



# GREEN-LOOP

## **Life Cycle Assessment of the Three GREEN-LOOP Value Chains.**

## **The concept and importance of LCA.**

Rocío Pena. AIMEN. 27/02/2025



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This project has received funding from the European Union's Horizon Europe, grant number 101057765. UK Participants in Horizon Europe Project GREENLOOP are supported by the UK Research and Innovation (UKRI) under the UK government's Horizon Europe funding guarantee, grant number 10038028.



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# GREEN-LOOP

## Sustainability



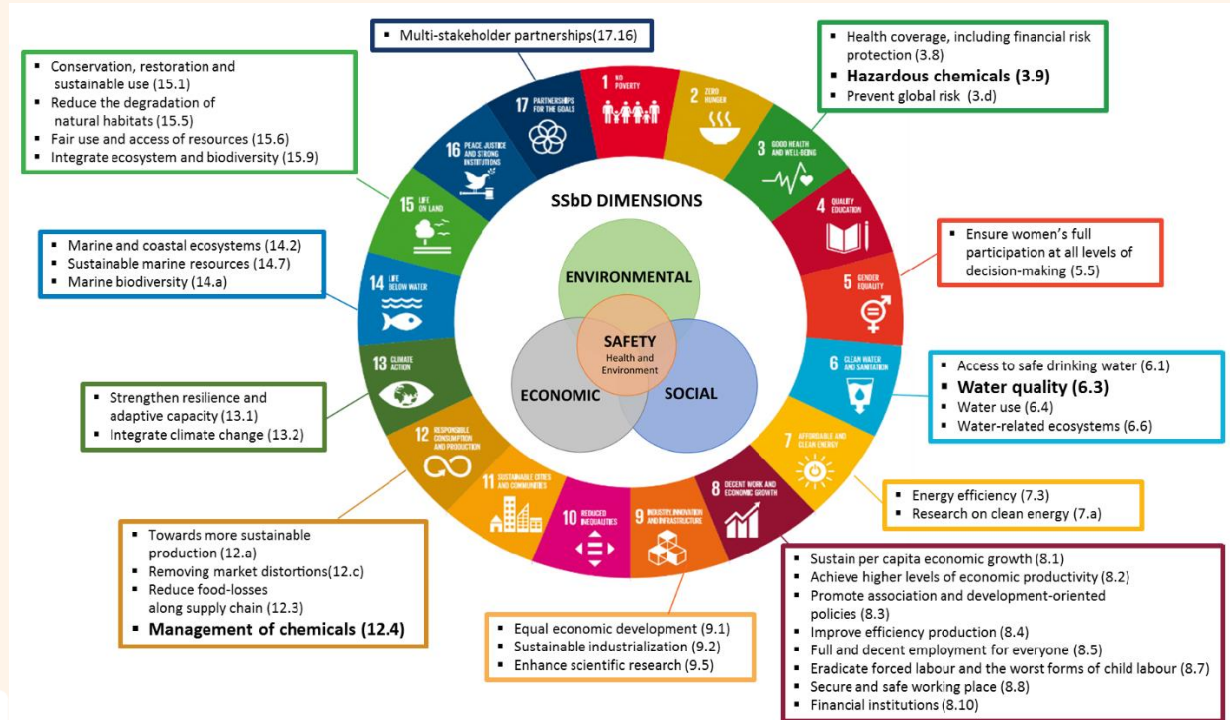
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# Sustainable Development Goals



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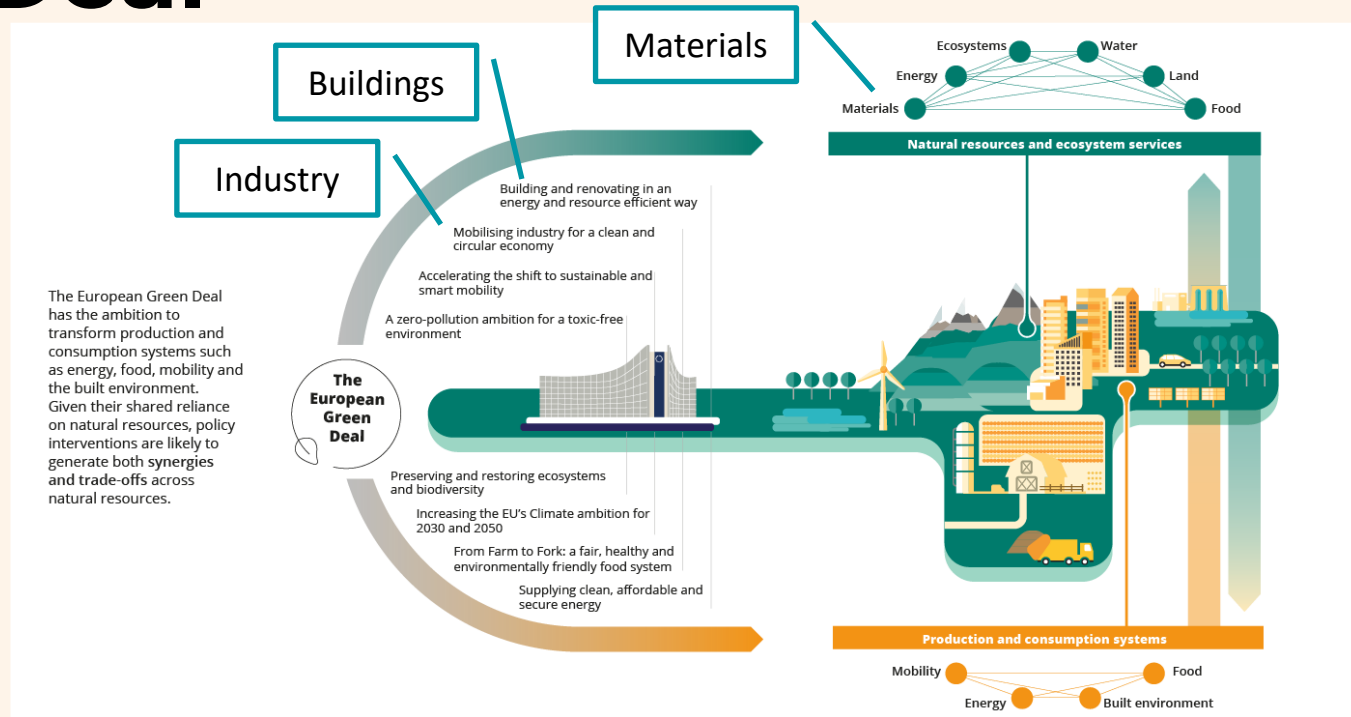
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# Green Deal



