

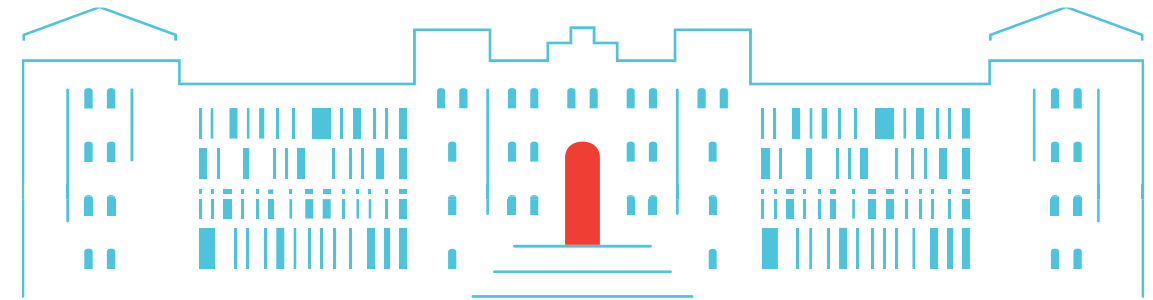
Life Cycle Assessment (LCA)

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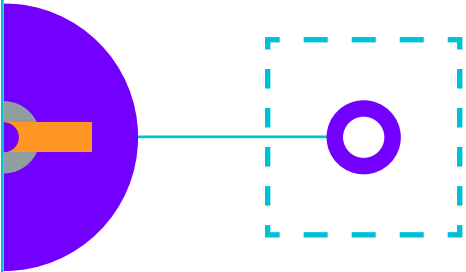


Research Group of Circular Resource Engineering and Management (CREM)Team



Agenda:

- 1. What is LCA? Why is it important?**
2. How to do LCA? Standards and framework
 - 2.1. Goal and scope definition
 - 2.2. Inventory analysis
 - 2.3. Impact assessment
 - 2.4. Interpretation



What is LCA?

- LCA (Life Cycle Assessment) is the only method that can provide a holistic overview of the entire life cycle of a system and assess the impact on all relevant environmental impacts
- Essential for supporting decisions to find the most environmentally friendly alternative

What is LCA?

According to ISO 14040, **LCA** is the compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system through its life cycle.

To do this, we need life cycle thinking!

LCT takes into account the entire life cycle – from extraction of natural resources to material processing, manufacturing, distribution and use; and finally reuse, recycling, energy recovery and disposal of residual waste (cradle to grave approach).

