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Process metallurgy: A key enabler of a circular economy

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Metals are an essential and critical component of today's society: a moment's reflection on their ubiquitous presence in virtually all energy and material production processes is enough to confirm this. Metals play a key role in enabling sustainability through various high-tech applications in society. However, the resources of our planet are limited, as is the strain to which we can subject it in terms of emissions, pollution, and disposal of waste. For these reasons, finding ways to lower the environmental footprint of our collective existence and therefore lowering greenhouse gas emissions and helping to mitigate climate change is a vital priority. The principal theme of this contribution is the maximization of resource efficiency as well as enabling a circular economy through the recycling of metals, Waste Electric and Electronic Equipment (WEEE) and cars with a focus on base metals, technology metals, precious metals (PMs) and platinum group metals (PGMs). The detail and deep knowledge that is required to systemically fully understand resource efficiency in the context of a circular economy will be discussed and Design for Resource Efficiency (DfRE) and Design for Recycling (DfR) elaborated on. Specifically, the understanding of product-centric recycling is highlighted, setting it apart from the usual material-centric recycling approaches. The base metals - copper, cobalt, lead, nickel, tin, and zinc - all play a crucial part in present society. Increasingly, these are linked in concert to form the crucial carrier metals for the sustainable circular economy society or in a more engineering paradigm System Integrated Metal Production (SIMP) or, in other words, the process metallurgical Internet-of-Things (IoT). This paper examines the special and crucial role minerals processing has and the recovery and properties of base metal metallurgy have in acting as enablers in any recycling efforts. Furthermore, the crucial importance of a hightech base metals metallurgical infrastructure for enabling a circular economy is highlighted (https://www.youtube.com/watch?v=0WE72HB7asY), which may simply be called Circular Economy Engineering.