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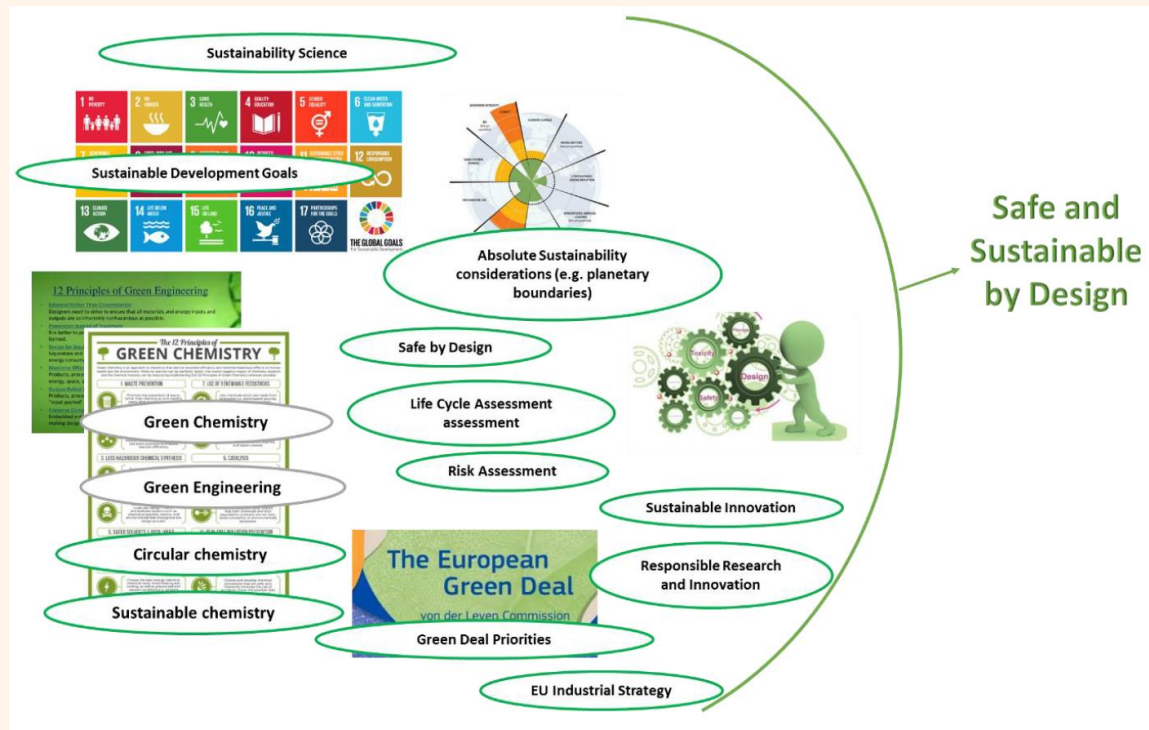
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# Safe and Sustainable by Design



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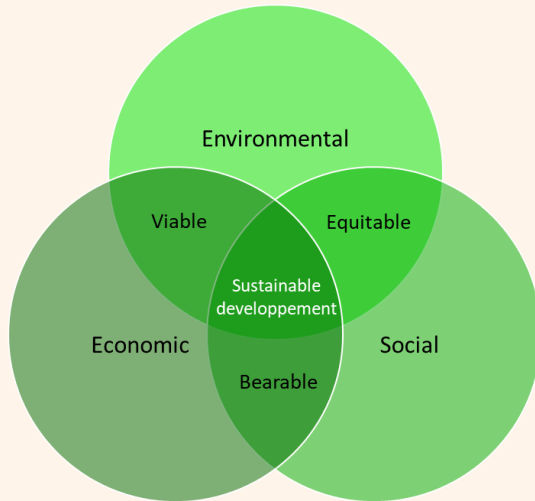


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# Circular economy

## Sustainability:

Sustainable development means meeting the needs of the present whilst ensuring future generations can meet their own needs



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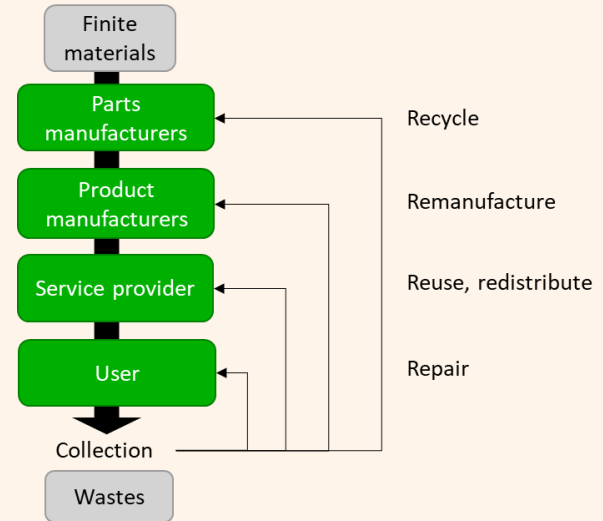


