LCA AS A PRACTICAL TOOL FOR ENVIRONMENTAL IMPACT ASSESSMENT

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WHAT IS LIFE CYCLE ASSESSMENT (LCA)?

- **Life Cycle Assessment (LCA)** is a practical tool used to evaluate the environmental impacts of a product, process, or service throughout its entire life cycle.
- It systematically assesses the environmental effects from the extraction of **raw materials (cradle)** to the **disposal or recycling (grave)**, covering all stages in between, such as production, transportation, use, and end-of-life treatment.

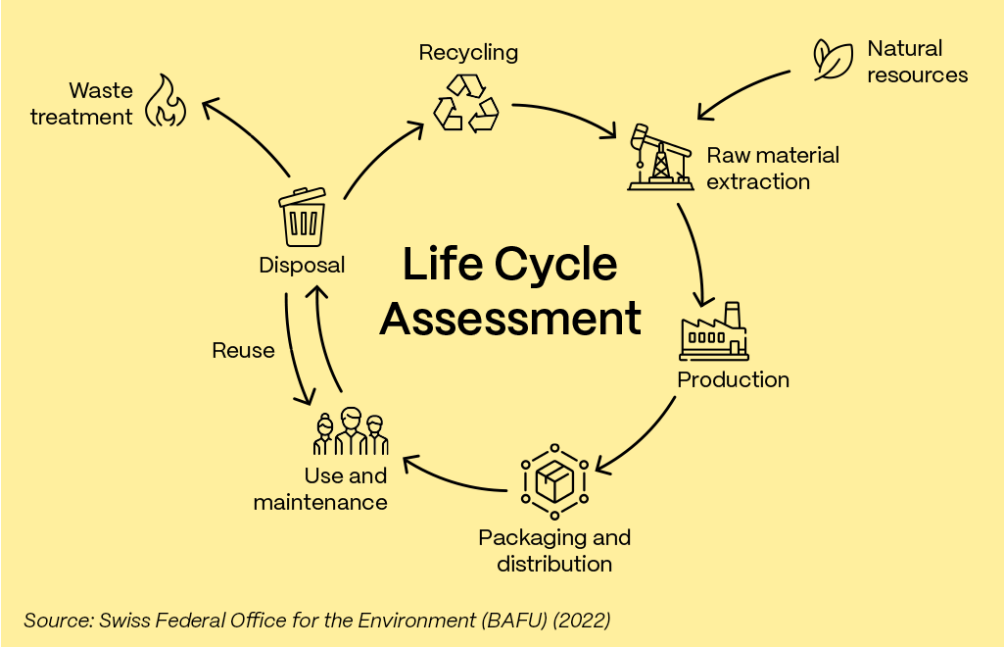
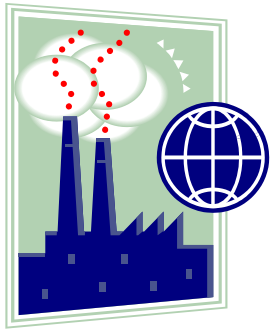


Fig. 1. Stages of life cycle assessment (*Source: Ecoinvent, 2024*)

1. Priorities for the environment



Industry

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Environmental policy

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Control of emissions → End of pipe solutions ?

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- Expressions of risks
- Environmental impact within all phases (raw material extraction, production, use, end of life)

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Not enough anymore!

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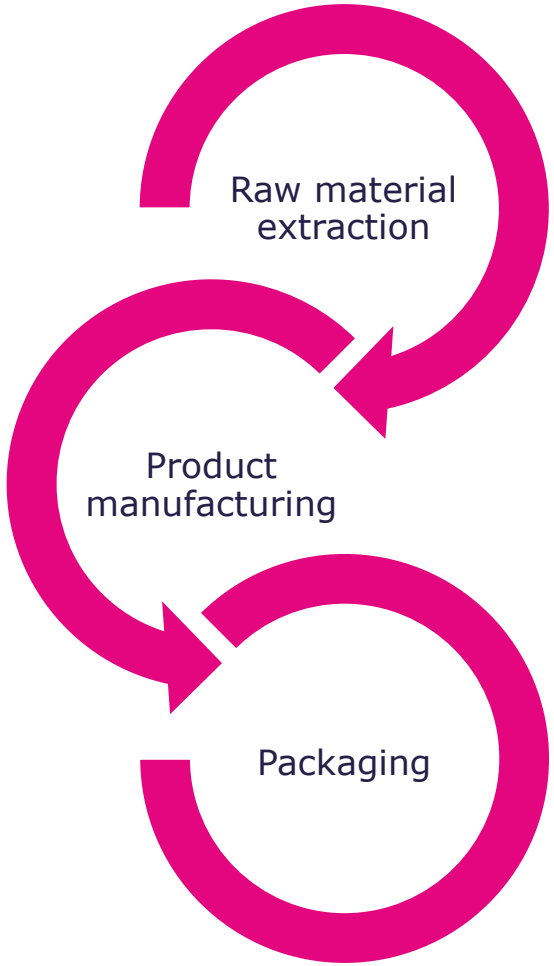
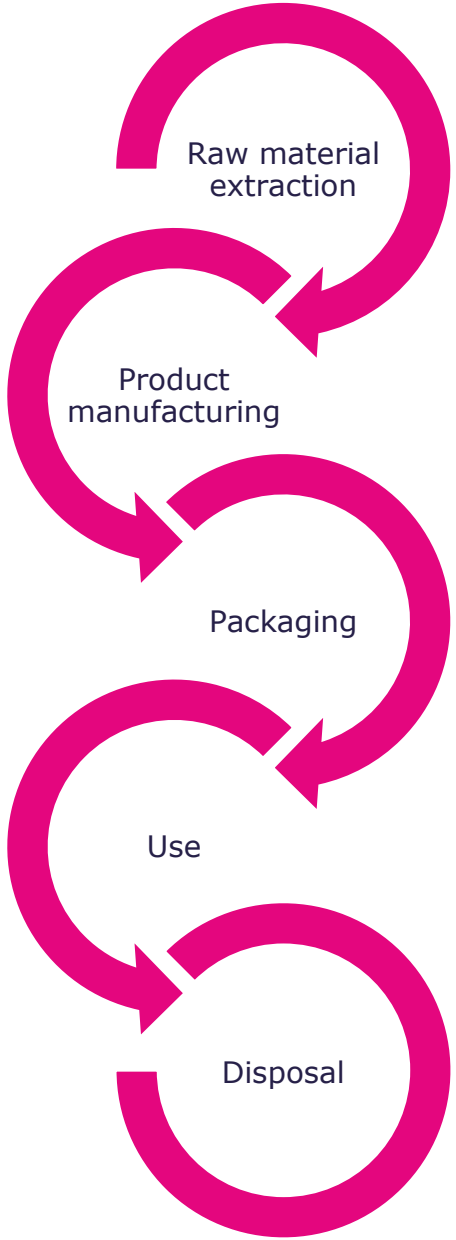
Cradle to gate approach



Cradle to grave approach



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What is the environmental impact?

