Umwelt Bundesamt

German Environment Agency

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Environmental hazard potentials of raw materials

Some facts & findings for manufacturing industries

1 Why do raw materials matter?

Raw materials such as minerals and metals are indispensable for all manufacturing industries. Despite efforts for more efficient use and improved recycling, most industry segments will continue to rely on raw materials from mining sources. In this context, industry is becoming increasingly aware that the dependency on raw materials is associated with distinctive risks:

- Risks associated with security of supply: Short-, mid- or long-term shortages in supply might significantly increase raw material prices and cause turbulences to supply logistics and corporate cost structures.
- Risks associated with environmental impacts and human rights issues: Mining and processing of many mineral commodities is conducted in world regions with weak governance and partly under dubious environmental and human rights conditions. Due to improved information flow across international boundaries, such shortcomings increasingly receive public attention across the world. Therefore, related issues can develop into reputational risks for mining companies, as well as major raw material using industries.

Developments over the last decade also suggest that the second risks – environmental impacts and human rights – also influence supply security: This is because shortcomings in mining often stir local public sentiments against mining, which often translate into increasing hurdles for mining operations and might even lead to shut down of individual mining sites.

2 What is the role of manufacturing industries?

Most manufacturing industries use a wide range of raw materials. These are commonly sourced in the form of components or semi-finished products. Therefore, most manufacturing industries have no direct contact to mining companies and their operations. Despite this removed situation, the raw material demand of manufacturing industries is a key driver behind mining and many related operations. Therefore, there is an increasing international consensus that manufacturing industries should

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aim to understand related risks in their mineral supply chains and try to avoid situations in which they indirectly benefit from unsound conditions in mineral extraction and processing. This growing international understanding is already routed in policy documents from the UN[1] and OECD[2] and led to the formation of various industry initiatives to support sound sourcing of minerals and metals.

Although many of these initiatives focus on the mitigation of human rights risks in mineral supply chains, environmental impacts are increasingly recognized as being also important in this regard. In extreme cases, environmental issues can have such drastic impacts on human health and livelihoods that they impede human rights, including the right of bodily integrity.

3 How can environmental issues of raw material mining be addressed in practice?

There is a broad understanding that manufacturing industries cannot resolve problems in foreign mining areas alone. Nevertheless, their purchasing policy and their influence along supply chains can help to support other efforts for improved conditions in mining. Naturally, leverage is biggest were companies and industry sectors control large shares of the world market of a certain commodity. Therefore, it is recommended that manufacturing industries prioritize those materials where they (possibly together with other companies of their sector) consume a high share of total world production.

Producers of battery powered electronic devices are, for example, major consumers of cobalt. And raw materials such as platinum and palladium are commonly used in catalytic converters for the chemical industry and the automotive sector with little alternatives for substitution.

From such an analytical starting point, focus should lie on raw materials with particular high environmental hazard potentials (EHPs). Based on this first screening, companies and industry sectors should identify specific environmental problems in their supply chain and seek for ways to reduce related impacts. Depending on the type of impact, commodity and world region, this can be done with support from existing initiatives, in-region-projects or raw material certifications. Generally, the number of related industry approaches significantly increased over the last years and now covers various raw materials such as aluminium, cobalt, gold, copper and steel.