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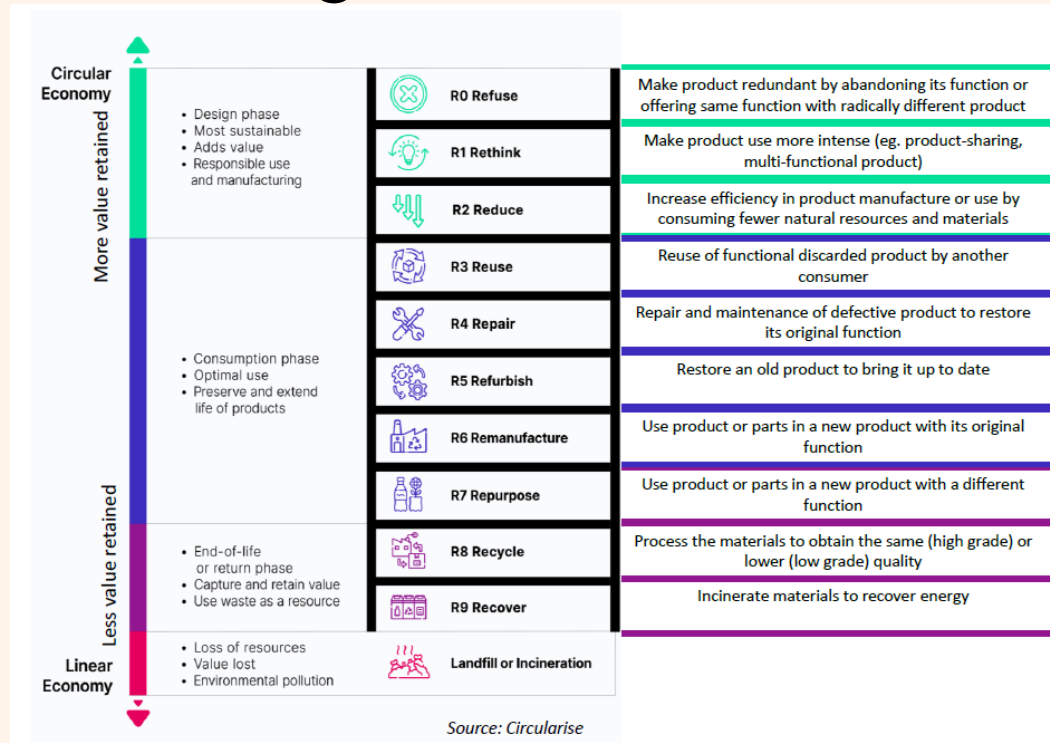
## Circular economy:

An economic system based on business models which replace the "end-of-life" concept with reducing alternatively reusing, recycling and recovering materials to reduce wastes and resources consumption, with the aim to accomplish sustainable development.



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# Circular economy



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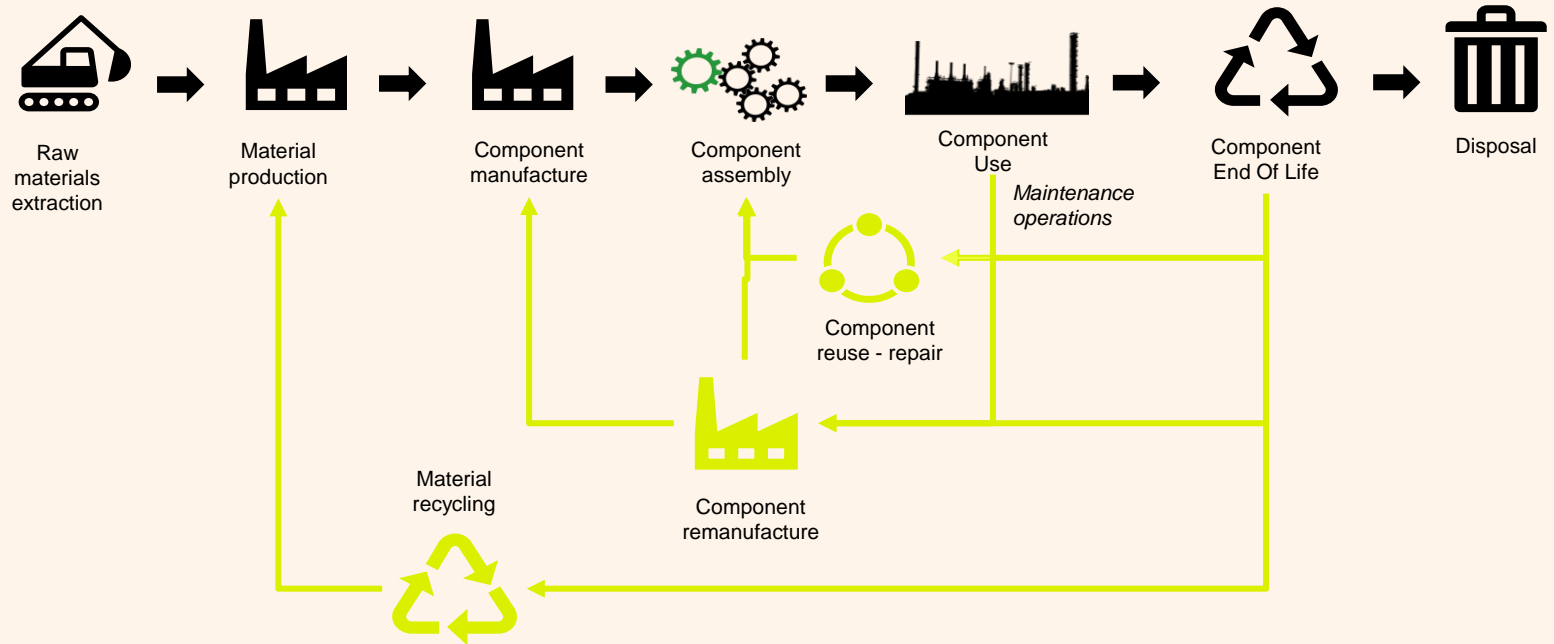
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# Circular economy



