SSbD implementation II: LCA, sLCA and LCC

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Next Technology Tecnotessile (NTT)

- **Next Technology Tecnotessile -** Società Nazionale di Ricerca r.l. is an **Italian research** company established in **1972** in **Prato**.
- **Stakeholders**: 40% Ministry of University and Research, 60% textile and machinery-textile industries.
- 24 employers
- **Main business**: R&D activities in textile, machinery, automation and material sectors; technological innovation and transfer; project management; testing and validation of products for different sectors.
- **Technological priorities**: Circular Economy, Sustainable textile, Industry 4.0, Chemistry and Nanotechnology, ICT and Photonics.

OTIR 2020 TUSCANY FASHION CLUSTER

Bio-based Industries Consortium

CEQ

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NTT – Main activities

- Consultancy services on textile technologies from raw materials to final products
- Modification of materials, surface functionalization, development of novel chemical processes
- Composites (packaging, automotive, furniture and building sectors)
- R&D on process automation and control systems
- Circular economy and sustainable textile practices
- R&D on treatment and reuse of industrial wastewaters
- Design of mechanical devices and machinery development
- Environmental monitoring of textile value chain by Life Cycle Assessment (LCA)

SimaPro

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The Tuscan Fashion Cluster

OTIR 2020 TUSCANY FASHION CLUSTER

Collaborative activities and R&D diffusion among 450 members (companies in the fashion sector of the Tuscany territory)

BRONZE Cluster Management Excellence
STRIVING FOR CLUSTER EXCELLENCE

- Strengthen the regional technology transfer
- Support R&D collaborative activities for new sustainable technologies, new products and services.

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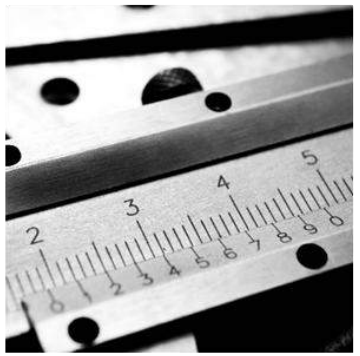
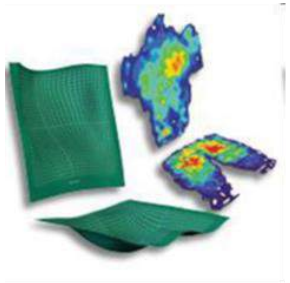


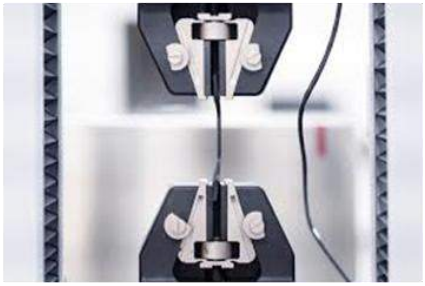
CEQ LAB

CEQ
Centro Eccellenza Qualità
(Excellence and Quality Centre)

-Applied research
-Technology transfer
-Tests and calibrations

- Chemical and ecotoxicological analysis
- Physical and mechanical testing
- Color fastness
- Surface test
- Environmental and accelerated corrosion test
- Defect and failure analysis
- Comfort analysis
- Chemical and metallographic analysis
- Mechanical test
- Welded joints and weld process qualification
- Composite material test
- Failure analysis





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International Partnerships

GALACTICA

TEX GLOBAL

REGIO GREEN TEX

Hi-Tech-TEX

EURO CLUSTERS

TEXB

NANO FAT

RECINDCOMP

EXTRA TEX

EU-ALLIANCE

- To support the creation of new industrial value chains
- To boost collaboration in technological innovation and technology transfer among different sectors
- To support the internationalization of European SMEs to identify growth opportunities, consolidating their business
- To accelerate green and digital transition

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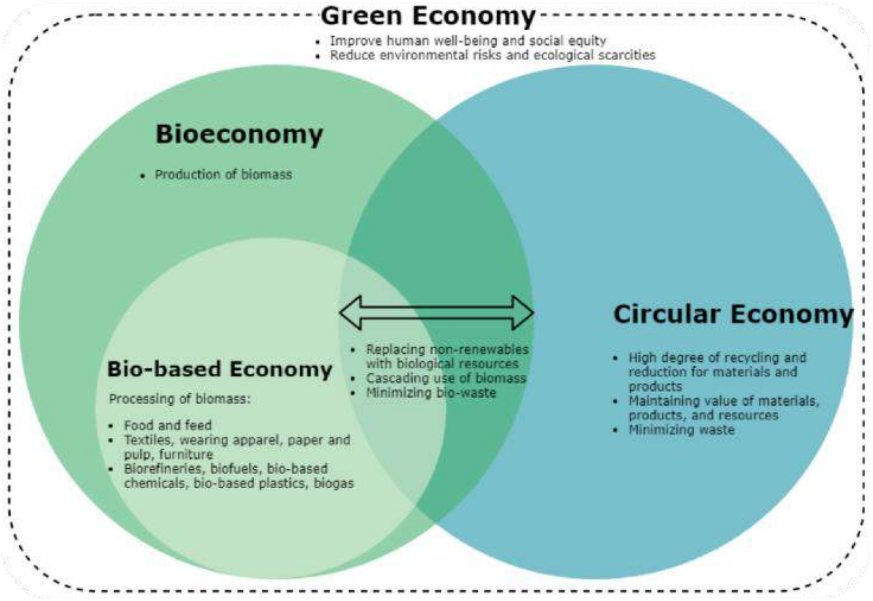
International, national and regional Partnerships