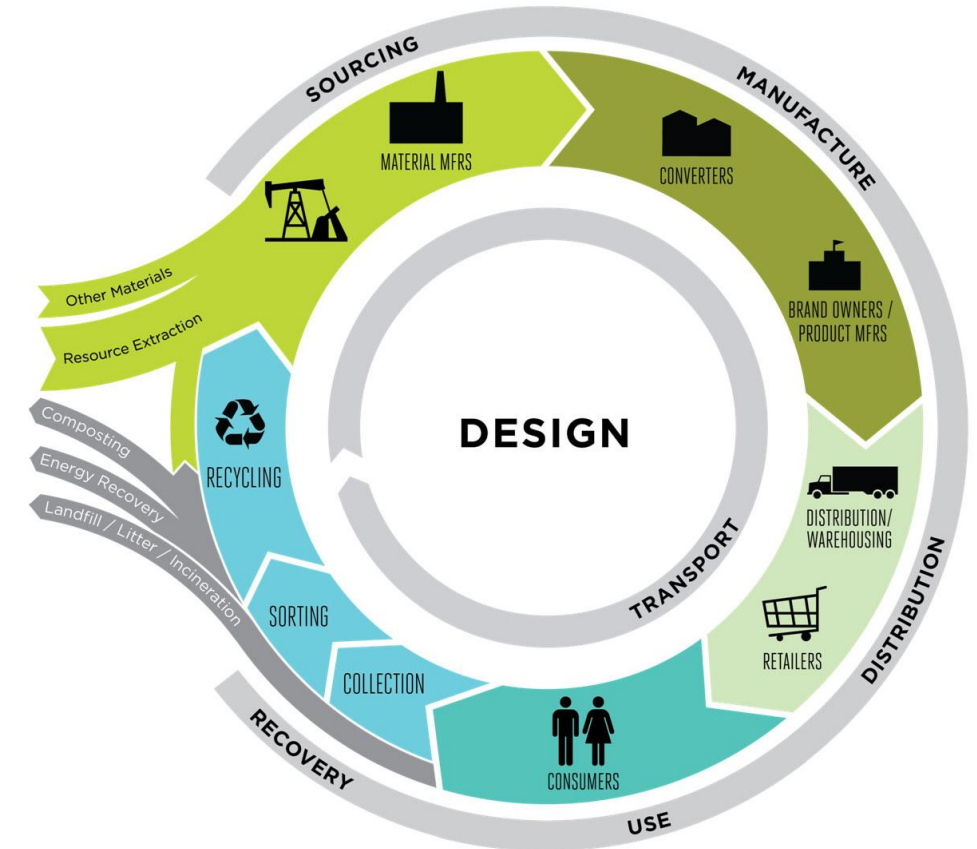
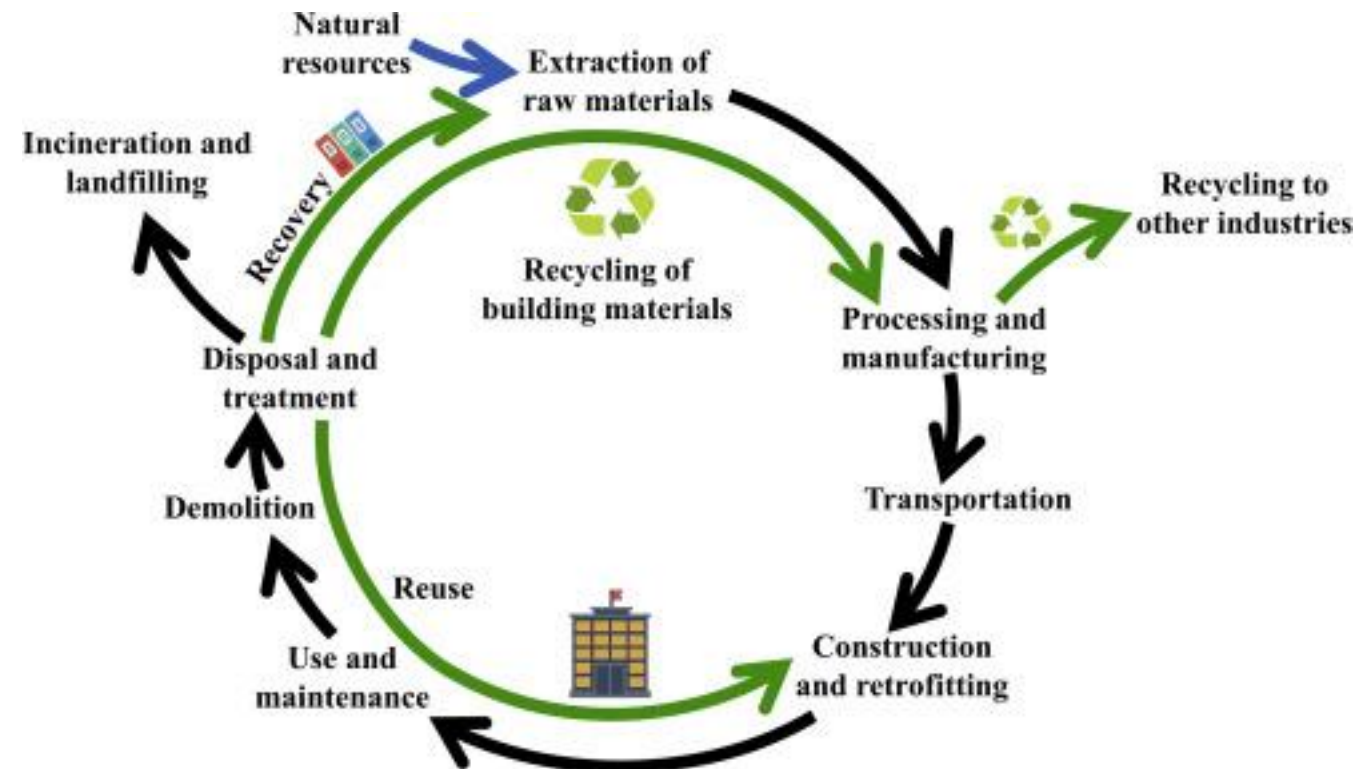


