Attachment 9 – LCA theory

Life cycle assessment

A life cycle assessment (LCA) evaluates the potential environmental impacts throughout the entire life cycle of a product or service (Figure 1). This can be divided into four main phases: Goal and scope, life cycle inventory (LCI), life cycle impact assessment (LCIA), and interpretation.

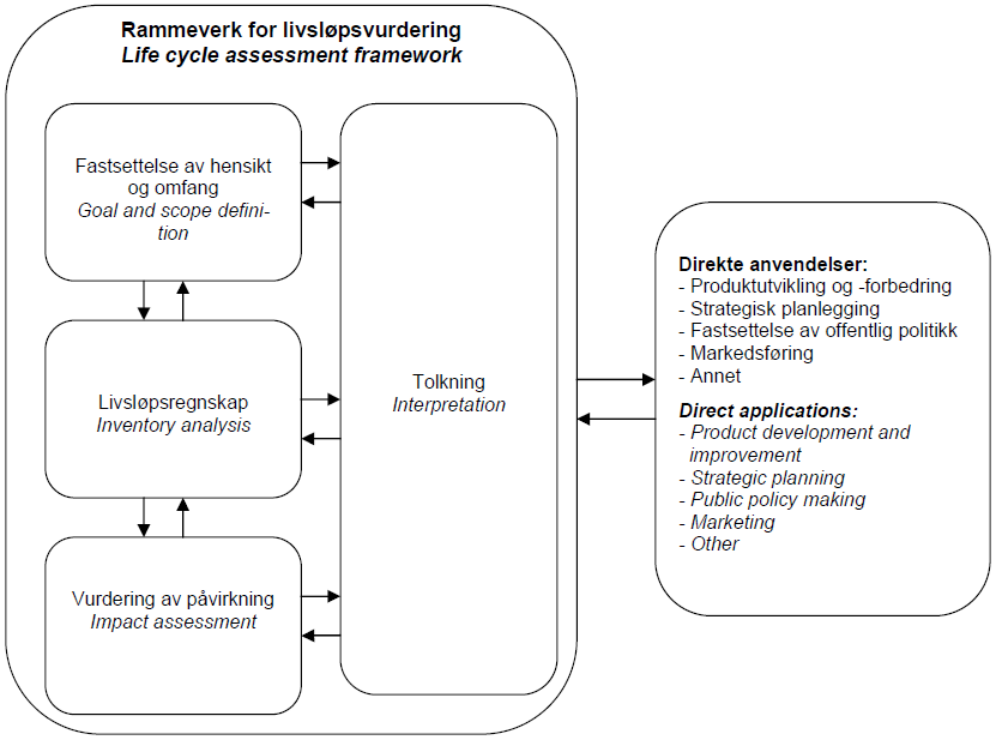

Figure 1. Life cycle assessment framework, built up by the four phases of an LCA study.

Goal and scope

In the first phase of a life cycle assessment, we have to define what we want to analyze, how we want to do it, and how far we will go with our analysis. This involves defining the system, functional unit, and system boundaries.

It is essential to understand and define the goal of a life cycle study to do a proper execution. Depending on the assessment, the system boundaries have to be decided. For instance, a company interested in reducing the emissions connected to the production of aluminum cans would only

need to do a cradle-to-gate assessment. In that way the company could ignore irrelevant parts and save themselves for a lot of work. A cradle-to-gate assessment includes the product stage (A1-A3), which can be seen in Figure 2.

When the goal has been defined, a functional unit has to be determined. It must be decided for which unit and quantify the analysis is to be performed for, so that further analyses will be based on this. Examples of two functional units are 1 kg of lettuce or 1 tonne-kilometre (e.g., for various freight transports). It's also important to determine which impact categories to measure the impact of the product or service, based on the goals of the assessment (e.g., measuring the impact on climate change in CO2-equivalent).

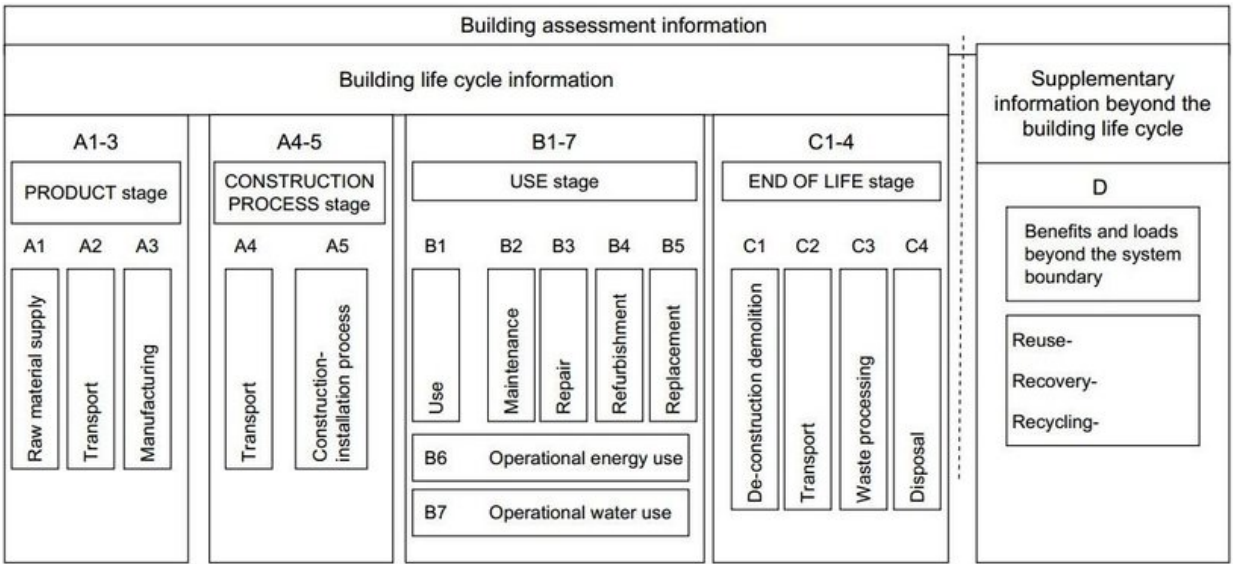

Figure 2. Building assessment modules for a life cycle assessment according to NS-EN 15978:2011.

Life cycle inventory

Before doing a life cycle assessment you have to collect data and information. A life cycle inventory (LCI) analysis involves the environmental inputs and outputs of a product or service. It is essentially just a phase where we account of everything involved in the system, including raw materials, energy used and needed, water, and emissions. Data are collected for the whole system and must be related to the function unit defined in the initial goal and scope phase.

Life cycle impact assessment

In a life cycle impact assessment (LCIA) the assessment is taken one step further with analyzing the inventory and assigning it to the impact categories chosen and defined earlier in the goal and scope step. After this, the environmental impacts are calculated and summarized in overall category totals (e.g., Global Warming Potential, Acidification Potential of land and water, and Human toxicity potential).

Interpretation

According to NS-EN ISO 14044:2006, the interpretation phase of a life cycle study should include:

- Identifying significant issues based on the results of the LCI and LCIA phases.
- An evaluation of the study, that includes completeness, sensitivity and consistency checks.
- Conclusions, limitations, and recommendations.

The results given from the LCI and LCIA phases will be interpreted according to what was decided in the goal and scope phase, and should include a sensitivity check of the inputs, outputs and choices done in the assessment. This will help understand the uncertainty of the results, as it may contain a lot of assumptions.