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JUDGING CHEMICALS FOR SUSTAINABILITY [1]

We must dematerialize our western economies
an average factor of 10 or more,
as well as de-energize them,
if they are to be sustainable
F. Schmidt-Bleek, 1993

In the early 70ies of last century it became apparent hat all products of chemical industry should be examined for their potential dangers to humans and the environment. Early legislation was put in place in Japan, the USA and in the EU. The OECD undertook a considerable effort to develop harmonized testing guidelines and Good Laboratory Practice procedures in order to avoid non-tariff barriers to trade. Jim McNeill, Margarita Idman, Peter Mencke-Gückert, Rune Longren, and Bio F. Schmidt-Bleek were among the first to put this work in motion. The Chemicals "Part Two Program" was established within the OECD Environment Directorate and Peter Crawford became its first leader.

In its work, the OECD focused on the toxicity of chemicals to humans and the biosphere, as well as on chemical and physical effects and the behavior of chemicals during production (worker's safety) and after release into the environment. During the past 30 years, the OECD chemical's testing procedures have become world standard.

The concepts for judging the relative environmental burden of material insults to the environment were only at their beginning in the 70ies and 80ies: the analyses generally remained on the level of the examined case study. It is scientifically impossible to derive a complete picture of the ecological consequences of placing even a single chemical compound onto the market. Future surprises can never be ruled out as we learned from cases like the use of CFC's. Generalizations of testing results were rarely possible, in part because of the tremendous complexity of ecological linkages and effects. And even if this complexity was ever completely understood for a particular case, it is by no means certain that the resulting discoveries would be transferable to other materials, procedures, facilities or services. In addition, something even more basic from an ecological point of view was missing from judging the dangers inherent in marketing chemicals in the 70ies and 80ies: although

[1] *Schmidt-Bleek: „WIEVIEL UMWELT BRAUCHT DER MENSCH, - MIPS, das Maß für ökologisches Wirtschaften", Birkhäuser, Basel, Boston, Berlin, 1994. English: "FACTOR 10, ECOLOGICAL RUCKSACKS, AND MIPS", translation by Reuben Deumling, Berkeley, California, 1993.* www.Faktor10.de

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members of both industry and politics had endorsed it as essential for analyzing the ecological quality of goods, the "cradle to cradle" principle was not applied.

What then is the common denominator for ozone holes, fish kills, erosion, contaminated water, climate change, forest dieback, air pollution, flooding, garbage inundations, salinization, advancing deserts and the pollution of our oceans? What is it that makes our economies so fundamentally un-ecological even though we have developed effective environmental technologies and have spent very large sums of money on analyzing the ecological effects of chemicals? Of what material is Ariadne's thread that could lead us out of the labyrinth of seemingly endless and endlessly varied environmental problems?

Each and every human interference in the material composition of any part of the biosphere forces that part to adapt to the new circumstances. The greater the extent and the more material is involved in these interferences, the more comprehensive the ecological reaction must necessarily be. Physical laws imply that the more material we set in motion, the greater the chance that some of the effects will be harmful, and that we create ever more "disorder" on the earth, the more technical energy we pump into our economy. Forest dieback, water shortages, the ozone hole, and global climate change are measurable signs of this development. As to chemical compounds, Paracelsius, the father of toxicology knew already 450 yars ago: *„dosis facit venum".*

In 1992 Schmidt-Bleek suggested that the total expenditure in natural resources (material, including fossils, water, and land) required to make a product available be used as a proxy measure for its environmental impact potential. He called this intensity aspect of products *ecological rucksack* [2]. The rucksack also contains all materials required for providing the requisite energy inputs.

When expanding this concept to "*cradle to cradle",* not only production and marketing of a good, but also the resource consumption for its use, transportation, storage, packaging, disposal, the use of infrastructures etc. must be included.

It is of considerable ecological and also financial importance to optimize the amount or the dosage of chemicals being used for achieving the desired effect. Using technically and biologically superior application methods, it is frequently possible to enhance the resource productivity of products, as is increasing their longevity and minimizing the transportation intensity and packaging.