Image ref: <https://doi.org/10.13140/RG.2.2.29340.23689>

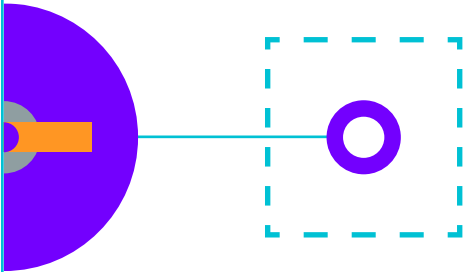
An example of LCT

Building Materials



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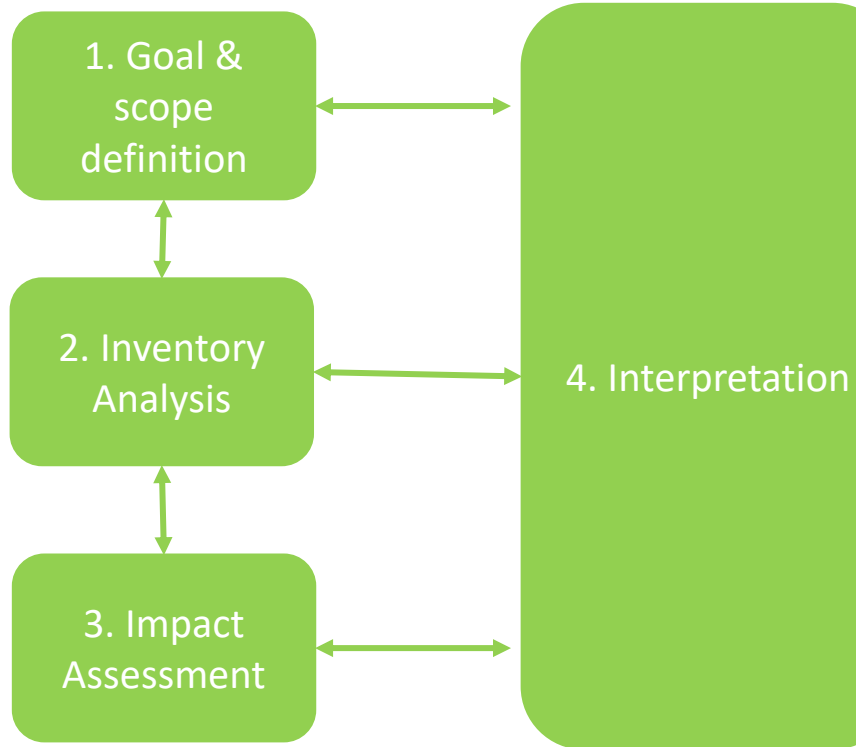
Life Cycle Assessment Framework– ISO 14040 & ISO 14044

- **ISO 14040** is the standards series for Life Cycle Assessment which address quantitative assessment methods for the assessment of the environmental aspects of a product or service in its entire life cycle stages.
- **ISO 14044** specifies requirements and provides guidelines for life cycle assessment for example definition of the goal and scope of the LCA, the life cycle inventory analysis phase, the life cycle impact assessment (LCIA) phase, and the life cycle interpretation phase.

<https://standardsdevelopment.bsigroup.com/projects/2020-01551#:~:text=This%20document%20specifies%20the%20calculation,the%20outcome%20of%20the%20assessment>
https://www.apec.org/docs/default-source/Publications/2004/2/Life-Cycle-Assessment-Best-Practices-of-International-Organization-for-Standardization-ISO-14040-Ser/04_cti_scsc_lca_rev.pd#:~:text=The%20ISO%2014040%20series%20standards,all%20four%20phases%20of%20LCA.

Life Cycle Assessment Framework- ISO 14040

Life Cycle Assessment (LCA) Framework



Direct applications:

- Product development & improvement
- Strategic planning
- Public policy
- Marketing
- other

Agenda:

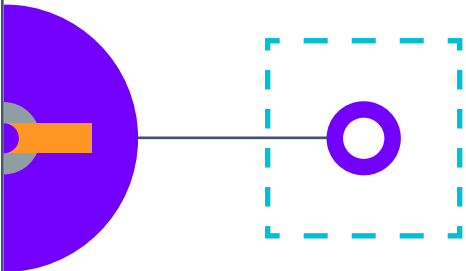
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Step one: Scope and Goal Definition