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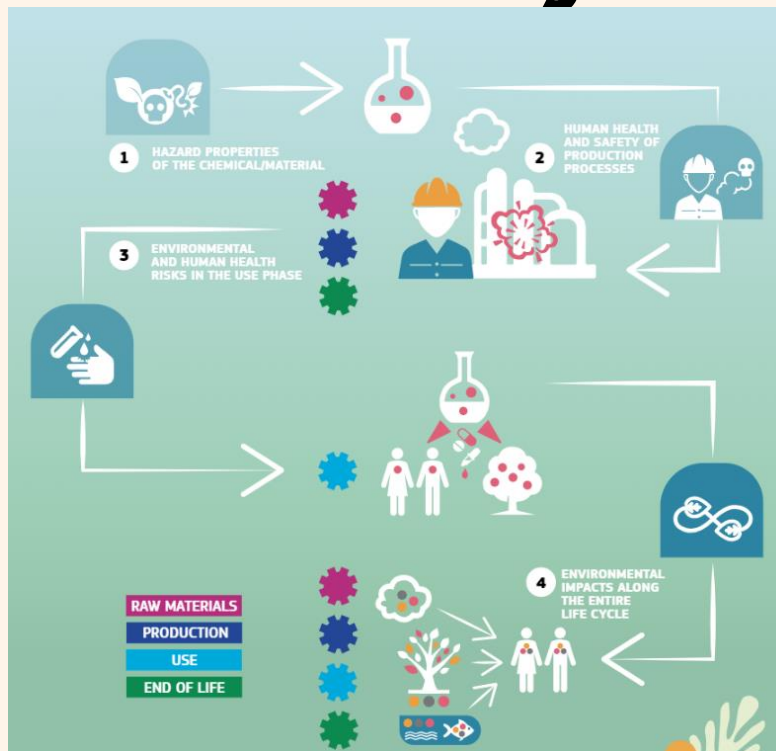
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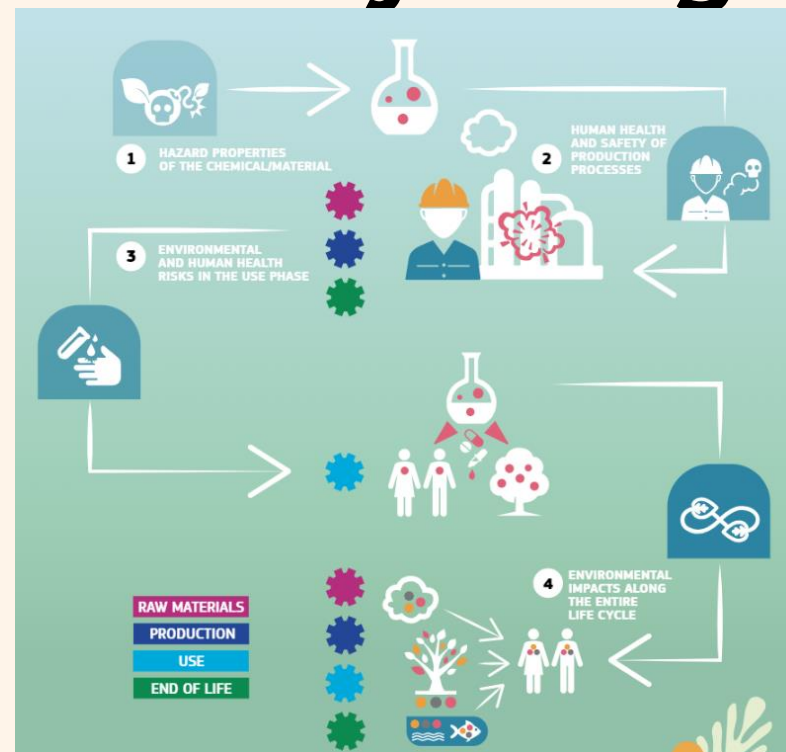
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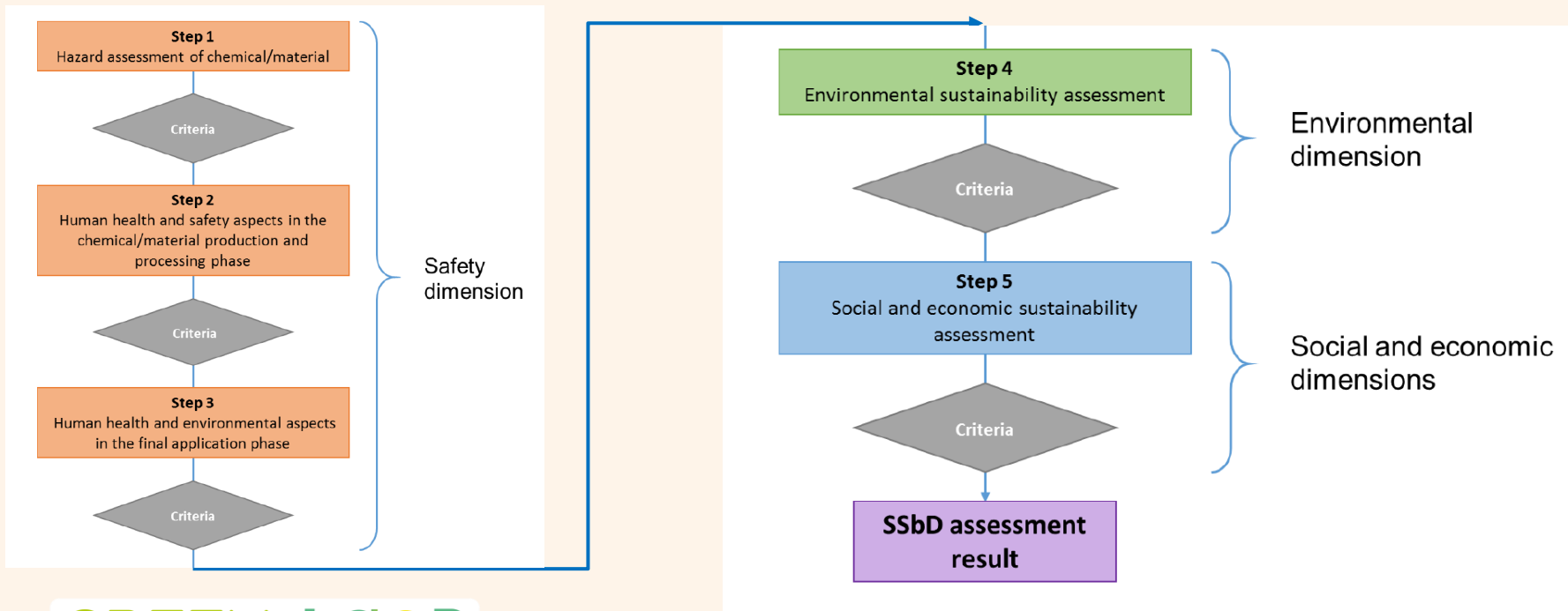
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# Safe and Sustainable by Design