Our funded projects are addressing sustainable practices to bring innovation to textile value chain form raw material to product validation, focusing on textile circularity and bio-based materials.



NTT is associate Member of the Biobased Industries Consortium.

Bio-based Industries Consortium

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International, national and regional Partnerships

Completed R&D projects

BIO4 SELF

ORTI BLU

now let's go

BLUE Net

FISH 4 FISH

ECOBULK

On-going R&D projects

bio_acouis

Redol

TORNAD

BIORADAR

REMEDIES

SUNRISE

SUPREME

PRESERVE

GRAPHERGIA

SEALIVE

Future R&D projects (2024-2027)

moBIOS

PHYBI

SOLSTICE

PLAMINPACK

POLYMEER

BioFibreLoop

STELEE

Bio-based Industries Consortium

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Environmental Life Cycle assessment (LCA) and eco-design

Step 1: The Goal and Scope Definition

Identification of the products or services, system boundary to be assessed are identified.

Step 2: Life Cycle Inventory Analysis (LCI)

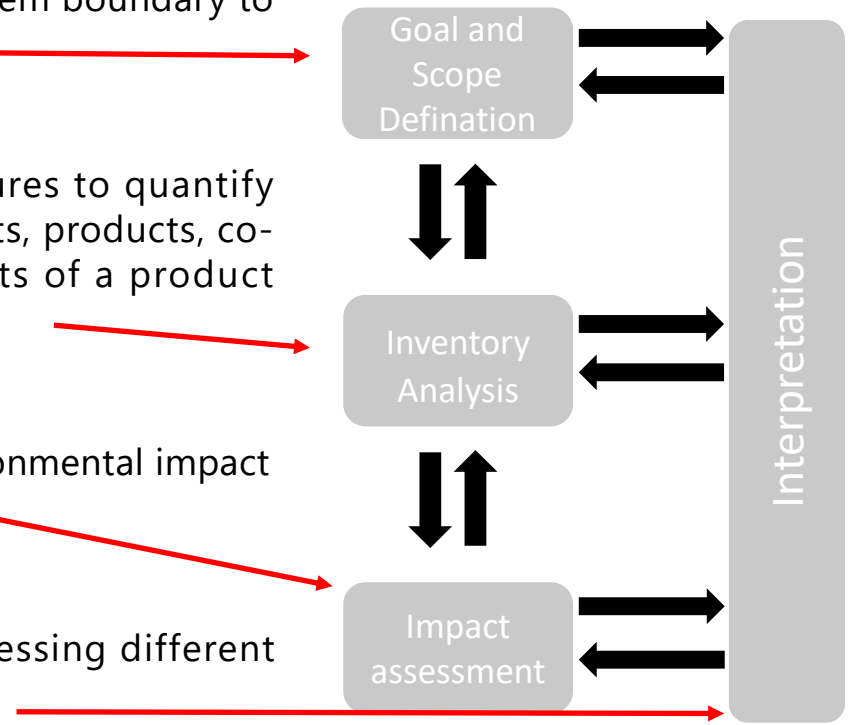
- Data collection and calculation procedures to quantify relevant energy inputs, raw material inputs, products, co-products and waste- inputs and outputs of a product system.

Step 3: Life Cycle Impact Assessment (LCIA)

- Linking inventory data with specific environmental impact categories and category indicators

Step 4: Life Cycle Interpretation

- Result interpretation by reporting, addressing different phases of the study under consideration.



