Green technologies and their global resource dependency: Material flow analysis using a global link input–output model

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How a future low-carbon society should be established is an important issue in Japan and in other countries. Particularly after incurring catastrophic damage from a strong earthquake and tsunami on 11 March 2011, Japan has been compelled to reconsider its dependence on nuclear power, which had been regarded as the main pillar supporting its realization of a low-carbon society. The further spread of nuclear power would have been the most effective path to decreasing carbon emissions per unit of energy use in society. However, Japan must achieve such carbon reduction through the improvement of energy efficiency of various products for the foreseeable future. For instance, so-called green technologies such as electric vehicles, fuel cells, and photovoltaic generation have arisen as leading alternatives to enhance social energy efficiency.

Some green technologies rely upon the particular physicality of scarce metals such as rare-earth minerals, which are distributed eccentrically throughout the world. That distribution implies that the shift of Japan to a low-carbon society with the mass introduction of the green technologies forces its economy to confront new resource-dependency problems related to those metals. Nevertheless, a quantitative indication of how to use green technologies is directly and indirectly related with global resource flows.

For this study, we carried out material flow analysis (MFA) on the use of green technologies in Japan using a global link input–output model (GLIO) (Nansai et al., ESR, 2009). GLIO was founded on a simplified multi-regional input–output model that covers 230 countries. Well known green technologies are electric vehicles, fuel cells, and photovoltaic generation. Resources on which MFAs focused were neodymium, cobalt, and platinum. Results revealed characteristics of global resource networks that are implicitly formed based on green technologies in Japan.