

An introduction to Life Cycle Assessment (LCA)

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Abstract

Life Cycle Assessment (LCA) is 'waste-to-gate' on all spatial scales. But how much is known about the methods behind these words? This article lays out the basics behind LCA notation and explains what it is, who would use it and how to perform such a study.

There is a general trend in the world today from fast Moving Consumer Goods (FMCG) industries, to the obvious environmentalists, to the person next door to produce and use up products, processes and services that are environmentally friendly. But what does this mean when there are so many types of 'certified eco-friend'?' These range from the original German Blue Angel, to Energy Star, the Forestry Stewardship Council (FSC) to various other certifications (Bret et al., 2014). Many of these have the words 'sustainable', 'environmentally friendly' or 'regener' around as if they are a shield to any environmental problems.

While many have genuine claims of being 'better' for the environment, should we not at least understand the claims being made? Just because something is natural/organic/vegetable does it mean it's better for us or the environment? One of the most popular quantitative tools for environmental comparison is Life Cycle Assessment (LCA). In this article, the basic concepts of LCA are presented in order to understand it more clearly.

What is Life Cycle Assessment (LCA)?

Life Cycle Assessment is a method to assess the full environmental impacts of a system. It is a quantitative tool which aims to assess cradle-to-grave attributes such as 'cradle-to-gate' or 'cradle-to-grave'. Instead it is a process of evaluating the effects that a system has on the environment, including extraction, processing, manufacture, transport, distribution, use, reuse, maintenance, recycling and final disposal. As such, an LCA is used to evaluate the 'cradle-to-grave' impacts of the system in question, but may also be defined as 'waste-to-gate' or 'gate-to-gate' (Figure 1).

LCA can focus on a product, process or a service. It can also be broken into separate or individual portions, eg. transport, packaging, manufacture etc. Further, it takes into account the broader geographic location (such as continent, country or region), depending on available data while avoiding social or political arguments. Since LCA is quantitative, the results should be replicable, thereby enhancing reliability.

LCA is data intensive. Obtaining this data may be difficult due to the quantity of data needed, the difficulty in measurement of the data and the variability of certain data (particularly if the data is not from one's own company). Due to the high data volumes, manipulation is often done using specialised software packages. This allows for easier data manipulation, faster calculation and identification which also allows for easy transfer across databases.

In order to standardise studies, LCAs are performed according to the framework defined by ISO (ISO 14040: 2006, ISO14044: 2006) allowing for common order among enough practitioners.

Who uses LCA?

Depending on the user (industry, government or NGOs), LCA studies may have different practical applications:

- Industry may use LCA to understand the full life cycle of their products, processes or services in order to understand their contribution to the total impact of their materials in the full life cycle (Greening responsibility).
- Government may be interested in things such as eco-labelling, decision support schemes (eg. the impacts of a glass recycling scheme on the welfare of all), subsidies, taxation or general policy decision-making.
- NGOs may use LCA in order to lobby consumers with information, support public decisions or influence companies and governments.

For all these instances, the buying power of consumers and influence market trends and environmental transfer

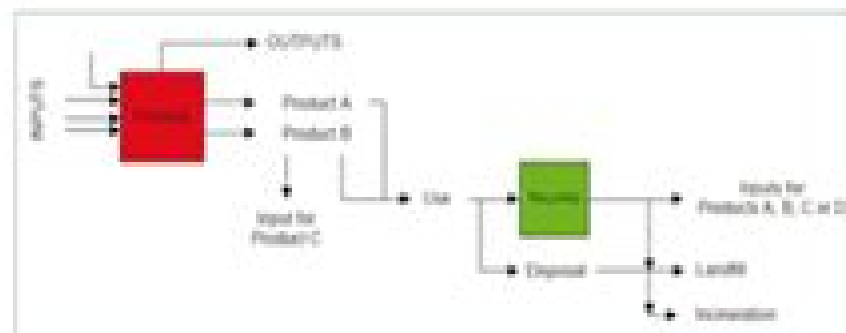


Figure 1: An LCA cradle-to-grave study. From the use, recycling and disposal is included, and the inputs and outputs of the production of a product

products may be preferred. When consumers seek truth, equity and comparable environmental information, LCAs can provide the information.

How to perform a Life Cycle Assessment Framework

According to the ISO standards governing Life Cycle Assessment (ISO 14040 and ISO 14044), an LCA is made up of four stages: Goal and Scope, Inventory Analysis, Impact Assessment, and Interpretation (Figure 2). From these four stages in the real world it is often not seen as linear, but it is possible to return to a previous stage once findings and interpretation of each have been performed. They form part of the iterative nature of LCA.

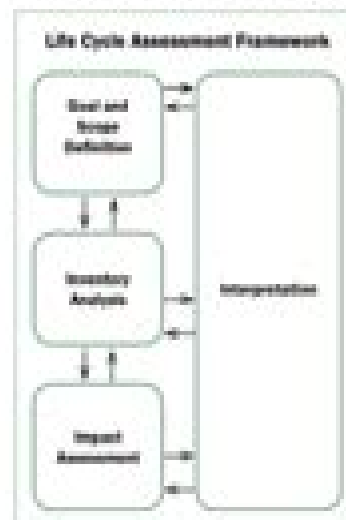


Figure 2: Flow of a cradle-to-grave life cycle study (ISO)

Goal and Scope

The Goal and Scope defines what it is that is to be investigated. As the goals of the study to perform a strength and weakness analysis, product comparison, product improvement or eco-labelling? Further, a functional unit is defined. This is the product/service service which is to be investigated and is related to the type of study, eg. the production of 1 ton of paper, driving 1 km in a small passenger car, etc. The functional unit may depend on the level of detail required in the study. When looking at an entire life cycle of a large process, multiple products may result. If the primary product of interest (and the functional unit) is unclear, allocation, or division of multiple products may be needed. This may be done by mass, economic or another factor.

Inventory Analysis

The second step of an LCA, the Inventory Analysis, can be seen in engineering terms as a mass and energy balance. Inputs and outputs, including the economic benefits and goods as well as environmental resources and emissions values, are needed.

This requires that the full flowchart, including all processes required in manufacture, use and final disposal are known. The entire life cycle implies that the flowchart starts with raw materials and ends with final use or disposal and includes all emissions (air, water, soil) along the chain. Data can be collected from literature, LCA databases, industry data, government records or process measurement. This is often the most difficult part of the study.

Once the processes are defined, the system boundary (or what are not being studied) can be more carefully defined. Further changes to the boundaries can have a big influence on final LCA results. Data that is directly calculated or measured for the specific study are known as foreground processes, while data collected from secondary sources (literature) are known as background processes (Figure 3).



An Introduction To Life Style Assessment

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