

Life cycle assessment

Goal and scope definition

– Part 2

Last lecture:

Goal & scope definition

Purpose

Intended application

Intended audience

Functional unit

Single system/Comparative LCA

(Accounting/Change-oriented LCA)

Today:

Accounting/Change-oriented LCA

Functional unit

System boundaries

Attributional vs. Consequential LCA

Attributional (accounting, book keeping)

Describes system as it can be observed (historical, current, or future)

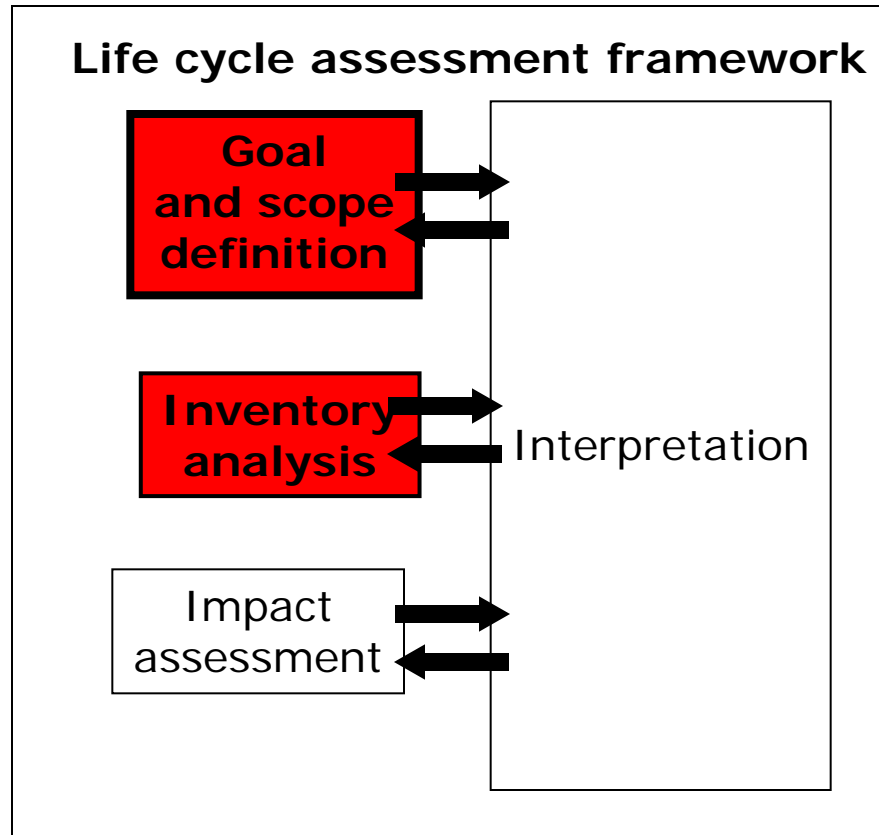
- **Type of question:** Determine potential environmental impacts of a product/service.
- **Scope:** Data and system boundaries describe the system *as it is* (or *was*, or *will be*).
- **Data:** Average data (representing average environmental burden from total production volume).

Consequential (Change-oriented)

Describes consequences of a change

- **Type of question:** Determine *consequences* of choosing alternative A instead of alternative B.
- **Scope:** Data and system boundaries describe the changes
- **Data:** Marginal data (representing environmental burdens when production volumes change).

LCA framework

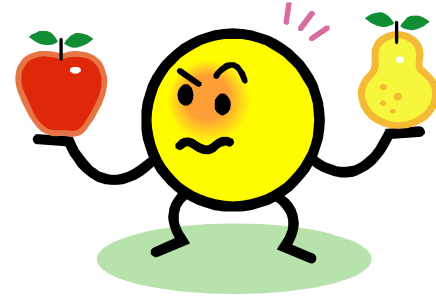


Source: ISO 14040:2006

Scope definition

- Precise definition of product or service
- Functional unit
- Initial flow chart
- System boundaries
- Impacts and impact assessment model
- Data requirements
- Assumptions, limitations, allocation methods
- Peer review procedure

Functional unit (ILCD)



The functional unit shall be specified across the following:

- Function provided (what)
- In which quantity (how much)
- For what duration (how long)
- To what quality (in what way and how well is the function provided)

(ILCD handbook, European Commission)

Glass bottle

What product?

33 cl glass bottle for
Loka water

Functional unit?

Standard
clear

Comparative:
Container for 100
litres of drink

Unquantified aspects?

- Aesthetics
- "Hip" factor
- Lasting quality of drink

House

What product?

Apartment building in
Stockholm

Functional unit?

Comparative:
Apartment building,
no of apts and size,
life time

Unquantified aspects?

- aesthetics
- indoor climate
- daylight
- noise...

Fuel

What product?

Ethanol from Brazilian
sugar cane

Functional unit?

Comparative: Fuel to
drive a compact car
100 km

Unquantified aspects?

- Employment in fuel
producing country
- Driving distance
with full tank.

For comparative LCA, you must describe and quantify the function!!!

Work in project groups

Explain briefly goal the of your project.

