

URBAN METABOLISM: MAJOR FLOWS, MAJOR ISSUES FOR DEMATERIALISATION. SOME RESULTS FROM FRENCH CASE STUDIES

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Abstract:

Cities consume huge amounts of energy and material and produce huge emissions to air, water and soil. This linear metabolism, first described by scholars like Abel Wolman (1965), Paul Duvigneaud (1974) and Eugen Odum (1975) to quote but three, contributes to resource exhaustion and environmental change, at local, regional, and global level. Being the main node of material and energy flows and at the same time the main places for innovation, cities can also be considered as strategic places where dematerialisation can be initiated. It seems thus necessary to better weigh and locate urban metabolism: to quantify direct inputs and outputs, but also indirect flows that concern remote areas, from time to time thousand kilometres away from the city. This requirement entails again two necessities: first methodological developments, second case studies in order to characterize urban metabolism and to understand its variations from one city to another, or within the city.

Two methodological frameworks can be used to address these questions: Material and Energy Flow Analysis (MEFA), and environmental imprints. MEFA has been developed in various contexts worldwide and the authors of this paper contributed to its adaptation to regional and urban scale (Barles, 2009; Kim and Barles, 2010) - among other scholars of course (see for instance the review by Kennedy et al., 2011). The notion and methodological framework of environmental imprints is less stabilised in the research arena (yet see: Rees, Wackernagel, 1996; Krausmann, 2005; Haberl et al., 2007; Hoekstra, 2009; Billen et al. 2011). In the case of this paper it rests on the hypothesis that indirect flows can be analysed through the notion of imprint, a way to understand the remote effects of urban metabolism. It also rests on the strong hypothesis that the place where things occur is of major importance, not only in order to determinate the imprint, but also in order to think about dematerialisation and flow management. The authors also developed such a methodological framework (Chatzimpiros and Barles, 2010; Chatzimpiros, 2011, Chatzimpiros and Barles, in preparation). These approaches have been applied to French case studies: first Paris, the French capital and the biggest French city, then other urban areas, like Toulouse in South-West France.

The aim of this proposal is to present these results and to discuss them in the perspective of dematerialisation. Looking at urban metabolism as a whole, we analyse the differences 1) from one city to another, 2) from rural to urban areas, and 3) in different parts of a single city (from the dense core to sprawl areas), in terms of major flows like Direct Material Input (DMI), Domestic Processed Outputs (DPO), Local extraction, Imports, exports, recycling, and Direct Material Consumption (DMC). Splitting up DMC allows identifying its main components and their variation according to various contexts.

Urban DMC is made of three major flows: 1) construction minerals, 2) food and biomass, 3) other energy fuels. Construction mineral consumption relates to various issues like resource exhaustion (in the surroundings of Paris for instance) and increasing supply distance, damage to ecosystems, increasing stocks, the latter relating itself to

urban sprawl. In the case of energy, we also observe a relation to sprawl, and a general increase in indirect flows while direct consumption seems quite stabilised (in our case studies, i. e. cities located in the old developed Europe). For food and biomass, the decreasing spatial imprint that is observed is often possible because the *depth* of the imprint (its true environmental consequences) increases. Furthermore, the imprint is now a splintered one, all the more so since livestock and feed are considered with acreages being increasingly scattered between regions and countries.

These results allow making some suggestions about flow management in the perspective of territorial ecology (Barles 2010). MEFA indeed (and at least) highlights 1) the role of urban morphology and then of urban planning in dematerialisation – and not only decarbonisation – 2) the issue of land use in the perspective of reducing the depth of urban imprint and simultaneously increasing the use of renewable resources, and 3) the role of consumption patterns in the search for dematerialisation.