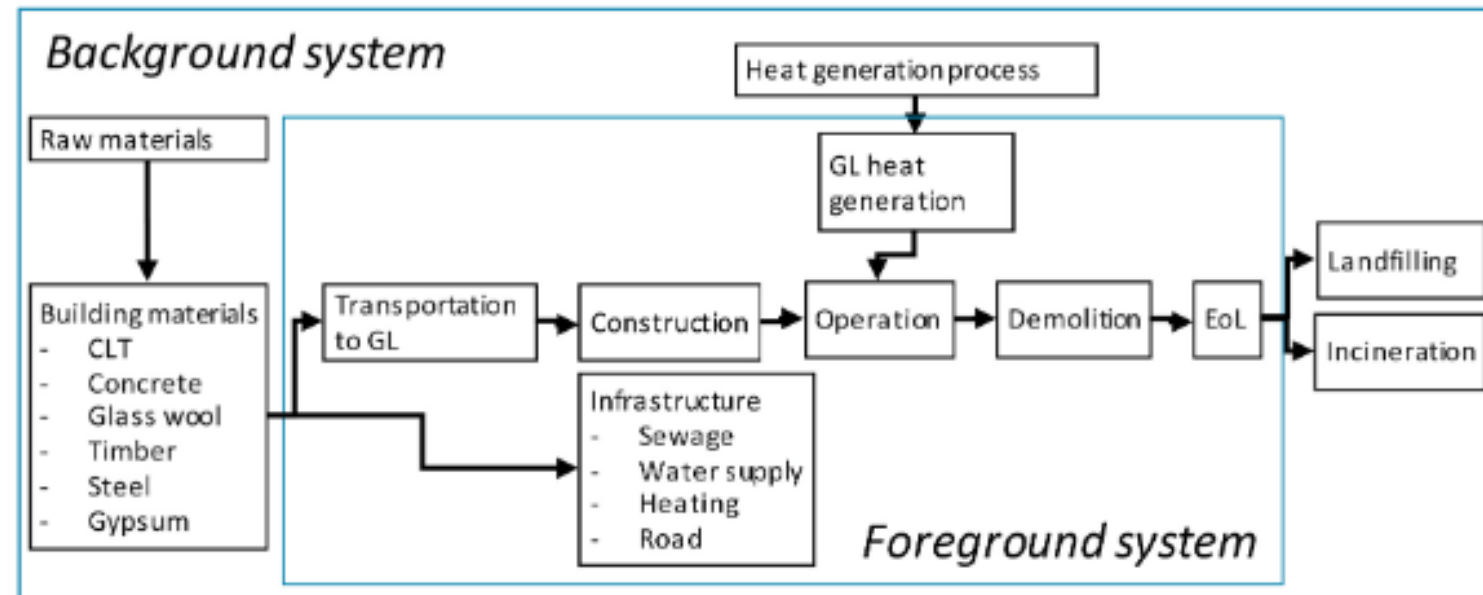
- Planned use of the LCA?
- Reason why the LCA study is made and which decisions should be supported
- Who is the target group?
- Type of audience is it?
- Limitations of the study
- Coverage of impact categories, unconventional assumptions, other methodological limitations
- Do the study involve comparisons and should these be published?
- Who is responsible for the study being done?

Two important sections in scope definition:
Functional unit and system boundaries
definition

Step one: Scope and Goal Definition

Definition of system boundaries

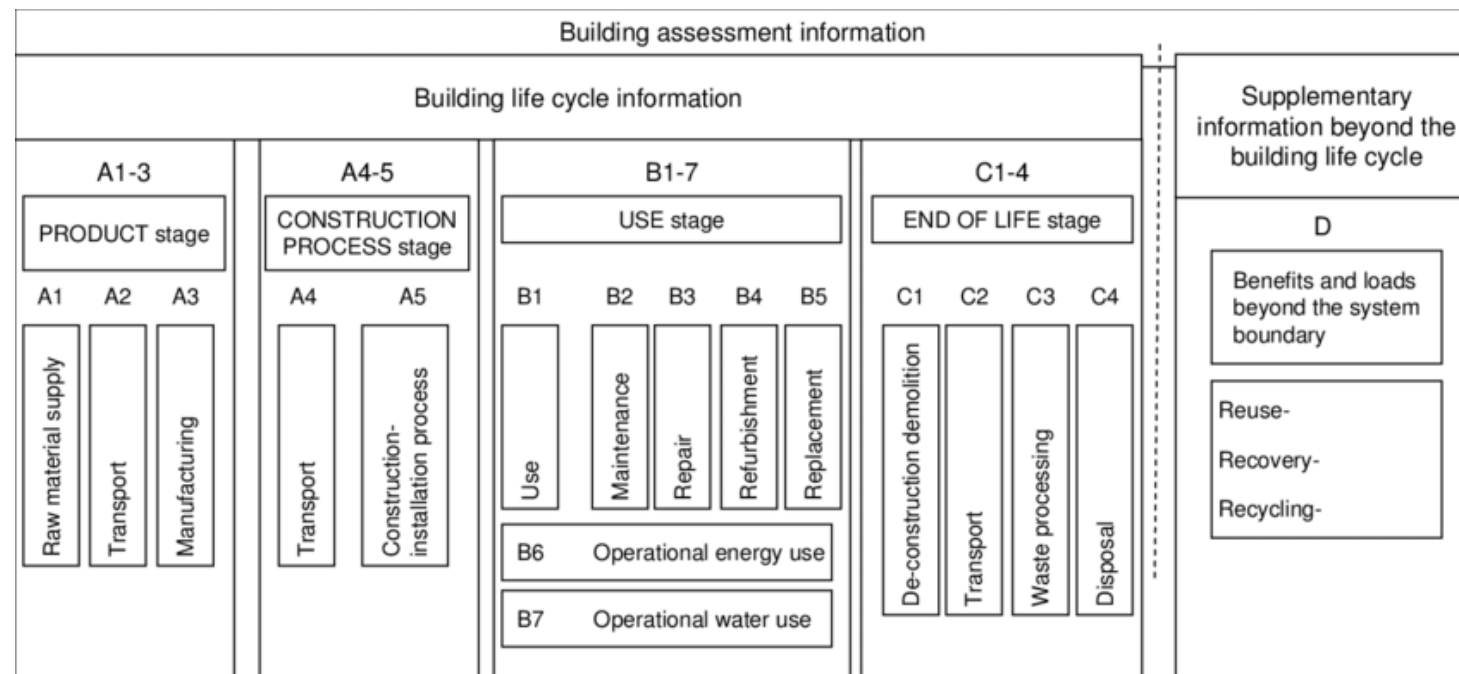
A system boundary is the set of criteria that determines which unit processes, inputs, outputs, and impacts are considered in an LCA.



