LIFE CYCLE ASSESSMENT

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Life Cycle Assessment (Life Cycle Analysis) is the evaluation of the potential environmental impacts throughout the entire life cycle of a product (production, distribution, use and end-of-life phases) or service. This also includes the upstream (e.g., suppliers) and downstream (e.g., waste management) processes associated with the production (e.g., production of raw, auxiliary and operating materials), use phase, and disposal (e.g., waste incineration).

Undertaking a Life Cycle Assessment (LCA) is becoming a fundamental part for companies in working toward net zero and more sustainable production, consumption, and supply chain processes. LCA, evaluates and measures the environmental impacts associated with products, services, processes, or activities, from the extraction of raw materials to the end of the lifecycle, is evidence of a company adopting more sustainable practices. It enables more systematic integration of sustainability information into reporting cycles, such as corporate sustainability reports.

Life Cycle Assessment Stages

The product life cycle consists of 5 main steps:

- Raw Material Extraction
- Manufacturing & Processing
- Transportation & Distribution
- Usage & Retail
- Waste Disposal/Recycling

There are several approaches to follow when carrying out the LCA:

1. Cradle-to-gate: this stage measures the impacts from the raw material extraction to the manufacturer's gate. It is one of the simplest and least expensive methods.

2. Cradle-to-grave: this stage measures the impacts from the raw material extraction to the end of the product's life. It is more comprehensive than the cradle-to-gate approach as it includes the use/maintenance and the disposal phase of the product.

3. Cradle-to-cradle: this stage measures the impact from the raw material extraction to when the product is recycled or reused and starts a new life cycle. It is considered the most comprehensive assessment of all the stages of a product's life cycle as it promotes the concepts of circularity, recyclability, and reuse, meaning the entire environmental impact of the product is assessed.

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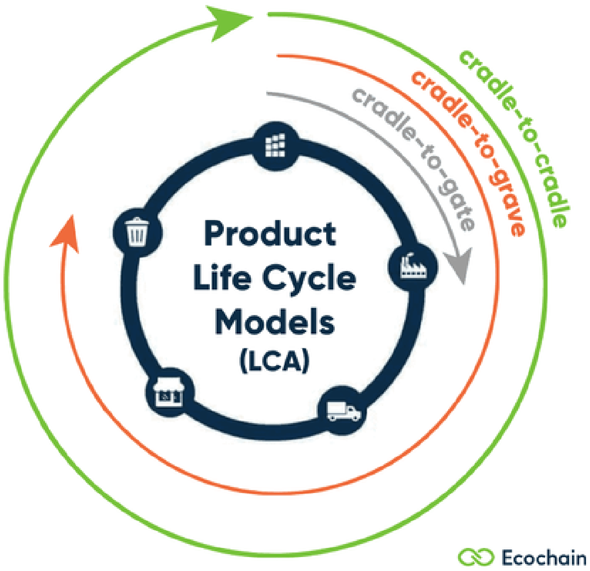

