Minimizing our CO_2-footprint by sustainability- and life-cycle-assessment

Climate & Energy Transition Seminar

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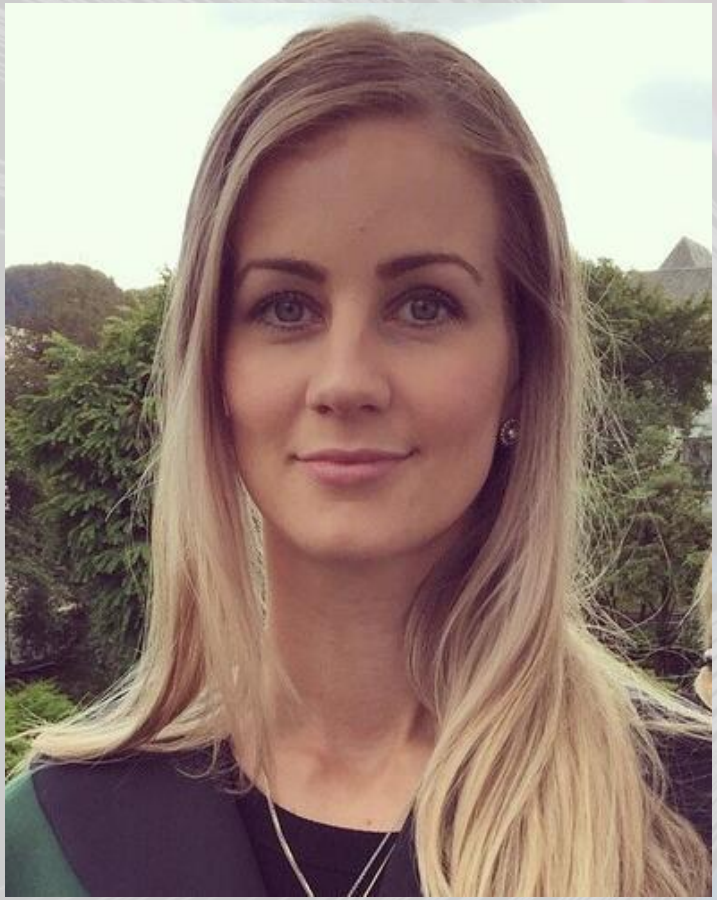

