THE UNIVERSITY OF BRITISH COLUMBIA

ENGR 544, Life Cycle Assessment and Management

School of Engineering, Faculty of Applied Science

The University of British Columbia (Okanagan)

Chapter 7, Goal Definition

Learning Objectives

- Define the goal of any LCA study.
  - **Intended applications** of the results,
  - Limitations due to methodological choices,
  - **Decision context** and reasons for carrying out the study,
  - Target audience,
  - Comparative studies to be disclosed to the public,
  - Commissioner of the study and other influential actors.

- Explain the six goal aspects and their relevance for the subsequent LCA phases.

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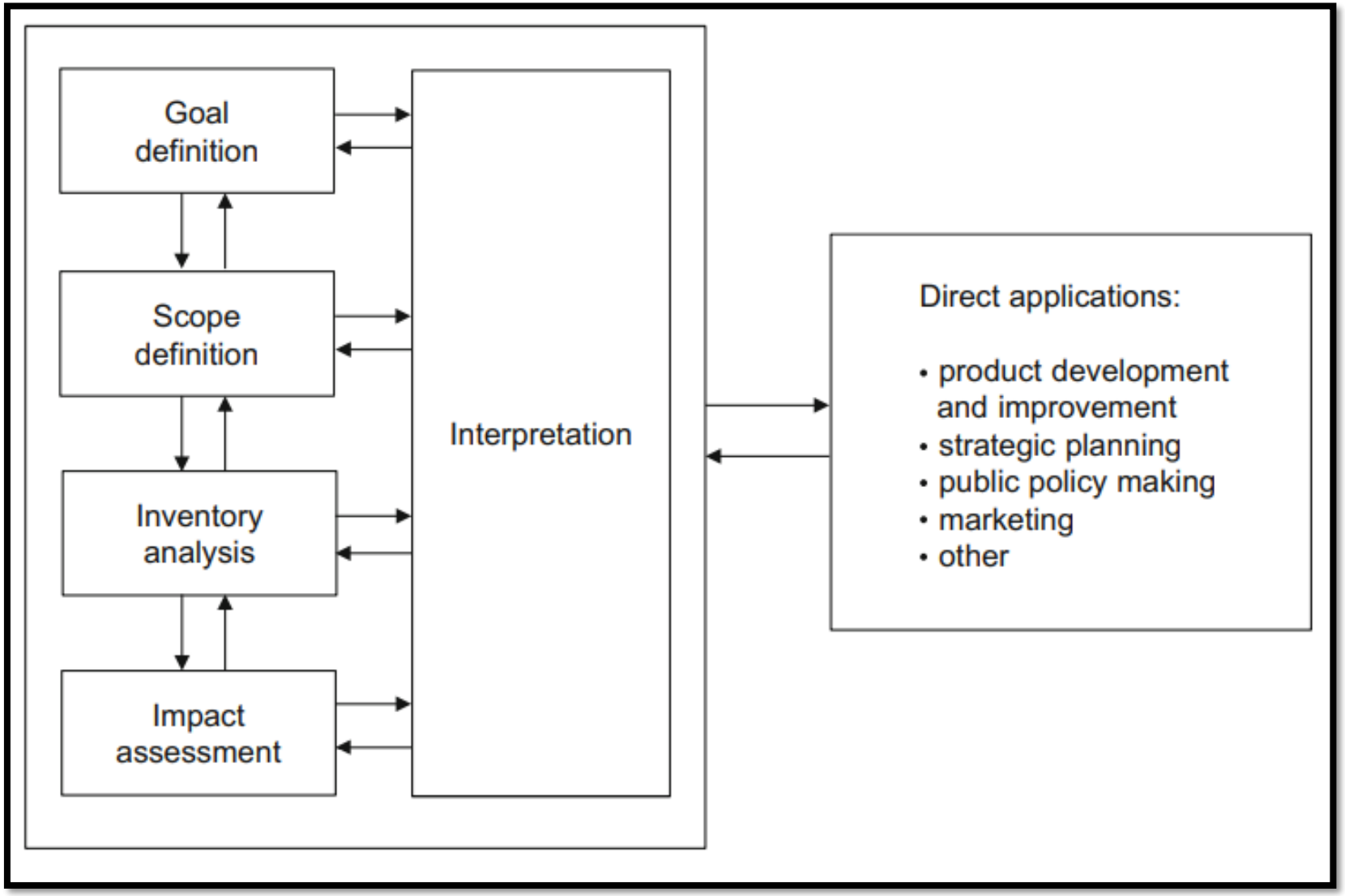
Framework of LCA modified from the ISO 14040 standard



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Intended Applications of the Results

It is important to determine the **intended application**(s) of the **LCA results**, since it influences later phases of an LCA (e.g., drawing of system boundaries and sourcing of inventory data).

- **Comparing** environmental impacts of **specific goods** or **services**.
- **Identifying** the parts of a product system that **contribute** most to its environmental impact (i.e. "hot spot identification", focusing in product development).
- **Evaluating** improvement potentials from changes in product designs (analysis and 'what-if' scenarios in eco-design).
- **Documenting** the environmental performance of products (e.g. in marketing using **environmental product declarations** or other types of product environmental footprints).
- Developing criteria for an **eco-label**.
- **Developing policies** that consider environmental aspects.

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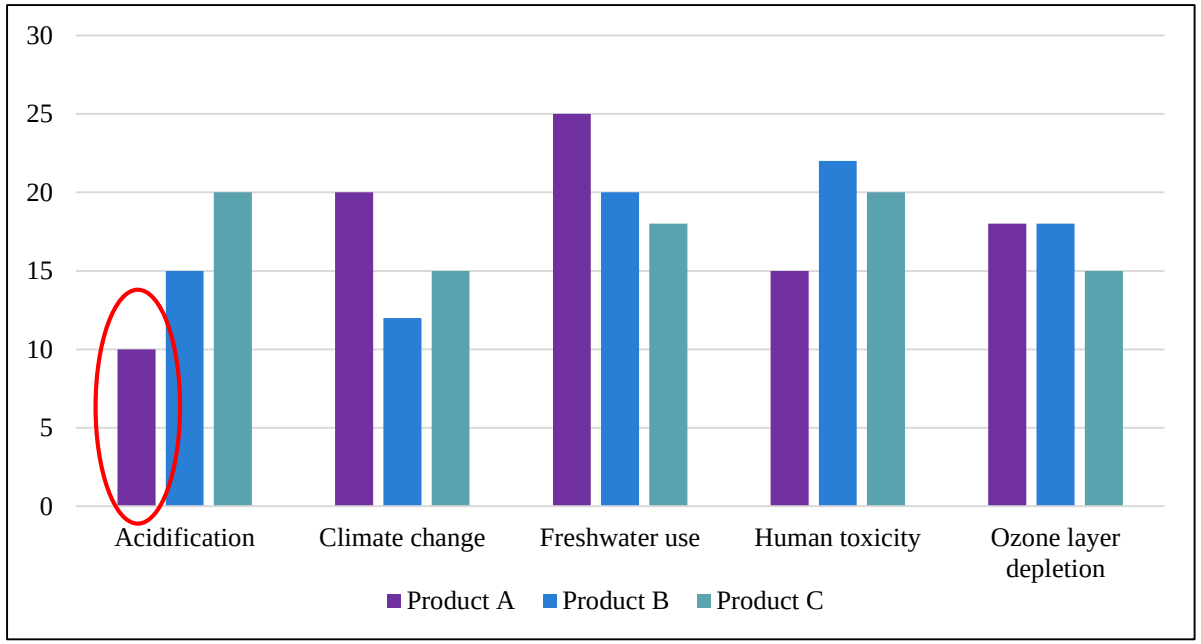
Limitations Due to Methodological Choices

