Factsheet

Life Cycle Assessment (LCA) and Social LCA

waterproof-project.eu

About the project

The WaterProof project aims to develop an electro-chemical process that converts CO_2 emissions captured from consumer waste incineration and wastewater treatment facilities into formic acid. Formic acid is used for the production of different consumer products such as cleaning detergents and fish leather, and as building block of acidic deep eutectic solvents (ADES).

These ADES can be applied for the recovery of precious metals from wastewater sludge and incineration ashes. A by-product of the CO_2-conversion process are peroxides that can be used to remove pharmaceuticals and pesticides from wastewater.

Powered by renewable energy, WaterProof fosters a zero-emission clean water-cycle, closing the waste carbon loop and promoting the shift from fossil to renewable carbon sources. It supports Europe's journey toward climate neutrality and a truly circular economy.

Sustainability as a key driver of economic change

Sustainability is becoming a major factor for businesses, driven by at least three different aspects:

- → **Customers demand relevant information from producers and the market.**
- → **Responsible entrepreneurs strive to reduce the negative impact of their actions.**
- → **Various political directives oblige companies to report on several non-financial aspects of their business and products and for green claims to be substantiated.**

Assessing and comparing the environmental performance of products is becoming a critical element in transforming the current economic system towards sustainability and circularity and in mitigating climate change.

How to make the environmental sustainability performance of products and processes comparable?

With regard to sustainability efforts and green claims, sustainability assessment tools play a crucial role in evaluating the environmental, social, and economic impacts of products, processes and services.

Currently, Life Cycle Assessment (LCA) is the most recognised methodology to assess potential environmental impacts of products or processes. The assessment covers a broad spectrum from raw material extraction, manufacturing and use, to end-of-life disposal, recycling or reuse. The results of an LCA serve the purpose to optimise and adapt processes in order to reduce environmental impacts.

An LCA is generally used to answer one of the following three questions:

1. **Where in the process or product are the main sustainability impacts?**
2. **How do the sustainability impacts of different alternatives compare to each other?**
3. **Do the identified sustainability impacts of a specific product system comply with external standards?**

Similarities and differences in LCA methodology

LCA is widely used in industries ranging from manufacturing to agriculture, construction, and energy production to identify opportunities for improvement and support decision-making towards more sustainable practices. LCA that follows the quantitative environmental standards ISO 14040[1] and 14044[2] has become the most widely accepted and applied metho-dology.

Over the years, different frameworks and guidelines for conducting LCAs have been published which are all applied in industry and academia. However, due to lack of harmonisation of standards and methodological choices, comparing different LCA studies can be challenging.

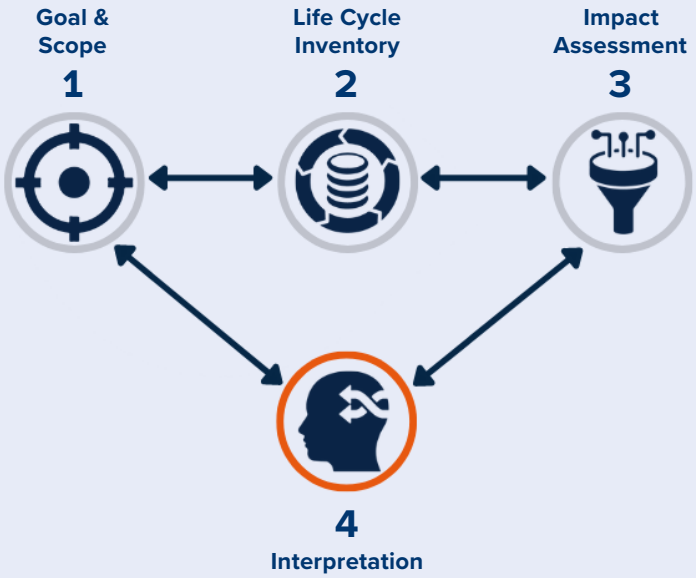
Successfully integrating Life Cycle Assessment into business processes

To ensure that environmental impacts are actually reduced and not just shifted, it is important to carry out LCAs at an early stage of the design process, rather than at the end, so that improvements can be adapted accordingly.