Jan. 2017

Defended my PhD in January 2017

2018

Postdoc from 2018

That is when Life Cycle Assessment methodology came into the picture

2017 & 2018

Contract researcher in 2017 and 2018

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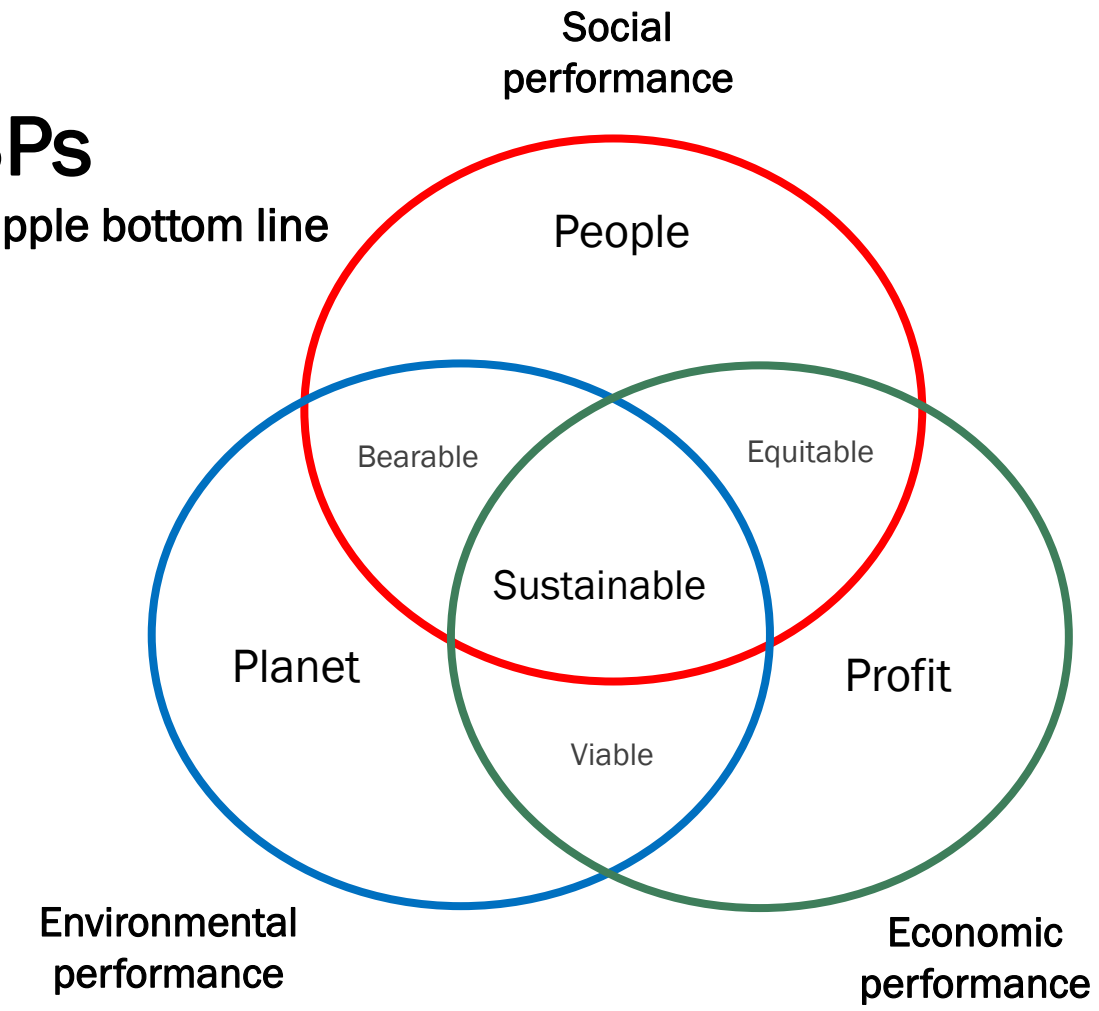
What is Life Cycle Assessment?

A Life Cycle Assessment (LCA) is the systematic analysis of the potential environmental impacts of products or services during their entire life cycle. [1]

[1] https://sphera.com/glossary/what-is-a-life-cycle-assessment-lca/

3Ps

Tripple bottom line



All three dimensions can be assessed and quantified separately:

Life Cycle Sustainability Assessment

[2]

Life Cycle Sustainability Assessment (LCSA)

LCSA = LCA + LCC + SLCA

[2] https://safechemicals.africa/introduction-to-life-cycle-thinking/

“SUSTAINABLE DEVELOPMENT IS DEVELOPMENT THAT MEETS THE NEEDS OF THE PRESENT WITHOUT COMPROMISING THE ABILITY OF FUTURE GENERATIONS TO MEET THEIR OWN NEEDS.”

THE UNITED NATIONS BRUNDTLAND COMMISSION, 1987

SUSTAINABLE DEVELOPMENT GOALS

Came into force in January 2016

"A call for action by all countries – poor, rich and middle-income – to promote prosperity while protecting the planet."

"Governments are expected to take ownership and establish national frameworks for the achievement of the 17 Goals."

[3]

[3] https://www.un.org/sustainabledevelopment/

SUSTAINABLE DEVELOPMENT GOALS

SUSTAINABILITY IS THE PROPERTY OF A SYSTEM

[3]

[3] https://www.un.org/sustainabledevelopment/

Environment, Social and corporate Governance = ESG [4]

12: Ensure sustainable consumption and production patterns

[4] Henrik Skaug Sætra, Sustainability 13(15), 8503 (2021)
https://www.mdpi.com/2071-1050/13/15/8503

The results of an LCA are expressed based on a functional unit (**fU**)
Functional unit
- *The quantifiable performance of the product system*
- Defined early in the analytical process!
- Arbitrary, but must be quantified

Life Cycle Assessment (LCA)

A holistic and systematic approach and framework for assessing the environmental impacts of a product system and decisions:

1) Goal and Scope Definition (G&S D)
2) Life Cycle Inventory Analysis (LCI)
3) Life Cycle Impact Assessment (LCIA)
4) Interpretation of the results

Cradle-to-Grave

Cradle-to-Gate

Gate-to-Gate

Gate-to-Grave

ISO-standards

The leading standards for LCA are ISO 14040 (general) and ISO 14044 (specific requirements)

Requirements, principles, framework and operational guidelines for:

- Definition of the goal and scope of the LCA
- Life cycle inventory analysis (LCI) phase
- Life cycle impact assessment (LCIA) phase
- Interpretation phase
- Reporting and critical review of the LCA
- Relationship between the LCA phases
- Conditions for use of value choices and optional elements

The results of an LCA are expressed based on a functional unit (**fU**)

Functional unit

- *The quantifiable performance of the product system*
- Defined early in the analytical process!
- Arbitrary, but must be quantified

Life Cycle Assessment (LCA)

A framework for assessing the environmental impacts of a product system and decisions:

1) **Goal and Scope Definition (G&S D)**
   - Defining the framing of the analysis (why?) and choosing a functional basis for comparison (***fU***)
   - What type of LCA/for what audience and what is the objective of the LCA
   - Deciding on system boundaries, meaning how much of the system will be accounted for in the analysis:
     - Temporal boundaries/Time horizon
     - Geographical boundaries
     - Technical system boundaries (cut-off criteria and insignificant inputs)
     - Demarcation toward system surroundings (co-products, emissions, wastes etc.)
     - Decide on depth/detail of study
     - Impact categories to be studied

2) Life Cycle Inventory Analysis (LCI)

3) Life Cycle Impact Assessment (LCIA)

4) Interpretation of the results

Cradle-to-Grave

Cradle-to-Gate

Gate-to-Gate

Gate-to-Grave

Life Cycle Assessment (LCA)

ISO 14044:

“The goal and scope of an LCA shall be clearly defined and shall be consistent with the intended application.

Due to the iterative nature of LCA, the scope may have to be refined during the study.”

Life Cycle Assessment (LCA)

A framework for assessing the environmental impacts of a product system and decisions:

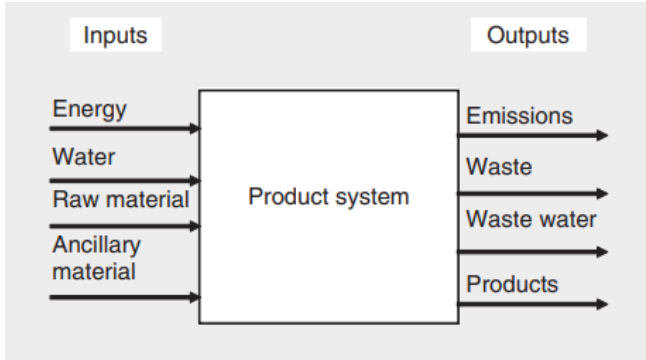
1) Goal and Scope Definition (G&S D)

2) **Life Cycle Inventory Analysis (LCI)**
   - Data compilation
   - Inventory analysis of extractions from and releases into the environment
   - Inputs and outputs
   - Structuring using flow sheets (software application)

3) Life Cycle Impact Assessment (LCIA)

4) Interpretation of the results

[5]



[5] Walter Klöpffer and Birgit Grahl, *Life Cycle Assessment (LCA)*, Wiley-VCH, 2014

Life Cycle Assessment (LCA)

A framework for assessing the environmental impacts of a product system and decisions:

1) Goal and Scope Definition (G&S D)

2) Life Cycle Inventory Analysis (LCI)

3) **Life Cycle Impact Assessment (LCIA)**
   - Clarify resource use and emissions according to their potential impacts
   - Quantify impacts for a limited number of **impact categories**
   - Assess importance of impact according to your goal and scope

4) Interpretation of the results

Life Cycle Assessment (LCA)

A framework for assessing the environmental impacts of a product system and decisions:

1) Goal and Scope Definition (G&S D)
2) Life Cycle Inventory Analysis (LCI)
3) Life Cycle Impact Assessment (LCIA)
4) **Interpretation of the results**
   - «Critical review»
   - Sensitivity analysis: contributions, relevance, robustness, data quality and limitations
   - Systematically evaluate opportunities for reducing negative effects of the product/service – “best practice”
   - Conclusions

SimaPro

GaBi
Product Sustainability
Performance

umberto®
know the flow.

openLCa

Databases:

Concluding remarks

Sustainability is the property of a system

A Life Cycle Assessment (LCA) is the systematic analysis of the potential environmental impacts of products or services during their entire life cycle

The leading standards for LCA are ISO 14040 (general) and ISO 14044 (specific requirements) to operate with common guidelines

Luckily, we have software to help us systematize and perform calculations

Thank you!

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