It is important to know what the LCA results can and cannot be used for.

- If a study only covers **climate change** (often referred to as a "carbon footprint" study), it is important to know that results **cannot be used** to claim a general environmental superiority of a studied product system or conclude anything about its overall "environmental friendliness".



Relative results for the selected impact assessment categories

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Limitations Due to Methodological Choices

- If a comparative study disregards one or more life cycle stages, it is important to stress how that limits the interpretation of results.

For example,

- A study comparing the production of **1 tonne aluminum** to the production of **1 tonne steel** **cannot be used** to identify the **environmentally reasonable material** for use in a car.

- The **density difference** of the two metals leads to differences in the amount of metal used for the **car body** and differences in the car mileage (**fuel consumption per kilometre**), causing different **environmental impacts** in the **use stage** and finally also in the **disposal stage**.

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Decision Context and Reasons for Carrying Out the Study

- The **reasons** for **carrying out** a study must be **understood**.
- The reasons should be clearly connected to the intended application of results.

Intended application

Comparative study of the overall environmental impacts associated with recycling (Option I) or incineration (Option II) of all used office paper in Australia

Reasons for carrying out the study

Support decision on governmental recommendations for environmentally handling of **paper waste** from commercial and governmental offices in Australia

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Three Different Decision Context Situations

1. Situation A (micro-level decision support):

- It will **not** **cause structural changes** in the systems.
- It intends to **compare individual product systems** (e.g., based on their environmental performance).
- In this situation, the decision support of the LCA study may lead to limited changes in other systems, e.g. **a reduced demand for electricity**, but the changes are not of a structural nature, e.g. no electricity production equipment will be prematurely taken out of use.

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Three Different Decision Context Situations

2. Situation B (macro-level decision support):

- In this situation, the decisions **may lead to structural changes** in one or more processes of the systems that the studied product system interacts with.
- For example, **decision support** for **policy development** on potential nationwide substitution of **diesel derived** from **oil** with **biodiesel** for private cars.
- Such a decision will lead to **structural changes** in the **biodiesel industry** in the form of new equipment being installed to respond to the substantially increased demand for biofuels.

Source: Image by Mitra Sahara.

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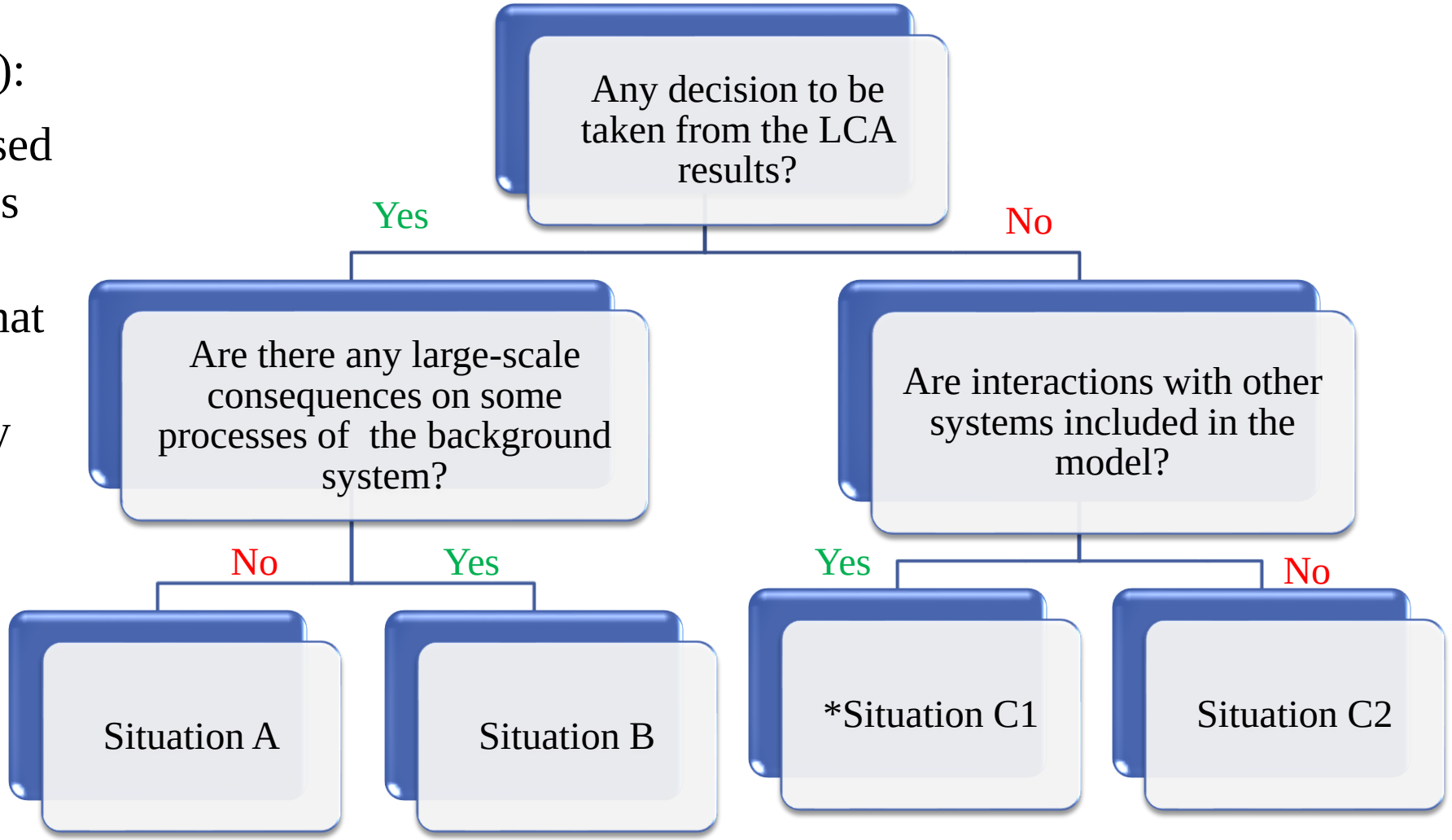
Three Different Decision Context Situations

3. Situation C (Accounting):

- The study is not to be used to support decisions. It is **documenting** what has already happened, or what will happen due to a decision that has already been taken.