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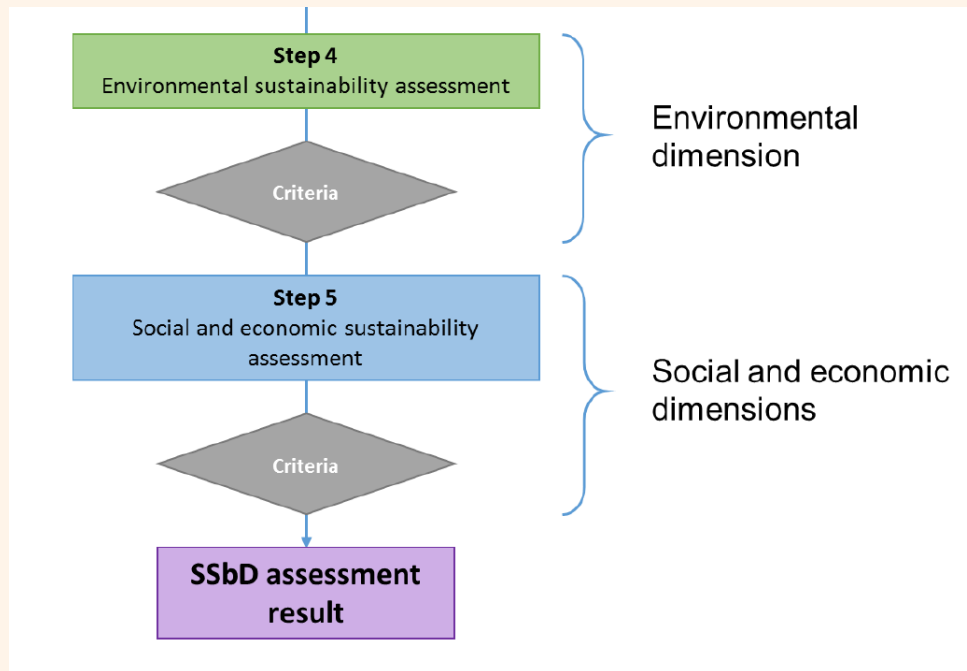
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# Sustainable by Design



- LCA: Life Cycle Assessment



- LCC: Life Cycle Cost assessment
- s-LCA: social Life Cycle assessment

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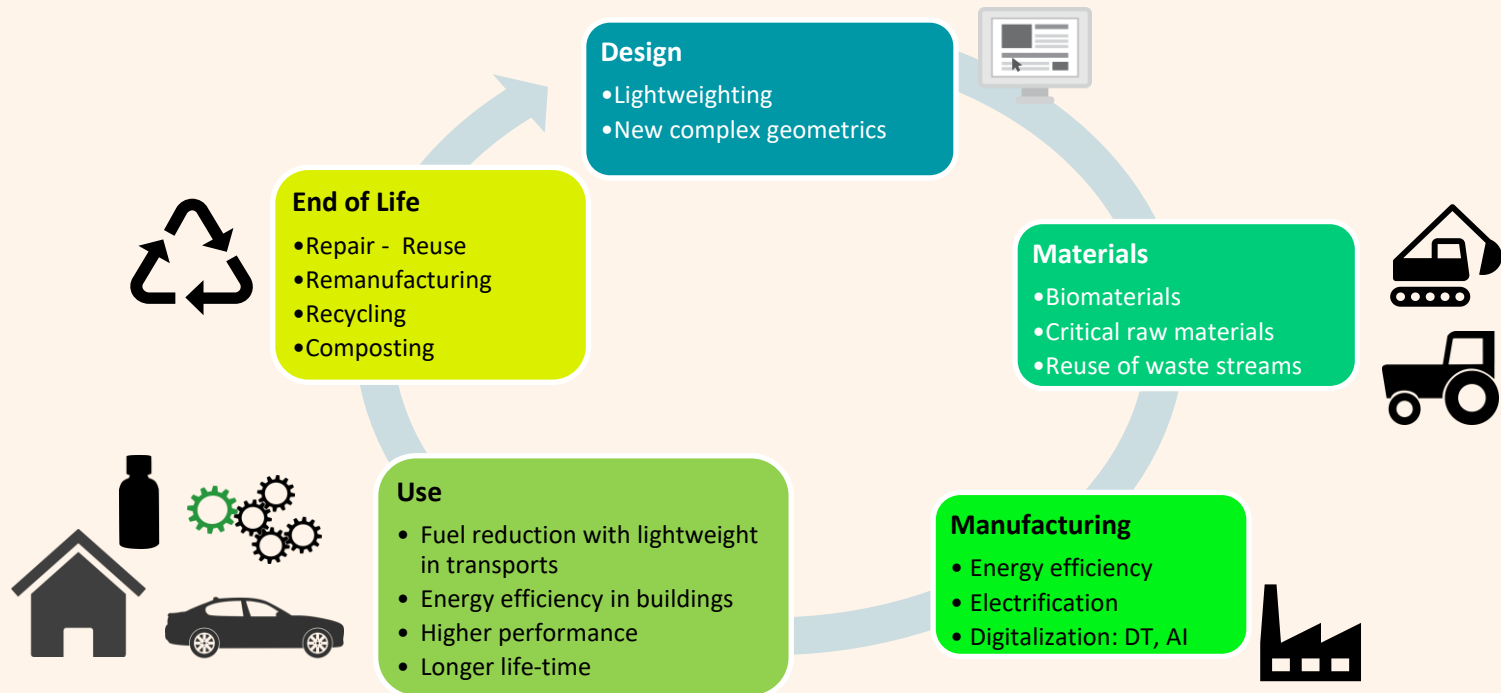
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# Sustainable by Design



