Carbon accounting and footprinting of cities using a virtual input-output laboratory

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With more than half of the world's population now living in cities, urbanization is recognized as a major driver of global greenhouse gas (GHG) emissions. To assess the full scale of cities' contribution to climate change both direct and indirect GHG emissions need to be accounted for. Two fundamental approaches have evolved in research and in practice: a) metabolism-based approaches (MBA) that record the physical flows of emissions within a city's territory, including important trans-boundary flows and b) consumption-based approaches (CBA) that account for the total direct and indirect emissions associated with the activities of urban consumers. So far, these two approaches have been used more or less independently and few studies exist that compare results for the same city, using both approaches. In this contribution we show how one detailed environmentally extended input-output framework can be used to account for GHG emissions from both perspectives, MBA and CBA. Based on the Australian Industrial Ecology Virtual Laboratory we demonstrate how supply and use tables for cities have been derived and converted into detailed 'carbon maps' at suburban spatial scale. These maps allow for an unambiguous identification of Scope 1 (direct, territorial), Scope 2 (electricity & heat) and Scope 3 emissions (out-of-boundary energy use, infrastructure supply chains and imported goods and services). The mathematical relationship between MBA and CBA derived from one IO table and the ability to convert from one approach to another is demonstrated. We show first empirical results for Australian cities and discuss limitations and challenges of the approach.