*Energy generated from waste incineration.
C1 is used unless C2 is specifically prescribed by the commissioner's goal of the study.

Advantages and Disadvantages of Waste Incineration | WELS (Waterpedia Environmental Learning Series) - YouTube

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Target Audience

- The **goal definition** must state the **target audience** of the study.
- **Who** may **use** and **benefit** from the results of the study?

- The target audience may be **consumers**, **organisations**, **companies** (managers, product developers, etc.), **government**, **NGOs** and others.
- The **target audience** greatly influences the extent to which details of the study should be documented, the **technical level of reporting** and the **interpretation of results**.
- For example, if the audience is **unfamiliar with LCA**, the content of the report should present pedagogically by **explaining technical terms** to make it more clear for the unfamiliar audience.

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Commissioner of the Study and Other Influential Actors

- The goal definition should also explicitly state who **commissioned the study**, who **financed it** and other organisations that have influence on the LCA study.
- This step of the goal definition is meant to highlight potential conflicts of interest to readers of the study.
- Conflict of interest may occur if a key provider of data has an economic interest in particular LCA results and interpretations.
- In **comparative studies**, it may also lead to **an unintentional bias** of **the data collection**.

For example,

- The commissioner of the study will normally provide **data** that is **up to date** and reflects the **current performance** of the **technology** for the commissioner's own product.
- In contrast, the **data collection** for the **other product**(s) in the comparison will be typically based on literature and databases published several years ago.

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Life Cycle Assessment using Idemat

Idemat

Integrated Scenarios

- Idemat features two **impact indicators** to **express environmental burden**:

1. **Eco-costs** are the types of costs imposed to our society, which are not included in the product price.

E.g., **prevention costs** of **human toxicity**, **eco-toxicity**, **resource depletion** (metals, oil, water).

- Advantages: It performs well in circular economy calculations since resource depletion is considered.

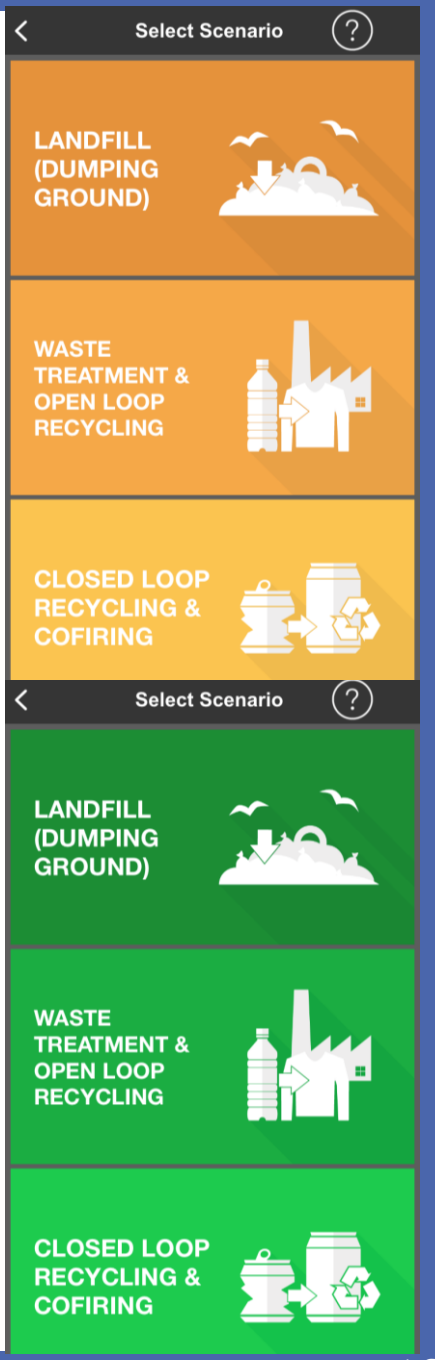
2. **Carbon footprint** is a measure of the impact of our activities on the environment in terms of the **amount of greenhouse gases** we produce (i.e., the amount of kg CO_2 equivalent emissions).

- Advantages: easy to understand.