Source: Morten Walbech Ryberg, Pernille Krogh Ohms, Eva Møller, Tove Lading - Comparative life cycle assessment of four buildings in Greenland
<https://www.linkedin.com/advice/3/how-do-you-deal-trade-offs-uncertainties#:~:text=What%20is%20a%20system%20boundary,transportation%2C%20use%2C%20or%20disposal.>

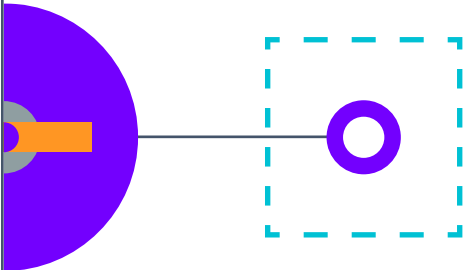
Scope Definition: System boundaries Example

- System boundary in building and construction (according to EN 15978)



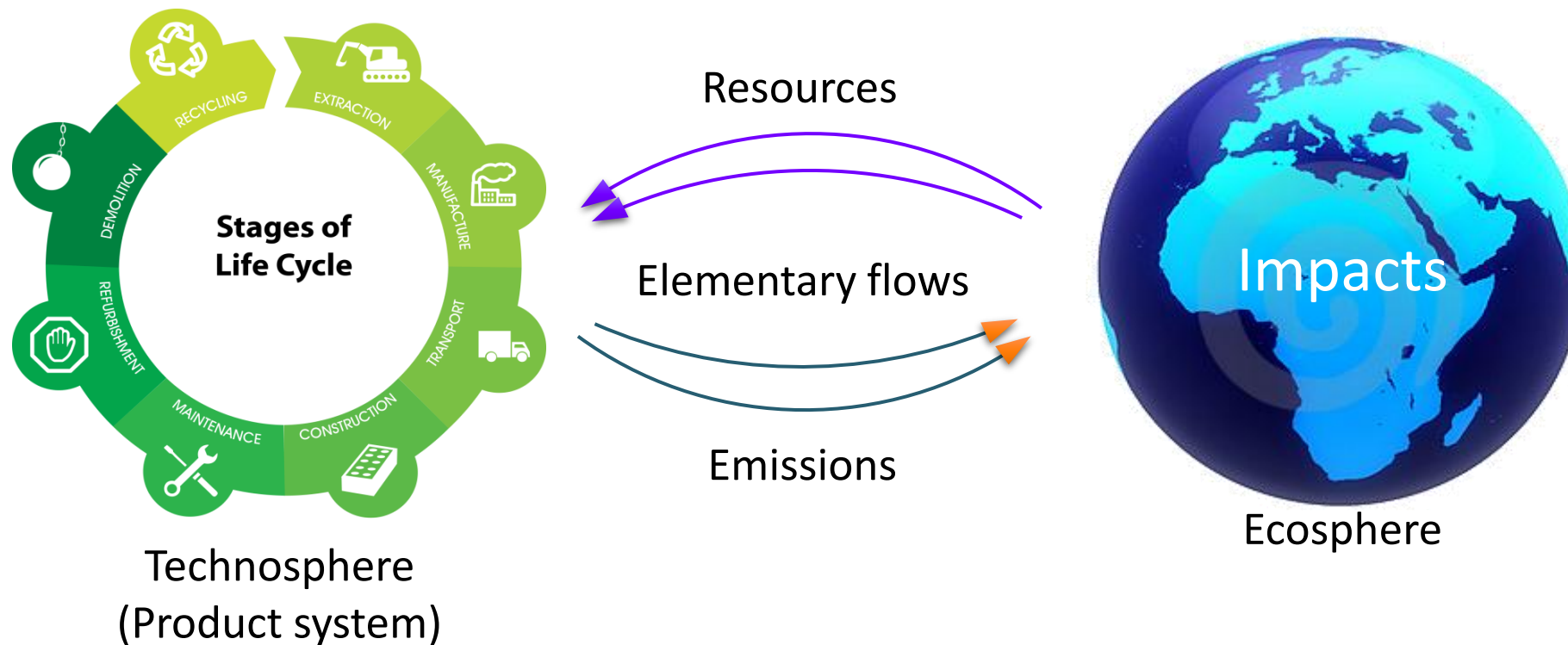
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Step Two: Life Cycle Inventory Analysis

- The purpose of LCI is to calculate emissions from the product systems.
- This is done by modelling the product system in programs and linking the processes to databases that contains information about emission.