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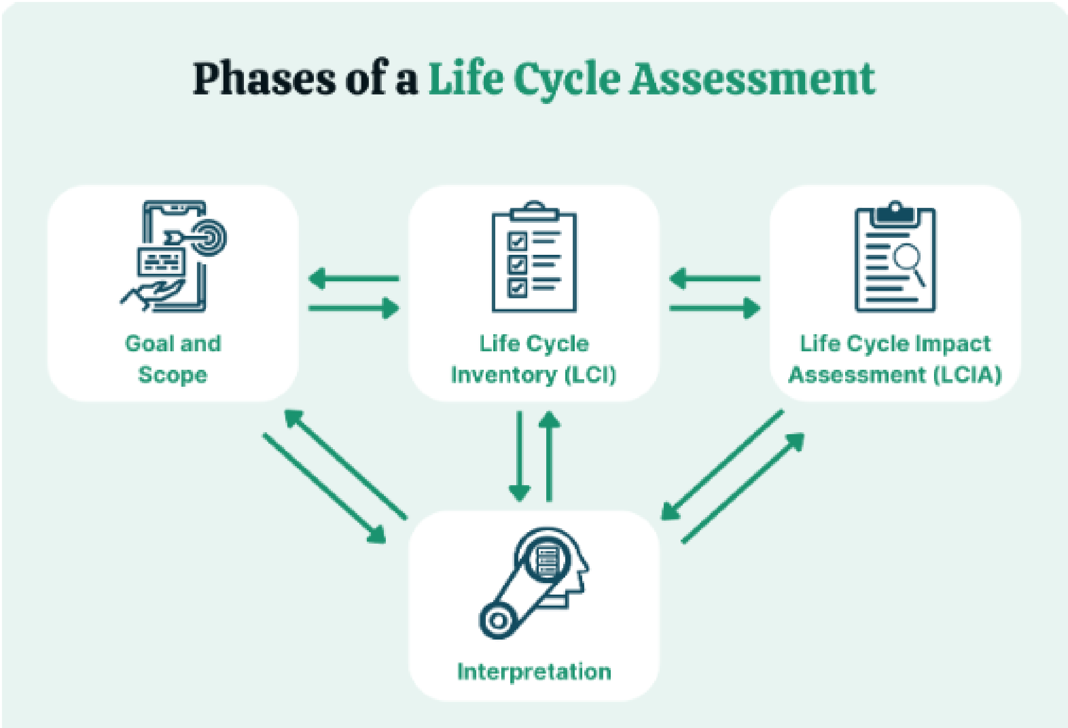
Life Cycle Assessment Stages

Life Cycle Assessment Regulations
The International Organization for Standardization (ISO) has developed a pair of complementary standards to facilitate the implementation of a Life Cycle Assessment (LCA). **ISO 14040** outlines the principles and framework, while **ISO 140442** specifies the requirements. Adhering to these standards enables organizations to establish the goals and scope of the **LCA**, model the targeted system, gather data, and present results.
These **ISO standards** encompass the definition of **LCA**, the inventory and impact phases, and guidelines for reporting and reviewing **LCA** outcomes. They also provide recommendations on the limitations of **LCA**, managing the relationship between phases, and present options for value choices. A conforming **LCA** typically involves four stages: defining the study's scope, creating a life cycle inventory (cataloging inputs and outputs), conducting impact assessments, and performing evaluations.

Main Phases of the Life Cycle Assessment

According to these standards, a life cycle assessment study is a systematic, phased approach and consists of four interconnected phases:

1. Goal definition and scoping,
2. Inventory analysis of the inputs and outputs of a system.
3. Impact assessment related to these inputs and outputs.
4. Interpretation of the results



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Life Cycle Assessment opportunities

A Life Cycle Assessment (LCA) study yields information on the quantified impact of a product on climate change. While commonly employed to evaluate carbon emissions associated with products, processes, or organizational operations, the **LCA's** scope extends beyond this. Companies can broaden their **LCA** assessments from measuring solely the **greenhouse gas (GHG)** equivalent emissions to include other impact categories such as ozone depletion, eutrophication, acidification, human toxicity, ecotoxicity, photochemical ozone formation, land use, and resource depletion.

Moreover, an **LCA** can pinpoint "**hotspots**" in a life cycle, indicating areas where companies or suppliers can swiftly adapt processes to reduce environmental impact. A comprehensive understanding of the product's operational context enables a more targeted action plan to address environmental impacts, emphasizing critical phases for intervention. This is crucial because a product might excel in emissions and global warming impact but could excessively consume water throughout its life cycle. This expanded scope also means that **LCA**s can contribute to the protection of oceans, biodiversity, and the natural environment.

Additionally, an **LCA** study involves measuring waste and evaluating the impact of associated disposal and treatment operations. By assessing all phases of the production process, including waste management, companies can discern which output streams affect the environment and explore alternative treatment options. **LCA**s can also uncover potential new uses for waste outputs, supporting the principles of a circular economy.

