



The role of global in-use material stocks in the course of the socio-metabolic transition, from 1900 -2009

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During the global socio-metabolic transition into the fossil fuelled age in the 20th century, annual material use increased nearly 10-fold (Krausmann et al. 2009). A substantial part of these materials were used to expand societal stocks such as infrastructure, buildings, factories or machinery. Long service-lifetimes lead to an ongoing accumulation of in-use stocks and determine the availability of materials for reuse and recycling. Systematic knowledge about material stock dynamics is crucial for understanding possible future resource use trends, the potential for increased recycling and thereby inform the development of strategies towards more sustainable resource use.

In this presentation we explore the relationship between material use and stock accumulation, estimating global material stocks in infrastructures, buildings and durable goods from 1900 – 2009 based on a dynamic material stocks and flows model. We apply a top-down modelling approach, tracking annual cohorts of inflows of stock-building materials throughout the time period. We utilize a global material flow database and auxiliary data sources covering the time period 1850 – 2009 (Krausmann et al., 2009; Schaffartzik et al. 2013) to distinguish inputs of 11 major stock building materials: concrete, asphalt, bricks/stones/tiles, sand/gravel/crushed rocks, copper, steel, aluminum, other metals, solid-wood products, paper and plastics. Two types of functions are then used to model the lifetimes of the materials in use: A uniform distribution is applied for materials with short lifetimes, while a normal distribution is applied for materials with longer lifetimes. Furthermore, end-of-life waste is subject to recycling, thereby turning into additional input flows of non-virgin materials. Due to the inherent uncertainty in such an exercise, we perform Monte-Carlo simulations, applying uncertainty ranges for all model parameters and the material inflow data introduced above. This allows us to a) identify further research & data requirements for improved stock estimations, b) discuss possible ranges of global material stocks in use and c) give an outlook on regionalized stock modelling exercises.

In conclusion, we reflect on quantitative long term developments of global material stocks and discuss the relation of economic development and stocks. We finalize with reflections on the role of in-use stocks in ongoing socio-ecological transitions into the fossil-fuel based regime as well as implications for more sustainable resource use strategies in the light of the need for a new transition towards sustainability.

Literature cited:

Krausmann, Fridolin, Simone Gingrich, Nina Eisenmenger, Karl-Heinz Erb, Helmut Haberl, and Marina Fischer-Kowalski. "Growth in Global Materials Use, GDP and Population during the 20th Century." *Ecological Economics* 68, no. 10 (2009): 2696–2705. doi:10.1016/j.ecolecon.2009.05.007.