Hybridising Multi-Regional Input-Output and Life Cycle Assessment models using the Maximum Entropy principle.

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Understanding global supply chains of our economy and their environmental impacts is an important step towards a sustainable economy. The two widely used methodologies to study supply chains are the process based Life Cycle Assessment (LCA) and Environmentally-Extended Multi-Regional-Input-Output models (EE-MRIO). Whereas LCA provides high detail at the inherent cost of incompleteness, EE-MRIO provides a high level of completeness but at low resolution. Because of the complementary nature of the two methods, various approaches have been taken to merge the two in a so called hybrid-LCA. Albeit the abundance of hybrid-LCA studies, no scientific consensus seems to exist on how to reconcile the different data types in a statistically sound manner.

Here we present our approach to develop a such statistically based method for the hybridisation of LCA and MRIO data. We employ the principle of maximum entropy, which provides a means to find the least biased estimation of a quantity in an indeterminate system, to reconcile information available at different levels of resolution and on different layers (monetary and physical). We determine the optimal sectoral and product resolution of the hybrid supply chain model given all, but only, the available information and its uncertainty. Moreover, we reconcile the available data at the supply and use table level, which allows us to make consistent modelling choices (also known as constructs or allocation models within the IO and LCA communities respectively), within our methodology.

Unlike existing footprint indicators derived from hybrid methods, this statistical approach will enable us to quantify the uncertainty of the footprints calculated and give quantitative information on where in the supply chain resolution needs to be increased and data uncertainty decreased to improve the accuracy of the footprint.

We currently apply our methodology to the Ecoinvent LCA database and the EXIOBASE MRIO data, although our methodology is not limited to any data or format in particular but aims to provide a statistical basis for any large scale hybridisation project on LCA and MRIO data.