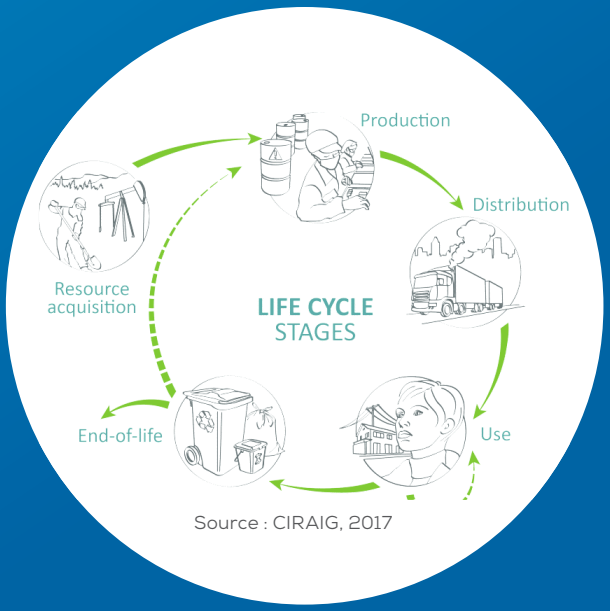
Summary sheet

LIFE CYCLE ASSESSMENT (LCA)

Abstract

Life cycle assessment (LCA) is a decision support tool that evaluates the potential environmental, social and cost impacts over the entire life cycle of a product or service[1]. Life cycle refers to all the processes required to generate the service provided by a product, including those associated with resource extraction, manufacturing, distribution, use and end of life. The analysis makes it possible to compare the potential impacts of the different stages of the life cycle of a product[2], to discover areas for improvement and to rethink its development.



Source : CIRAIG, 2017

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[1] For easier readability, LCA is here discussed with reference to a product only. However, LCA can just as well examine a service or a process. There is also the concept of organizational LCA, which evaluates all the products and services provided by an organization.

[2] See the Methodology section for details on the impact categories considered by each of these approaches.

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History

To date, there are three main types of LCA: environmental LCA (ELCA), social LCA (SLCA) and cost LCA (CLCA). The ELCA looks at potential environmental impacts, such as global warming, depletion of the ozone layer and the formation of photochemical smog. It is part of a stream of environmental accounting and valuation. The idea of energy balance emerged in the 1960s, while LCA emerged more significantly in the early 1990s. Although the methodology behind this concept dates back to the 1970s, it wasn't until twenty years later, with the start of the international standardization process (ISO 14040)[3], that it gained credibility and became usable. The SLCA explores the potential social impacts that exist between the different organizations working across the life cycle of a product and their respective stakeholders, such as workers, local communities or consumers. It addresses issues such as health and safety, working conditions, corruption and human rights. The SLCA draws its origins from the ELCA and stakeholder theories of management science. The initial studies and publications on the subject date back to the early 2000s and the first framework for SLCA was published by UNEP-SETAC in 2009. Finally, the CLCA focuses on the economic costs incurred throughout the life cycle of a product, from the extraction of raw materials to its disposal. The scope of the costs involved may vary depending on the study. Some CLCAs consider only internal costs, while others also consider externalities. The objective of a CLCA is generally to identify, from a holistic perspective, how the total life cycle cost of a product can be reduced. Today, in addition to the International Organization for Standardization (ISO), several other important organizations are involved in the development of LCA, including the Society of Environmental Toxicology and Chemistry (SETAC) and the United Nations with the United Nations Environment Programme (UNEP).

[3] The ISO 14000 series of standards refers to the set of standards for environmental management.

Method

Life cycle analysis differs from other methods in that it focuses on all stages of the life cycle of a product, making it possible to compare products that offer the same service but perform differently. It should be noted that the ELCA is a standardized evaluation method (ISO 14040 and ISO 14044) and that the phases specific to the SLCA and the CLCA were developed based on these same standards with, of course, adaptations.

The main phases of an LCA are:

1. Definition of objectives and scope of study;
2. Life Cycle Inventory;
3. Life Cycle Impact Assessment;
4. Interpretation.

These steps are iterative, in other words, they are repeated as many times as necessary. Despite their differences, the various types of analysis (ELCA, SLCA and CLCA) also have many commonalities, such as the phases of the methodology. To assess potential social impacts, qualitative or quantitative data relating to impact subcategories are collected from various sources (e.g., literature, interviews, databases). These data are then usually assessed against performance benchmarks, in other words, rating scales based on international standards and best practices in corporate social responsibility. These scales, which typically consist of 3 to 5 levels, are used to identify practices or performances that suggest potential negative or positive social impacts.