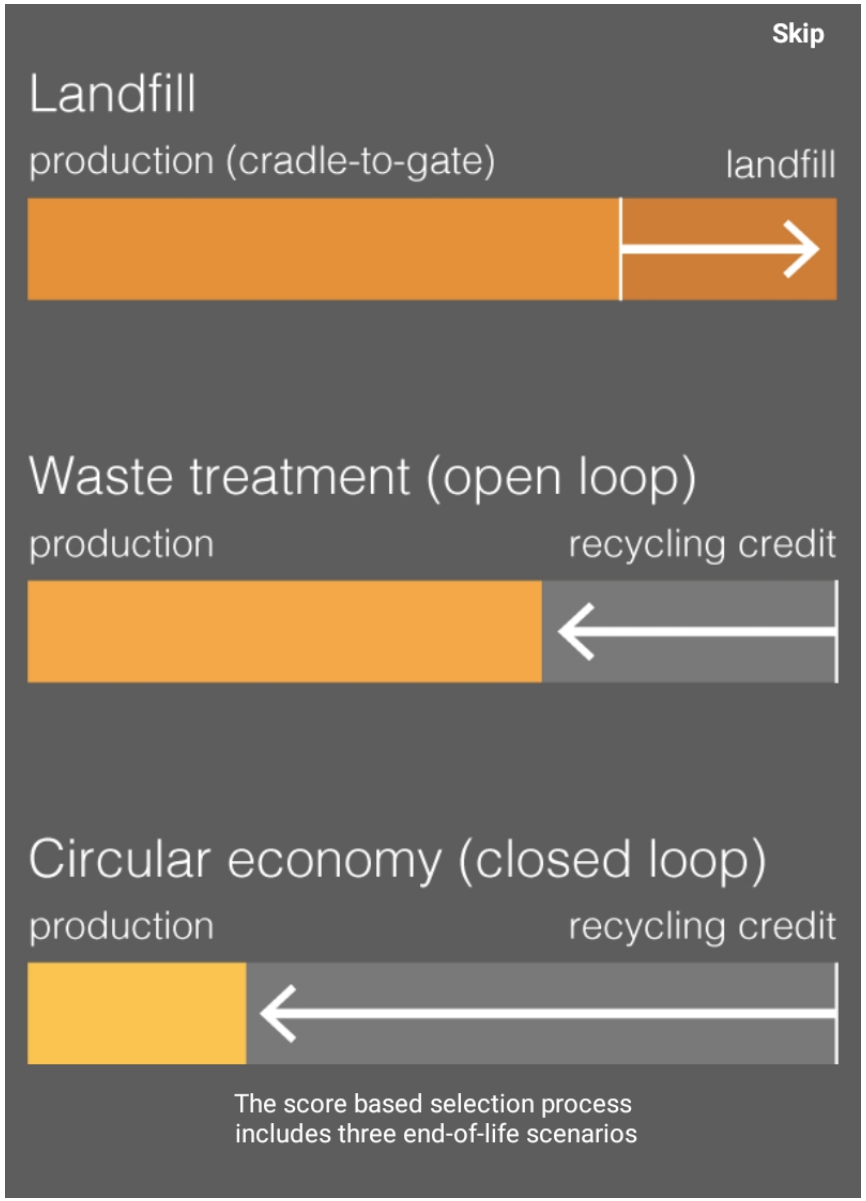
Integrated Scenarios

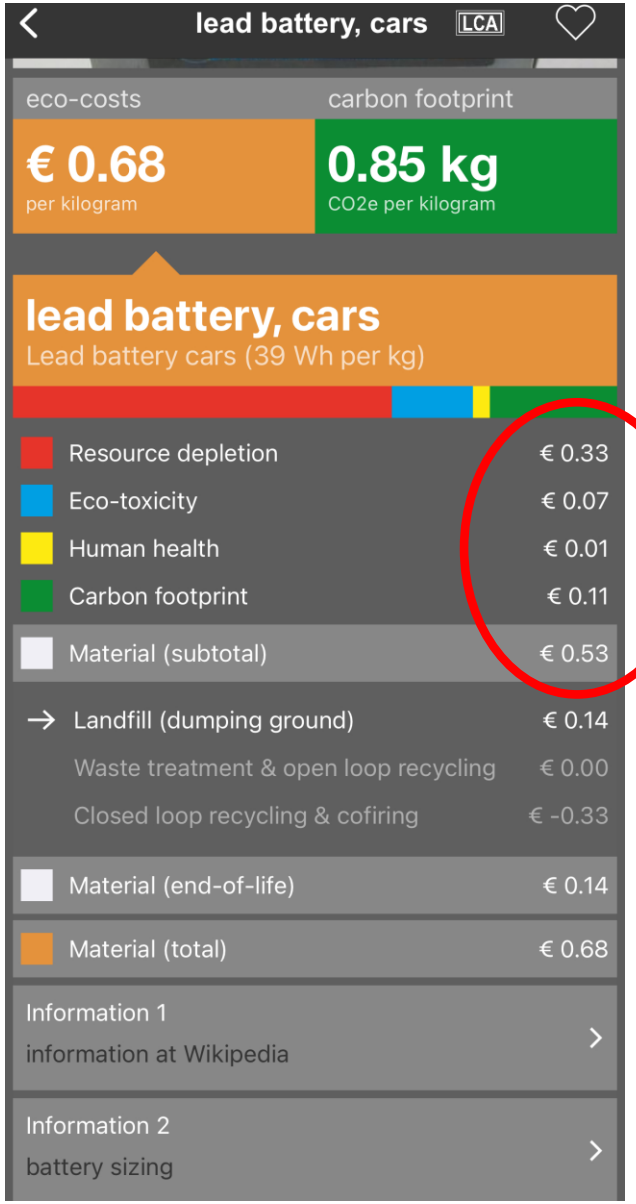
- **Landfill** (Dumping Ground): material waste ends up in a refuse dump.
- **Waste treatment & open-loop recycling**: the material is processed in a modern municipal waste treatment system. The waste is separated with **recycling of metals** and incineration with heat recovery of plastics, textile, and wood products.
- **Closed-loop recycling**: used products are taken back by the manufacturer, and the **materials are reused**.

