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Final Sinks – Prerequisite for a Cycling Society

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Abstract

Final Sinks – Prerequisite for a Cycling Society

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To sustain the so called "anthropogenic metabolism", that is the use of materials and energy by society to support human activities, very large amounts of materials are extracted from the earth crust as well as synthesized by technical processes. After providing utility to people, these materials are either recycled, or they have to be disposed of in "sinks". The term "sink" is used here as an antonym to "source" designating a process that receives off-products like wastes and emissions. Natural sinks comprise environmental compartments such as soil, air, water, or sediments. Technical sinks include incinerators, landfills, water purification plants and others.

The capacity of natural sinks to accommodate substances is limited. While technical sink facilities can be supplied in nearly unlimited amount, numerous examples have shown the lack of natural sinks: The most striking examples are the missing sink for carbon resulting in greenhouse gas accumulation and corresponding climate change, and the depletion of the ozone layer due to accretion of CFCs in the stratosphere.

In a cycling society, the need for resource extraction and synthesis is smaller than for a linear material use. Hence, the output of wastes is also smaller. In theory, if the input into the anthroposphere is zero because all materials are recycled, then the output is also zero. However, there are three reasons why such a complete cycling society is not feasible: First, some goods are intended to be consumed and thus released to the environment such as fossil fuel, or nutrients in food. Second, processes such as wear, tear, corrosion, and erosion cannot be completely avoided, resulting in demand for new materials, and in substance flows to sinks. Third, total recycling is not possible due to hazardous substances in wastes and thermodynamic limits to recycling. Thus, even a highly effective cycling society requires technical and natural sinks to accommodate emissions and off-products.

A special type of sinks are so called "final sinks", defined as sinks where substances either have residence times larger than 10'000 years, or where they are completely destroyed. A waste-to-energy (WTE) plant is a final sink for organic substances because these are completely mineralized during incineration. A landfill can be a final sink for metals, however it is only an intermediate sink for nitrogen and carbon because N and C are slowly released over many centuries. The ocean is a final sink for chloride, and sediments are final sinks for many metals.

Besides recycling, the key role of waste management is to supply sinks and final sinks, and to direct materials to appropriate sinks. The presentation will start with figures about consumption and utilization of materials, and will then focus on the amount of wastes that are produced. Based

on the results, the need for sinks is assessed. It is shown that even very sophisticated urban regions that are close to a cycling society have a large demand for sinks and final sinks. Finally, recommendations are given for future resource and waste management strategies to avoid potential sink limitations.