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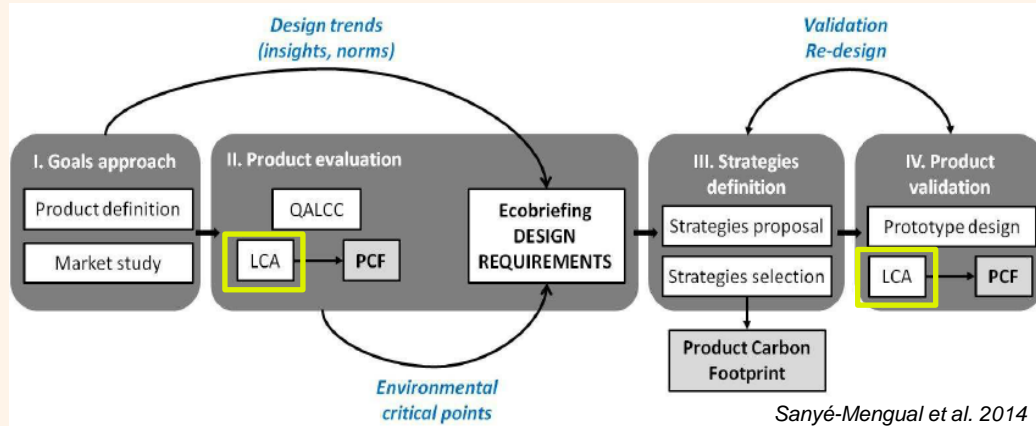
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# Ecodesign

- **Methodology:** ISO 14006 / Regulation (EU) 2024/1781 (ESPR)
- **Objective:** environmental impact reduction in all life cycle stages



- R&D results: Recommendations & evaluation impact reduction



# Life Cycle Assessment



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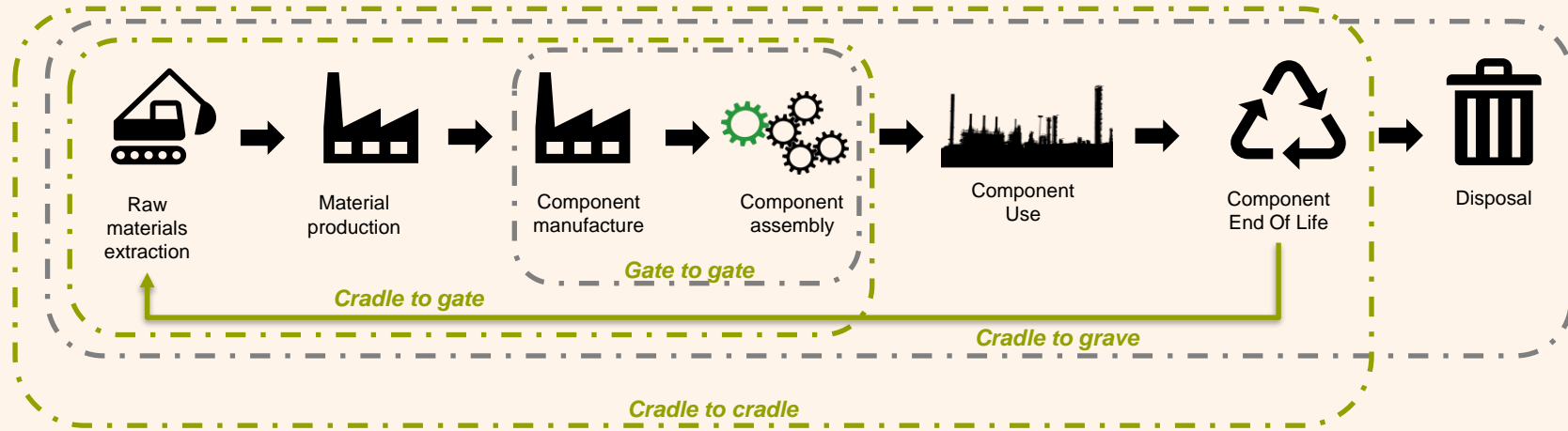
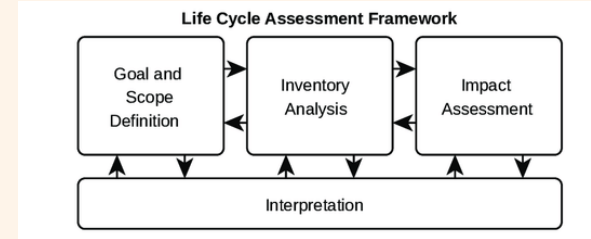
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# LCA Methodology

- **Goal, definition:** system limits, blocks diagram, functional unit
- **Examples of functional unit:** 1 component / 1 kg material
- **Scope:** Cradle to grave / Cradle to gate / Cradle to gate with End-of-Life



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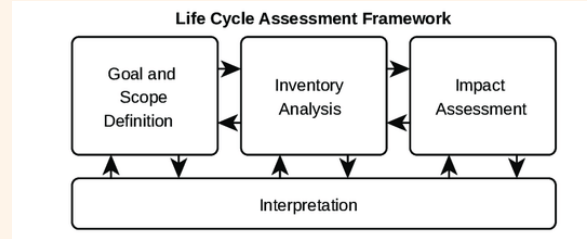