The methodology of LCA involves four main stages:

1. **Goal and scope definition**
   What will be assessed, and why?
2. **Inventory analysis**
   How extensive will the assessment be and what data is available, what data is needed and how can it be collected?
3. **Impact assessment**
   What is the qualitative and quantitative impact of the product or process?
4. **Interpretation of results**
   What are the biggest impact categories and what conclusions can be drawn?

4 Phases of a Life Cycle Assessment (LCA)



The assessment design follows different key tasks and faces different challenges:

Environmental impact
LCAs evaluate various environmental indicators such as climate change, acidification, use of fossil resources, particulate matter, land use, water use and ecotoxicity.

System boundaries
LCA considers all stages of the product life cycle, including upstream and downstream processes, to avoid shifting burdens from one stage to another.

Data quality
LCA relies on accurate and reliable data to ensure the credibility of the results.

Interpretation of results
Drawing meaningful conclusions and insights from the gathered information to allow informed decision-making processes.

PLUS – peer review
A rigorous evaluation by independent experts in the field can ensure the quality, credibility, and reliability of the methodology and results of an LCA.

Social Life Cycle Assessment (S-LCA)

S-LCA is a methodology to assess the social, sociological and socio-economic impacts of products and services throughout their life cycle. The assessment covers the actual and potential positive or negative impacts of a product. This includes aspects like human rights, labour practices, health and safety, community engagement, and socio-economic development, working conditions or cultural heritage with many different sub-indicators for various stakeholder groups.

S-LCAs use generic as well as site-specific data and usually complement the environmental LCA. Here, the evaluation and significance of social impact are based on stakeholder perception and specifically defined relevant indicators. Thus stakeholder engagement presents a key element of S-LCA. Nevertheless, S-LCAs face various challenges due to low data availability, cultural differences, and the complex and subjective nature of social impacts assessment.

A key task of S-LCA is to increase social perception and uptake of sustainable solutions by helping organisations to understand and address the social risks and opportunities associated with their products or operations. S-LCAs foster responsible supply chains and corporate due diligence, improve corporate social responsibility (CSR) practices, and help to enhance stakeholder trust.

Integrating and complementing LCA and S-LCA

It has proven useful to combine LCA and S-LCA in research design processes to provide a more comprehensive sustainability assessment, considering both environmental and social aspects.[3] Integration enables decision-makers to prioritise actions that maximise positive impacts while minimising negative effects across the triple bottom line (environmental, social, and economic).responsibility (CSR) practices, and help to enhance stakeholder trust.

LCA and S-LCA in WaterProof

To ensure that all developed technologies and materials have a positive impact on the environment and communities, the WaterProof project makes the assessment of environmental, economic and social benefits of the developed solutions a priority. This will be done by using validated comprehensive analysis, such as a multi-level stakeholder analysis, (S-)LCA and Techno-Economic Evalution (TEE). The assessments will follow the recognised ISO standards 14040 and 14044 as well as additional standards and guidelines (e.g. Product Environmental Footprint (PEF), ILCD-Handbook, and ISO 16760).

Conclusion

Life Cycle Assessment (LCA) and Social Life Cycle Assessment (S-LCA) are valuable tools for evaluating the environmental and social sustainability performance of products and processes. By considering environmental and social dimensions, these methodologies help organisations to make informed decisions for more sustainable practices and contribute to the achievement of general sustainability goals like the 17 UN Sustainable Development Goals.[4]

References

1 International Organization for Standardization 2024: ISO 14040:2006/Amd 1:2020 Environmental management and Life cycle assessment – Principles and framework https://www.iso.org/standard/76121.html

2 International Organization for Standardization 2024: ISO 14044:2006 Environmental management and Life cycle assessment https://www.iso.org/standard/38498.html

3 Larsen, Vibeke Grupe; Tollin, Nicola; Sattrup, Peter Andreas; Birkved, Morten; Holmboe, Tine 2022: What are the challenges in assessing circular economy for the built environment? A literature review on integrating LCA, LCC and S-LCA in life cycle sustainability assessment, LCSA, in Journal of Building Engineering Vol 50 June 1st 2022, https://www.sciencedirect.com/science/article/abs/pii/S2352710222002169

4 United Nations Department of Economic and Social Affairs 2024: https://sdgs.un.org

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