Goods provide people with opportunities and choices to function in certain ways. Often, different products, systems or approaches are able to offer comparable or "functionally equivalent" services. Through this approach, the environmental burden can be lowered significantly while maintaining end users satisfaction.

Therefore Schmidt-Bleek suggested in the early 90ies to relate the resource intensity of goods to the services or functions that can be derived from their use, "S". For material inputs, the measure for the environmental stress intensity is the *Material Input Per unit of Service (utility,*

[2] Ecological rucksack of a product is *its complete material input MI (including all materials needed to generate the energy needed) for manufacturing a product from "the cradle to the point of sale", minus its own weight (own mass). Unit: kilograms, metric tons.*

value) with respect to the entire product life: in other words, the material consumption from the cradle to the cradle per unit service or function—*The Chemical Footprint/MIPS* [3].

MIPS is defined for service-yielding final goods, and not for raw or auxiliary materials which enter its manufacturing process. MIPS can be used both for short-lived and for durable goods, for biotic and abiotic products, and can be derived for quite complex facilities and infrastructures. *"Natural"* products such as plant material or stone are not unequivocally better in terms of MIPS than "artificial" or "chemical" products. MIPS data should be available for all chemical products. Frequently, chemicals carry large ecological rucksacks.

In the case of non-reusable products or packaging, the "S" of MIPS is equal to one. MIPS in this case is equal to the aggregate amount of material for all process increments, potentially even including material needs incurring as a consequence of having applied a product (medical side-effects, cleaning of soil etc.).

Requirements for the usefulness of a *"universal"* ecological measure include the following:

- The measure must permit the transparent and reproducible estimation of environmental stress potentials of *all* kinds of processes, goods and services from "cradle to cradle".
- The selected characteristics must be measurable.
- Its use should be cost-effective.
- Its use should always lead to directionally reliable results.
- The measure should form a bridge to market activities.
- It should be usable everywhere: locally, regionally and globally.

MIPS (the "material footprint") fulfills these expectations. A wealth of literature explains ecological rucksacks and MIPS and their application in detail. Using the concept of dematerialization in practice is described (2010) in http://www.wupperinst.org/en/publications/entnd?beitrag_id=1309

The recent definition of eco-innovation summarizes the situation:

> "Eco-innovation *means the creation of novel and competitively priced goods, processes, systems, services, and procedures that can satisfy human needs and bring quality of life to all people with a life-cycle-wide minimal use of natural resources (material including energy carriers, water, and surface area) per unit output, and a minimal release of toxic substances."* (Reid, Alasdair, Miedzinski, Michal (2008), EUROPE INNOVA, Final Report for the EU Sectoral Innovation Watch Panel on Eco-Innovation, www.europe-innova.org [4], see also http://www.eco-innovation.eu/index.php?option=com_content&view=article&id=200%3Aannual-report-2011&catid=77%3Aeio-reports&Itemid=38.

CV FSB: Laureate, World Environment Award; German Chemicals Act-Development and Application; OECD, Head of Division, Chemical Safety and Management; G 7, Director, Early Env Warnings; IIASA, Head of Dept.; Wuppertal Institut, Founding Vice President; Factor 10 Institute and International Factor 10 Club, Founding President. Pioneered Dematerialization Concept, Factor 10, MIPS, Ecol.Rucksack, World Resources Forum Davos.

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[3] *Resource productivity and resource intensity are key concepts used in sustainability measurement as they measure attempts to decouple the connection between resource use and environmental degradation. Their strength is that they can be used as a metric for both economic and environmental cost. Although these concepts are two sides of the same coin, in practice they involve very different approaches and can be viewed as reflecting, on the one hand, the efficiency of resource production as outcome per unit of resource use (resource productivity) and, on the other hand, the efficiency of resource consumption as resource use per unit outcome (resource intensity). The sustainability objective is to maximize resource productivity while minimizing resource intensity (in part from internet).*

[4] *F. Schmidt-Bleek, „The Earth: Natural Resources and Human Intervention", page 166, Haus Publishers, London, 2008;*

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