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# LCA Methodology

## Step 4

Environmental sustainability assessment



- **Methodology:** ISO14040 / ILCD Handbook
- **Impact method:** Environmental footprint EF3.1 (includes carbon footprint)

SimaPro

ecoinvent

- Methodology for product or process environmental impact assessment, taking into account all life cycle.
- Comparison current production process vs. new process/product
- Scope: cradle to grave / cradle to door

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Carbon footprint  
(kg CO<sub>2</sub>eq)



International Development Research Network, 2023



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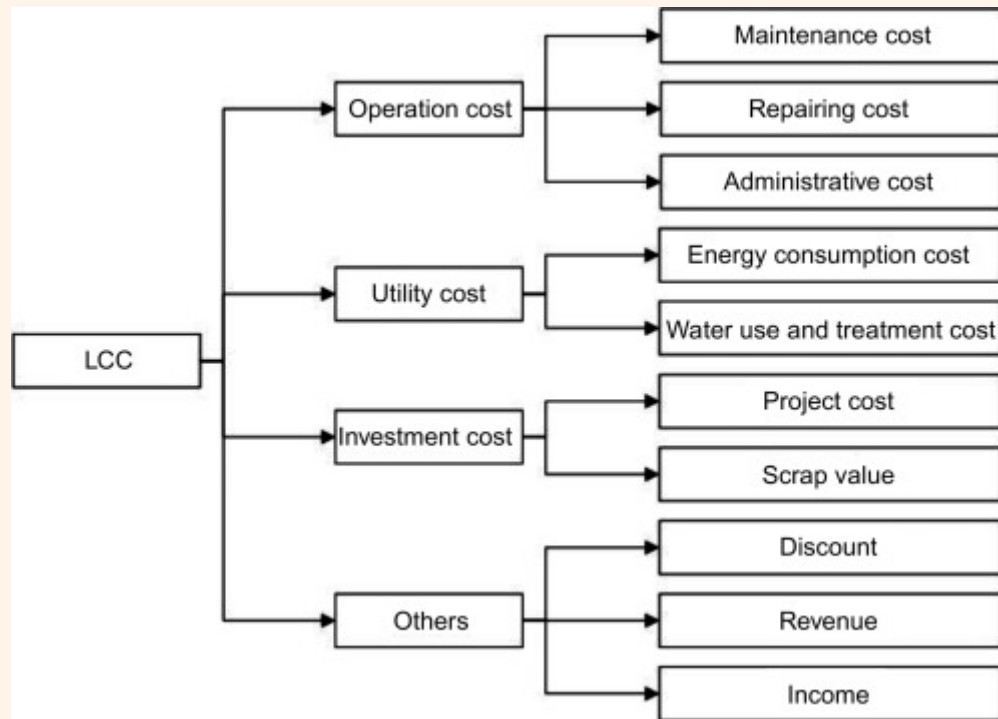
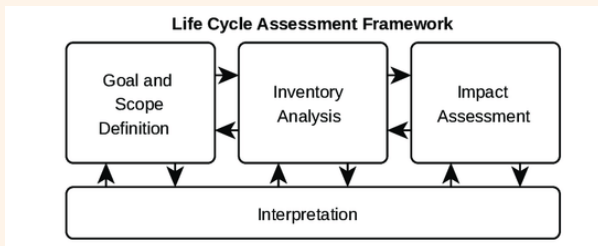
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# LCC Methodology

## Step 5

Social and economic sustainability assessment

- **Methodology:** SETAC / EN 60300
- **Net present value (NPV)** calculation
- Environmental externalities: eLCC



- Comparison current production process vs. new one
- Scope: cradle to grave / cradle to door

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# sLCA Methodology

## Step 5

Social and economic sustainability assessment

- **Methodology:** UNEP
- Potential positive/negative impacts social/sociological aspects



SimaPro

PSILCA 

- Social impact examples: labour conditions, equal opportunities; health & safety; gender dimension
- Comparison current production process vs. new one
- Scope: cradle to grave / cradle to door

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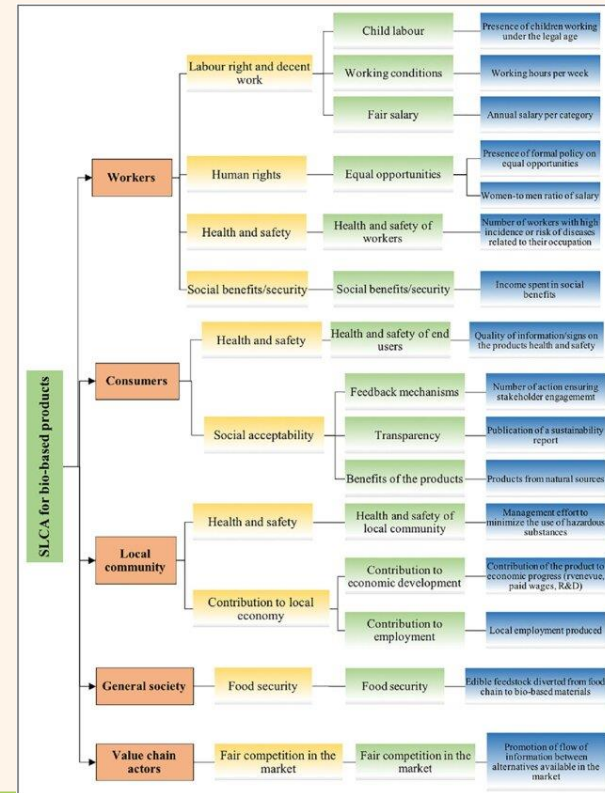


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### LCA Methodology

Methodology: ISO14040 / ILCD Handbook. Impact method: Environmental footprint EF3.1 (includes carbon footprint)

AIMEN tools: SIMAPRO 9 / ECOINVENT 3.6

Methodology for product or process environmental impact assessment, taking into account all life cycle