Closed Loop Recycling Explained in 2 Minutes - YouTube

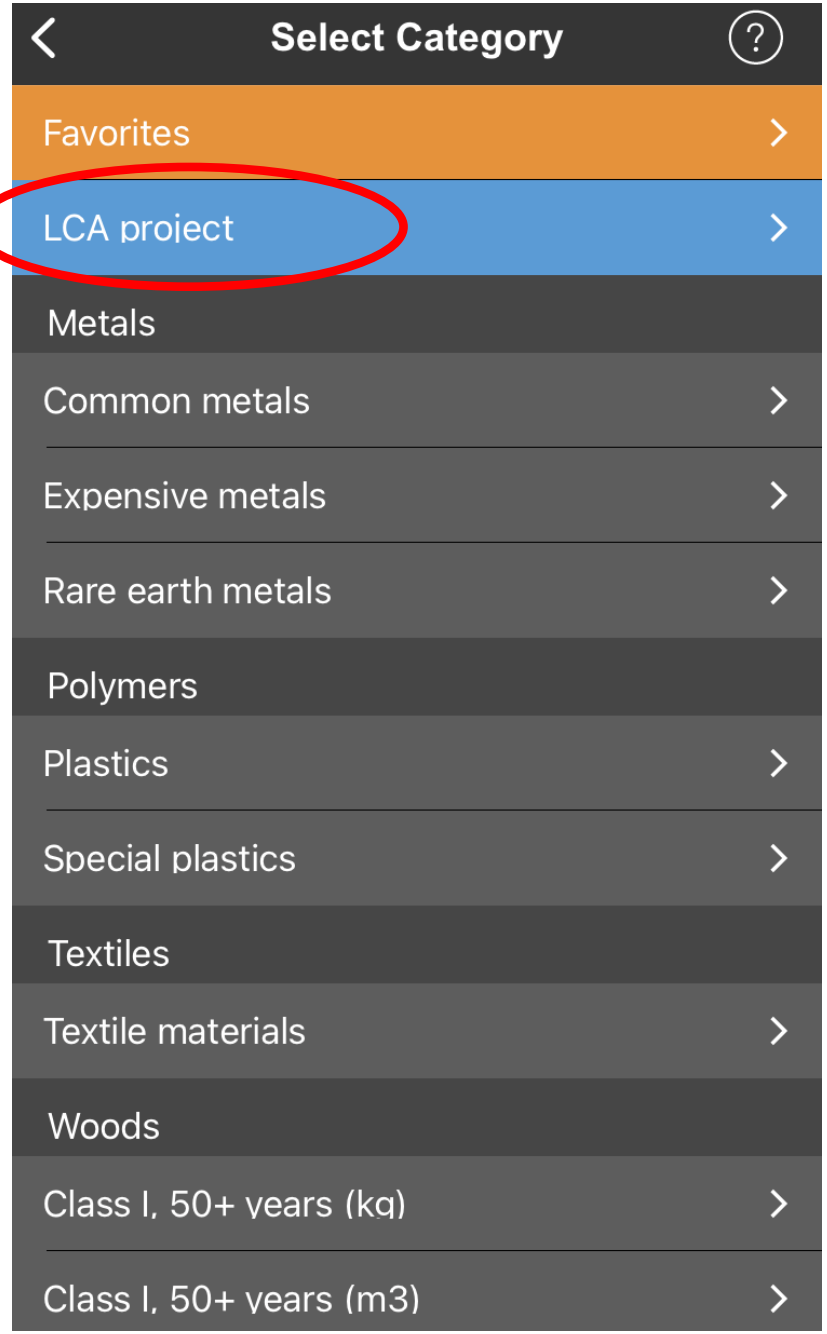


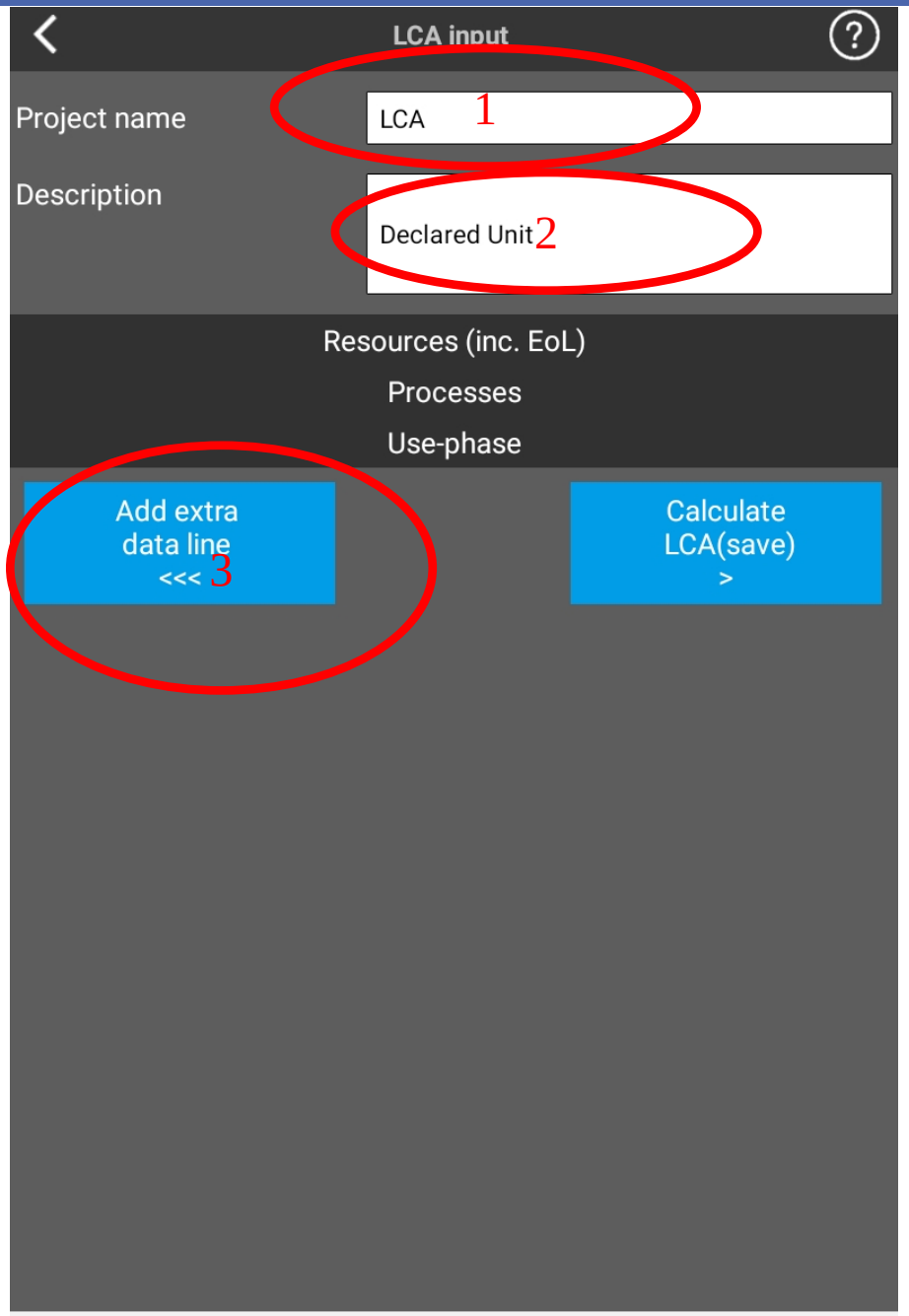
Environmental Burden of Material





PET Bottle


Select Category
Favorites
LCA project
Metals
Common metals
Expensive metals
Rare earth metals
Polymers
Plastics
Special plastics
Textiles
Textile materials
Woods
Class I, 50+ years (kg)
Class I, 50+ years (m3)


LCA input
Project name
LCA
1
Description
Declared Unit
2
Resources (inc. EoL)
Processes
Use-phase
Add extra data line <<<
3
Calculate LCA(save) >

Select Category

Favorites

Metals

Common metals

Expensive metals

Rare earth metals

Polymers

Plastics 4

Special plastics

Textiles

Textile materials

Woods

Class I, 50+ years (kg)

Class I, 50+ years (m3)

Class II, 40-50 years (kg)

Plastics

POM
thermoplast (kg)

PET, 30% GF
thermoplast (kg)

PP, 30% GF
thermoplast (kg)

PTT (Sorona)
thermoplast (kg)

PET, amorph
thermoplast (kg)

PET, bottle grade 5
thermoplast (kg)

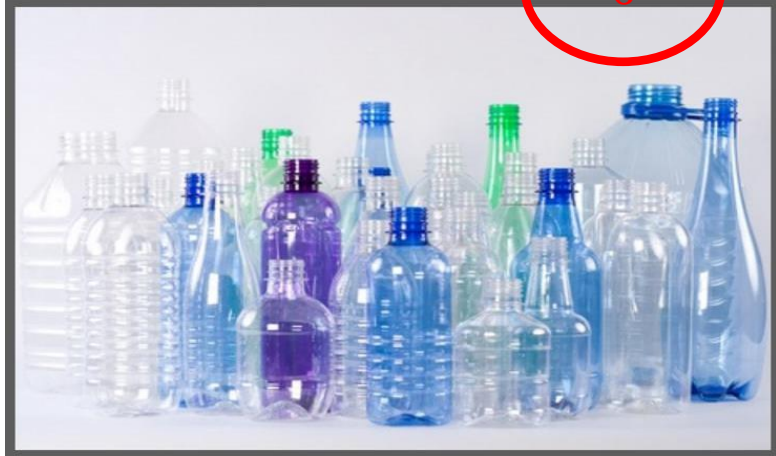
PC, 30% GF
thermoplast (kg)