Define your functional unit (FU). If you plan a comparative LCA, make sure that the FU allows a fair comparison.

- *Function provided (**what?**)*
- *In which quantity (**how much?**)*
- *For what duration (**how long?**)*
- *To what quality (**how well?**)*

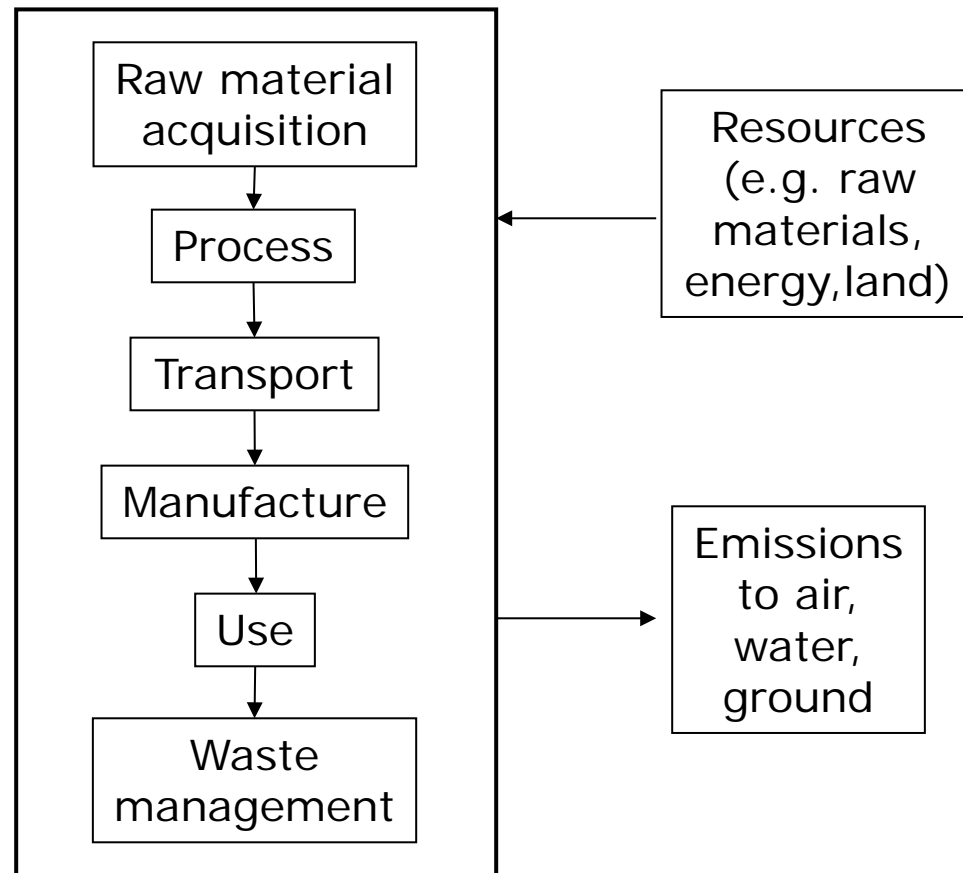
Are there any important aspects that cannot be quantified?

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Initial flow chart (ISO)

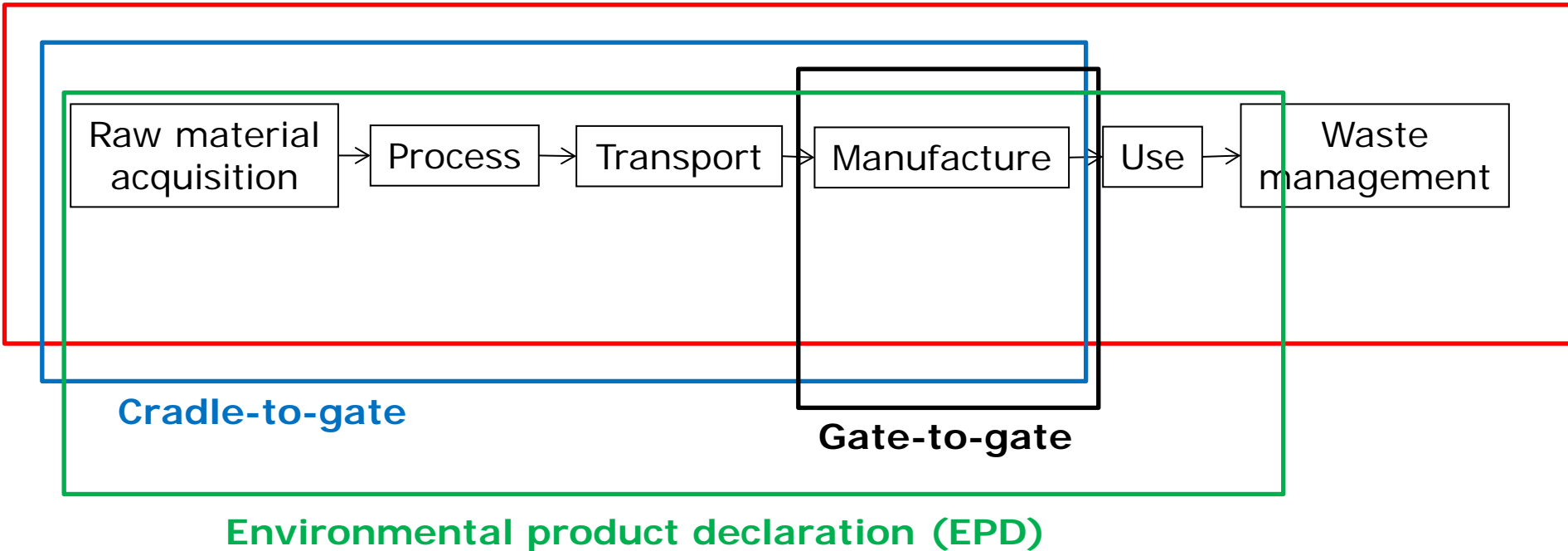
System boundary diagram (ILCD)