Comparison current production process vs. New process/product

Scope: cradle-to-grave / cradle-to-door

### LCC Methodology

Methodology: SETAC / EN 60300. Net Value Present (NVP) calculation

AIMEN tools: Excel / SIMAPRO / ECOINVENT / Cost Databases

Environmental externalities (eLCC)

### sLCA Methodology

Methodology: UNEP. Potential positive/negative impacts social/sociological aspects

AIMEN tools: SIMAPRO / ECOINVENT / PSILCA

Social impact examples: labour conditions, equal opportunities; health & safety; gender dimension



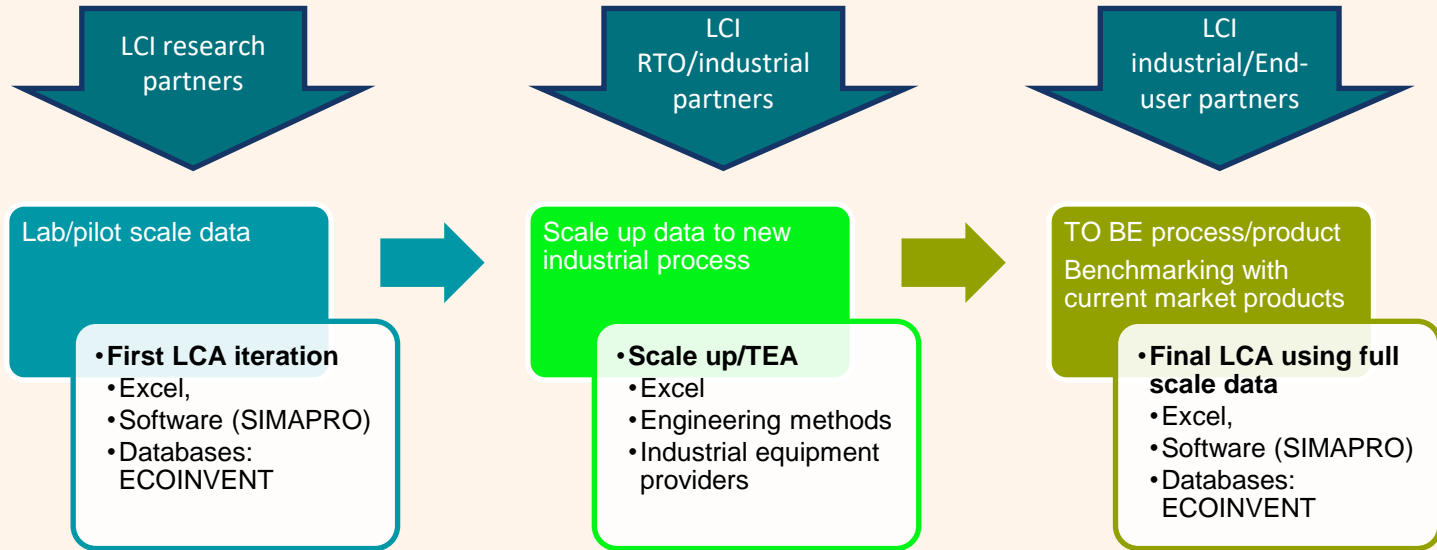
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# LCA Methodology



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# LCI Life Cycle Inventory

## Re-Manufacture

- Raw material: kg and characterization.
- Material flows
- Energy: electricity/heat (kWh); fuel/gas (m3)
- Factory waste (kg)
- Equipment (capacity & cost)
- Labour (LCC & sLCA)
- ...

## Use phase:

*Improve characteristics vs. conventional products*

- Longer life
- Higher efficiency

## End-of-Life

- Remanufacturing
- Reuse
- Recycling



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# LCI Life Cycle Inventory

Phase	1	2	3	4	5	6	7	8	9	
Phase description	No.	Component/Material name	Type of material (e.g. wood, plastic, recycled)	Menu, index, V/E, CAF	Physical description of component/material based on criteria, location and environmental regulations (technological/scenariological indicators, etc.)	Material characteristics (origin, ingredients, method of manufacture, etc.)	Percentage content of component(s) [%]	Amount supplied to this process phase	Source of origin, Provider, Supplier (e.g. name, address, contact details, etc.)	Component cost (€/kg)

Phase	10	11	12	13	14	15	16	17	18
Product name / Intermediate product name	CFR name	Menu, index, V/E, CAF	Material characteristics (origin, ingredients, method of manufacture, etc.)	Percentage content of component(s) [%]	Production yield in the process (t/t)	Amount of material/intermediate product needed to produce the final product	The amount of intermediate product needed to produce the final product	Product sale price (€/kg) (Net recovery for intermediate product)	Additional comments
Waste Name	CFR name	Menu, index, V/E, CAF	Material characteristics (origin, ingredients, method of manufacture, etc.)	Percentage content of component(s) [%]	Waste yield in the process (Phase) (t/t)	The amount of waste generated in the process of manufacturing the final product	Waste treatment /disposal cost (€/kg)	Additional comments	

## ENERGY REQUIREMENTS

No.	Equipment	Description	Brand, model	Power (kW)	Operation time (h)	Energy consumption (kWh)	Energy cost (€/kWh)	Fuel	Fuel consumption	Energy cost (€/kg or L / kg produced)	Equipment Cost	Equipment Lifetime (years)	Comments
1				Nominal power (kW)	Operation time, capacity (h/kg produced)	Energy consumption (kWh/kg)	Electricity cost (€/kWh)	Fuel (natural gas, diesel, ...)	Fuel consumption (kg or L / kg produced)	Fuel cost (€/kg or L of fuel)	Equipment cost (€)	Equipment Lifetime (years)	Additional comments




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# LCA Results in R&D



## Decision support tool to next steps in development:

- Identification of bottlenecks: need to new developments
- Identification of hotspots: more effort to achieve higher efficiency (energy, materials)
- Selection of alternatives: process, raw materials,...
- Strategies in design and manufacture phases
- Circular economy: End-of-life scenarios

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Rocío Pena AIMEN [rpena@aimen.es](mailto:rpena@aimen.es)

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