# LCA DEVELOPMENTS FOR PROMOTING SUSTAINABILITY

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Invited Keynote Lecture for 2nd National Conference on LCA, Melbourne, 2000.02.23-24.

## 1. Introduction

Promoting sustainability means changing the future.
Recent developments in the methodology of LCA (Life Cycle Assessment) have been connected to the understanding of LCA as a tool for decision making ñ as a prospective assessment of the consequences of a choice between several substitutable product alternatives.
This implies that LCA must address the decision-making context in terms of:

- the stakeholders involved,
- issues that are important for sustainable development,
- the relevant product system (with regard to time horizon, scale, affected markets),
- secondary effects on other product systems.

This paper is devoted to discussing these demands in more detail, as compared to traditional practice.

## 2. Addressing the stakeholders

The realization that an LCA is not made in a vacuum, but serves as support for decision making, highlights the importance of involving the decision-makers during the study. It is a waste of resources if the issues addressed by the study are different from those that the decision-makers regard as important. Depending on the situation of the decision-maker, it may be relevant to include other stakeholders that may be affected by or have influence on the consequences of the decision.

In spite of this, it is often seen that studies do not adequately address the decision-making context and the concerns of the decision-makers. Also, it is common that studies without proper stakeholder involvement result in controversies, which hamper the smooth implementation of the suggested environmental improvements.

Whether justified or not, the general perception of the LCA technique will be colored by such studies, which are regarded as inadequate by the decision-makers or lead to controversies among stakeholders.

## 3. Adressing the issues that are important for sustainability

Surprising discrepancies can be found when comparing the issues of largest importance from an environmental point of view with the issues covered by currently published LCAs. There seems to be no proportion between the way LCA deal with a certain issue and the environmental importance of that issue.

This is true both with regard to:

- the products studied (e.g. more studies deal with packaging than with the contents of the packaging, more studies deal with automobile parts than with redesigning transport systems),
- the life cycle stages (e.g. there is very little focus on the use phase, which determine a large part of the environmental effects of the rest of the chain, more studies go into detail with the food industry than with agriculture, which cause the main impacts related to food products),
- the applications (e.g. the number of studies made for ecolabelling purposes is out of proportion with the environmental importance of this application as opposed to product development and strategic studies),
- the environmental impact categories (e.g. biodiversity and noise, which are important issues in the public perception of the environment, are hardly touched upon by LCA, while trivial issues

such as material resource use and BOD/COD-emissions are often described with great precision).

The credibility of LCA as a technique is affected by such examples of misplaced concreteness.

It is obvious that a large part of the reason for the described discrepancies is the availability of funding. Areas with competitive interest and demands from the authorities receive more funding than areas where there are no competitive challenges and no regulation. Another part of the explanation is convenience. Some of the significant areas are simply more difficult to study.

However, the readiness of LCA practitioners to accept to study any issue without questioning its environmental importance, may eventually fall back on the way the technique is perceived. If the full transformation potential of the technique is not utilized, the technique may eventually be discredited as uninteresting.

A similar problem occurs when a large data collection effort is directed towards data of minor importance. It is often stated that 80% of the results are obtained with 20% of the effort. The most important part of the work is the correct identification of the object of study and the correct modeling of the product systems. Often, it may be determined which of two alternatives is the environmentally superior without collecting and calculating emission data.

The simplicity and ease of applying LCA as a qualitative technique has lead to an undue academic interest in the problems that occur when the technique is applied in its quantitative form. Thus, LCA is too often presented and perceived as an excessively quantitative technique at the expense of the many results obtained from qualitative studies. This is also the case for the description given in the ISO standards, although they do not explicitly require any quantification.

