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Water scarcity footprint of renewable electricity generation in the context of regional impacts from mining activities

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Renewable energies play a key role in avoiding carbon dioxide emissions from fossil electricity generation. However, support for certain renewable energy technologies focused only on greenhouse gas reduction can reinforce other environmental impacts and thus shift the problems. The authors therefore compare three forms of renewable electricity generation, namely concentrated solar power, run-of-river hydropower and sugarcane bagasse burning, to classical electricity generation from hard coal combustion with respect to their contribution to regional water scarcity. In a comparative life cycle impact assessment the quantitative and qualitative demand for water is assessed in a comprehensive conceptual framework against the background of regional water availability. A spatially explicit analysis reveals hotspots of water use along the case studies' supply chains with a strong focus on mining activities. For this purpose, the global supply chains of nine mineral resources (aluminium, clay, coal, copper, gypsum, iron, lime, lithium and phosphate) were regionalised at mine site level in advance, so that contributions to environmental impacts can be assigned to single mine clusters. Next to the locations of the case studies itself, about 40 % of all contributions are associated with mining activities. Hard coal mining in Russian and Chinese mines as well as in South Africa as part of the supply chains of all case studies makes up the largest share of this. Further contributions are from mining of iron ore in Australian mines and copper extraction in Chinese, North American and Peruvian mines. However, up to 65 % of the life cycle impacts cannot be spatially analysed due to limited data availability. These findings indicate that a detailed investigation of mining supply chains is necessary to compare power generation technologies in a meaningful way. Results also show that sugarcane bagasse burning, if used as by-product and not as waste, is responsible for the largest contributions to all indicators, suggesting that targeted use of biomass for electricity generation is not is not very effective in reducing global environmental impacts, such as contribution to water scarcity.