The Value of a Life Cycle Assessment

The **Life Cycle Assessment (LCA)** can function as either a framework or an operational tool designed for collecting input and output data related to products and processes. Regardless of its form, LCAs generate value primarily through insights and data obtained during the assessment process:

- **LCAs** enable users to compare the environmental performance of two or more products, such as ordinary Portland cement versus Portland slag cement in construction, electric versus internal combustion engine vehicles in transportation, or steel produced with raw materials versus Electric Arc Furnace steel made from recycled material in manufacturing.
- They provide insights into environmental impacts throughout various stages of the product life cycle, including extraction, transportation, manufacturing, and use. This empowers users to make informed decisions, address identified hotspots, and better navigate pathways toward carbon reduction goals.
- **LCAs** contribute to improved product design and marketing by promoting "**Design for Environment (DfE)**." This involves reducing environmental impact from the design phase through manufacturing and supporting product and service marketing through data and trend analysis.
- **LCAs** foster innovation by facilitating more sustainable product development and driving research into the environmental impact of new materials and manufacturing processes.
- The emphasis on the entire lifecycle and the treatment and reuse of waste positions the **LCA** as a foundational element for Circular Economy strategies and processes.
- Procurement and purchasing departments can leverage **LCA**s to identify suppliers with the most sustainable products and methods. This information can be used to design transparent and standardized contracts, transforming the entire supply chain into one that is more sustainable.

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Main challenges

Conducting a detailed Life Cycle Assessment (LCA) study can be intricate and costly, involving the collection of extensive environmental data throughout each stage of the life cycle. The setup and implementation of the methodology and databases demand significant time and financial resources. To accommodate companies lacking the expertise and resources for an in-depth study, simplified LCA tools are increasingly being developed, offering prompt verification of a product's life cycle.
Recognizing the critical importance of reliable data availability for the success of an LCA study, international and European initiatives are underway to enhance the accessibility and availability of LCA data. Databases like Ecoinvent8, which is both open for use and accredited, facilitate the free exchange of information and support Life Cycle Inventory analysis for various sustainability assessments.
However, it is crucial to acknowledge the limitations of an LCA. Its environmental focus often means that economic and social challenges are not addressed. Additionally, the LCA methodology, while assessing potential and non-real environmental impacts, computes global or regional effects rather than local environmental consequences. This implies that while the LCA acknowledges the global impact of emissions, it may not identify smaller, more localized impacts on ecosystems or human health.

Life Cycle Assessment Tools

Lifecycle assessment tools, also known as LCA tools, serve as analytical instruments employed to assess the environmental effects of a product, service, or process throughout its entire lifecycle — from the extraction of raw materials to disposal or recycling. These tools conduct a systematic and quantitative evaluation of various environmental factors, including energy consumption, greenhouse gas emissions, water usage, and waste generation. By comprehensively considering the environmental impacts associated with a product or process, LCA tools empower decision-makers to pinpoint areas for improvement, make informed choices, and devise more sustainable alternatives.
The following software tools are generally well-suited for conducting life cycle assessments (LCA) and sustainability evaluations across diverse sectors and industries. Some tools may possess specific features or databases tailored to particular sectors:

- Simapro9: Applicable across a wide range of sectors, including manufacturing, energy, construction, agriculture, transportation, and consumer goods.
- GaBi10: Relevant to various sectors such as manufacturing, chemicals, energy, electronics, automotive, and packaging.
- OpenLCA11: A versatile open-source tool adaptable to different sectors and applications, including product manufacturing, building construction, waste management, and renewable energy.
- Umberto 12: Suitable for sectors like manufacturing, process industries, energy production, waste management, and circular economy initiatives.
- Earthsmart13: Primarily used for assessing the sustainability of products, materials, and packaging across various sectors, including consumer goods and electronics.
- Sustainable minds 14: Designed for product designers and engineers across multiple sectors, such as consumer goods, electronics, furniture, and building materials.
- OneclickLCA15: Specifically focused on the building and construction sector, providing lifecycle assessment capabilities for assessing the environmental impacts of buildings.