How it can be measured?

Environmental impact refers to the direct effect of socio-economic activities and natural events on the components of the environment and human health.

In the frame of **Life cycle assessment** environmental impact can be measured through environmental indicators.

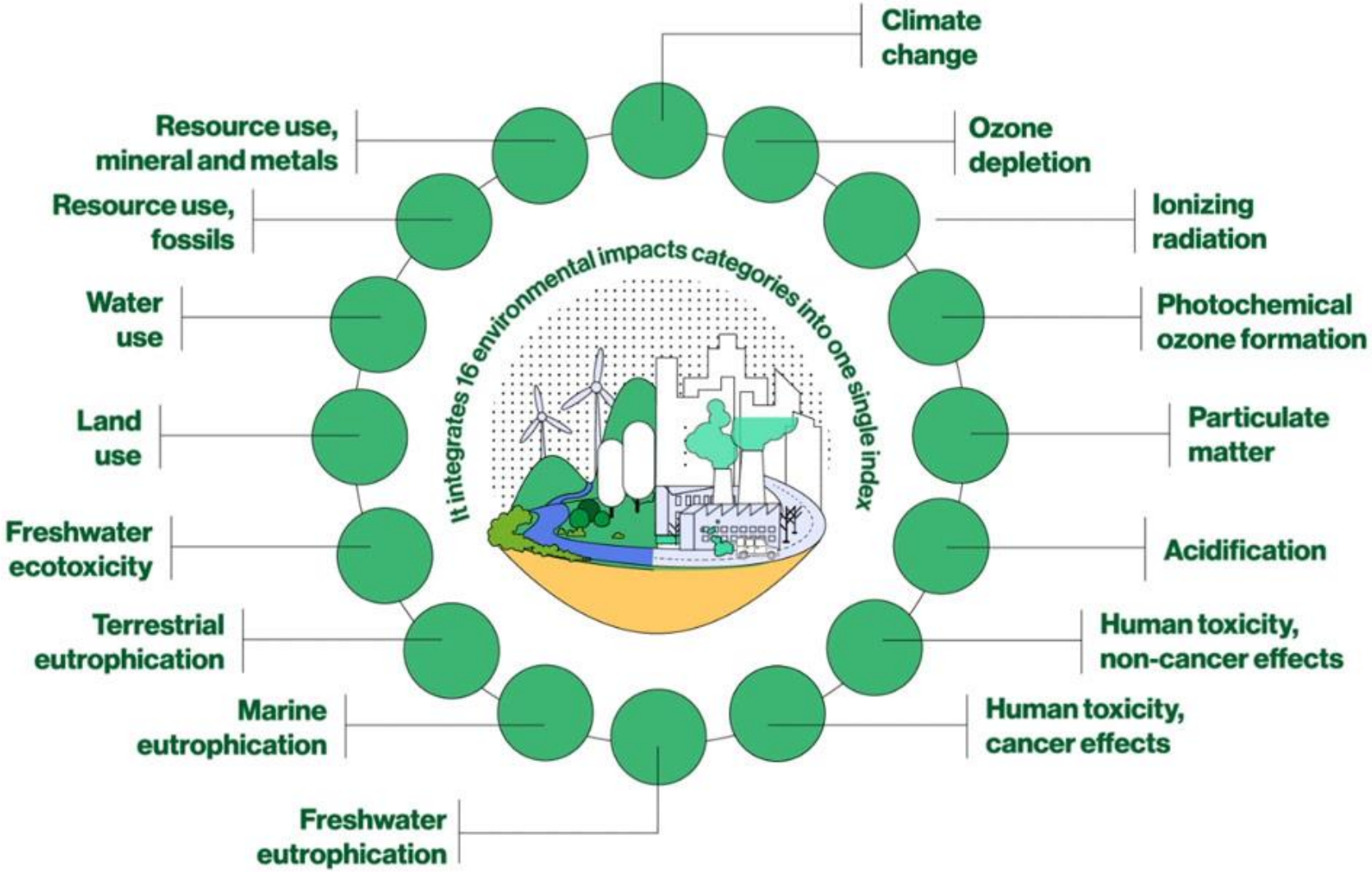

Fig.2 Environmental indicators
(*Photo:Enviroscore, 2024)*

LCA STANDARDS

ISO 14040 and ISO 14044 on life cycle assessment

ISO 14040:

- Establishes the principles and framework for LCA, covering the goal, scope, inventory analysis, impact assessment, and interpretation.
- It ensures consistency in methodology, providing a clear and structured approach for organizations to assess the environmental aspects of products or services throughout their life cycles.

ISO 14044:

- Expands on ISO 14040 by detailing the specific requirements and guidelines for conducting LCAs, including how to quantify and interpret results.
- It outlines the steps necessary for conducting a life cycle inventory (LCI) and life cycle impact assessment (LCIA), ensuring that assessments are transparent, comprehensive, and comparable.

LCA STANDARDS

ISO 14067 on the carbon footprint of products

- ISO 14067 is an international standard that focuses on the quantification and communication of the carbon footprint of products (CFP).
- It provides guidelines for calculating the total greenhouse gas (GHG) emissions associated with the life cycle of a product, from raw material extraction through production, distribution, use, and disposal.
- ISO 14067 defines the methodology for quantifying GHG emissions and removals, using reliable and consistent data sources. It applies life cycle assessment (LCA) principles aligned with ISO 14040 and ISO 14044 but focuses specifically on carbon-related emissions.
- The standard requires transparency in the reporting process and ensures that CFP assessments can be compared between products.
- It also provides guidelines on how the CFP should be communicated to stakeholders, ensuring clarity, accuracy, and relevance, whether the footprint is shared through labels or environmental reports.

LIFE CYCLE IMPACT ASSESSMENT (LCIA)-EXAMPLE CALCULATION OF GLOBAL WARMING POTENTIAL (GWP)

- In the LCIA phase, the potential climate change impact (global warming potential) is calculated by multiplying the mass of GHG released or removed by the 100 – year potential given by IPCC in units of „kg of CO_2 equivalents per kg emission".
- **Global warming**

Many of the substances emitted to the atmosphere as a result of human activities contribute to this manmade greenhouse effect and must be classified in this impact category. Listed in order of importance:

- ✓ CO_2 (carbon dioxide)- 60%
- ✓ CH_4 (methane) – 15%
- ✓ N_2O (nitrous oxide) - 4%
- ✓ Halocarbons (hydrocarbons containing chlorine, fluorine or bromine) – 10%