Elements potentially considered in an SLCA:

Categories of stakeholders	Impact subcategories
Workers	Freedom of association and collective bargaining Child labour Salaries Hours of work Forced labour Equal opportunities/discrimination Health and safety Social benefits/security
Local communities	Access to material resources Access to intangible resources Offshoring and migration Cultural heritage Healthy living conditions Respect for indigenous rights Community involvement Local employment Safe living conditions
Company	Public engagement on sustainable development issues Contribution to economic development Prevention and mediation of armed conflicts Technological development Corruption
Consumers	Consumers Health and safety Feedback mechanism Protection of privacy Transparency End-of-life liability
Value chain actors (other than consumers)	Healthy competition Promotion of social responsibility Supplier relations Enforcement of intellectual property rights Scope and limitations

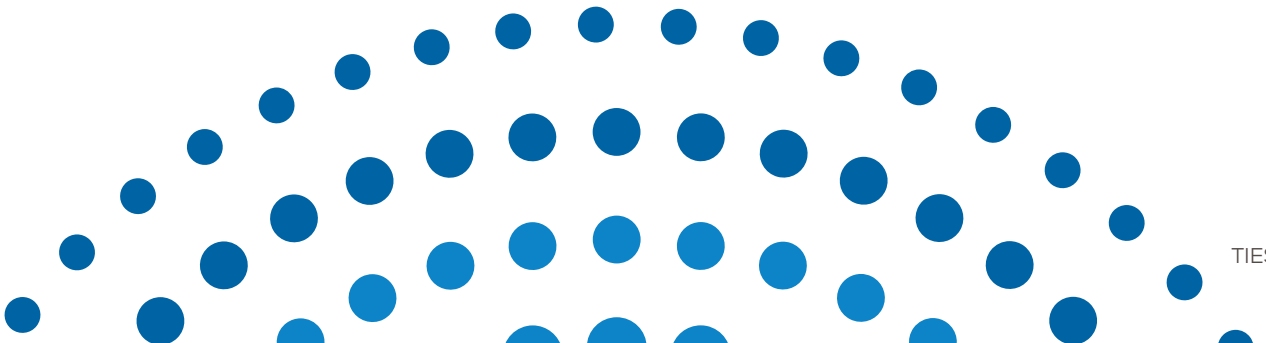
Scope and limitations

The LCA offers certain advantages:

- A comprehensive analysis tool. LCA in all its forms allows a very broad view of a product and its supply chain. The numerous indicators taken into account as well as the consideration of all stages of the product life cycle offer a holistic and systemic approach.

- Better decision-making. Decision-making, both political and economic, and even individual decision-making, is increasingly influenced by a variety of environmental and social issues. It is in this perspective of analyzing the different options, in order to choose the best one and to set priorities for action, that the LCA tool is useful.

- A communication tool. When a certain decision is made or a policy is adopted, it is usually necessary to communicate, explain or even defend it. An LCA can be used to justify the decision and to communicate about it.