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Environmental Life Cycle assessment (LCA) and eco-design

	SUSTAINABLE DESIGN	ECODESIGN	CIRCULAR DESIGN
Definition	Designing a product in a way that takes the reduction of social, environmental, and economic impacts at the heart. Minimize these impacts as much as possible.	Ecodesign focuses on reducing environmental impact in every step of your product's life cycle. The foundation for Ecodesign is environmental data on a product.	Circular design means designing a product or service that creates no waste and pollution and keeps products and materials in use.
In practise	Look at design choices that reduce social and environmental impacts along every step in the life cycle of your products. From production to the waste phase. Where can you improve?	Environmental data is calculated through Life Cycle Assessments (LCA). The result: 15+ impact categories for each step in a product's life cycle. Analyze which process, material, or component causes your biggest impact- and improve your design.	Analyze and improve your product's design with two specific goals: (1) Minimum (preferably zero) waste & pollution throughout your product's life cycle. (2) Make sure your product's value doesn't decrease at the end of its life.
Examples	• *Analyze Social Impact: Are workers being paid fair wages? Will your product have health-endangering effects on consumers when it's used?* • *Analyze environmental impact: Which materials in production are impact-intensive? Which processes could be sustainably optimized?*	• *Product Stewardship: Take full responsibility for your product's entire lifecycle. And make sure the product doesn't get lost at the end of its life- but stays in the value system.* • *Dematerialization: Reduce the weight, size, and number of materials you use in your design.*	• *Designing for inner loops: Materials in your product should maintain the highest value during- and after the end of its life.* • *Moving from products to services: Shifting from ownership to access. Instead of purchasing, you offer your product as a service.* Ecochain

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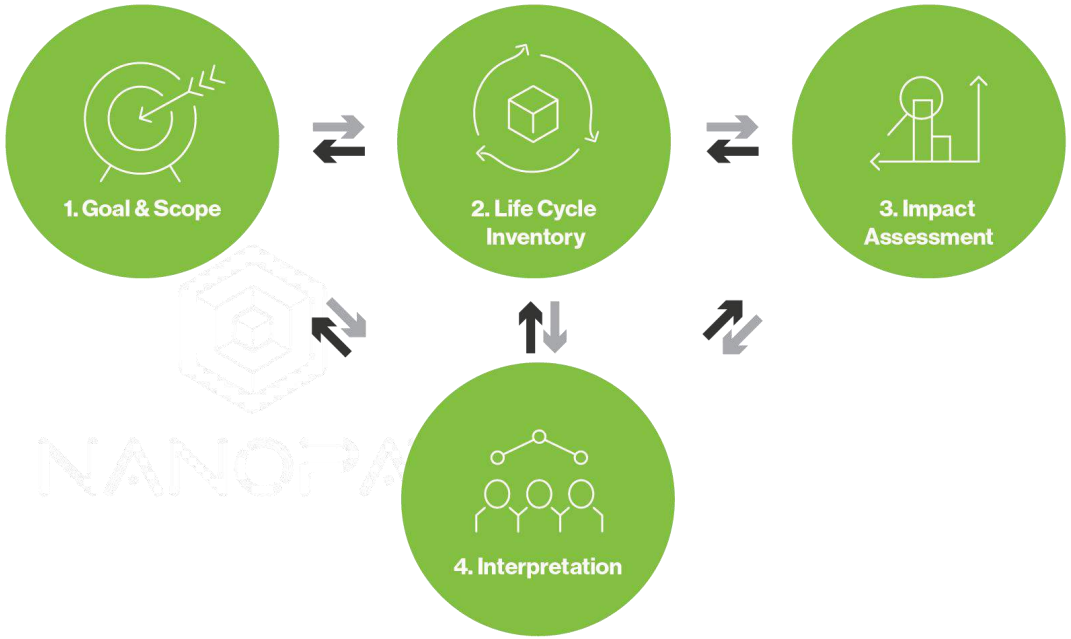
Environmental Life Cycle assessment (LCA) and eco-design