LIFE CYCLE IMPACT ASSESSMENT (LCIA)- EFECT OF THE GREENHOUSE GASES

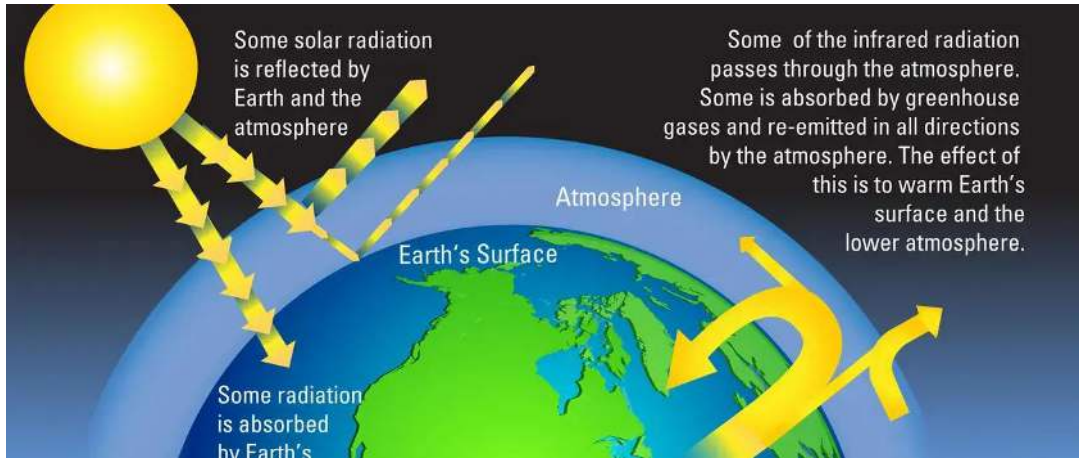

Figure 3: Greenhouse gas effect (*Source: Earth Journalism Network, 2024)*

Table 1 Global warming potential (GWP) values relative to CO2 (*Source: IPPC, 2024)*

Industrial designation or common name	Chemical formula	GWP values for 100-year time horizon		
		Second Assessment Report (SAR)	Fourth Assessment Report (AR4)	Fifth Assessment Report (AR5)
Carbon dioxide	CO_2	1	1	1
Methane	CH_4	21	25	28
Nitrous oxide	N_2O	310	298	265

EXAMPLE – CALCULATION OF CARBON FOOTPRINT FOR GREEN EVENTS IN ESTONIA

The main objective was to calculate the carbon footprint of reusable plastic dishware used at the Green Events in Estonia:

- production of the materials
- end-of-life points
- comparison with SUP dishware options

Events are:

- “Youth Song and Dance Celebration” in Estonia in 2023
- LHV Maijooks in Estonia 2022
- LHV Maijooks in Estonia 2023
- Merepäevad in Estonia 2023
- Tallinna maraton in Estonia 2022
- Tallinna maraton in Estonia 2023

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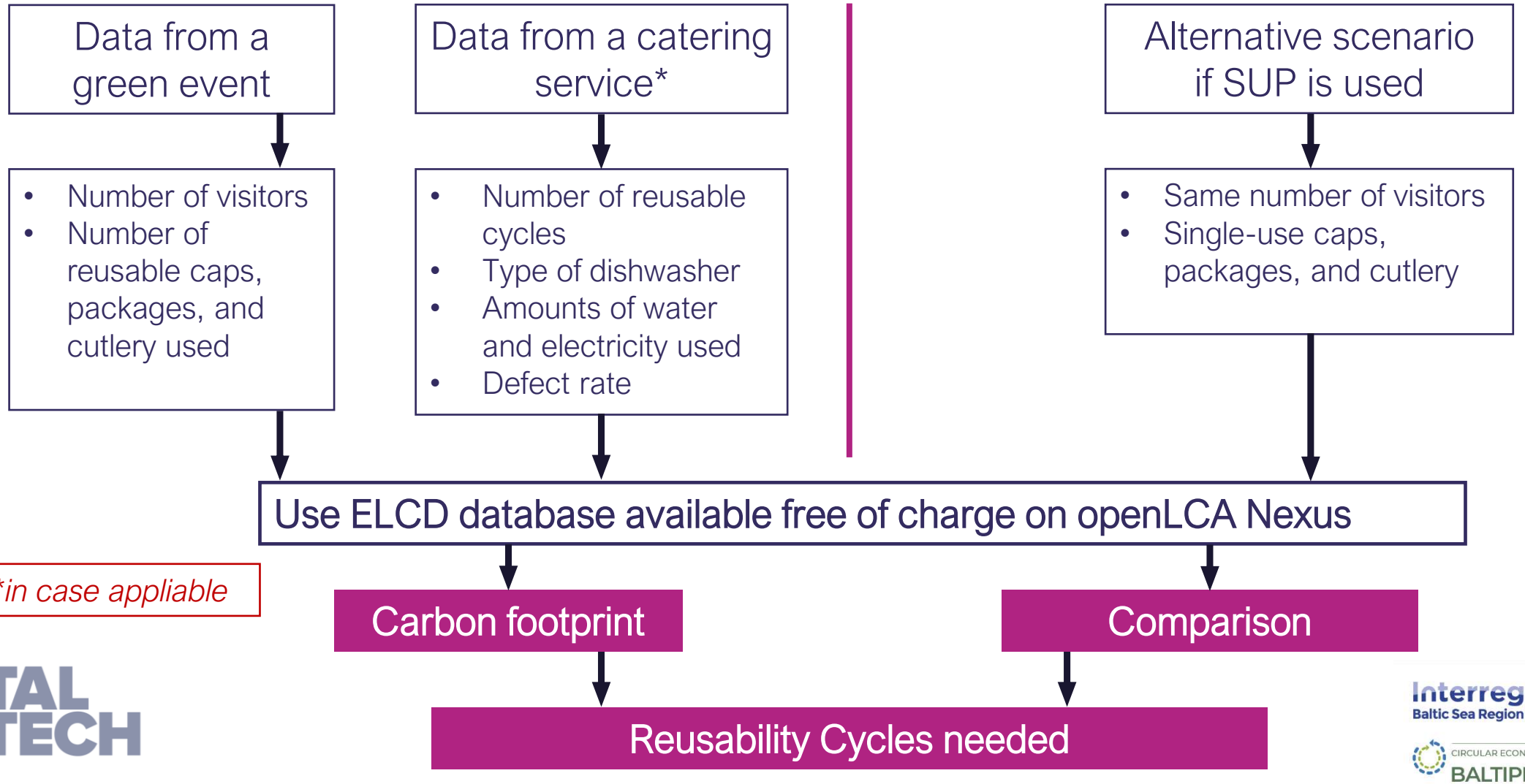
GREEN EVENTS