- Which input and output materials can be identified?
- Which material and energy value streams flow within the observed system?

Step Two: Life Cycle Inventory

- The purpose of LCI is to calculate emissions from the product systems.
- This is done by modelling the product system in programs and linking the processes to databases that contains information about emission.

Activities of the Life Cycle Inventory include:

1. Definition of the system boundary (according to the system boundaries decided on in the goal and scope definition)
2. Data collection for all the activities in the product system followed by documentation of collected data.

Step Two: Life Cycle Inventory Analysis – Example

Task: How to sketch a system boundary for brewing a cup of coffee?

Hint:

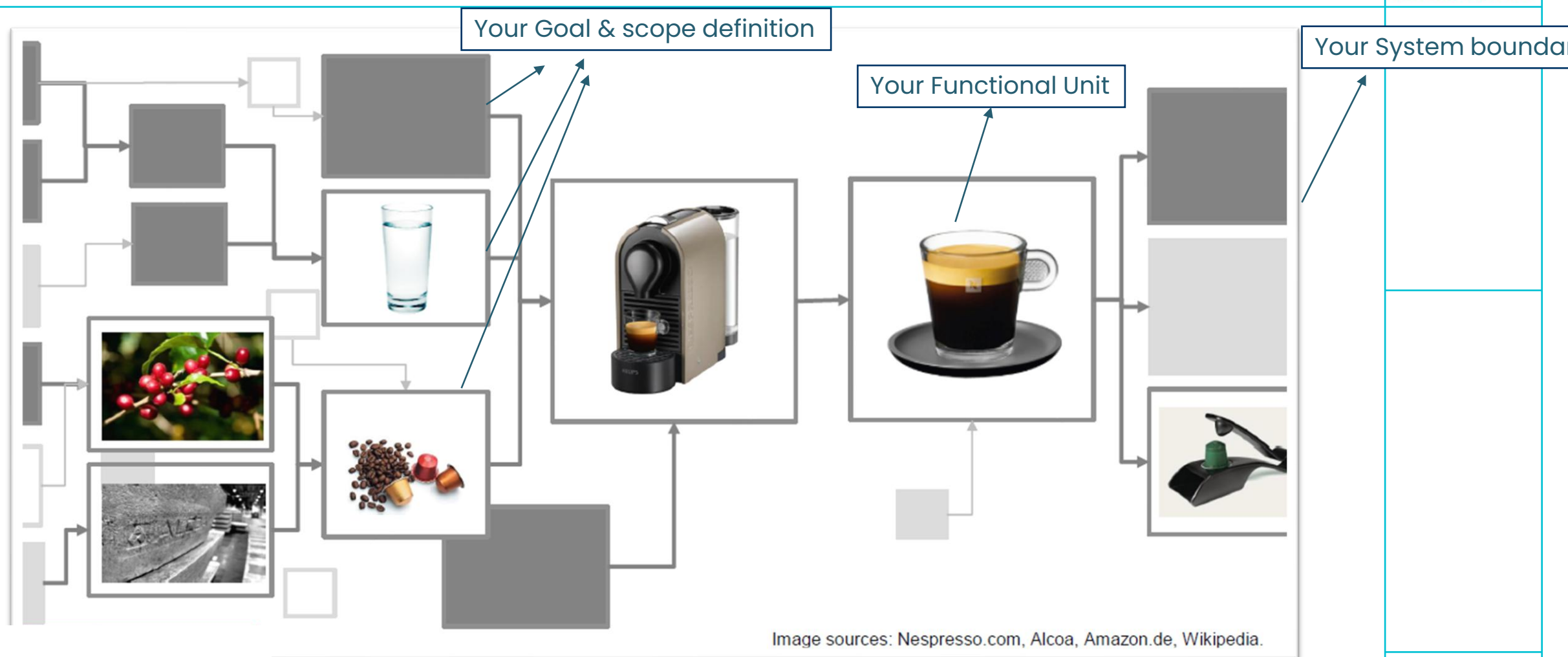
- Think in LCT mode!
- Define the input and output processes involved!
- Define the reference flow!

Reference flow is a quantified amount of product(s), including product parts, necessary for a specific product system to deliver. Usually described by the functional unit.



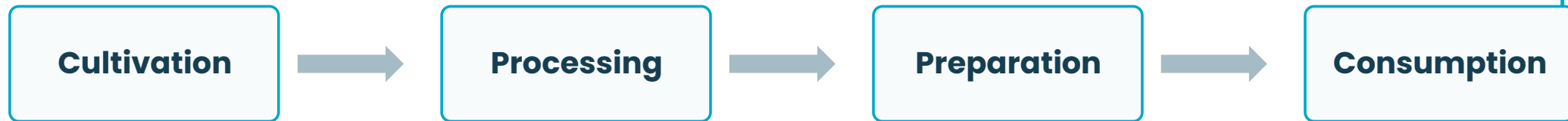
Image ref: AI-generated by the author using ChatGPT (OpenAI)

Step 1 in one picture!

