Engage 4BIO

Educating Life Cycle Thinking: LCA for Sustainable Bioproduct Innovation

14.3.2025

https://www.engage4bio.eu/

Content of this presentation

- Skills for sustainable innovations according Green Comp
- Description of the whole “the Life cycle of sustainable packaging” –course
- Life cycle assessment, LCA & Life cycle thinking, LCT – section in the course
- Circular economy and future of packaging –section in the course
- Learning outcomes from LCA from the perspective of sustainable innovations

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GreenComp is a European framework defining essential sustainaility competencies.

The objective of it is to empower citizens for the green transition and a sustainable future.

It is developed by European commission 2022.

It is ment to education and training at all levels.

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The four competence areas of GreenComp are:

- Embodying sustainability values
- Embracing complexity in sustainability
- Envisioning sustainable future
- Acting for sustainability

Embodying sustainability values and embracing complexity

AREA	COMPETENCE	DESCRIPTOR
1. Embodying sustainability values	1.1 **Valuing sustainability**	To reflect on personal values; identify and explain how values vary among people and over time, while critically evaluating how they align with sustainability values.
	1.2 **Supporting fairness**	To support equity and justice for current and future generations and learn from previous generations for sustainability.
	1.3 **Promoting nature**	To acknowledge that humans are part of nature; and to respect the needs and rights of other species and of nature itself in order to restore and regenerate healthy and resilient ecosystems.
2. Embracing complexity in sustainability	2.1 **Systems thinking**	To approach a sustainability problem from all sides; to consider time, space and context in order to understand how elements interact within and between systems.
	2.2 **Critical thinking**	To assess information and arguments, identify assumptions, challenge the status quo, and reflect on how personal, social and cultural backgrounds influence thinking and conclusions.
	2.3 **Problem framing**	To formulate current or potential challenges as a sustainability problem in terms of difficulty, people involved, time and geographical scope, in order to identify suitable approaches to anticipating and preventing problems, and to mitigating and adapting to already existing problems.

Envisioning sustainable futures and Acting for sustainability

AREA	COMPETENCE	DESCRIPTOR
3. Envisioning sustainable futures	3.1 **Futures literacy**	To envision alternative sustainable futures by imagining and developing alternative scenarios and identifying the steps needed to achieve a preferred sustainable future.
	3.2 **Adaptability**	To manage transitions and challenges in complex sustainability situations and make decisions related to the future in the face of uncertainty, ambiguity and risk.
	3.3 **Exploratory thinking**	To adopt a relational way of thinking by exploring and linking different disciplines, using creativity and experimentation with novel ideas or methods.
4. Acting for sustainability	4.1 **Political agency**	To navigate the political system, identify political responsibility and accountability for unsustainable behaviour, and demand effective policies for sustainability.
	4.2 **Collective action**	To act for change in collaboration with others.
	4.3 **Individual initiative**	To identify own potential for sustainability and to actively contribute to improving prospects for the community and the planet.

The life cycle of sustainable packaging / Open course

General

Introduction

Life cycle assessment LCA and life cycle...

Sustainable supply chain

Packaging design process

Packaging regulations

Packaging materials (Bioplastics)

Sorting, recycling and reuse

Circular economy and future of packa...

Key content of the course

The course consists of seven study sections, which introduce you to the different dimensions of sustainability in packaging life cycle.

1. Life cycle assessment LCA and life cycle thinking LCT
2. Sustainable supply chain
3. Packaging design process
4. Packaging regulations
5. Packaging materials (bioplastics)
6. Sorting, recycling and re-use
7. Circular economy and future of packaging

The material in each section will be studied independently. Each section contains the material to be studied in a PDF format. The material contains text material, pictures and links to videos. In addition, there are links to additional material to deepen your knowledge according to your own interests. The sources for the course are listed in the material.

Each section includes a questionnaire, which requires 100% correct answers for successful completion.

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The life cycle of sustainable packaging

Life-cycle assessment LCA

&

Life cycle thinking LCT

Riitta Lehtinen

10/2024

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Learning outcomes

After completing the life cycle assessment LCA and the life cycle thinking -section of the course

- The students can describe the three dimensions of sustainable development (ecological, social and economic).
- The students outlines the three dimensions of sustainable development as a systemic whole and can argue the interdependencies between them.
- The students are able to look at the environmental impacts of human activities.
- They know what life cycle assessment and life-cycle thinking mean.
- They have an understanding of how life cycle assessment can be used to assess the environmental impacts of products and services and human activities in general.

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Agenda 2030

All United Nations members 2015 (193 in total) created these 17 goals with the aim “peace and prosperity for people and the planet”.