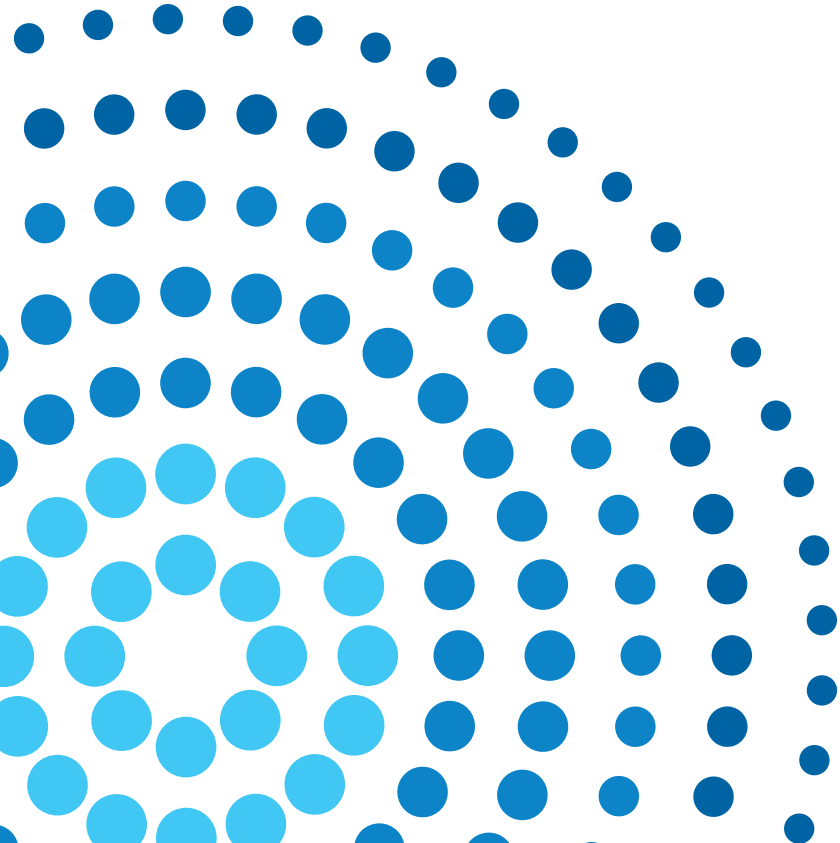


However, LCA has certain limitations:

- Access to data and assumptions. Some sensitive elements can bias the results of an LCA. A technical difficulty relates to the data used. Depending on the source and method of collection, the data is subject to a certain level of uncertainty and may be inaccurate, lacking in detail or incomplete. In such cases, assumptions must be made in order to use or substitute the data, leading to subjective choices that may be more or less accurate.

- Results from different types of LCA difficult to aggregate. Results from different types of LCA (ELCA, SLCA and CLCA) are difficult to aggregate as they deal with different topics. Furthermore, it is difficult to rank them in relation to one another. This can sometimes complicate decision-making.

- Limitations of the analysis of the use stage of a product. In the case of SLCA, the analysis of the use stage of the product is usually not optimal. Indicators to address this life cycle stage are not yet at a desirable level of maturity and are not relevant to all products. More research and methodological development are needed to arrive at a more adequate treatment of this stage.



Uses

LCA is in line with the tools for sustainable development. Currently, it is mainly used by governments and the private sector in cases where the goal is to understand the potential impacts of a product in a holistic manner, be it for communication, risk management or design purposes.

In Quebec, the Interuniversity Research Centre for the Life Cycle of Products, Processes and Services (CIRAIG) is a centre of expertise in this field. In partnership with other organizations, it has conducted a number of LCAs on topics such as:

- the environmental impacts of different electricity production processes (CIRAIG, 2014);
- the potential social and environmental impacts of milk production in Canada (Quantis et al., 2013);
- the potential social and environmental impacts of hardware management, particularly with respect to the end-of-life stage (Fagnen et al., 2011).

Aside from this last analysis, which studied the processes of a social economy enterprise (Insertech Angus), few LCAs specifically address the practices of social economy organizations in Quebec.

References

CIRAIG. (2014). *Rapport technique : comparaison des filières de production d'électricité et des bouquets d'énergie électrique.* Prepared for Hydro-Québec. ***https://www.hydroquebec.com/data/developpement-durable/pdf/comparaison-filieres-et-bouquets.pdf***

Fagnen, S., Charron-Doucet, F., Brodeur, C. & Revéret, J.-P. (2011). *Rapport d'analyse détaillée – analyse du cycle de vie environnementale et sociale de deux options de gestion du matériel informatique en fin de vie.* CIRAIG & Groupe AGECO.

Jolliet, O., Saadé, M. & Crettaz, P. (2005). *Analyse du cycle de vie : comprendre et réaliser un écobilan.* Presses polytechniques et universitaires romandes. 242 p.

Quantis, Agéco, CIRAIG (2013). *Environmental and Socioeconomic Life Cycle Analysis of Canadian Milk*. ***https://www.dairyresearch.ca/pdf/LCA-DFCFinalReport_e.pdf***

Russo Garrido, S. (2017). "Social Life-Cycle Assessment: An Introduction". *Encyclopedia of Sustainable Technologies*, Vol. 1, pp. 253-266.

Udo-de-Haes, H.A., Finndeven, G. & Goedkoop, M. (2002). *Life-Cycle Impact Assessment: Striving Towards Best Practice*. Society of Environmental Toxicology & Chemist, 272 p.

UNEP-SETAC, 2009. *Guidelines for Social Life Cycle Assessment of Products*. Benoît C., Mazjin B. (Eds), UNEP: Paris.

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Contributions

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