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What is Life Cycle Assessment?
What are the Elements Needed for a Life Cycle Assessment?

With many commercial and industrial products claiming to be "green" or "sustainable", how do you know who is telling the full story and who is using those terms inappropriately or solely as marketing propaganda? Does the use of "toxic chemicals" in the manufacture of a product make it environmentally undesirable? These questions can be answered through the proper implementation of Life Cycle Assessment (LCA) practices. LCA is a tool for evaluating the environmental impacts of a product or process over a defined life cycle period using a set principles and guidance that are common amongst products. The use of LCA provides the practitioner an ability to assess the environmental aspects of a product or process and allows for comparison of the environmental attributes of alternative products. The principles and guidance for performing an LCA are defined by the International Organization for Standardization (ISO) in its 14000 series of standards.

The four basic stages of conducting an LCA include: 1) goal and scope definition; 2) inventory analysis (or model of the product's inflows and outflows); 3) impact assessment (an evaluation of the environmental relevance of the inflows and outflows); and 4) interpretation. The major stages in the life cycle of a product or process are material acquisition, materials manufacture, production, use/reuse/maintenance, and waste management. The system boundaries, assumptions, and conventions to be addressed in each stage all are necessary to understand any limitations on the use of the final LCA product. ISO 14040 states that LCA is an iterative technique, and as data and information are collected, it may be necessary for various aspects of the scope to be modified in order to meet the goal of the study.

The goal and scope of an LCA should be carefully developed prior to beginning the inventory of inflows and outflows. In general, the goal and scope should establish the reason for executing the LCA and outline the questions which need to be answered. Because small variations in products or processes under evaluation can result in major differences in LCA accounting, a precise definition of the life cycle and the function the product or process fulfills should be included in the goal and scope. Similarly, the functional unit, or basis for assessment, should be defined and a description of the inventory boundaries provided. While scoping an LCA, the practitioner should decide on the level of data quality that the project will require, as well as the assumptions and limitations that achieving that level of quality will put on the product of the effort.

The LCA inventory is a process of quantifying energy and raw material requirements, atmospheric emissions, waterborne discharges, solid wastes, and other releases over the life cycle of the manufactured product. The first step in the life cycle inventory is development of a process flow diagram illustrating the inputs and outputs (both material and energy) required for the life cycle of the product or process being evaluated. The second step in the life cycle inventory is development of a data collection plan. The data collection plan should include data quality goals, identification of data sources and types, and identification of any data gaps. The significance of data gaps must be determined – can new data be obtained, can assumptions be used, and will such gaps affect the usability in the final LCA product? The third step in the life cycle inventory is collection of data. The final step in the life cycle inventory is the evaluation and documentation of the results, ensuring that the data quality objectives have been met.

The LCA impact assessment uses the inventory results to calculate impact categories. The selection and definition of impact categories allows the practitioner to classify (assigning life cycle inventory results to the impact categories) and characterize (modeling life cycle inventory impacts within impact categories using science-based conversion factors) the data for interpretation. Once classified and characterized, these data can be normalized, grouped, and weighted. Normalization is the process of expressing potential impacts in ways that allow comparison of alternative products. Grouping is the process of sorting or ranking the indicators and weighting emphasizes the most important potential impacts. ISO 14044 specifies that weighting, as a possibly subjective step, is not permitted in LCAs that include comparative assertions.

The interpretation component of the LCA should identify, quantify, check, and evaluate information derived from the assessment. The objective of the interpretation, as defined by ISO, is to analyze results, reach conclusions, explain limitations, and provide recommendations based on the findings of the inventory and assessment phases of the LCA. The results of the interpretation must be reported in a transparent manner and provide a readily understandable, complete, and consistent presentation of the results of the LCA study, in accordance with the goal and scope of the study. The key steps in interpreting the results of the LCA include: 1) identification of significant issues for the product or process being analyzed, which are based on the life cycle inventory and life cycle assessment; 2) evaluation, which considers completeness, sensitivity, and consistency checks; and 3) reporting, which includes providing conclusions and recommendations.

The party commissioning the LCA project might decide to have the product reviewed by qualified independent persons, or peer-reviewers, to validate the LCA product and reduce the concern that the LCA product might be viewed as being biased. LCAs intended for use in comparative analyses require third party review and comments associated with such reviews must be included with documentation of the LCA. The peer-review panel would be expected to scrutinize the methodology, data collection, and analysis done in the LCA in accordance with ISO 14044.

If you are the party having an LCA performed on a product or process, there are several key elements that should be met to fulfill the definition of "good LCA practice". These elements include the following.

1. The LCA should follow the principles and guidelines of the 14000 series of ISO standards.

2. A goal and scope should be prepared, reviewed, and thoroughly agreed upon prior to data collection.

3. An inventory phase should be undertaken that includes all processes specified within the system boundary.

4. The inventory assessment should be completed on a set of impact indicators that are comprehensive and unbiased.

5. An interpretation should be developed that provides a discussion of the findings and conclusions and provides a summary of the sensitivity of such conclusions and the limitations and assumptions used to derive the conclusions.

6. Third party independent peer review should be done to provide a level of scrutiny that eliminates unsubstantiated claims or product bias. The third party review is best done by independent LCA practitioners, industry experts and other interested parties, such as those who might be impacted by comparative assertions.

7. LCA is an iterative process, and the assumptions and data inventory should be discussed with interested parties during development and industry experts should be allowed to provide input.

8. All LCA information should be transparently provided. If the LCA product does not clearly explain how the practitioner arrived at conclusions, the LCA is not appropriately done.