EIA METHODOLOGY - CARBON FOOTPRINT CALCULATION



*in case appliable

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GREEN EVENTS

EIA METHODOLOGY – EMISSION FACTORS

Name in the table	Material, description	Emissions, kg CO_2 eq/ kg of material	Emission factor source
Bio-PP	Bio Polypropylene	-0,06	Greenhouse Gas Emission Reduction Potential of European Union's Circularity
PP	Polypropylene granulate (PP), production mix, at plant	2,12	OpenLCA ELCD database, Impact assessment method - CML-IA baseline, Global warming (GWP100a)
Wood fiber	Graphic Paper, production mix, at plant, technology mix, 79% primary fibre, 21% recycled fibre	0,83	
PS	Polystyrene (general purpose) granulate (GPPS), production mix, at plant	3,80	
PET	Polyethylene terephthalate (PET) granulate, production mix, at plant, amorphous	3,56	
-	1 kg waste (incinerated)	3,23	
PP	1 kg recycled polypropylene (PP)	0,22	US EPA, AR5 method

GREEN EVENTS

INITIAL DATA

	Reusable dishware		
	Cups	Plates/Food package*	Cutlery
1. Youth Song and Dance Celebration			
Pieces, #	85 000	155 000	161 500
Weight, g	43	125	7
Material	PP	PP	Wood fibre 60%, Bio-PP 40%
2. LHV Maijooks 2022			
Pieces, #	14 610		
Weight, g	15		
Material	PP		
3. LHV Maijooks 2023			
Pieces, #	17 260	1 289	3 250
Weight, g	14	116	5
Material	PP	PP	PP
4. Merepäevad 2023			
Pieces, #	10 242	7 469	28 450
Weight, g	52	76	6
Material	PP	PP	PP
5. Tallinna maraton 2022			
Pieces, #	9 110	3 900	
Weight, g	24	52	
Material	PP	PP	
6. Tallinna Maraton 2023			
Pieces, #	72 919	1 389	6 000
Weight, g	12	72	6
Material	PP	PP	PP

ALTERNATIVE SCENARIO

For comparison purposes, the alternative scenario with SUP was calculated.

	Single use dishware			
	Cups	Plates	Food packaging	Cutlery
Weight, g	7	20	125	1,5
Material	PP	PP	PP	PS

Quantities of the SUP dishware are the same as for the corresponding green event.
Reiteration (100-120 events) was used.

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GREEN EVENTS

INITIAL DATA

Dance Celebration - Hobart™ industrial tunnel washer data:		
Total loading	26,9	kWh
Blow drying	5,4	kWh
Other events - MEIKO™ K 200KVP conveyer dishwasher:		
Total loading	31,33	kWh
All events - Capacity		
Emission factor for 1 kW	0,715	kg CO_2-eq*
Cups/Food package	4000	pc/h
Cutlery	8000	pc/h

**Elering 2022 report*

https://www.hobart-export.com

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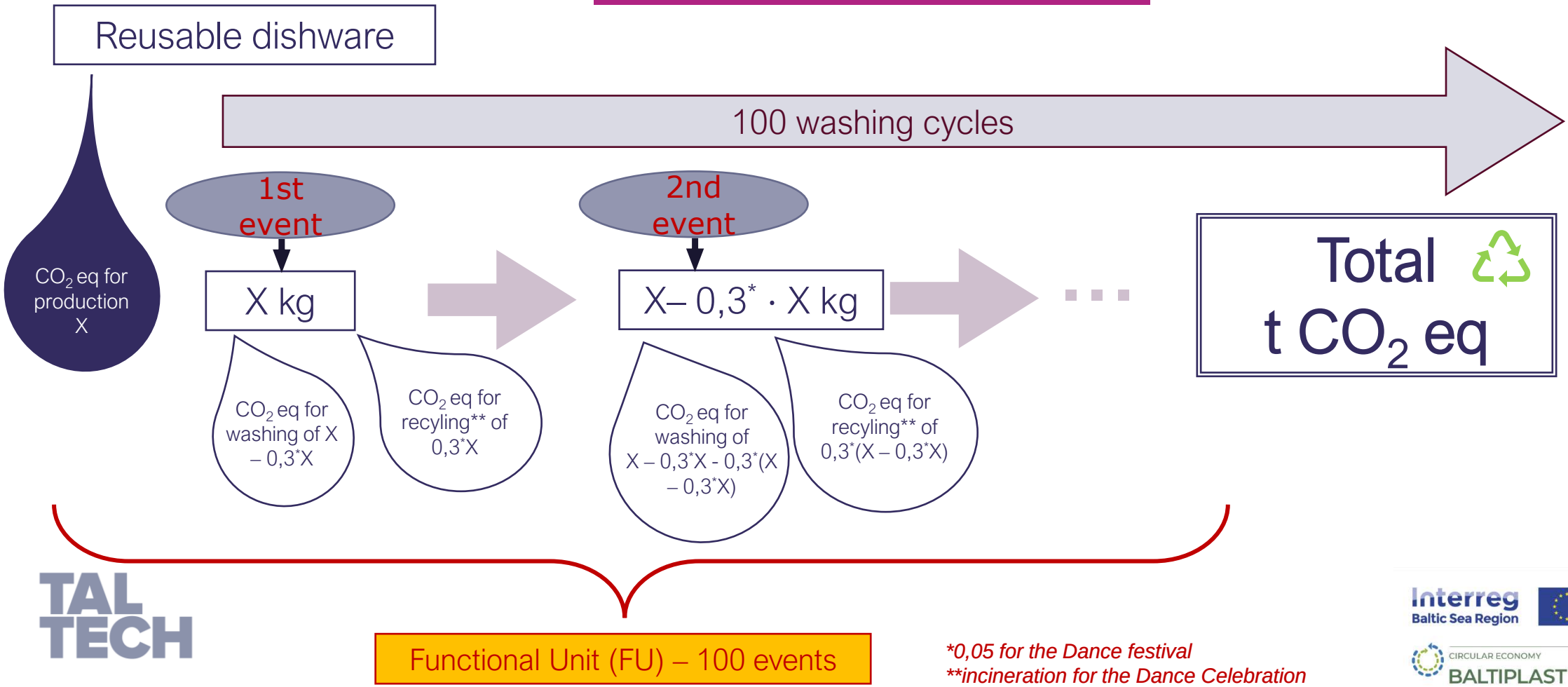
GREEN EVENTS

