In the next few decades there is expected to be a global shift in power generation from fossil fuels and nuclear fission to various forms of renewable energy. This process will be accompanied, however, by a strong demand for non-fuel raw materials required for the generation, storage, transmission and utilisation of these energy forms. Some of the raw materials are potentially exhaustible; some are already regarded, rightly or wrongly, as geochemically “scarce”. Many of them have been characterised by steep price increases in recent years. Examples are neodymium, praseodymium and dysprosium for rare earth-based permanent magnets in wind turbines; indium, gallium, selenium and tellurium for thin film solar cells; helium. The supply situation with regard to such elements is often described as “critical”. A possible geochemical scarcity is, however, not the only factor contributing to this designation; the supply situation is influenced by various other parameters. We discuss the use of the terms “critical” and “criticality” in this context, pointing out the confusion which arises because of a different meaning of the terms in the physical sciences. In examining the elements mentioned above – both with respect to the supply situation and to their specific energy-oriented applications – we look at the issues of potential geochemical scarcity, substitutability and extraction as by-product. Together with the recycling potential these are three
important indicators, or constraint parameters, in so-called criticality analyses. Geochemical scarcity already seems to play a role in the case of helium and could also soon become apparent for tellurium, indium and possibly dysprosium. We conclude that geochemical scarcity may pertain as a consequence of mineral depletion when average grades of ore are falling, but at the same time inflation-corrected mineral prices are rising. The use of rare metals for the production of renewable energy – like nearly all resource-consuming systems in our society – does not satisfy “strong” sustainability criteria.

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