Mapping flows of embodied emissions through the global production system – a quantitative investigation using a global multi-regional input-output model

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Global, environmentally extended, multi-regional input-output (MRIO) models have recently been used to investigate embodied emissions associated with finished goods (the consumption perspective) and internationally traded goods. Results have been presented as national and industry sector carbon footprints, accounting for both direct and indirect emissions occurring anywhere within the global production system. In contrast, conventional emission inventories account for only direct emissions associated with an entity under investigation (the production perspective). Several studies have explored linkages between regions and industry sectors in order to explain discrepancies between production and consumption perspectives by using Structural Path Analysis (SPA). However, the complexity of the global MRIO framework means that it is impossible to exhaustively quote SPA results.

This paper presents a methodological approach that builds on SPA to exhaustively map flows of embodied emissions through the global production system, linking the production and consumption perspectives. The approach allows us to draw Sankey-type diagrams that visually unravel the cumulative flows of embodied emissions that run from the depths of the production system to the point of consumption of finished goods, picking up additional direct production emissions along the way as intermediate goods are processed. These diagrams are designed to ease the communication of results to policy-makers, industry actors and the general public.

To illustrate the approach, we report results at the global industry sector level, using an empirical MRIO framework derived from the GTAP Version 7 database for the year 2004, which disaggregates global economic activity into 113 regions and 57 industry sectors. Using the resultant Sankey-type diagrams we explore the interlinkages between global industry sectors and discuss the relative weight of direct and indirect emissions associated with each industry sector through the sequential layers of the global production system. Finally we acknowledge the limitations of the approach and suggest possible future applications.