

Change in supply security footprints of critical metals induced by Japanese household consumption from 2005 to 2035 (for special session on MFA and IO model)

Topic: Material flow/stock analysis in input-output modelling II

Author: Yosuke Shigetomi

Co-Authors: Keisuke Nansai, Susumu Tohno

With expansion of electronics for hybrid vehicle and IT products, the demand of critical metals including rare earth metals has been increasing. These metals are strongly related to not only usefulness of today's our life styles but also new energy technologies such as solar power, wind power for a low carbon society in the future. It is reported that, in terms of life cycle assessment of the whole of nation, household consumption is the most important factor on environmental burdens in developed countries, however, there is few study analyzing the metal consumption from the viewpoint of household consumption similarly to the previous studies focusing on greenhouse gases (GHG) emissions and energy consumption.

This study detected the global material flows of critical metals directly and indirectly caused by Japanese household consumption with a global link input-output model (GLIO) and international material flow data. The target metals here are neodymium, cobalt and platinum whose demands will be expected to increase with the further expansion of new energy technologies. The detected global material flows are called here material flow footprints (MFFs) of the household consumption. Multiplying MFFs by the risk factor of each country involved in the MFFs yielded supply security footprints of household consumption. We calculated the supply security footprints in 2005 and then forecasted them in 2035 taking into account an aging society with fewer children coming to Japan in the near future. We considered six household types with age of household head (20s, 30s, 40s, 50s, 60s, 70s and older) and estimated respective annual expenditures by disaggregating the household sector defined as a single sector in Japanese input-output table into the six household sectors with the national household statistic, and then calibrated them with mathematical programming to be consisted with the annual expenditure of each commodity written in Japanese input-output table.

As a result, from 2005 to 2035, the trends in the MFF of neodymium by the age group of household head of the household show that remarkable reductions occur in the 20s and 30s, while rapidly boost occur in the 70s and older. The difference of MFF between reductions by 20s and 30s and increasing by 60s and 70s and older during the period is nearly same, which is slightly higher the MFF of the latter households than by the former ones. Thus, changing the number of older households with the aging society can be considered to offset the reductions achieved by younger households. As a whole volume, the MFF was estimated to be 712.8 t / y in 2005, and then fall, ultimately decline to 627.3 t / y in 2035. This change rate is about 12% below 2005 under the demographic change. This implies that ongoing of the aging society with fewer children in Japan can make the MFF of neodymium derived from Japanese household consumption reduce. The results of the supply security footprints by household types will be presented at the conference.