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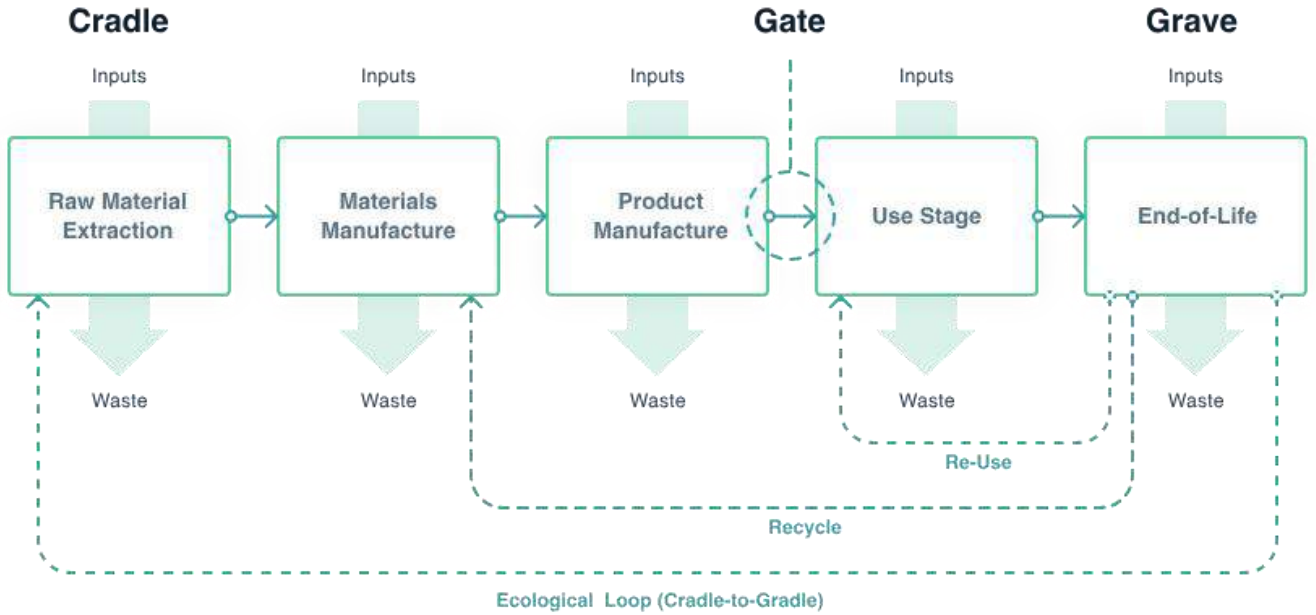

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Environmental Life Cycle assessment (LCA) and eco-design

Inputs	Amount	Unit [7]	Data quality and comments [9]
Energy carrier including efficiency [10]			
electricity	2	kWh	DQ: S; Stadtwerke Neuss, Fr./Hr. Mustermann (01 234 56 -
Compressed air	0,1	Nm³	DQ: M; Master press, cleaning press
Material inputs [11]			
ABS	0,3	kg	DQ: M; Supplier company XXX, Musterstadt, Fr./Hr. Muster
PC	0,7	kg	DQ: M; Supplier company YYY, Musterdorf, Fr./Hr. Muster
Supplies [12]			
Hydraulic oil	0,01	l	DQS; Master press, maintenance; Press manufacturer Fa. Druckhart, Mr. Hydraulics
Domestic water	0,02	l	DQ: C; Loss of cooling
Domestic water	0,15	l	DQ: S; Cleaning press
cleaning supplies	0,015	l	DQ: S; commercially available
cleaning rags	0,01	kg	DQ: S; commercially available

Process

Process name [1]	Production of Masterbatch XYZ (ABS-PC)	
Process operator [2]	Company	
Location [3]	Address, Postcode City (Country)	
Reference value and unit [4]	1 kg Masterbatch XYZ (ABS-PC)	
Contact Person	Company (First Name, L	**Creation Date**
address	Address Postcode City (Country)	dd.mm.yyyy
Telefon		**Observation period** [5]
e-mail		dd.mm.yyyy - dd.mm.yyyy
Process flow diagram [6]	Please create or attach a separate sheet "Process flow diagram"	

Outputs

Product/s [13]			
Masterbatch XYZ (ABS-PC)	1	kg	DQ: M; including granulation
Emissions to air [14]			
No			
Emissions to water [15]			
No			
Waste / disposal route [16]			
Plastic waste	0,083	kg	DQ: M; currently still disposal via the Musterstadt landfill
Municipal waste	0,01	kg	DQ: S; Cleaning rags, model town landfill
sewage	0,165	l	DQ: S; Dirty water from machine cleaning; Disposal of munic

Transport [17]

Material inputs, operating materials and waste (delivered to or from the factory) [18]	Distance (km) [19]		Workload (%) [21]
Delivery ABS	450		50 (Outward journey full, empty journey back)
Delivery rPC	120		50 (Outward journey full, empty journey back)

