BSESC—Life-Cycle Analysis

# Proficiency Level 1. Remember

## Learning Objective 1

Define life-cycle analysis (LCA) terms, including goal, scope, functional unit, life-cycle inventory, and uncertainty analysis.

### Lecture Notes

Life-cycle analysis (LCA) is a term used to describe a family of calculations. In all LCAs, the objective is to consider the total life of a product or service. In building science, LCA is often used to quantify the impact from production through the end of life or demolition. The life-cycle cost is a way to understand the way components or features of a building may perform over the expected life of service in the building.

The principles for all LCA are captured with a few key terms. For additional detail about each term in an LCA, the International Organization for Standardization (ISO) standards are an excellent resource (International Organization for Standardization 2006).

* The **goal** of an LCA is a clear statement of the question you are trying to understand with the calculation.
* The **scope** of the LCA is a bounding of the analysis parameters and selection of the product alternatives. For example, in the case of a light-emitting diode (LED) product, the scope might include the operation of the light, the recycling of the light, and the production of the LED components. An accurate description of the system and its boundaries may influence the final LCA results, so be clear about **your scope and system boundaries.**
* The **functional unit** serves as the basis of comparison between products.
* The **inventory analysis** is a study of the processes included in the LCA. Often this is a spreadsheet or table that outlines the elements of the LCA relative to the functional unit. For example, the cost of raw materials, transportation, labor, and energy may all be captured in the inventory analysis.
* The **impact assessment** is the calculation of the LCA from the inventory analysis based on the functional unit. The **interpretation** of the LCA is the review and analysis of the LCA result.
* The **uncertainty analysis** of the LCA is the final cross-check on the inputs and allows the analyst to consider the accuracy of the data sources used in the analysis. This often includes a sensitivity study to determine how errors may propagate in the LCA.

Life-cycle analysis based on cost, or life-cycle cost analysis (LCCA), is often used for buildings to determine the lowest cost options over time, which includes operation. For example, it may be less expensive to buy a low efficiency lighting product (compact fluorescent lamp or incandescent) off the shelf; however, over the life of the product, the cost of an LED light will be much lower due to lower electricity costs and the longer operational life of the LED.

LCCA is well established in building science communities, and even required by many federal government projects. Because LCCA is well established, there are many resources available:

* Building Life-Cycle Cost (BLCC) computer programs to perform LCCA calculations developed by NIST
* Life Cycle Costing Manual for the Federal Energy Management Program (NIST Handbook 135)
* OpenLCA, a free tool that provides a computational structure for environmental LCA work.

LCCA often focuses on cost categories specific to buildings or building systems. These may include the purchase cost, construction cost, fuel cost, operation cost, maintenance cost, replacement cost, disposal cost, and fees associated with loans.

### References

International Organization for Standardization. 2006. *ISO 14040:2006 - Environmental management -- Life cycle assessment -- Principles and framewor*k. Pub. L. No. ISO 14040:2006. <https://www.iso.org/standard/37456.html>