Boundary between
technosphere/environment

System boundaries (of initial flow chart)

Cradle-to-grave



Reference flow in SimaPro

Reference flow (LCA terminology)

The amount of product required to fulfill the functional unit

Reference flow in SimaPro

The output of a *process data set* or *assembly*. Covers *cradle to gate*.

Reference flow of processes data sets (material, energy, transport etc) are measured in their standard units:

- Ex: "Packaging glass" [1 kg]
- Ex: "Electricity" [1 kWh]
- Ex: "Transport" [1 tkm]

Reference flow of assemblies are measured as number of items (pieces)

- Ex: "Bottle with cap" (1 p)

Reference flows of process data sets are scaled in order to match the functional unit.

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System boundaries

- Technical/natural system
- Significant/insignificant processes
- Geographical/Spatial
- Temporal

System boundaries - ***Technical system/environment***

- **Inflows:** resources as found in nature
 - Extracted from ground, air, water, biotic
 - Examples: Crude oil, iron ore, water, biomass, land
- **Outflows:** emissions to nature
 - Emissions to air, water and soil
 - Landfilling problematic

System boundaries in SimaPro - ***Technical system/environment***

Inputs

- from technosphere (links to other processes in data base)
- from nature (compartments: air, water etc.)

Outflows

- to nature (compartments: air, water, soil)
- to technosphere (waste to treatment)

Ecoinvent data comes in:

- "**U**" = Unit process (full network of unit processes)
- "**S**" = System process (total of unit processes)

System boundaries - ***Significant/insignificant processes***

Possible cut-off criteria:

- **Mass** (may lead to omission of important flows)
- **Monetary value** (may lead to omission of important flows)
- **Environmental significance** (difficult to use)

System boundaries in SimaPro

Significant/insignificant processes

Ex: Petrol, low sulphur

- Included: Trp of product, operation of storage tanks, emissions from evaporation
- Excluded: Car-washing at petrol station

System boundaries - ***Significant/insignificant processes***

Instead of cut-off

1. Use surrogate (similar) data to build rough screening LCA model
2. Check significance of uncertain data (eg. try +/- 10%)
(Significant = affects final results and conclusions)
3. If significant, improve data quality (if possible!) by collecting more data

System boundaries - ***Spatial boundaries***

- Describe geographical location of modelled system. Affects eg. choice of electricity mix.
- Set geographical data requirements (where should data sets come from?)
- Less common: site-dependent modelling of impacts.
- In SimaPro: Should be documented in meta data ("Documentation").

System boundaries - ***Temporal boundaries***

- Define time period (past/current/future assessment?)
- Set temporal data requirements (eg. not older than 10 years)
- Include long-term emissions (eg. from landfills)?
- Include long-term impacts (eg. time perspective on global warming, emissions from landfills)?
- In SimaPro: Should be documented in meta data ("Documentation").

Work in project groups

- Draw initial flow chart of your case study
- Identify system boundaries
 - Technical system/environment
 - Significant/insignificant
 - Geographical
 - Time

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Data quality

Quality is a relative concept (= appropriate data for the intended purpose)!

- Temporal (relevant time-period)
- Geographical (relevant geographical origin)
- Technological (relevant technology level)
- Completeness (enough relevant sites included)
- Accuracy/reliability of measurements

Data quality in SimaPro

- In "Documentation" of process and material data sets (often lacking)
 - Time period
 - Geography
 - Technology
 - Representativeness
- Data Quality Indicators (DQI) indicate data quality of LCA projects. **NOT available in Classroom version.**
- Importance of data quality can be assessed in LCA by
 - sensitivity analysis (do in your projects!!!)
 - uncertainty importance analysis
 - Monte Carlo analysis

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- Assumptions, limitations, allocation methods (lecture 4)
- Peer review procedure

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- Data requirements
- Assumptions, limitations, allocation methods
- Critical review procedure

Critical review

- Credibility of LCA affected by lack of data & more or less subjective methodological choices
→ Criticised for being a "hired gun"
- Therefore, critical review is required for
 - Comparative assertions disclosed to the public (ISO, ILCD)
 - Environmental Product Declarations (ILCD)
 - LCI data sets (ILCD)
 - Environmental management schemes (ILCD)
- Either review of final report, or integrated in project process