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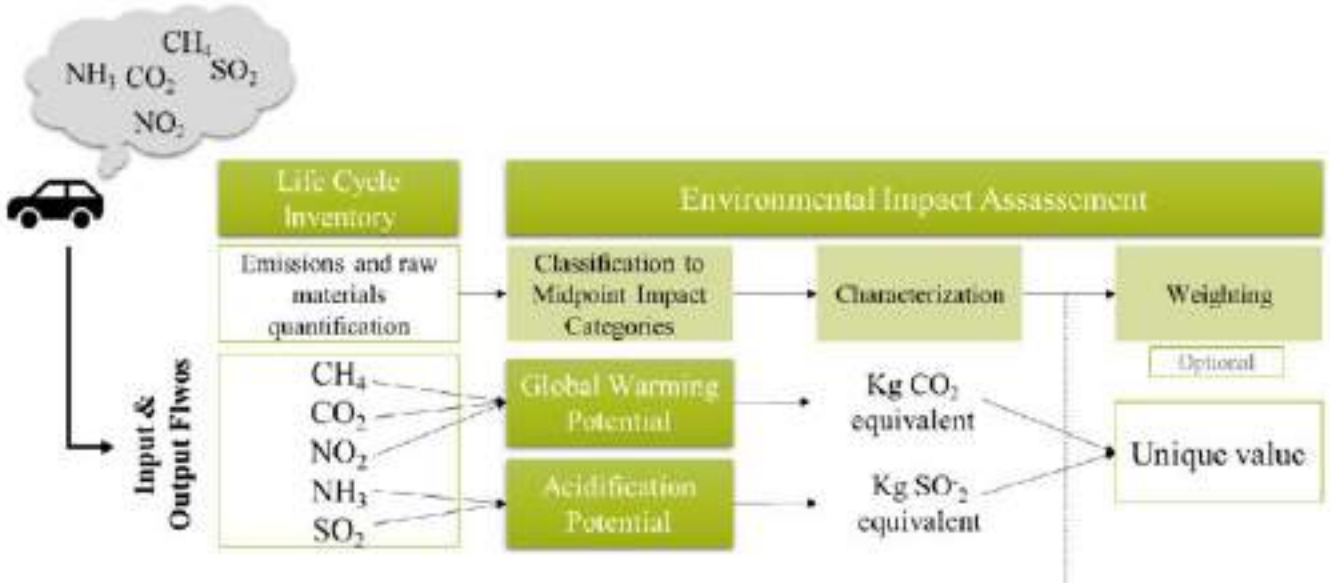
Environmental Life Cycle assessment (LCA) and eco-design



ReCiPe

Impact Category	Unit of the Results
Global warming (GWP)	kg CO_{2eq}
Stratospheric ozone depletion (ODP)	kg CFC^{-11}_{eq}
Ionizing radiation (IRP)	kBq $Co\text{-}60_{eq}$
Ozone formation, human health (HOFP)	kg NOx_{eq}
Fine particulate matter formation (FPMF)	kg $PM2.5_{eq}$
Ozone formation, terrestrial ecosystems (EOFP)	kg NOx_{eq}
Terrestrial acidification (TAP)	kg SO_2
Freshwater eutrophication (FEP)	kg P_{eq}
Marine eutrophication (MEP)	kg N_{eq}
Terrestrial ecotoxicity (TETP)	kg 1.4-DCB
Freshwater ecotoxicity (FETP)	kg 1.4-DCB
Marine ecotoxicity (METP)	kg 1.4-DCB
Human carcinogenic toxicity (HTPc)	kg 1.4-DCB
Human non-carcinogenic toxicity (HTPnc)	kg 1.4-DCB
Land use (LOP)	m^2 year
Mineral resource scarcity (SOP)	kg Cu_{eq}
Fossil resource scarcity (FFP)	kg oil_{eq}
Water consumption (WCP)	m^3

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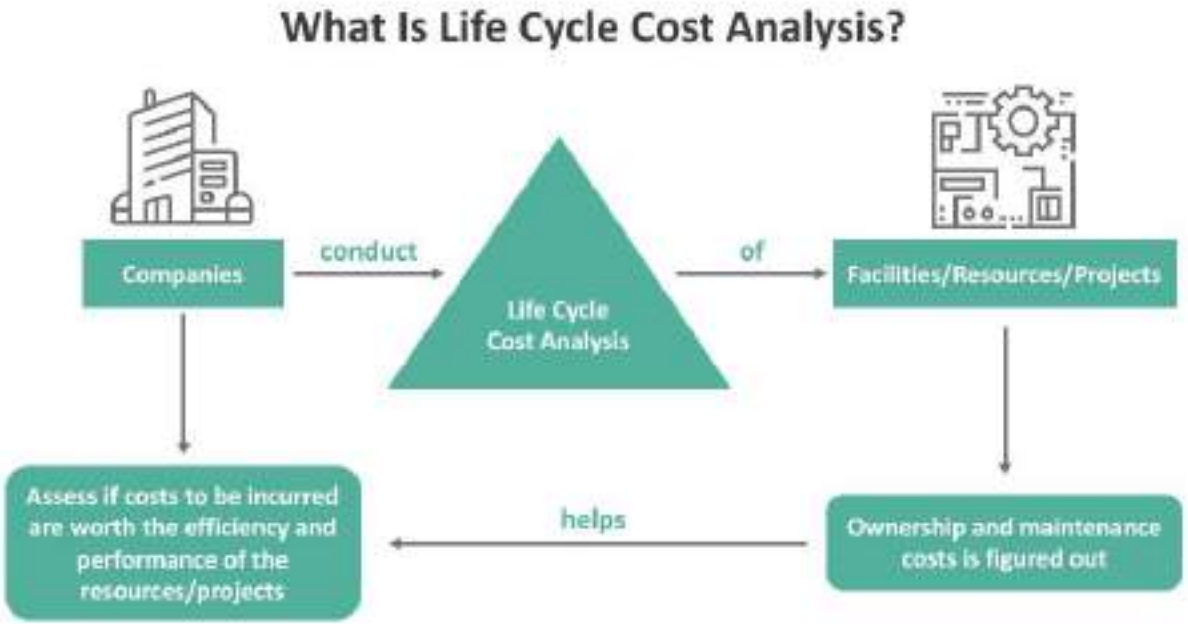
Life Cycle Cost (LCC) and cost-feasibility

