

## **Indirect emissions and carbon mitigation: Structural analysis of IPCC sectors**

Topic: (3.5) Designing of Energy Policies with I-O

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Only 6% of global greenhouse gas emissions occur in buildings, yet buildings are designated as a sector worthy of its own chapter in the IPCC WGIII report series, based on indirect emissions caused during production of electricity consumed in buildings. However, the account of indirect emissions in the IPCC report is incomplete, restricted to electricity and systematically ignoring the construction of the buildings and the inputs of products, services, heat, and fuels. A more complete, life-cycle based assessment of emissions would provide a clearer view of the scope and consequences of mitigation actions within each sector. We conduct an input-output investigation of direct and indirect greenhouse gas emissions for each of the five IPCC sectors, energy supply, transport, industry, buildings, and agriculture & forestry, applying consumption based accounting and Hypothetical Extractions method to the EXIOBASE multiregional input-output model. Relating emissions to services provided to final consumers, we find that industry is by far the most important sector with 22 GtCO<sub>2</sub>e in 2007, followed by buildings with 13Gt and transport with 5 Gt. The construction and operation of buildings causes indirect emissions in the industry sector that are larger than the direct emissions of the buildings sector, but today outside the scope of analysis of the buildings chapter of the IPCC. The largest flows of indirect emissions are from the energy to the industry sector and from the industry to the building sector. Accounting for both direct and indirect emissions of each sector using the hypothetical extraction method, we show that industry affects two thirds of all emissions, buildings 22%, while transport and agriculture are about equally important with 16% each. Our work suggests that given its narrow system boundaries, the IPCC seriously risks underestimating the influence of sectors over emissions and thus not recognizing emission reduction opportunities. In particular, the role of industry is grossly underestimated, with most attention given to energy supply.