17 Goals to Transform Our World

The Sustainable Development Goals are a call for action by all countries – poor, rich and middle-income – to promote prosperity while protecting the planet. They recognize that ending poverty must go hand-in-hand with strategies that build economic growth and address a range of social needs including education, health, social protection, and job opportunities, while tackling climate change and environmental protection.

Source: https://www.un.org/sustainabledevelopment/

Image: https://www.un.org/sustainabledevelopment/news/communications-material/

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Life cycle assessment LCA

LCA studies help to avoid resolving one environmental problem while creating others. Life Cycle Assessment is therefore a powerful decision support tool necessary to make consumption and production more sustainable.

LCA quantifies all relevant emissions and resources consumed and the related environmental and health impacts and resource depletion issues that are associated with any goods or services.

Life Cycle Assessment considers a product's full life cycle: from the extraction of resources, through production, use, and recycling, up to the disposal of remaining waste.

Image: Adobe Stock By Parradee

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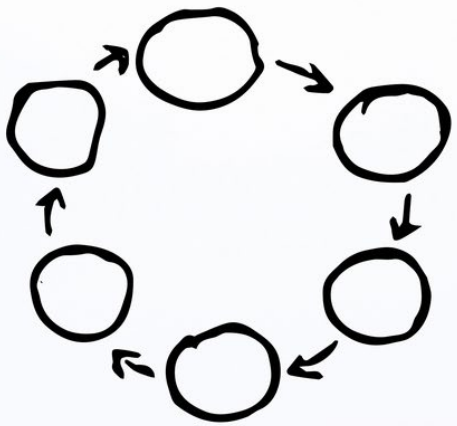
Instructions for making a life cycle analysis LCA



Adobe Stock By Song_about_summer

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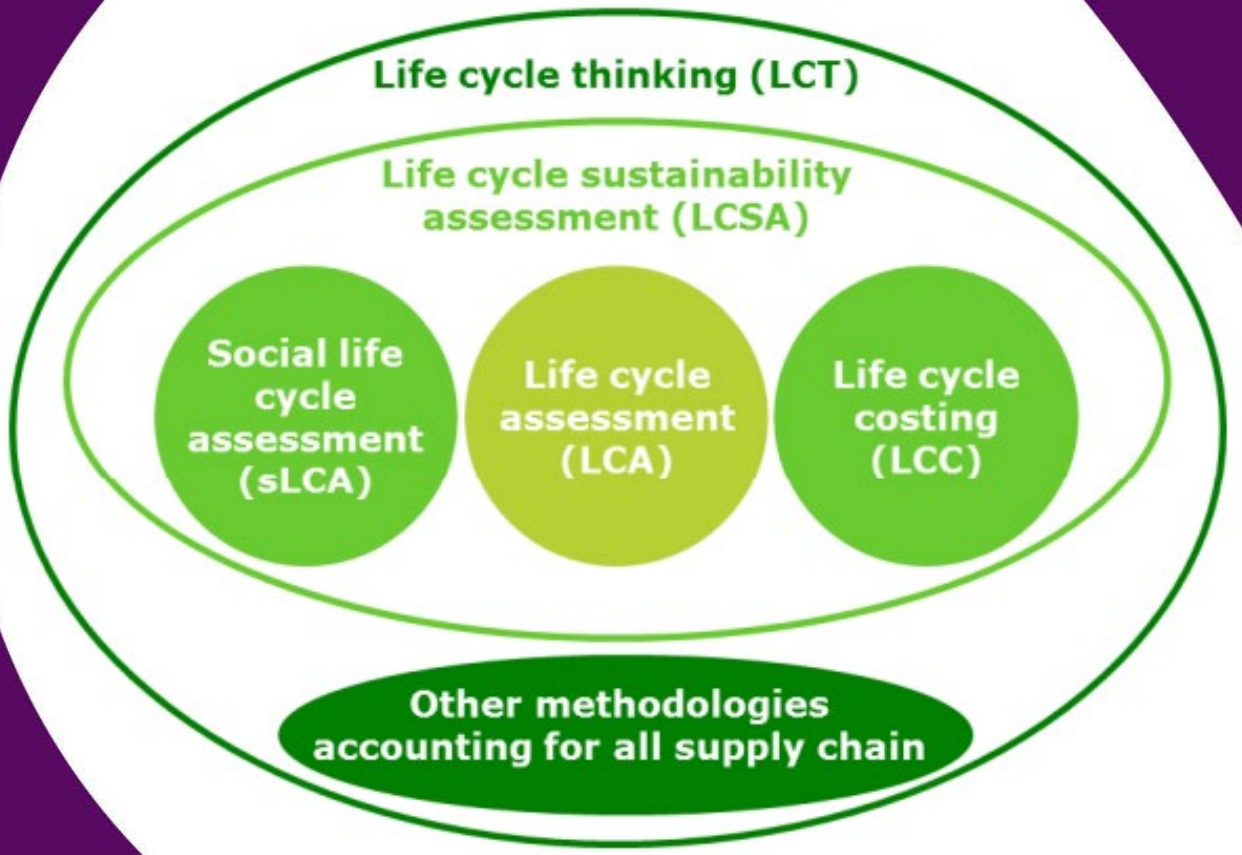
Life cycle thinking