- This analysis will be implemented by LCC, which will be conducted in parallel to the LCA
- LCC will be developed in two steps: cost identification and cost-benefits analysis



LCC Operational Data Template

	Reference year	Year 1	2	3	4	5
Output volumes						
Raw materials						
Packaging Materials						
Services						
Electric						
Steam						
Air						
Other						
Labour						
Production						
Cleaning						
Maintenance						
Maintenance materials						
Overheads						
Rent/rates						
Heat/Light						
Total Operational Costs						

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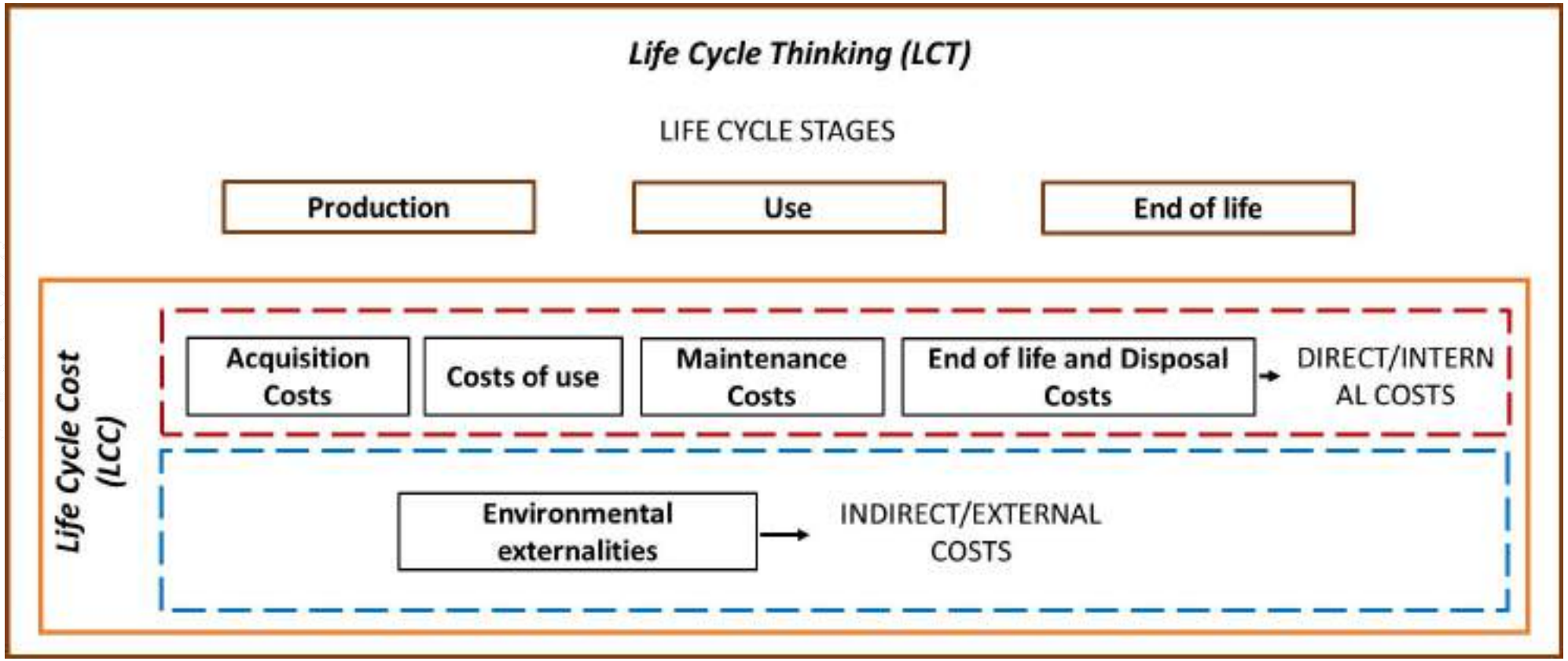
Life Cycle Cost (LCC) and cost-feasibility



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Life Cycle Cost (LCC) and cost-feasibility

- ❑ Costs not directly related by the users of the product
- ❑ Costs related to environmental externalities related to the products, services or works during the life cycle

The Directive provides that *"these costs are included if their monetary value can be **determined** and **verified**; costs may include the costs of emissions of greenhouse gases (GHG) and other pollutants as well as other costs related to climate change mitigation."*

Indirect costs are calculated respect to the load associated with material flows and consumption related to life cycle stages.

