**From Kebabs to a Holistic Representation of Society**

What is the greenhouse gas (GHG) footprint of a kebab? To answer such question, we need not only to know the quantity of lamb and the amount of enteric methane (i.e. farts) emitted by these delicious creatures, but a whole lot more of information: the amount of fuel used to ship the meat, but also the GHG emissions associated with the energy needed to build the trucks that were used, the machines used to build these trucks, the machines used to build those machines, etc. Following the seminal work of Leontief (the 1973 “Nobel prize”), the field of industrial ecology offers answers to this kinds of questions thanks to its representation of the economy in a holistic way, via Input-Output Tables (IOT). Indeed, social metabolism (i.e. the linkages and impacts of human activities) can be viewed in a matrix form. The transformation matrix *A* gives the quantity *ai,j* of input *i* required to produce one unit of output *j*. Given a vector of demand *y*, one can retrieve the inputs required to produce *y*: *A·y*, the inputs required to produce these inputs: *A·*(*A·y*)=*A2·y*, etc. Summing the inputs embodied in each stage of the supply chain, we find the production *x* required to satisfy demand *y*: *x=y+A·y+A2·y+...=*(*I-A*)-1*·y*. Hence, to know the emissions embodied in a kebab, it suffices to premultiply the embodied inputs required for the kebab by a characterization vector *C*, which provides the GHG emissions associated with each kind of inputs: *C·x*. The computations I just described are the basics of Life Cycle Analysis (LCA), which is used to assess the environmental impacts of all sorts of projects, using very detailed datasets describing all industrial processes.

To give you an idea of the GHG emissions of a kebab, I reproduced the results of Poore & Nemecek (2018) that analyze the impacts of food production. Of course, the usefulness of input-output analysis goes beyond the assessment of diets; let me give you a few examples. Using LCA, a report from ADEME (2012) warned that the global warming potential of electric cars is higher than that of thermal cars in Germany, because of the high share of coal in their electricity mix. Using an input-output model, Quirion (2013) estimated that the 100% renewable scenario of negaWatt would create half a million jobs in France in one decade. Using linear programming, Ward et al. (2017) optimize the global system of production: they show that GHG emissions could be reduced by 23-43% just by replacing the technologies used in industrial processes by adequate substitutes. Although environment is the main focus of input-output studies, IOT can be used to various other purposes. For example, I analyzed the labor force embodied in trade for each country, and found that the labor embodied in French imports is 7 times higher than the labor embodied in French exports: this means that, while 10% of French labor ultimately serves a foreigner, the foreigners who serve French people represent 74% of the French labor force. On the other hand, 23% of African labor is exported, while imports provide less than 5% of their labor. With such a framework, the notion of “labor productivity” can be reinterpreted as one of power balance (operating through the price system), rather than one of intrinsic difference in skills or effort.

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