CARBON FOOTPRINT CALCULATION

CALCULATION FLOW



*0,05 for the Dance festival
**incineration for the Dance Celebration

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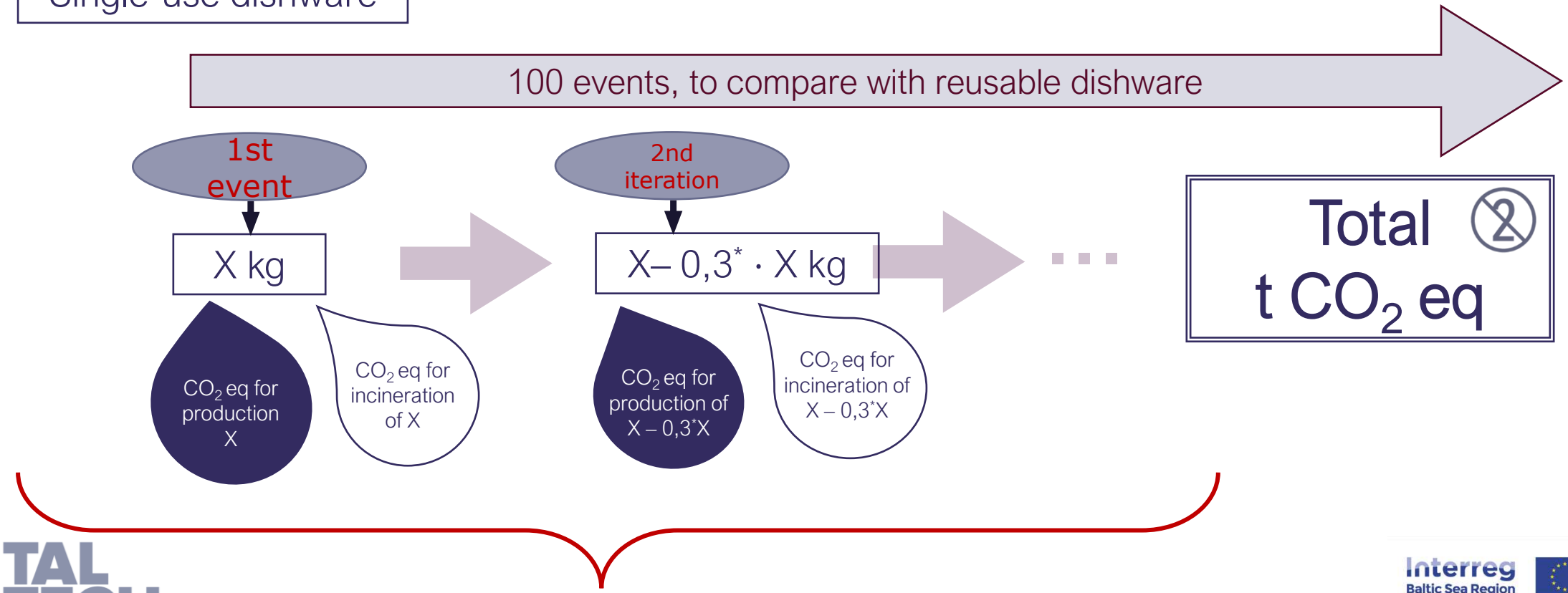
GREEN EVENTS

CARBON FOOTPRINT CALCULATION

CALCULATION FLOW

Single-use dishware



Functional Unit (FU) – 100 events

*0,05 for the Dance Celebration

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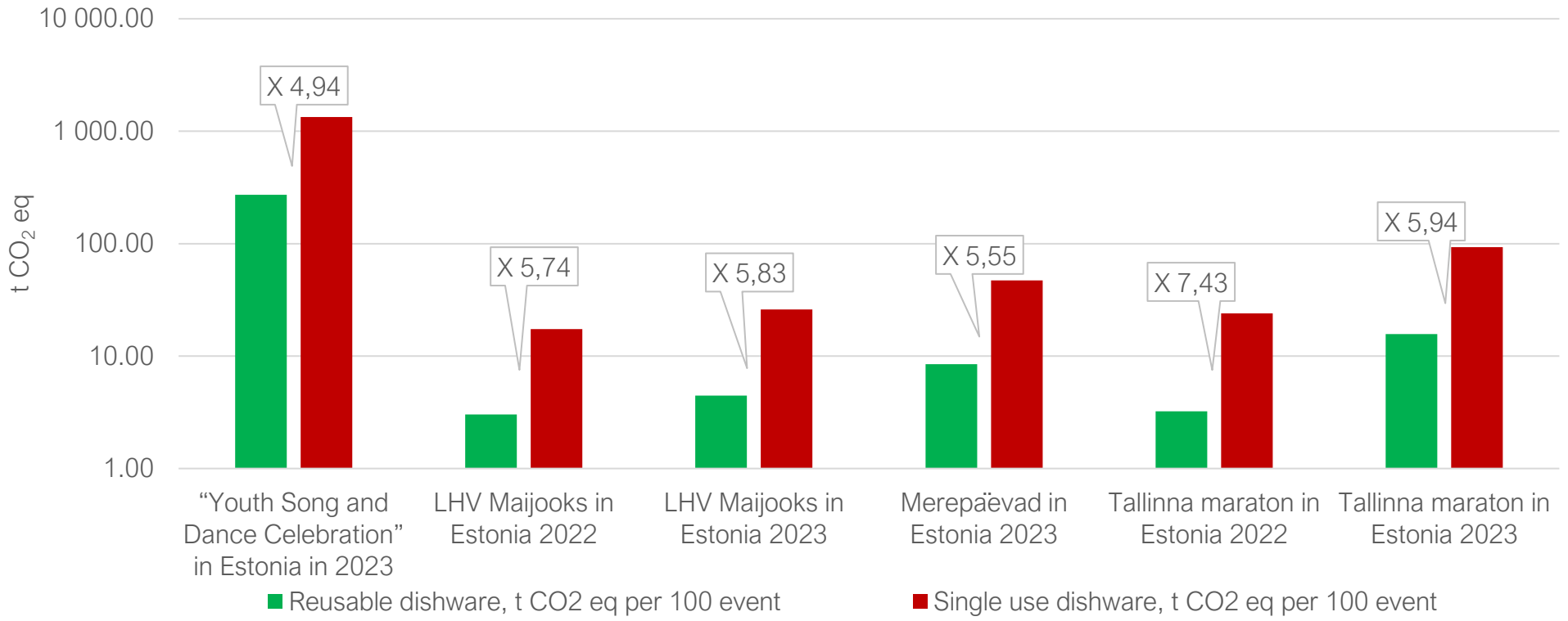
GREEN EVENTS

RESULTS



The results show, that in the case of **reusable dishware** usage total emissions in t CO_2 eq are **4,94 – 7,43 times** less than in the case of **single-use plastics**.

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BENEFITS FOR THE COMPANY

LCA helps organizations pinpoint the stages in their product’s life cycle or operations that have the highest environmental impacts, reducing resource consumption, energy use, and emissions, ultimately lowering the company's ecological footprint.

By identifying inefficiencies in resource use and energy consumption, LCA can help organizations optimize processes, reduce waste, and lower operational costs.

LCA provides a comprehensive framework to assess and report environmental performance, ensuring that organizations stay compliant with current regulations (e.g., carbon emissions, waste management) and are better prepared for future regulatory changes.