The focus on the quantitative approach has lead to an unfortunate ñ and paradoxical - disregard for the importance of uncertainties. More often than not, data are presented as single values without indication of uncertainty or data quality. Combined with a far to scarce use of alternative scenarios, this leads to an inability to distinguish between important and less important. If instead knowledge on uncertainties is applied to create different scenarios and to calculate the uncertainties of these, an iterative process can quickly focus the data collection on the items of largest importance. Although it is often stated ñ also in the ISO standards - that LCA is an iterative technique requiring the use of sensitivity analysis and consequent refinement of the system boundaries, this does not show very clearly in the LCA studies published so far.

The inability to distinguish between important and less important not only causes a waste of resources on less important issues. The opposite side of the problem is that too few resources are directed to the important issues. Sometimes, this apparently leads to the paradoxical situation that irrelevant data are used, just because they were available. Important process data are often not adequately validated, e.g. by mass balances, and crosschecks with similar data, model results, and statistically derived top-down estimates (the critique of Ayres 1995 on this point is unfortunately still valid). Important processes and important impact categories are often disregarded with the argument of lack of resources or lack of knowledge ñ which, however, does not always discourage the practitioner from making a conclusion in which this limitation is seldom repeated!

# 4. Addressing the right product systems

A dynamic, prospective LCA, understood as an assessment of the consequences of a potential product substitution, may well include very different processes compared to a study with a static, retrospective perspective. This is because a prospective study addresses several important issues, which are ignored by a static perspective:

- The time horizon of the study. In a prospective LCA, different forecasting techniques are combined in an attempt to capture the dynamic interactions of different developments (Pesonen et al. 2000), while in most current studies, the future is either not regarded as relevant, or it is taken into account in too simple a way, e.g. by direct extrapolation of current trends.
- The scale of a product substitution, taking into account that large-scale change may affect the boundary conditions of the study, and thus the technologies to be studied.
- The market upon which a product is traded. A prospective LCA seeks to determine which specific product substitutions will actually take place and to what extent. Based on the market trends and an identification of the process most sensitive to changes in demand, the processes included in the system are the processes ultimately affected by these changes. This implies a combination of physical and economic analysis (Weidema et al. 1999). In static studies, the market mechanisms are often disregarded and instead those processes are included, which can be linked by current physical deliveries. A special case of this "market blindness" is that recycling credits are often arbitrarily applied, assuming that recycling will automatically increase either when increasing the content of recycled materials, or when increasing the amount of product provided for recycling.

# 5. Considering effects on other product systems

Understanding LCA as an assessment of consequences of a potential product substitution makes it relevant to include also secondary consequences on other product systems, typically ignored in a static analysis:

- Changes in social behavior, i.e. in the way the products are used, as a result of the substitution between product alternatives (Goedkoep et al. 1998).
- Effects of the substitution on the overall spending-pattern, when there is a price difference between the substituted products. The money saved on the cheaper alternatives will eventually be liberated for

alternative consumption in the customer segment affected by the price difference. The cheaper alternatives should therefore include the marginal spending of the money saved, by utilizing information on what products increase their market volume when the spending increases.

- The consequences of the substitution for the surrounding or complementary product systems, e.g. an additional need for maintenance as a side-effect of a choice of a specific alternative, or the change in consumed volume as a side-effect of a change in packaging size.
- The secondary use of the product, which may displace other products.
- The effects on other product systems caused by changes in the supply of co-products from the studied systems. These effects can be studied by applying techniques for system expansion (Weidema 1999). In a static analysis, the environmental exchanges of the systems are instead allocated arbitrarily among the co-products.

# 6. Conclusion

For LCA to maintain its role in promoting sustainability, it is essential that the practice of LCA address the issues mentioned in this paper:

- involving stakeholders,
- focusing on the issues of environmental importance,
- avoiding unnecessary focus on quantification,
- applying adequate forecasting techniques,
- taking into account the scale of the studied change,
- including market information to determine what processes to include in the study,
- taking into account secondary effects on other product systems, including effects caused by social behavior, alternative spending patterns, complementary products, secondary use of the product, and changes in supply of co-products.

Failure to adequately address these issues will compromise the results and applicability of the LCA technique in general.

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