what should be researched and developed to “close” the circular economy system. It thus provides a “ground zero” or baseline for the evaluation of the true economic viability of the CE paradigm relative to what we are presently achieving in our linear economy paradigm.

Keywords
Circular Economy, Lead, Technology Elements, Process metallurgy, Resource efficiency, Sustainability