2007 CTCI Foundation Environmental & Energy Convention,
January 16-25 , 2007

"The case study of national-scale material flow assessment – the European experience"

Paul H. Brunner
Vienna University of Technology
Institute for Water Quality, Resources and Waste Management

The first generation of strategies to protect the environment focused on emissions and aimed at reducing the substance flows from single processes and objects at the back end of the life cycle. This so called filter strategy was successful in reducing heavy loadings, but often the measures were costly and of little efficiency. Thus, a new generation of strategies was developed, focusing on the total life cycle and on cause and environmental effects of products and services. This allows on one hand to analyze the total loadings of the environment, reducing the likelihood of shifting problems from air to water, water to soil, soil to water etc. On the other hand, this also points to the magnitude of the different sources polluting a particular sphere, facilitating the identification of the most relevant sources. The main backbone of this second generation of strategies is Material Flow Analysis MFA, a technique describing material flows and stocks within a defined system in a systematic and rigid way.

The emerging third generation of environmental strategies expands the scope and focuses on the total anthropogenic system, aiming at sustainable development, that is the balance between the economic system, the environment and the social (human) system with regard to neighboring and future societies. Again, MFA plays a crucial role, because MFA allows defining a system of physical flows and stocks of materials that are the common grounds for all other systems. Ultimately, combined with other tools, MFA will be the crucial method to analyze, evaluate und design future human activities in view of resource availability and protection of the environment.

MFA development took place along two pathways: In so called national flow accounts, the flows, latter also the stocks, of goods are measured and accounted for. The base for these material flow accounts are national statistics and Leontief Tables; they are built on economic data about a country, a region (from continent to small valley), or an enterprise. Since the data is usually given in monetary values, a certain “translation” is essential to yield mass flows which are the units for material flow accounts. Such material flow analyses are useful for e.g. comparing the material throughput of countries, for assessing resource efficiency, and, in combination with flow accounts of the so called “Hinterland” (the region outside the nation that produces the supply of the nation) for assessing the ecological footprint of a nation.

Another pathway MFA has taken focuses not on products and goods but on substances (elements or individual chemical compounds). The reason for investigating into substance flow analysis is, that environmental loadings are caused by substances and not by products or goods: it is the phosphorous in a detergent that may harm a lake by eutrophication, and not the detergent itself. Also, the resource quality of a (waste-) product is determined by substances: the cadmium used in the 1980ies to stabilize plastic products is a real problem for recycling plastic materials today, it reduces the value of old plastic to below zero.

Today, MFA is following both lines: the term “material” stands for both, goods as well as substances. According to the problem that is to be addressed, the MFA takes place on the level of goods or on the level of substances. Most often, substance flow analyses are based on an initial analysis of flows and stocks of goods.

The main advantage of using MFA methodology is, that it is based on the physical law of the conservation of matter. Whatever material enters a system, it must be found either leaving the system or accumulating/depleting the stock. Thus, in contrast to LCA, MFA allows checking if the system definition, the initial assumptions, and the collected data are valid.

The presentation will include three case studies showing on various levels how MFA is instrumental to identify and solve problems regarding environmental management, waste management and resources management. It is suggested to include MFA in the regular curriculum of civil engineers, to apply this methodology systematically in planning (e.g. environmental impact statements and in the evaluation waste management systems), and to start collecting a set of relevant data for decisions regarding regional materials management. Such a data set will serve as a highly valuable information base for decisions regarding resource management, environmental management and waste management.