I. **The inputs (materials, energy, water) and outputs (emissions to air, water, soil and. waste) of the reference product system must be calculated**

II. **The inventory is defined**

III. **The inventory is then evaluated according to one or more impact categories**

IV. **Through the use of monetisation factors, the results of impact categories are transformed into values monetary**

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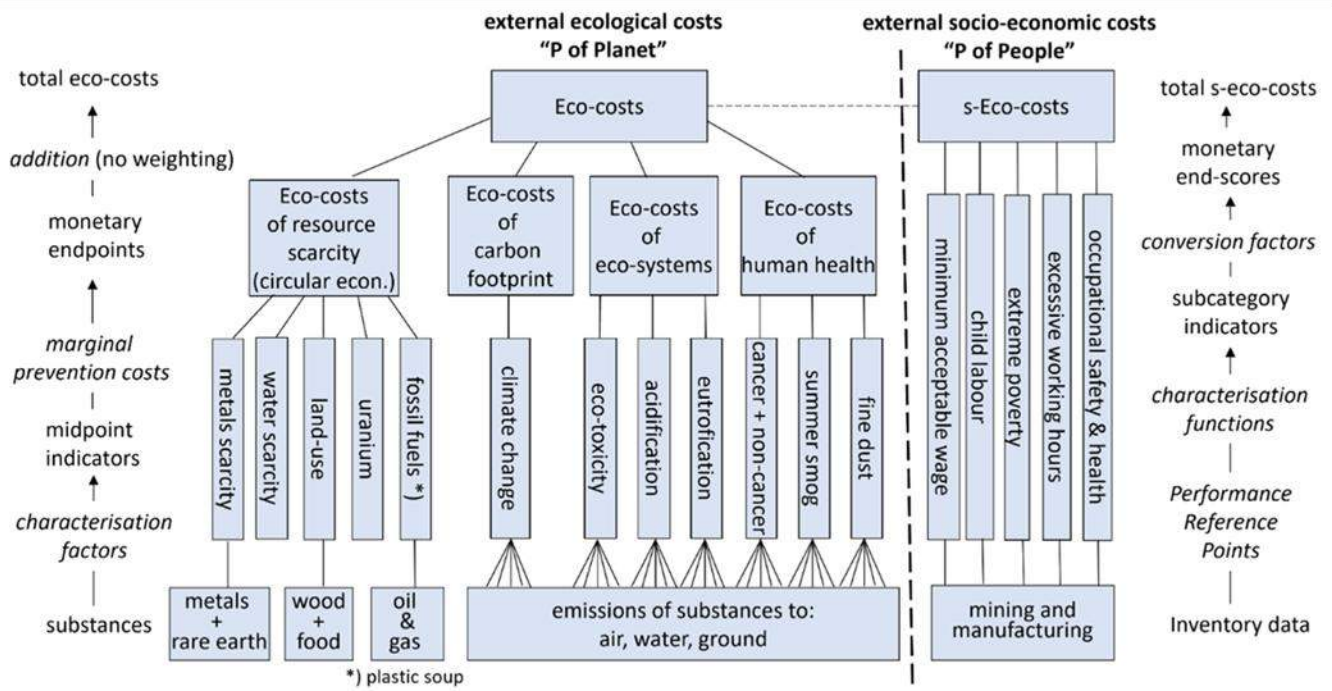
Life Cycle Cost (LCC) and cost-feasibility

Eco-cost

Eco-costs are the costs of the environmental burden of a product on the basis of prevention of that burden. They are the costs which should be made to reduce the environmental pollution and materials depletion in our world to a level which is in line with the carrying capacity of our earth.



eco-costs of	equivalent
acidification	9.275 €/kg SO_x equivalent
eutrophication	5.0 €/kg phosphate equivalent
ecotoxicity	360.0 €/kg Cu equivalent
human toxicity, cancer	3754 €/kg Benzo(a)pyrene equivalent
human toxicity, non cancer	25500 €/kg Mercury equivalent
summer smog (respiratory diseases)	5.67 €/kg NO_x equivalent
fine dust	37.1 €/kg fine dust PM2.5
global warming (GWP 100)	0.123 €/kg CO_2 equivalent

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Social LCA

A social life cycle assessment (S-LCA) is a method that can be used to assess the social and sociological aspects of products, their actual and potential positive as well as negative impacts along the life cycle.