EVA
rubber (kg)

Phenolics (Bakelite)
thermoset (kg)

Neoprene (CR)

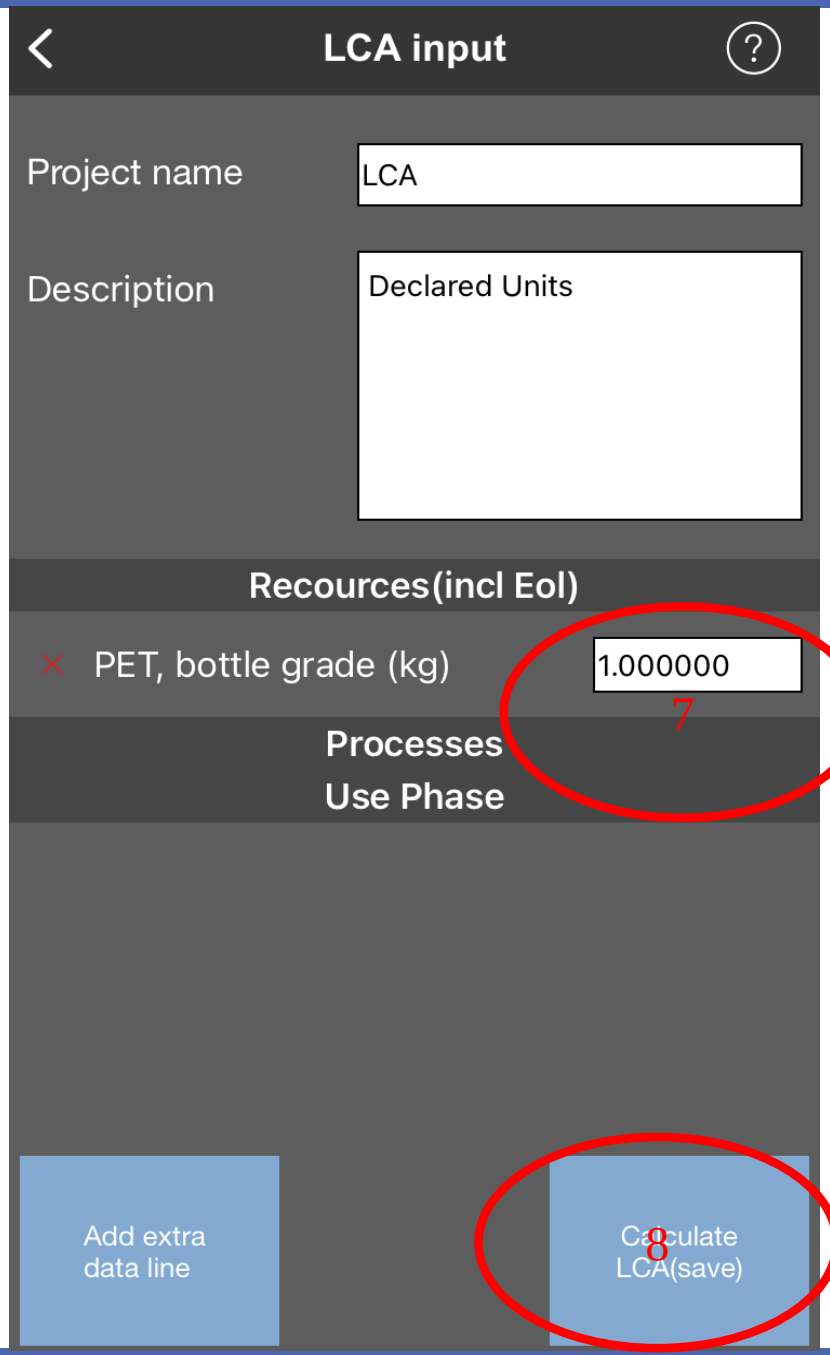
PET, bottle grade LCA 6



eco-costs	carbon footprint
€ 1.13 per kilogram	2.19 kg CO2e per kilogram

PET, bottle grade
PET bottle grade

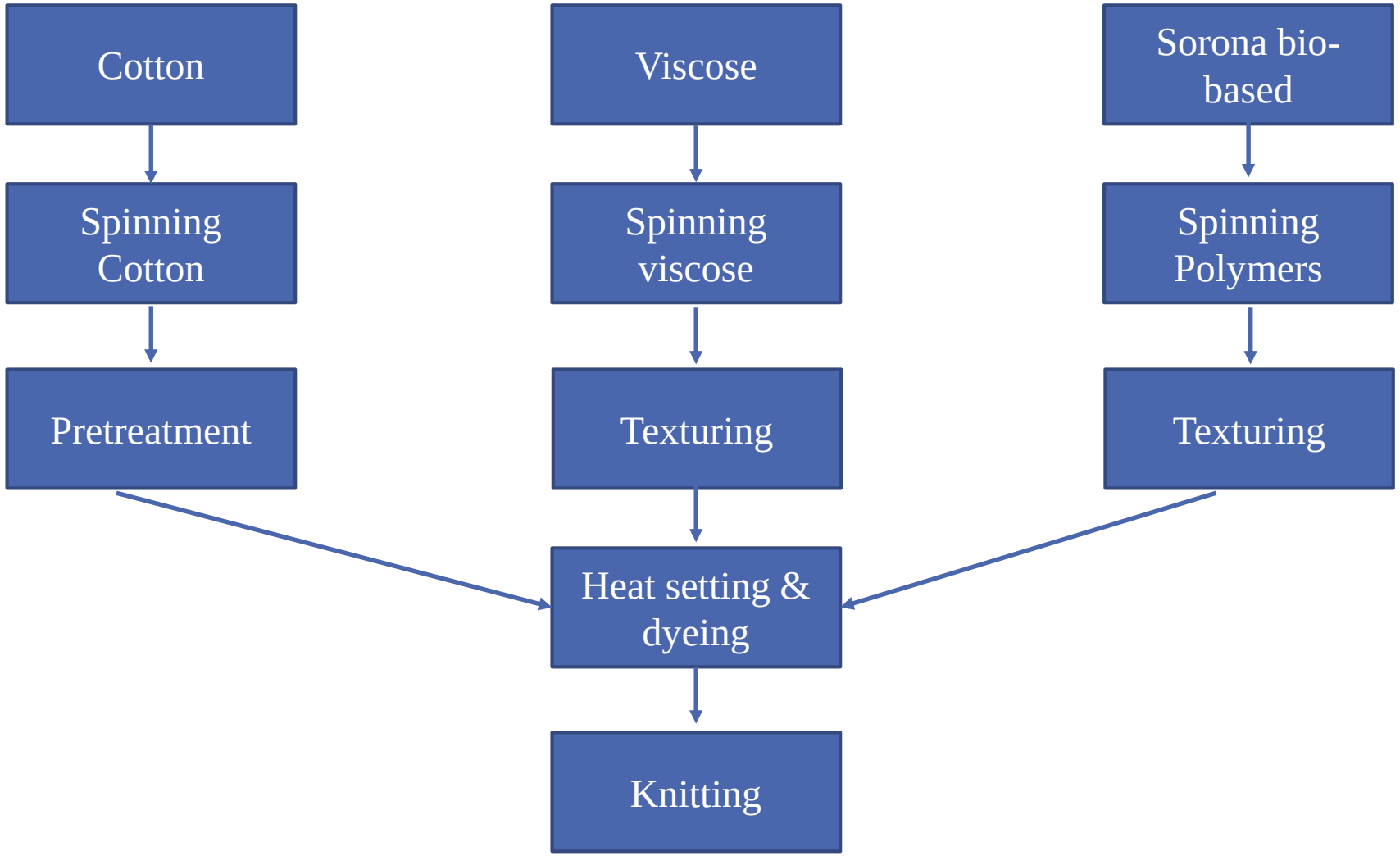
Resource depletion	€ 0.57
Eco-toxicity	€ 0.07
Human health	€ 0.06
Carbon footprint	€ 0.29
Material (subtotal)	€ 0.99
→ Landfill (dumping ground)	€ 0.14
Waste treatment & open loop recycling	€ 0.17