When life cycle assessments consider not only environmental impacts but also social and economic effects, it is referred to as life cycle thinking.

Take a look at 3 minutes video about life cycle thinking:

Intro to Life Cycle Thinking https://youtu.be/ZYP0AGbY2X4



Source: https://www.lifecycleinitiative.org/activities/e-learning-modules/

Image: Sala, S. & Reale, F. & Cristopal-Garcia, J. & Marelli, L. & Pant, R. 2016. Life cycle assessment for the impact assessment of policies, JRC Technical Report, European Commission.

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Benefits of life cycle approaches

At a macro level, life cycle approaches avoid shifting problems from one life cycle stage to another, from one geographic area to another and from one environmental medium (for example air quality) to another (for example water or land).

At a micro level, they enable individuals (e.g., product designers, service providers, government agents) to make choices for the longer term and with consideration of all environmental media (i.e., air, water, land).

The impacts of all life cycle stages need to be considered comprehensively by citizens, companies and governments, when they make decisions on consumption and production patterns, policies and management strategies!

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The life cycle of sustainable packaging

Future of packaging

Riitta Lehtinen, Mari Hiljanen &
Veera Tolonen
12/2024

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Learning outcomes

After completing this module

- The students understand, what is circular economy's vision and how ecological, social and economic sustainable development are linked to each other.
- They know what the six principles of circular economy are and can name some examples of them.
- They know what the four reuse models for packaging are.

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Circular economy vision

The long-term vision of a circular economy is, by design, to provide appropriate solutions for the reduced, efficient and effective use of resources, and to prevent harmful releases, losses and environmental degradation when meeting societal needs.

Under this vision, social and economic growth are decoupled from resource consumption. This is done by reducing waste, extending the productive life of resources, maximizing recovered resources, maintaining them at their highest value and keeping the inflow of virgin resources as low as possible, in particular non-renewable resources. Natural resources are managed sustainably in a way that protects and contributes to the regeneration of ecosystems.

Source: SFS-ISO 59004:2024:en Circular economy — Vocabulary, principles and guidance for implementation