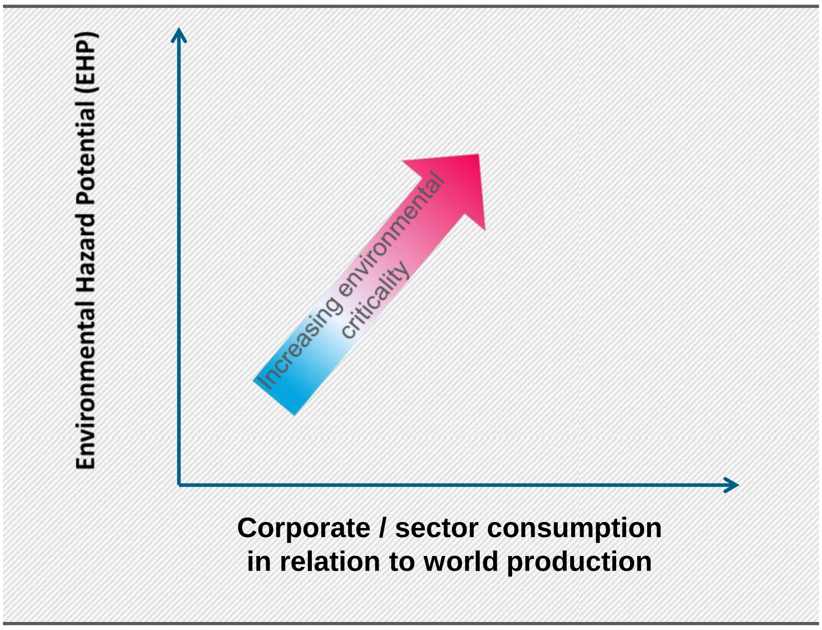
4 The supporting role of OekoRess results

The results of the OekoRess project can support the raw material related risk assessment of companies by indicating raw material specific aggregated Environmental Hazard Potentials (aEHPs) (see table 1 in the annex). Materials with a high aEHP have a higher likelihood for severe environmental shortcomings in mineral supply chains. Combined with the information on company / sector consumption in relation to the total world production, this will result in a well-founded prioritisation for further raw material related activity planning (see figure 1). An indicator on environmental governance in producing countries adds another level of information.

[1] UN (2011): Guiding Principles on Business and Human Rights.

[2] OECD (2016): OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas. Third edition.

Figure 1: 2-dimension concept of corporate / sector specific environmental criticality



Activity planning can further be supported by the OekoRess raw material profiles that give more detailed insights in specific characteristic problems in the mining of each listed commodity. For example the profiles for platinum and palladium reveal that their high aggregated Environmental Hazard Potentials (aEHP) mainly go back to the geological and processing conditions (Indicator 1 on preconditions for acid mine drainage, Indicator 2 on paragenesis with heavy metals and Indicator 5 use of auxiliary substances). Subsequently, a sound management of tailings and process chemicals are key factors for environmental risk mitigation in mining areas of these raw materials.

5 Further reading

Methodological background reports of the OekoRess I project can be downloaded from: https://www.umweltbundesamt.de/publikationen/discussion-of-the-environmental-limits-of-primary

The full assessment report is available at:

https://www.umweltbundesamt.de/publikationen/environmental-criticality-of-raw-materials

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Table 1 Raw material specific OekoRess results

EHP Indicators								GSMEF		Raw materials	Aggregated results		Supplementary information			
1.	2.	3.	4.	5.	6.	7.	8.	SMF	SEF		aEHP	EGov	GSMEF	M/B/C	ASM	AR
										Antimony				M+**B**+C	ASM	< 1 %
										Cobalt				M+**B**	ASM	< 5 %
										Platinum				M+B+C		< 10 %
										Vanadium				M+**B**		< 5 %
										Rhodium				C+B		< 20 %
										Copper				M		< 5 %
										Gold				M+B	ASM	< 5 %
										Phosphate rock				M		< 5 %
										Zinc				M		< 1 %
										Palladium				C+B		< 30 %
										Indium				B		< 1 %
										Lead				M+C		< 1 %
										LREE				M+C		< 5 %
										Molybdenum				M+B		< 1 %
										Silver				M+C+B	ASM	< 5 %
										Bismuth				B		< 1 %
										Selenium				B		< 5 %
										Tellurium				B		< 5 %
										Nickel				M		< 15 %
										Germanium				B		< 10 %
										Rhenium				B		< 5 %
										HREE				M+C		< 1 %
										Aluminium				M		< 1 %
										Borates				M		0 %
										Gallium				B		< 1 %
										Scandium				B		< 10 %
										Beryllium				**M**+B	ASM	< 5 %
										Niobium				M		< 1 %
										Silica sand				M		0 %