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While these software tools may feature sector-specific attributes or databases, their fundamental functionality and methodologies can be applied across a broad spectrum of industries to assess environmental impacts and facilitate sustainable decision-making. It is advisable to explore each software's website or contact the respective providers for more detailed information and suitability for specific requirements.

Application of LCA in ESG Implementation

In recent times, there has been a notable increase in attention and disclosures related to the Environmental, Social, and Governance (ESG) aspects of companies. This trend is closely tied to a growing necessity for manufacturers to provide transparent information to a diverse set of stakeholders, including customers and the general public. Life Cycle Assessment (LCA) data, particularly information related to carbon footprint, plays a crucial role in fulfilling these information and disclosure requirements, applicable not only to corporate-level reporting such as Scope 3 but also for product-centric assessments.

Within the practice of LCA, there has been a gradual evolution in standardization and maturity, progressing from standards to category rules and guidance documents like Product Environmental Footprint (PEF) and Environmental Product Declarations (EPDs). These developments aim to establish consistency and comparability in the data derived from LCA studies.

The field of LCA has expanded beyond traditional environmental considerations to encompass new dimensions like Social LCA, Life Cycle Costing, Organizational LCA, and more. It is essential to align LCA-driven data with various aspects of ESG considerations to identify potential opportunities for improvement in delivering value from an ESG perspective. The ESG landscape has also evolved, giving rise to various reporting frameworks such as GRI, TCFD, SASB, and WEF.

This meta-analysis of the frameworks associated with LCA and ESG will highlight the synergies between them and identify focal areas for further development. The goal is to enhance the value of LCA-driven information within the context of ESG, considering the dynamic changes in both fields in recent years.

Life Cycle Assessment for a circular economy transition

To effectively utilize Life Cycle Assessment (LCA) in supporting the transition to a circular economy, it is crucial to recognize its limitations and regard it as one tool in a diverse toolkit rather than a sole definitive source. Instead of focusing solely on optimizing within the existing system, it is imperative to envision the desired end state, a circular economy, and initiate innovative approaches to achieve it. LCA can play a pivotal role in this process through various applications:

- Identifying Areas for Improvement: LCA can pinpoint specific stages within the life cycle of a solution where there are significant environmental impacts. This could involve highlighting resource-intensive or polluting phases in a product's life. Subsequently, LCA aids in assessing how various options for that particular life cycle stage address these impacts.

- Testing Resilience Against External Factors: Life Cycle Assessments offer a means to examine the effects of external factors that may vary across geographical locations or change over time. Examples include alterations in the energy mix, the development of recycling infrastructure, or the introduction of new technologies. By adjusting the input parameters of an LCA, it becomes possible to assess the impact of these changing external factors.

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- Assess Similar Solutions: LCA is most effective when comparing solutions with similar system components. For instance, it can provide a definitive answer when evaluating the carbon emissions associated with two different packaging materials, assuming all other aspects of the business model remain constant.
- Employ LCA in Advanced Innovation Stages: The utility of LCA is maximized when there is reliable input data and fewer uncertainties. It becomes more effective when the flow of materials and resources through the system is well-defined. Therefore, the later stages of the innovation process, such as scale-up or improvements to an existing system, are optimal times for conducting LCAs. Caution is advised when applying LCA in the early phases of the innovation process.

References:

- https://ecochain.com/blog/life-cycle-assessment-lca-guide/
- https://sphera.com/glossary/what-is-a-life-cycle-assessment-lca/
- https://www.pwc.com/sk/en/environmental-social-and-corporate-governance-esg/measuring-environmental-impact/life-cycle-assessment.html
- https://kpmg.com/xx/en/home/insights/2023/10/life-cycle-assessment-guide.html