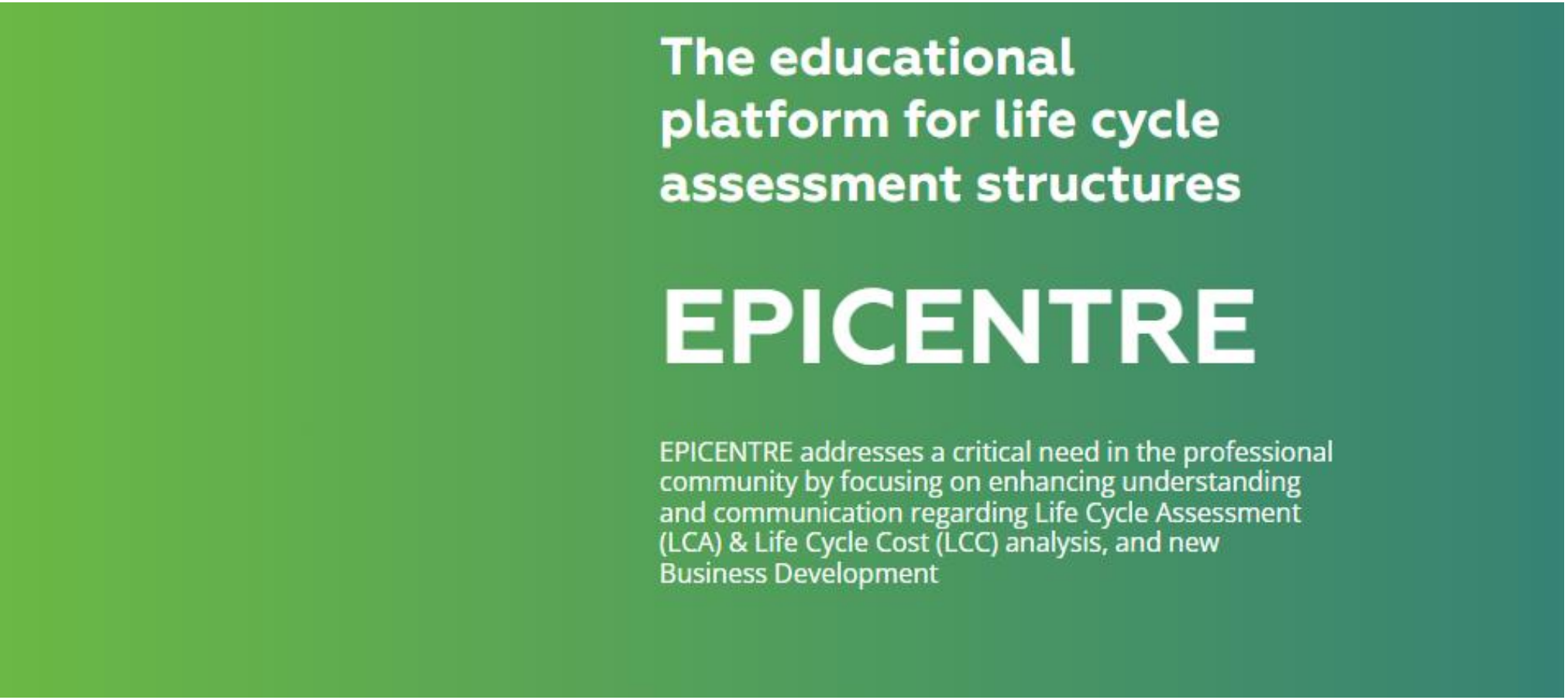
LCA brings competitive advantage in markets where customers, investors, and partners prioritize environmental responsibility.

LCA provides a scientifically robust and transparent way to communicate environmental impacts, making sustainability reports more credible and comprehensive.

LCA can help organizations move toward circular economy principles by assessing opportunities for recycling, reuse, and resource recovery. This supports waste reduction and encourages the design of products that have a longer life span or are easier to disassemble and recycle at the end of their life.

LEARNING OPPORTUNITIES

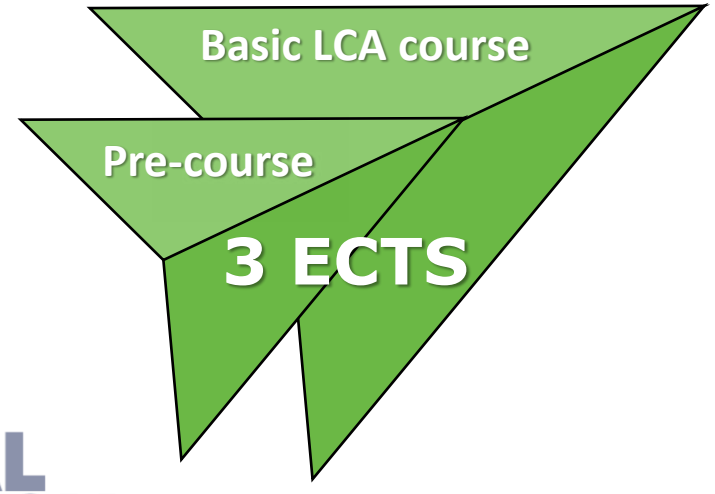
EPICENTRE



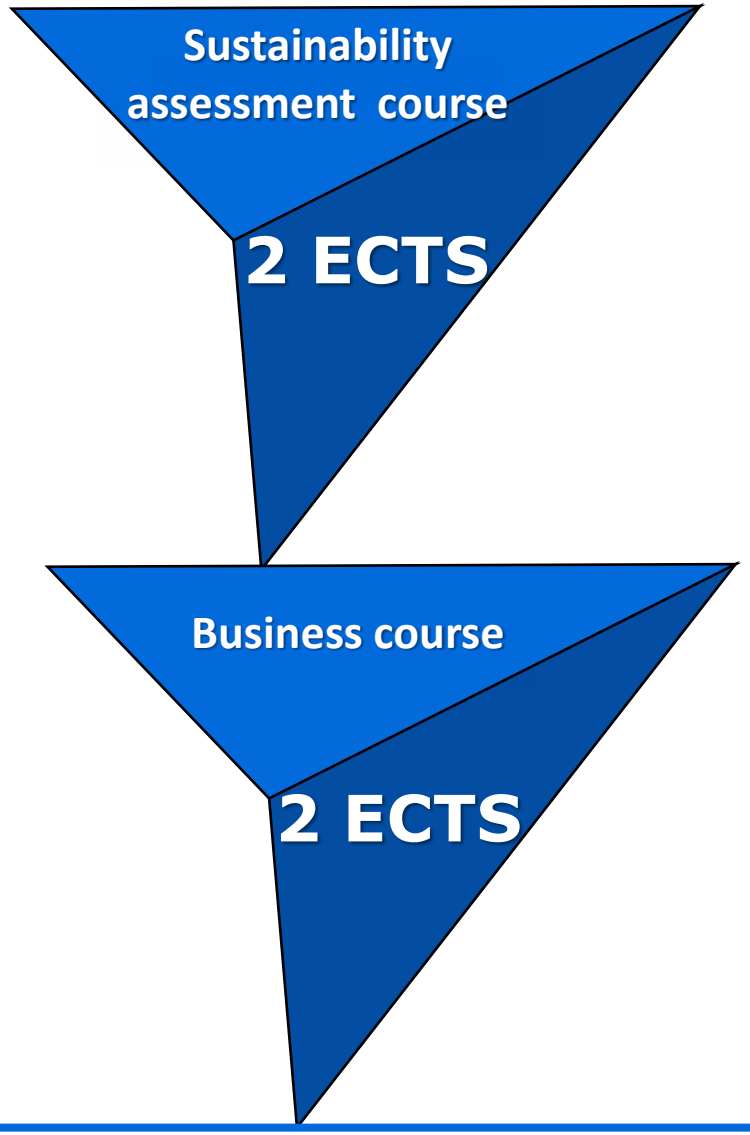
Two level courses of summer school

Basic level

- Online pre-course (3-4 weeks)
- On-site Basic LCA course (2 days or 16 acad. hours)
- Independent work
- Includes mentoring