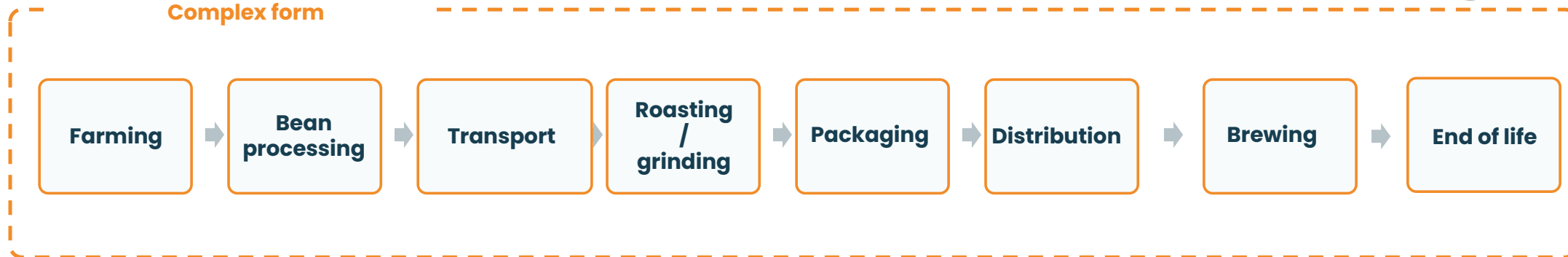


System Boundaries- Example

Simplified form

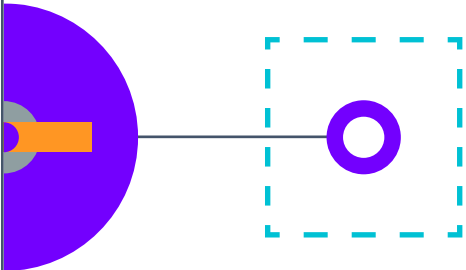


Complex form

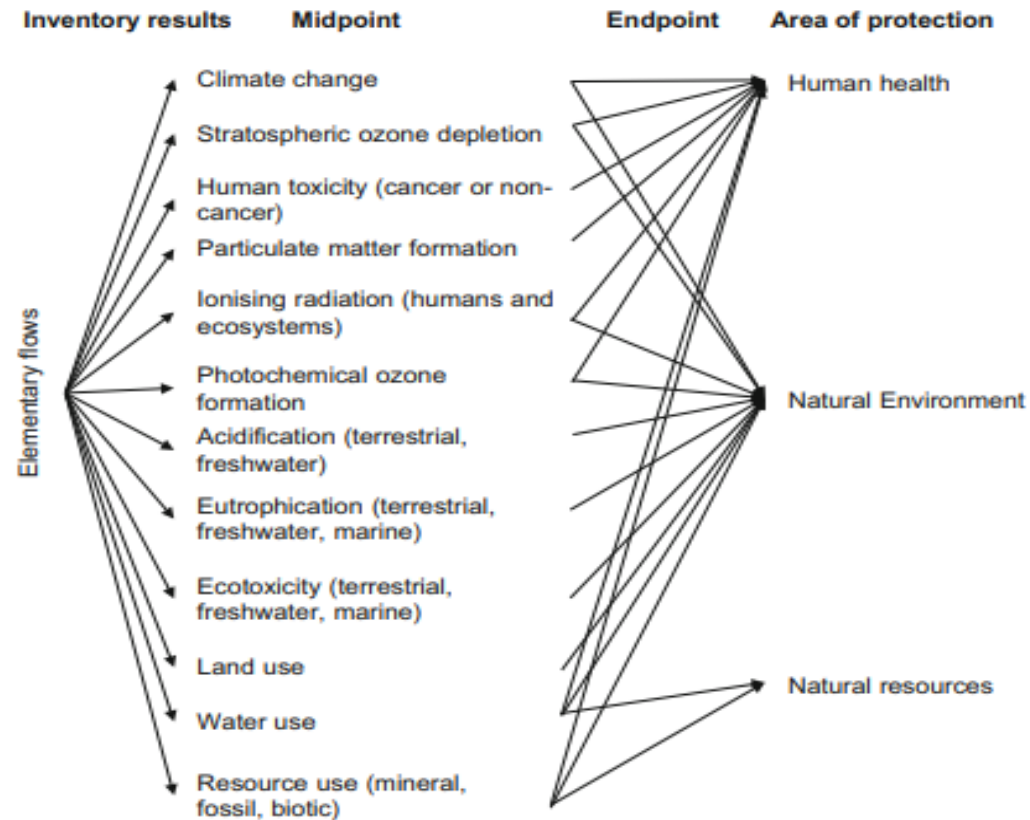


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Midpoint and Endpoint Indicators