LCA input
Project name
LCA
Description
Declared Units
Recources(incl Eol)
PET, bottle grade (kg)
1.000000
7
Processes
Use Phase
Add extra data line
Calculate LCA(save)
8

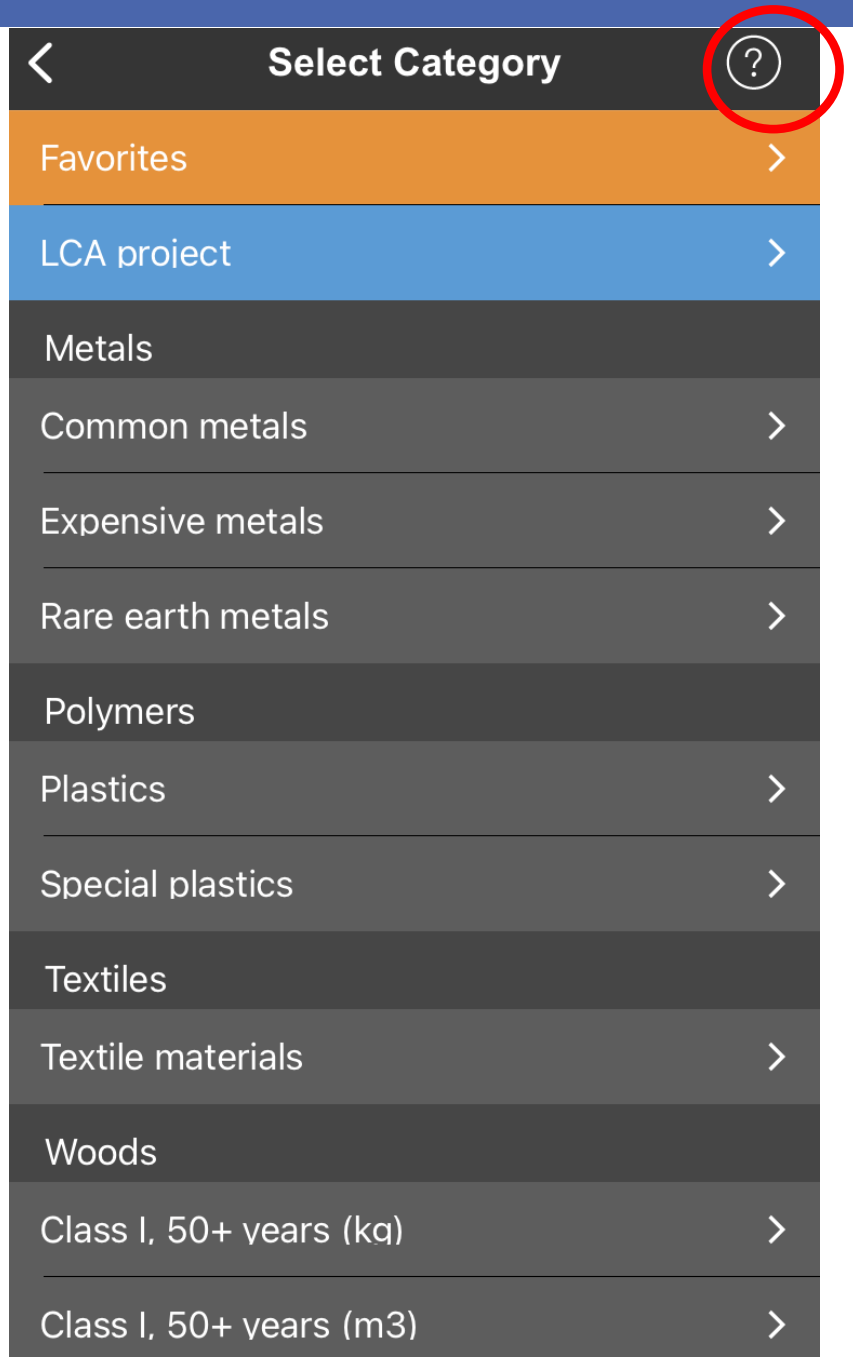

LCA output
eco-costs (euro)
carbon footprint (kg CO2e)
landfill
€ 1.13
waste treatment
€ 1.16
circular economy
€ 0.35
landfill
2.19
waste treatment
3.44
circular economy
1.26
eco-cost for EoL scenarios (euro)
landfill
waste treatment
circular economy
Materials
PET, bottle grade
€ 1.13
€ 1.16
€ 0.35
Processes
Use phase
Total
Total LCA 1
€ 1.13
€ 1.16
€ 0.35
New LCA
Export LCA

Process of Textile Fabric

The Production Process of Fabric



Source from Idemat (idematapp.com)



The following table provides additional clarification regarding the wood categories displayed on the previous screen.