EHP Indicators								GSMEF		Raw materials	Aggregated results		Supplementary information			
1.	2.	3.	4.	5.	6.	7.	8.	SMF	SEF		aEHP	EGov	GSMEF	M/B/C	ASM	AR
Green	Red	Yellow	Green	Yellow	Yellow	Red	Yellow	Red	Red	Chromium	Yellow	Red	Red	M	ASM	0 %
Yellow	Yellow	Yellow	Red	Green	Yellow	Green	Yellow	Red	Yellow	Tin	Yellow	Red	Red	M	ASM	< 1 %
Green	Green	Green	Yellow	Red	Red	Red	Green	Yellow	Yellow	Magnesium	Yellow	Red	Yellow	M		0 %
Green	Yellow	Red	Yellow	Green	Green	Yellow	Red	Yellow	Red	Manganese	Yellow	Red	Yellow	M	ASM	0 %
Green	Yellow	Yellow	Red	Yellow	Yellow	Yellow	Yellow	Red	Yellow	Bauxite	Yellow	Yellow	Red	M		< 1 %
Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Red	Red	Red	Iron	Yellow	Green	Red	M		< 1 %
Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Red	Red	Yellow	Iron ore	Yellow	Green	Red	M		< 1 %
Green	Yellow	Red	Red	Green	Green	Green	Red	Red	Red	Titanium	Yellow	Green	Red	M		< 1 %
Green	Green	Green	Yellow	Yellow	Red	Red	Yellow	Yellow	Yellow	Gypsum	Yellow	Yellow	Yellow	M	ASM	0 %
Green	Green	Green	Yellow	Green	Red	Red	Yellow	Yellow	Red	Magnesite	Yellow	Yellow	Yellow	M		0 %
Green	Green	Yellow	Red	Yellow	Red	Yellow	Green	Green	Green	Lithium	Yellow	Green	Green	M		0 %
Green	Yellow	Red	Yellow	Green	Green	Green	Yellow	Yellow	Yellow	Tantalum	Light green	Red	Yellow	C	ASM	0 %
Green	Green	Green	Green	Yellow	Green	Red	Yellow	Yellow	Yellow	Fluorspar	Light green	Yellow	Yellow	M	ASM	0 %
Yellow	Yellow	Yellow	Green	Yellow	Yellow	Green	Green	Yellow	Yellow	Tungsten	Light green	Yellow	Yellow	M	ASM	< 5 %
Green	Green	Green	Green	Yellow	Yellow	Yellow	Yellow	Green	Green	Graphite	Green	Red	Green	M	ASM	< 5 %
Green	Green	Green	Yellow	Yellow	Yellow	Yellow	Green	Red	Red	Coking coal	Green	Yellow	Red	M		0 %
Green	Green	Green	Green	Yellow	Green	Yellow	Yellow	Red	Red	Potash	Green	Green	Red	M		0 %
Green	Green	Green	Yellow	Green	Green	Yellow	Green	Yellow	Yellow	Kaolin clay	Green	Green	Yellow	M		0 %

1. Preconditions for acid mine drainage (AMD)
2. Paragenesis with heavy metals
3. Paragenesis with radioactive substances
4. Mine type
5. Use of auxiliary substances
6. Accident hazards due to floods, earthquakes, storms, landslides
7. Water Stress Index (WSI) and desert areas
8. Designated protected areas and Alliance for Zero Extinction (AZE) sites

SMF Size of material flow
SEF Size of energy flow
EGov Environmental governance
EHP Environmental hazard potential
aEHP Aggregated environmental hazard potential
EGov. Environmental governance
M/B/C Main (M), co- (C) or by (B)-product. **Fat** and underlined represents the largest share (e.g. **B**). '+' indicates that the raw material is mined as M, B, and/or C

GSMEF Global size of material and energy flows
ASM Artisanal and small-scale mining
AR Share of mining sites in the arctic region
HREE Heavy rare earth elements
LREE Light rare earth elements

- Red: High EHP
- Orange: Medium to high EHP
- Yellow: Medium EHP
- Light green: Low to medium EHP
- Green: Low EHP