Image: Adobe Stock by Pornarun

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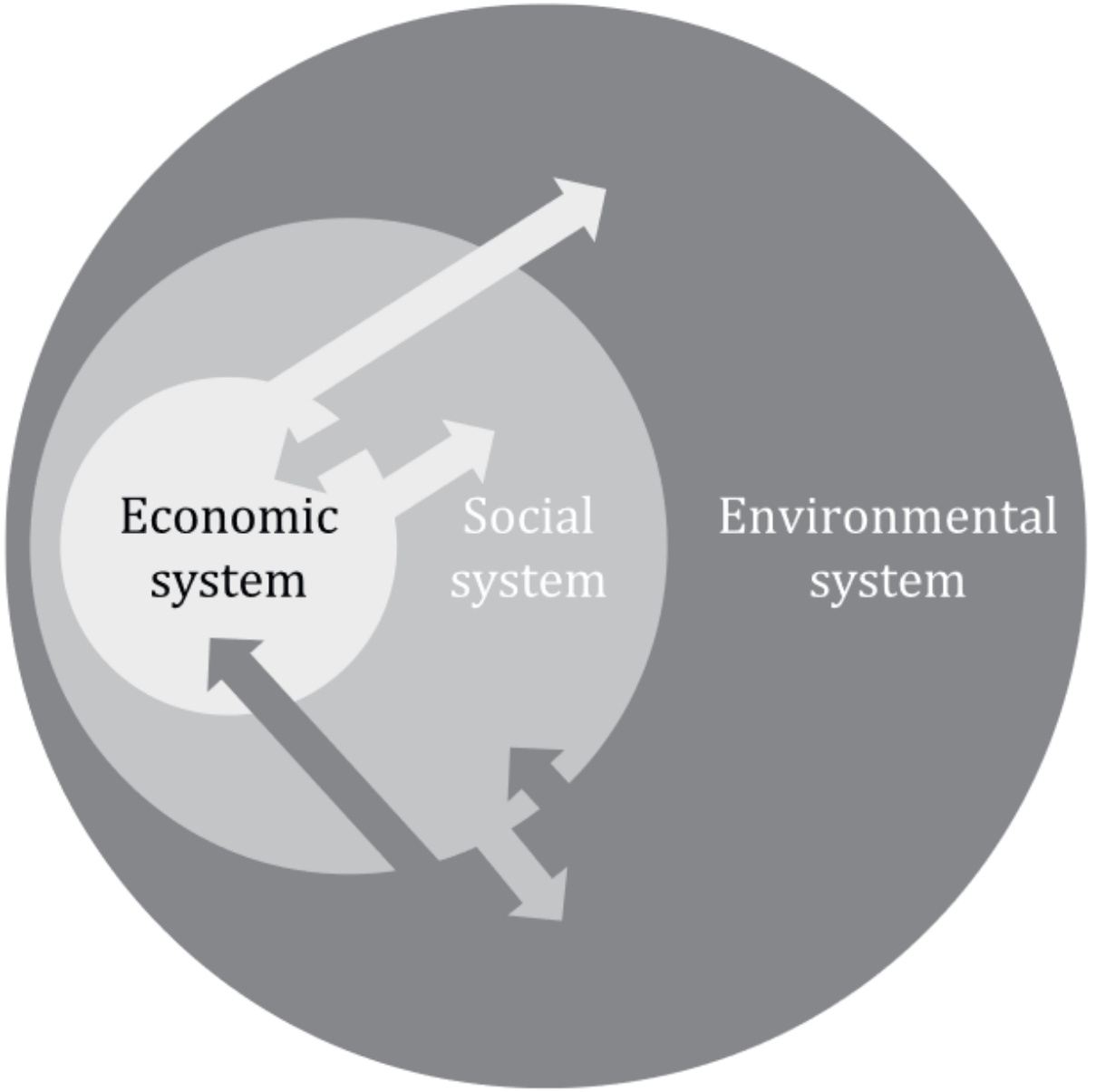
Circular economy principles

In understanding the circular economy principles, it is important that the organization considers environmental, social and economic systems and their interactions (adjacent image).

The economic system is understood as embedded into the social system, and both are relying on and embedded into the environmental system.

The set of circular economy principles are interlinked and complementary and they should be considered by an organisation to transition towards a circular economy.



Source: SFS-ISO 59004:2024:en Circular economy — Vocabulary, principles and guidance for implementation

Illustration of the interactions between the environmental, social and economic systems.
Image: SFS-ISO 59004:2024:en

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Six circular economy principles

1. System thinking
Organizations take a life cycle perspective and apply a long-term approach when considering their impacts on environmental, social and economic systems.

2. Value creation
Organizations recover, retain or add value by providing effective solutions that contribute to socio-economic and environmental value, and use resources in an efficient way.

3. Value sharing
Organizations collaborate with interested parties along the value chain or value network in an inclusive and equitable way, for the benefit and well-being of society, by sharing the value created with the provision of a solution.

4. Resource stewardship
Organizations manage stocks and flows in a sustainable way including by closing, slowing and narrowing resource flows to contribute to resource accessibility and continued availability for present and future generations and to reduce risks associated with dependence on virgin resources.

5. Resource traceability
Organizations collect and maintain data to enable tracking of resources through their value chains and are accountable for sharing relevant information with interested parties.

6. Ecosystem resilience
Organizations develop and implement practices and strategies that protect and contribute to the resilience and regeneration of ecosystems and their biodiversity, including preventing harmful losses and releases and taking into account planetary boundaries.

Source: SFS-ISO 59004:2024:en Circular economy — Vocabulary, principles and guidance for implementation

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Examples for organizations to consider circular solutions

Source: SFS-ISO 59004:2024:en Circular economy — Vocabulary, principles and guidance for implementation

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Packaging industry and innovations & sustainability

