# Attributional and Consequential LCI modelling

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The life cycle model developed in a life cycle inventory analysis (LCI) should be an appropriate description of the relevant parts of the technological system. What parts are relevant depends on the aim of the study. An attributional LCI aims at describing the environmentally relevant physical flows to and from a life cycle and its subsystems. Such a description is useful to assess the environmental performance of the systems investigated. Consequential LCI, on the other hand, aims at describing how the environmentally relevant physical flows to and from the technological system will change in response to possible changes in the life cycle. It generates information on the consequences of decisions.

The distinction between attributional and consequential LCI was originally made to resolve the methodological debates on allocation and on marginal versus average data. To describe the environmental burdens of a life cycle and its subsystems, an attributional LCI model includes all stages of the life cycle from cradle to grave. To avoid irrelevant information, it does not include technological activities outside of the life cycle investigated. This means that system expansion is not an applicable way to avoid allocation. Since other methods for avoiding allocation are rarely feasible, allocation is typically not avoided in an attributional LCI. Instead, a method for partitioning must be chosen.

The environmental burdens from the life cycle are divided by the functional output from the life cycle to obtain the environmental burdens per functional unit. Similarly, the environmental burdens of any subsystem are described by the use of average data, i.e., the total environmental burdens of the subsystem divided by the functional output from that subsystem.

The consequential LCI model, on the other hand, should ideally include the activities where the environmental burdens are affected the most by a change within the life cycle of the product investigated. A consequential LCI excludes unaffected parts of the life cycle, but it includes activities within and outside the life cycle to the extent that they are affected. In many cases this implies the use of marginal data. It also means that allocation is typically avoided through system expansion. However, the aim to describe effects of decisions on environmentally relevant physical flows has implications for the system boundary far beyond allocation problems. The consequential LCI model includes the alternative use of constrained production factors. It also includes the marginal supply and demand on markets that are affected by decisions in the life cycle investigated. As a result consequential LCI model does not resemble the traditional LCI model, where the main material flows are described from raw material extraction to waste management. Instead, the starting point of a consequential LCI is the decision at hand or the decision-maker to be informed by the study. The consequential model is a model of causal relationships originating at this starting point. Economic causal relationships are at least as important as physical flows in this context.

Describing the consequences of decisions also means facing the general challenge of futures studies. The future is inherently uncertain, and the actual future consequences of decisions are very uncertain. Dealing with this uncertainty requires that methods of futures studies are applied in the consequential LCI.