*Includes learning materials and short introduction about Sustainability assessment and Business

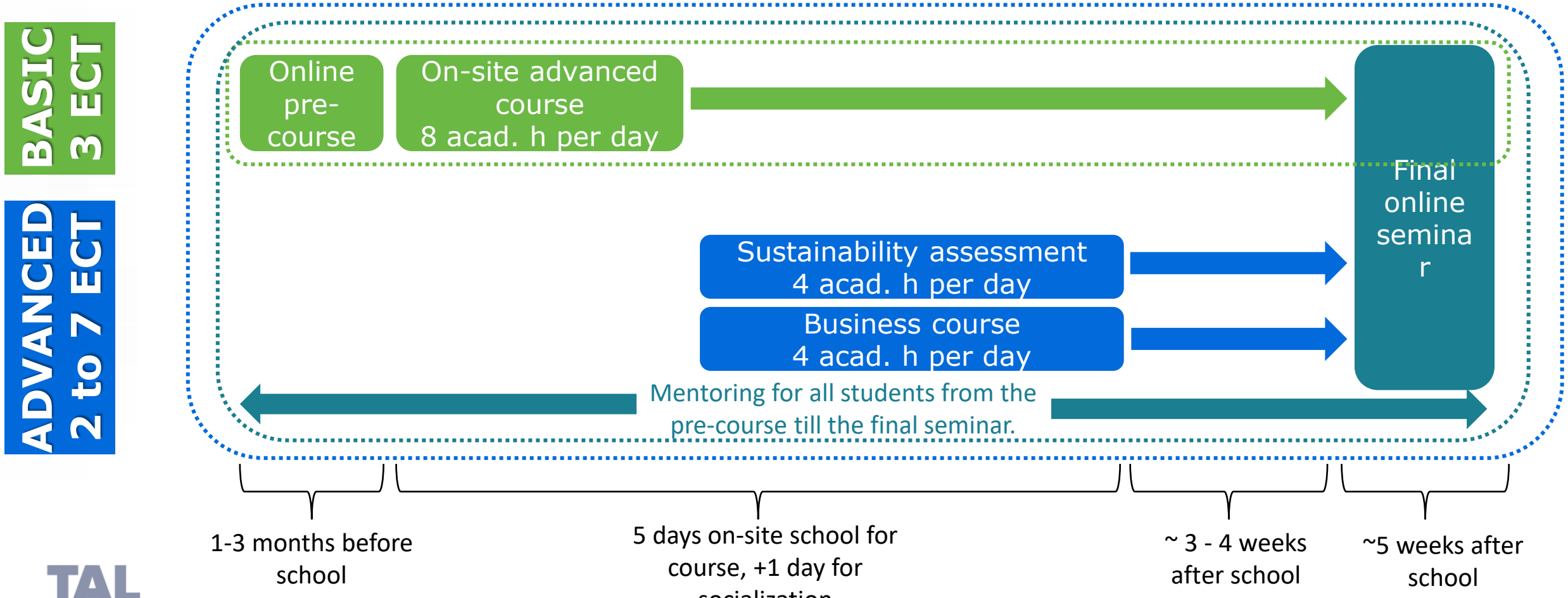


Advanced level

- On-site LCA and LCC course (3 days or 12 acad. hours)
- On-site Business course (3 days or 12 acad. hours)
- Independent work
- Includes mentoring

The structure summer school

1 ECT = 27 acad. h

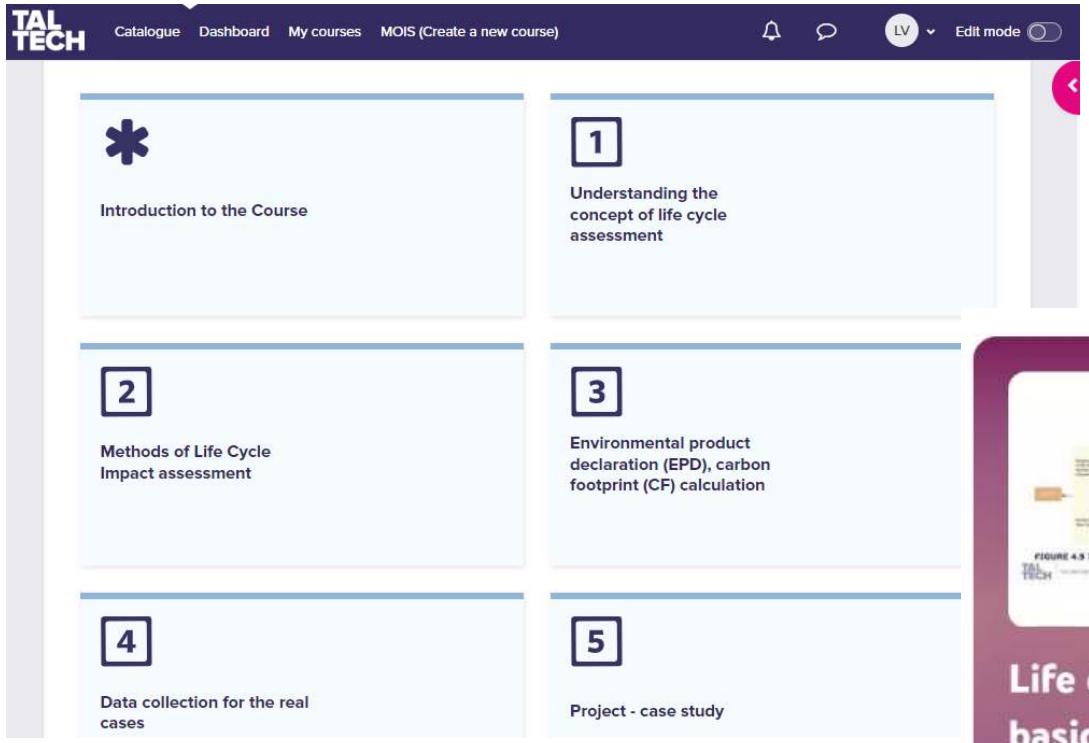


Online test after pre-course, can take test to prove previous knowledge and skip the pre-course