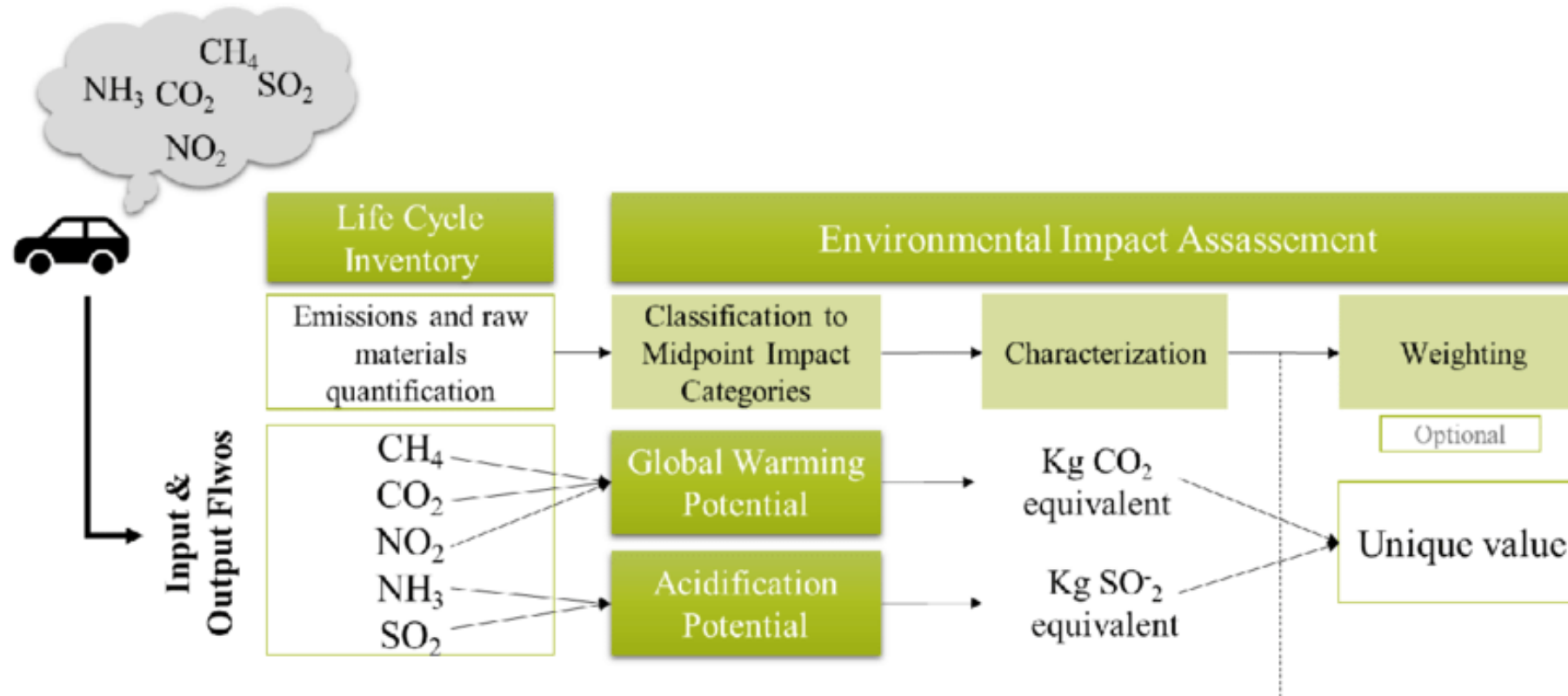
Impact Indicator: Different emissions that cause the same impacts are converted into one unit that translates into one impact category.

A **midpoint** method looks at the impact earlier along the cause-effect chain before the endpoint is reached, e.g., increased concentration of the chemical in the lake water.

While midpoint methods measure an effect before the damage to one of the areas of protection occurred, **endpoint** methods follow the consequences of certain emission until it causes damage.

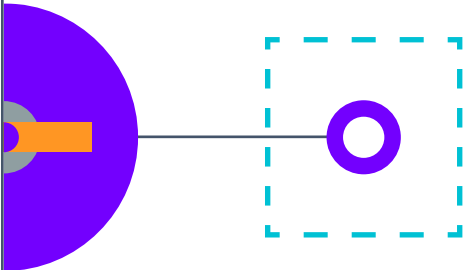
Step Three: Life Cycle Impact Assessment (LCIA)

Classification, Characterization, and Weighting



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Step Four: Interpretation

- Identifying significant issues based on the LCI and LCIA phase
- Evaluating the study itself, how complete it is, if it's done sensitively and consistently
- Conclusions, limitations, and recommendations
- How high are the emissions of the product or service?
- How does it compare to other products in our portfolio?
- What are the biggest leverages to reduce the impact of our product?
- Can we be more efficient in manufacturing it?

Thanks for your
attention



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