

Towards sustainable business model innovation in mining

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INTRODUCTION

The mining industry is at a turning point where the course for its future is set. Mining actors are confronted with a growing demand for raw materials, decreasing ore grades, and growing pressure through 'responsible investing' depicted by environmental, social, and governance (ESG) principles. According to the latest industrial survey by Ernst and Young, the most significant risk of all is the loss of the 'social licence to operate', which describes the evolving relationship between the mining actor and its local or regional stakeholders, presuming procedural and distributional fairness, trust, and acceptance¹. The KPMG Global Mining Survey Report in 2020 revealed that 75% of its respondents think that the mining industry needs to redefine success using a more holistic group of measures that take into account the values of all its relevant stakeholders. Of the respondents, 33% expressed their urgent need for business model innovation.² Business model innovation is already known as a prime technique to achieve unique strategic positions and competitive advantages.³ The UN Sustainable Development Goals (SDGs) facilitate the derivation of sustainability-oriented activities.

However, the road to sustainable business model innovation in mining is not mapped out sufficiently. Until now, there has been limited research progress in operationalisation. A holistic sectoral perspective is required. It has to support all kinds of players from artisanal to large mining actors in identifying economically viable business cases that support sustainable development. Our approach points out potential sustainable business model patterns in the mining context (Table 1). Rare earth elements (REE) are considered as they are essential for the decarbonisation process.

¹ Ernst & Young (2021). Global mining and metals top 10 business risks and opportunities. Available from:

https://www.ey.com/en_ca/mining-metals/top-10-business-risks-and-opportunities-for-mining-and-metals-in-2021

² KPMG (2020). Risks and opportunities for mining. Global Outlook 2020. Available from:

<https://assets.kpmg/content/dam/kpmg/xx/pdf/2020/02/risks-and-opportunities-for-mining.pdf>

³ Breuer, H., & Lüdeke-Freund, F. (2017). *Values-Based Innovation Management. Innovating by What We Care About*. Palgrave Macmillan, Houndmills, UK.

Table 1. Sustainable business model patterns in the (REE) mining context and SDG contributions (Own, enhanced illustration based on Bocken et al.⁴)

	Patterns (supported SDGs)	Potential mining activities
Environmental	1) Maximise material and energy efficiency (6, 7, 11, 12, 13, 15, 17)	Network activities; reduction of water and energy consumption; use of by-products
	2) Closing resource loops (9, 11, 12, 13, 15)	Industrial symbiosis, waste as value
	3) Substitute/use of renewable and digital processes (9, 12, 13)	Service innovation
Social	4) Deliver functionality not ownership (9, 12)	Resource-service-systems
	5) Adopt a stewardship role (1, 2, 3, 4, 15)	Integration of local communities; (occupational) health and safety; biodiversity protection
	6) Encourage sufficiency (9, 12, 17)	Supporting customer awareness
	7) Repurpose for society/environment (9, 12, 13, 15, 16)	Responsible supplier assessment
Economic	8) Inclusive value creation (1, 4, 8, 10)	Creating shared value: development of skills and knowledge, distribution of wealth; integration of local suppliers; support of local clusters, 'mine-to-end product strategy'
	9) Develop scale up solutions (8, 9)	Transition of the mining sector (integration of different players from small to large scale)

METHODOLOGY

Sustainable business models provide the platform for innovation and the creation of strong business cases. These result from activities that allow companies to create economic value while creating environmental and social value⁵. Sustainable value creation integrates all stakeholders. Thus, it supports the process of gaining and retaining the 'social licence to operate'. Performance can be measured using a triple bottom-line approach.

The nine potential sustainable business model patterns by Bocken *et al.*,⁶ deliver a basis for sustainable business model prototyping in the mining context⁷. They are supplemented by their SDG contributions (Table). Individual parameters, e. g. the REE market structure, REE characteristics and materiality

⁴ Bocken, N., Short, S., Rana, P., & Evans, S. (2014). A literature and practice review to develop sustainable business model archetypes. *Journal of Cleaner Production*, (65), 42-56.

⁵ Schaltegger, S., Lüdeke-Freund, F.H.E. (2012). Business Cases for Sustainability: The Role of Business Model Innovation for Corporate Sustainability", *International Journal of Innovation and Sustainable Development*, (2), 95-119.

⁶ Bocken, N., Short, S., Rana, P., & Evans, S. (2014). A literature and practice review to develop sustainable business model archetypes. *Journal of Cleaner Production*, (65), 42-56.

⁷ Drusche, O., Krause, S., Kretschmann, J., Mischo, H., & Ayres da Silva, A. (2021). Business Models for Sustainability. *Ökologisches Wirtschaften*, (36), 43-50.

analyses of mining actors, refine business model prototyping. The procedure can be adapted for other raw materials.

RESULTS

Due to their use in wind energy and e-mobility applications, REE have a significant impact on sustainable development. However, the extraction, separation and processing of REE are associated with severe environmental and social impacts resulting in a negative ecological footprint. Currently, many REE companies act as feedstock suppliers, or specialise in the cost-intensive and complex hydrometallurgical separation processes. The resulting loss of value creation for the local communities may lead to adverse community reaction to mining projects.

Two examples point out how these contradictions and conflicts can be resolved. First, the incremental innovation type is illustrated by the 'REE specialist', which is capable of vertical integration (approximately six, predominantly Chinese companies). This strategy enables 'inclusive value creation' (Table 1) by covering the entire REE supply chain with sales opportunities from rare earth oxides (REO) to final products, like the neodymium-iron-boron magnet. The circular economy (CE) concept reveals radical innovation potentials, integrating several patterns at once. Achieving circularity requires closing of material loops, by (1) direct recycling of pre-consumer manufacturing scrap/residues, (2) urban mining of post-consumer end-of-life products, and (3) landfill mining of historic (and future) urban waste streams.⁸ All nine patterns can be applied to different extents, creating strong business cases while supporting a wide range of SDGs. Considering the rising demand and the anticipated reduction of entry barriers in the REE market, significant business opportunities for new market entrants like the Namibian Lofdal-Bergville project can be expected. The World Economic Forum has quantified the material cost savings of a circular economy with up to \$1 trillion per annum by 2025, excluding new opportunities for additional business cases.^{9,10}

CONCLUDING REMARKS

It is an opportunity for new entrants to position themselves with the aid of sustainable business model innovation. There are plenty of sustainability-oriented opportunities that have the potential to strengthen profitability and competitiveness. Cleaner production and consumption are driven by green and technology-driven innovations. These induce opportunities for large mining companies and new market players ('Mining 4.0'). 'Base of the Pyramid' (BoP) approaches focus on social issues in developing and emerging countries¹¹ and bear promising options for the artisanal mining sector.

⁸ Jones, P. T., Geysen, D., Tielemans, Y., Van Passel, S. et al. (2013). Enhanced Landfill Mining in view of multiple resource recovery: a critical review. *Journal of Cleaner Production*, (55), 45-55.

⁹ Lacy, P., Long, J., & Spindler, W. (2020). *The Circular Economy Handbook. Realizing the Circular Advantage*. Palgrave Macmillan, London, UK.

¹⁰ World Economic Forum (2019). *The Next Frontier: Natural Resource Targets. Shaping a Competitive Circular Economy within Planetary Boundaries*. Available from

http://www3.weforum.org/docs/WEF_The_Next_Frontier_Natural_Resource_Targets_Report.pdf

¹¹ Lüdeke-Freund, F., Massa, L., Bocken, N., Brent, A., & Musango, J. (2016). *Business Models for Shared Value: Main Report*. Network for Business Sustainability, Cape Town.



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