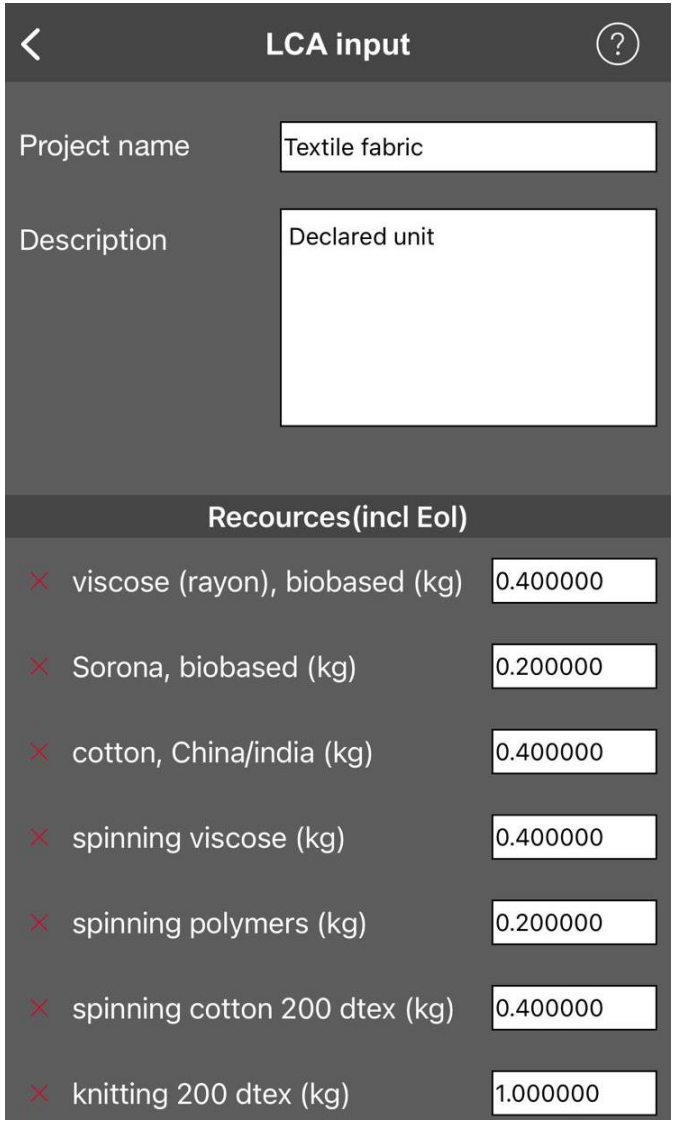
Classification according to NEN-EN 350-2:

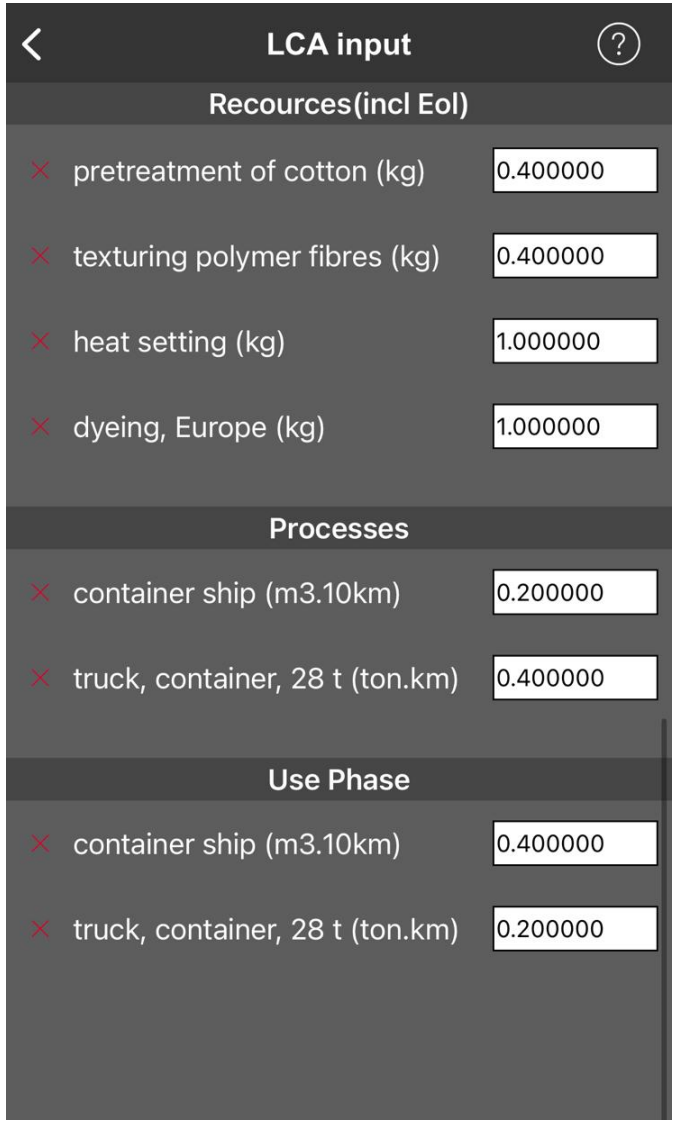
Class I	Very sustainable
Class II	Sustainable
Class III	Moderate sustainable
Class IV	Poor sustainable
Class V	Not sustainable

Lifetime	condition A	condition B
Class I	>25 years	>50 years
Class II	15-25 years	40-50 years
Class III	10-15 years	25-40 years
Class IV	5-10 years	12-25 years
Class V	<5 years	6-12 years

Condition A: Wood in constant contact with humid soil (not underwater and not protected)

Condition B: Wood exposed to outdoor conditions (not protected)


LCA input
Project name
Textile fabric
Description
Declared unit
Recources(incl Eol)
viscose (rayon), biobased (kg) 0.400000
Sorona, biobased (kg) 0.200000
cotton, China/india (kg) 0.400000
spinning viscose (kg) 0.400000
spinning polymers (kg) 0.200000
spinning cotton 200 dtex (kg) 0.400000
knitting 200 dtex (kg) 1.000000


LCA input
Recources(incl Eol)
pretreatment of cotton (kg) 0.400000
texturing polymer fibres (kg) 0.400000
heat setting (kg) 1.000000
dyeing, Europe (kg) 1.000000
Processes
container ship (m3.10km) 0.200000
truck, container, 28 t (ton.km) 0.400000
Use Phase
container ship (m3.10km) 0.400000
truck, container, 28 t (ton.km) 0.200000


Add extra data line <<<
Calculate LCA(save) >

Class Participation 4

- Use the information related to the production process of fabric, and then compare the eco-cost and carbon footprint in terms of:

  - Landfill (dumping ground)
  - Waste treatment and open loop recycling
  - Closed-loop recycling

- Upload your findings to Canvas.