RESOURCE RISKS ASSOCIATED WITH RAW MATERIALS FOR THE ENERGY TRANSITION

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Overview

Traditionally, security of supply of natural resources for the energy production or conversion has been discussed with respect to oil, gas, coal and nuclear fuels. The peak oil controversy is the most prominent example of the question regarding long-term availability of energy resources. The oil crises of the 1970s as well as the Russian-Ukrainian conflicts and their consequences for oil transport from the Middle East to the world markets respectively gas transport from Russia to Central and Western Europe are examples short-term supply risks in the traditional energy systems.

These traditional risks of energy security will be reduced by integrating more renewable energies into the system as demand for fuels will be reduced (Schaefer et. al., 2016). However, the energy transition with its focus on additional capacities of renewable energies in electricity production changes the nature of relevant supply risks in the energy sector. The most prominent supply risk of wind and solar based electricity is that its hourly availability depends on natural conditions: Wind can be stronger or weaker, sunshine depends on daytime and distribution of clouds. The results are fluctuations in the supply and therefore the need to install extra capacity, storage technologies or to strengthen demand side reactions to changes in short time supply.

Beyond these well analysed (however not yet mastered) challenges of the energy transition, there are additional risks related to raw material supplies that have not been sufficiently addressed yet. These risks become relevant as new technologies like windmills, solar panels, and stationary or mobile batteries increase the demand for certain resources, especially metals, significantly. These raw material supply risks should be analysed briefly in this paper.

Over the last few years, companies and public authorities have become increasingly concerned about the security of supply of mineral resources (Bardt, 2008). The main driver for this increased attention was the steep rise of prices before and after the global economic crisis 2008/2009. Numerous elements are needed for all kinds of production in building, manufacturing and even the service sector, but also for modern energy technologies in a more climate friendly energy system.

Methods

In this paper, we use the methodology of vbw / IW Consult (2017) as described in Bardt (2016). To analyse the risk profile of the elements, we use eight indicators that represent different risk perspectives. Five of these are quantitative indicators, which are composed of various publicly available data sources. The qualitative indicators are based on literature and expert interviews

The eight indicators (reserves-to-production ratio, country risks, 3-countries-concentration, 3-companies-concentration, price risks, relevance for future technologies, strategic potential, substitution potential are standardised and multiplied by their respective weight factor. The total is the Resource Risk Index, which can reach a maximum value of 25. The Index (RRI) is constructed to give guidance regarding the level of risks. We use it to group 45 elements and define three classes of criticality: critical (red), less critical (orange) and not critical (yellow). All elements with an RRI score of more than 15 have to be considered critical. Currently, the most critical resource is Yttrium with a value of 21.3 (vbw / IW Consult, 2017).

Results

Based on the analysis of Marscheider-Weidemann et al (2016), we define the following elements as relevant for further investigation as demand will grow significantly caused by modern energy system technologies: cobalt, lithium, magnesium, molybdenum, nickel, scandium, vanadium, tin, and the groups of rare earth elements dysprosium / terbium (heavy rare earth elements / HRE) as well as neodymium / praseodymium (light rare earth elements / LRE).

The elements covered in this paper have very different supply risk profiles. However, there are some similarities: A very high degree of relevance for future technologies is not surprising, as relevance for energy technologies was a selection criterion. Another common characteristic is that substitution is hardly possible – and impossible in many cases. Furthermore, concentration on company and / or country level is very high, while political risks are medium to high in average. Price risks are lower and range from low to high risks like rising and fluctuating prices. In geologic terms, resource scarcity is not the mayor problem. Reserves-to-production ratios are high in many cases, while investments in exploration and mining are necessary in other cases – and will become more pressing when demand will rise as projected in the next two decades.

Conclusions

Among the energy technologies in the different sectors, electro mobility and battery technologies are of special importance as this is the most promising technological option of decarbonisation in the sector. Therefore, lithium a resource of strategic importance, especially for a country with high value added in the automotive industry. The current and potential future risks increase the need for global technology corporations to develop strategies to secure long-term lithium supply. Asian producers of batteries and motor vehicles have already made efforts to implement diversified supply through strategic cooperation and joint ventures with resource firms (USGS, 2014). Furthermore, initiatives to develop recycling strategies for lithium from batteries are necessary. Today, recycling of lithium-ion cells is not very common, but growing markets for batteries and rising lithium prices will make the production of secondary lithium more relevant.

However, other elements – from the well known metals tin and nickel to less known resources as molybdenum, the rare earth elements and the politically discussed cobalt are relevant for the future development of our energy systems as well. Security of supply of these elements have to be further investigated in order to secure supply of the resources necessary for future energy technologies.

References

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