Image: Adobe Stock by Suriyo

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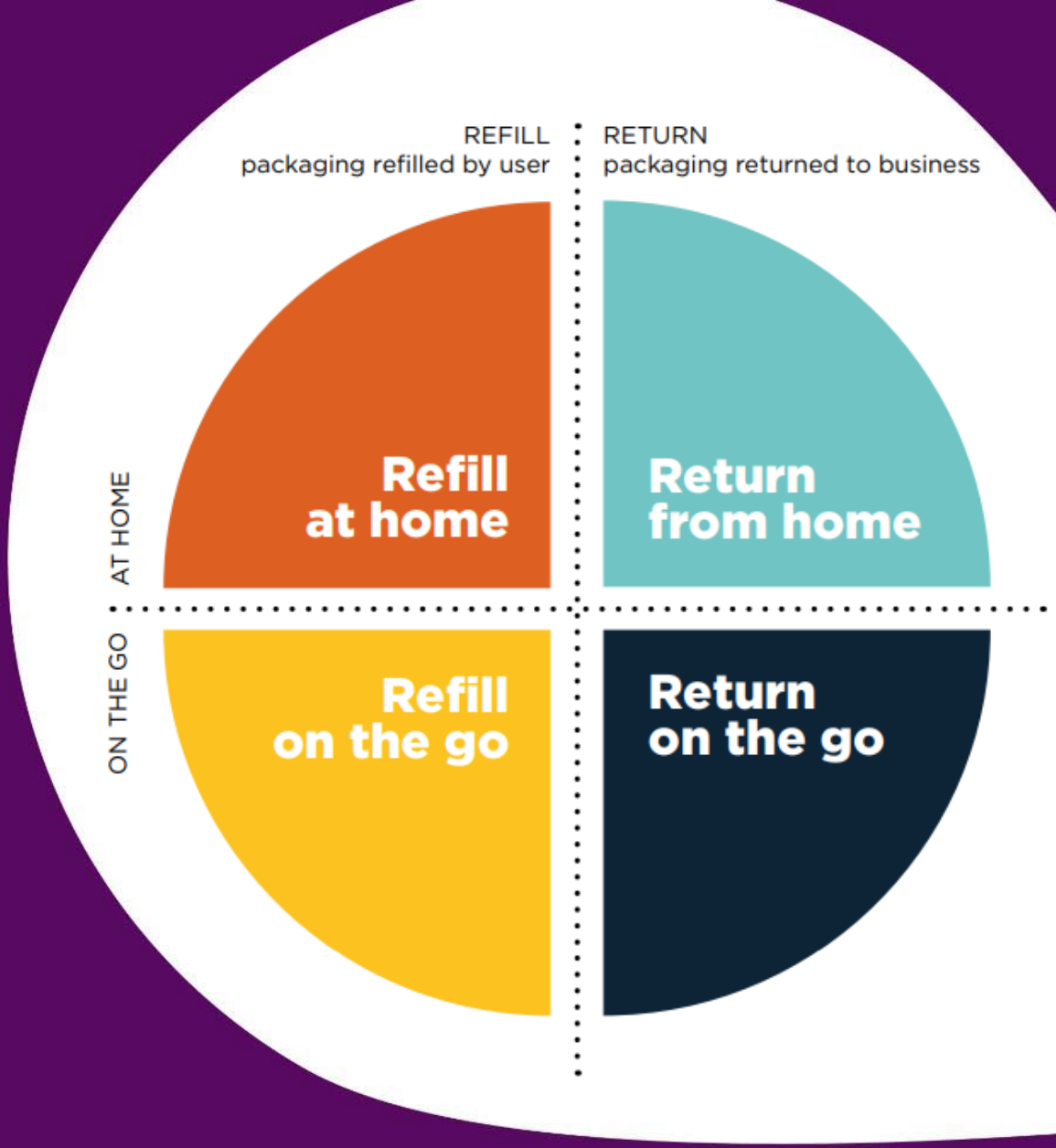
Rethinking packaging: reuse for sustainability

"Reuse presents an innovation opportunity to change the way we think about packaging from something that's simply as inexpensive and light as possible to viewing it as a highvalue asset that can deliver significant benefits to users and businesses."

Reusable packaging offers significant opportunities for both businesses and the environment. Transitioning just 20% of single-use plastic packaging to reusable models represents a market opportunity worth at least USD 10 billion. It also plays a crucial role in reducing plastic waste and advancing the circular economy.



Source: Ellen MacArthur Foundation, Reuse – rethinking packaging (2019).

The four reuse models.
Image: Ellen MacArthur Foundation

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Learning outcomes from the LCA from the perspective of sustainable innovations!

Systems thinking:

- Seeing the big picture.
- Understanding the whole system and the interdependencies of its subsystems.

Critical thinking:

- Assessment of the necessity of the product or service.
- Analysis and the critical examinations of prevailing practices.

Foresight competence and future thinking as well as strategic expertise:

- Ideation on how the entire production chain and/or its parts could be implemented in a more sustainable way than as present.

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