Submits and presents the project 3-5 weeks after school

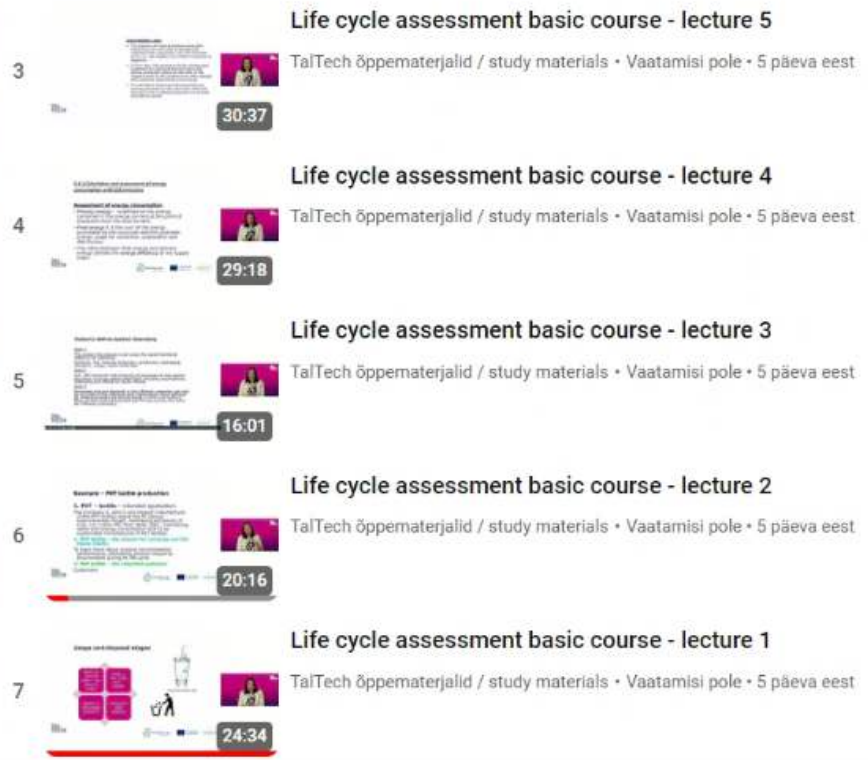
Presentation is obligatory to receive certificate

Learning **platform & materials**

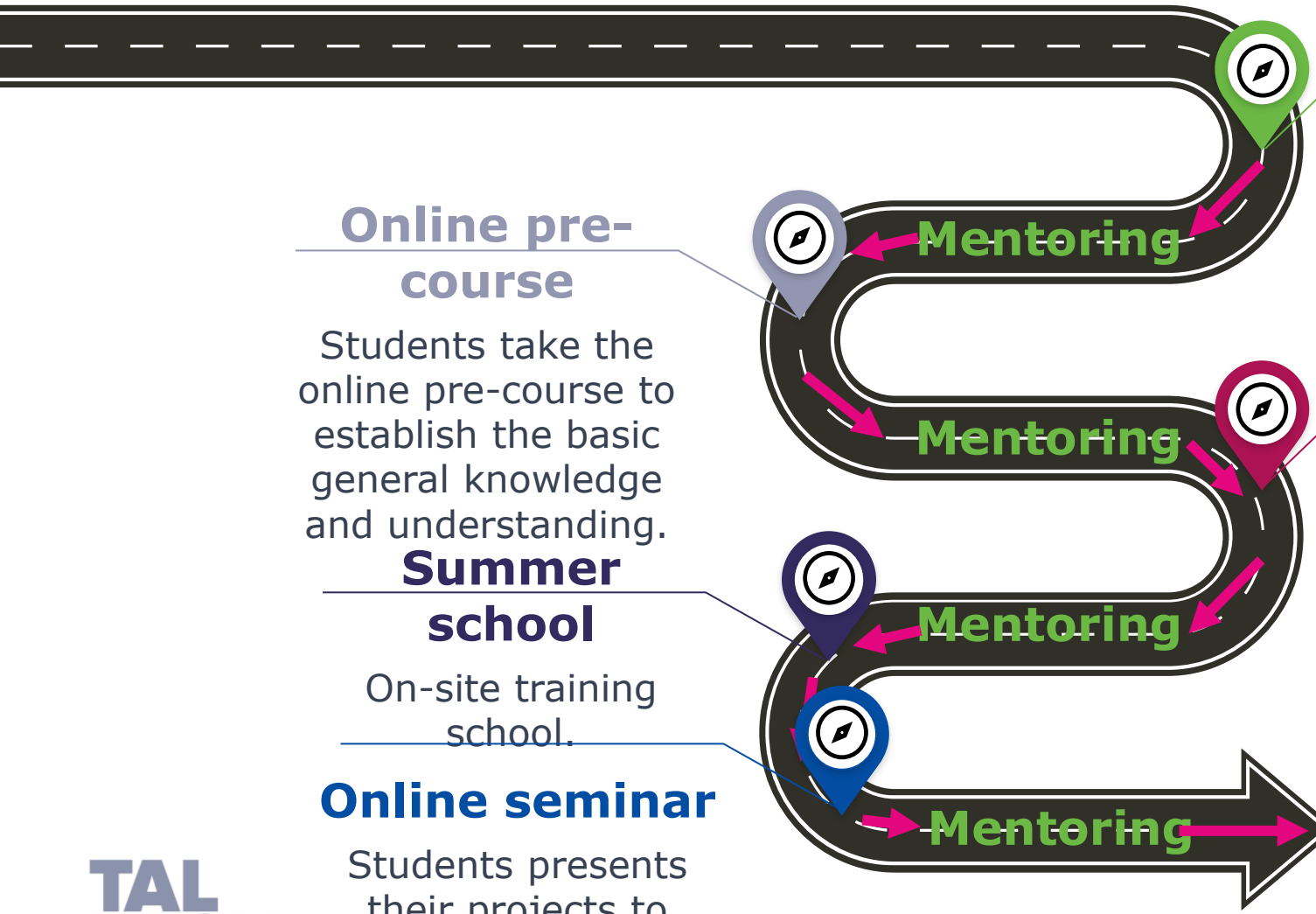


User friendly learning platform organized and maintained by TalTech.

Modern and comprehensive learning materials.



Roadmap of summer school



Application

Students fill the application form and are divided into groups for mentoring.

Online test

Online test to evaluate the knowledge level.

Online pre-course

Students take the online pre-course to establish the basic general knowledge and understanding.

Summer school

On-site training school.

Online seminar

Students presents their projects to receive the certificate and receive feedback.

CERTIFICATE &

Understanding
Contacts
Experience

LCA/LCC summer school for professionals

18th – 23rd September 2025 @Riga

More information about the project: https://epicentre.rtu.lv/

General plan:

- 18th September – Introduction, basic LCA course
- 19th September – Basic LCA course
- 20th September – Sustainability assessment course & Business course
- 21st September – Excursion & socialization
- 22nd September – Sustainability assessment course & Business course
- 23rd September – Sustainability assessment course & Business course

THANK YOU!

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