Targeted audience

- Workers
- Consumer
- Local community
- Society
- Value chain actors

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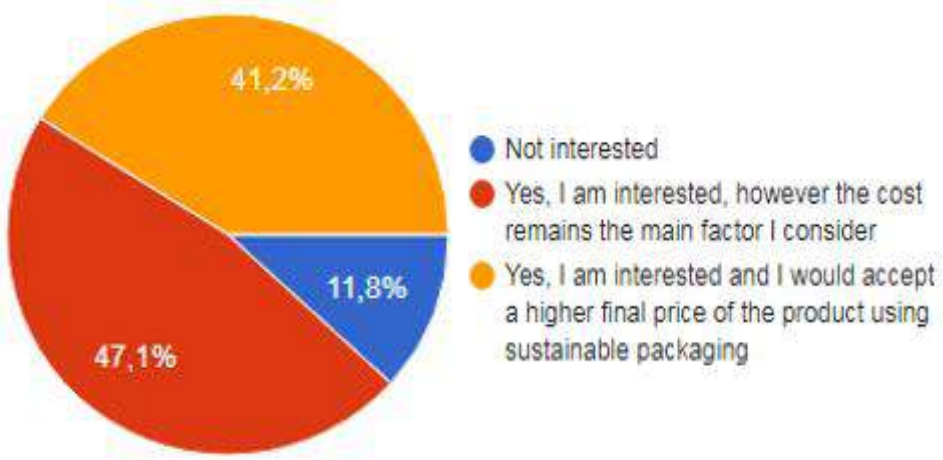
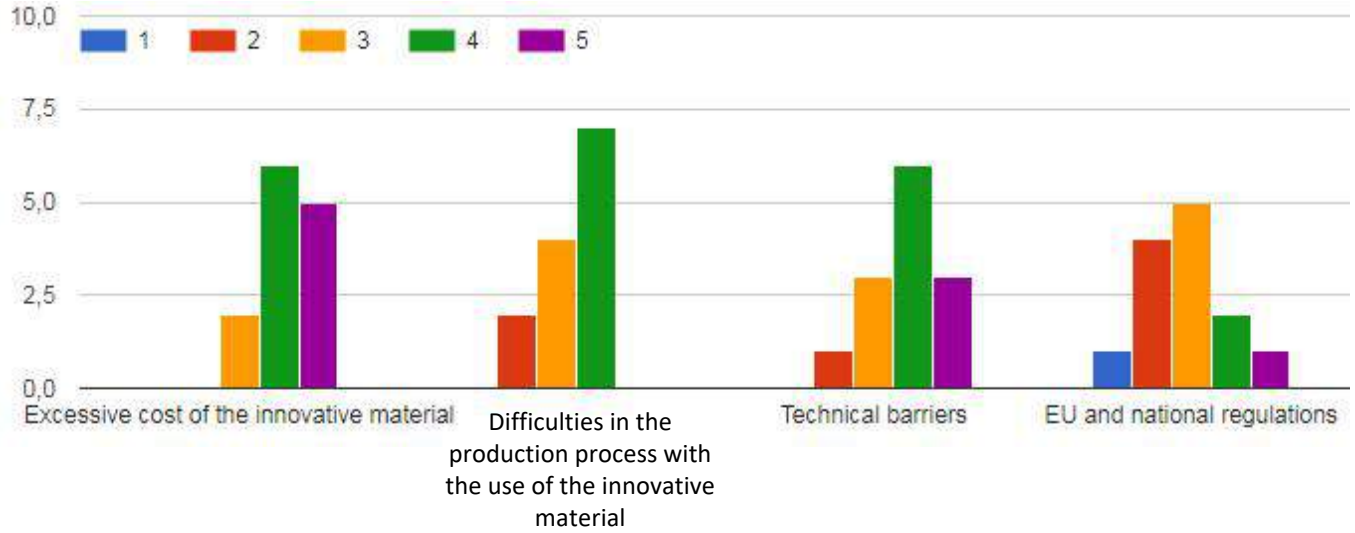
Social LCA

Are you interested in the social benefits deriving by the use of innovative sustainable materials for packaging?



Which are the main obstacles do you identify? (Rate 1-5 for each option, where 1 is the minimum and 5 is the maximum)



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Safe and Sustainable by Design

SSbD is an approach for developing sustainable chemicals and materials with the goal of preventing harm to human health and the environment

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