Hybrid LCA with MRIO for supply risk comparison among low-carbon energy technologies

Topic: (5.4) Industrial Ecology using IO Tables
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The Paris Agreement adopted during the 21st Session of the Conference of the Parties (COP21) has entered into force on 4th November 2016. It aims to reinforce the global efforts to attain â€œthe 1.5 or 2 C targetâ€• which limits a temperature rise in this century to 1.5 to 2 C above pre-industrial levels. The ratified nations are required to make their best efforts for reducing own greenhouse gas (GHG) emissions through their Nationally Determined Contributions (NDCs). The pathway to the 1.5 or 2 C target is by no means simple, it is therefore inevitable to make a great change in the current system of production and consumption. NDCs of Japan include a 26% reduction of 2013 greenhouse gas emissions by the year 2030, which needs to promote development and expansion of low-carbon energy technologies in Japan. However, some of such technologies must use critical metals of which only few countries mine them, and some of these countries may not be economically or politically stable. Hence, there is a concern that Japan will be further exposed to supply risk of the critical metals with the reduction of GHG emission through the technological reliance. The study carries out hybrid life cycle assessment (LCA) for comparing the supply risk footprints among low-carbon energy technologies. The hybrid LCA combines process analysis and multiregional input-output analysis (MRIO) and calculates mining risk footprints of the technologies (photovoltaic solar, hydropower, wind power, electric vehicles etc.) with the assumption that they are introduced in Japan. The CEDA integrated scenarios is used to compile the process data on the technologies, and a global-link input-output model (GLIO) is employed as MRIO to ensure a global system boundary and high sector resolution of Japanese commodities. Mining risk is quantified by using the market concentration of output of the metals and political risk of the countries where the metals are mined. The mining risk footprint implies direct and indirect the mining risk affecting a technology through its consumption of the metal.