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PackAlliance:
European alliance for innovation training & collaboration towards future packaging

Linking Academy to Industry.

Training program: modules

- **Eco-design & novel manufacturing processing**
- New materials and biomaterials
- Citizen and Consumer Engagement
- Residue management and valorisation

Co-funded by the Erasmus+ Programme of the European Union

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COURSE 2: Packaging Design for Sustainability

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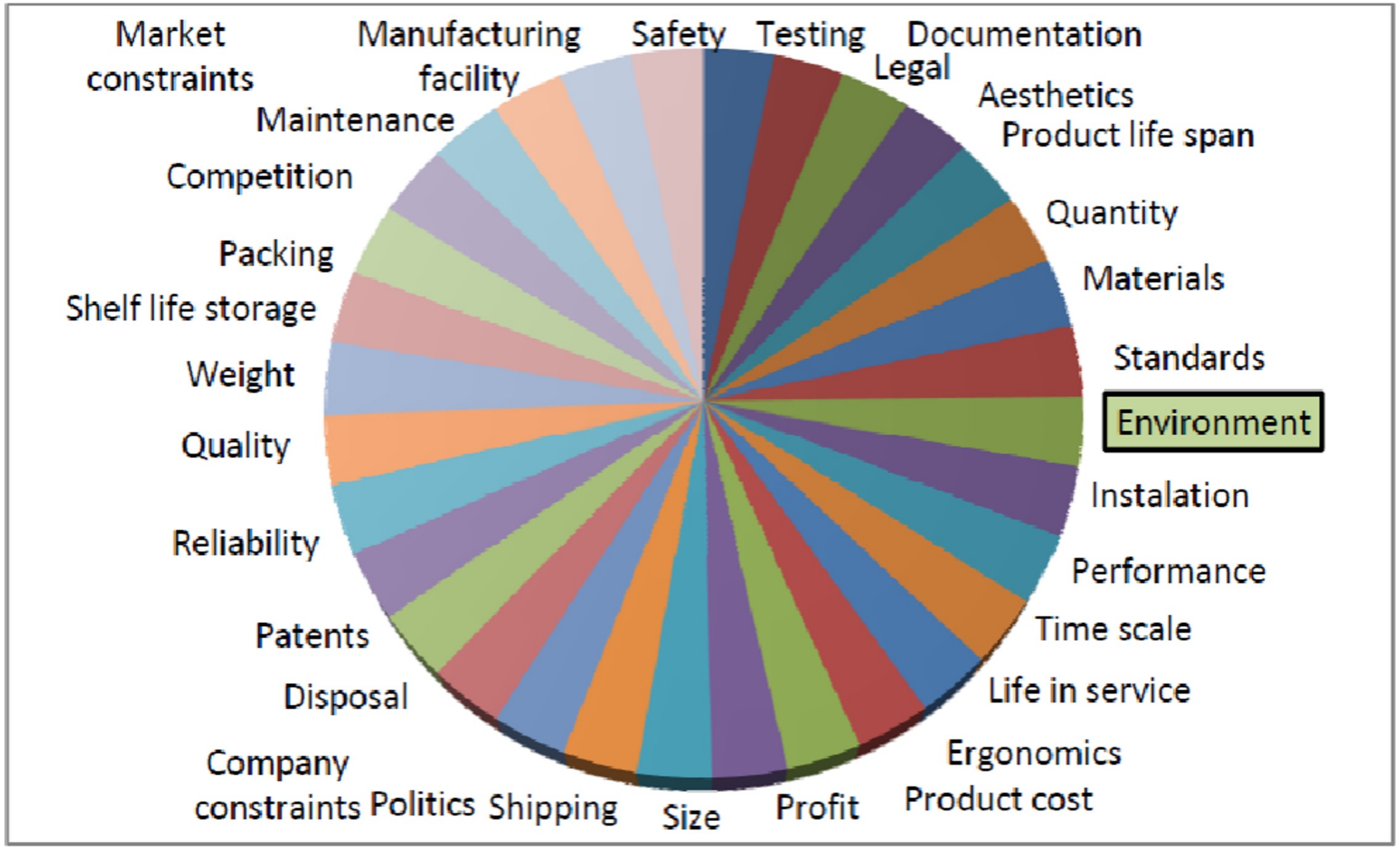
1. Introduction

During product developement process you need to consider several parameters



Luttropp &Lagerstedt, 2006

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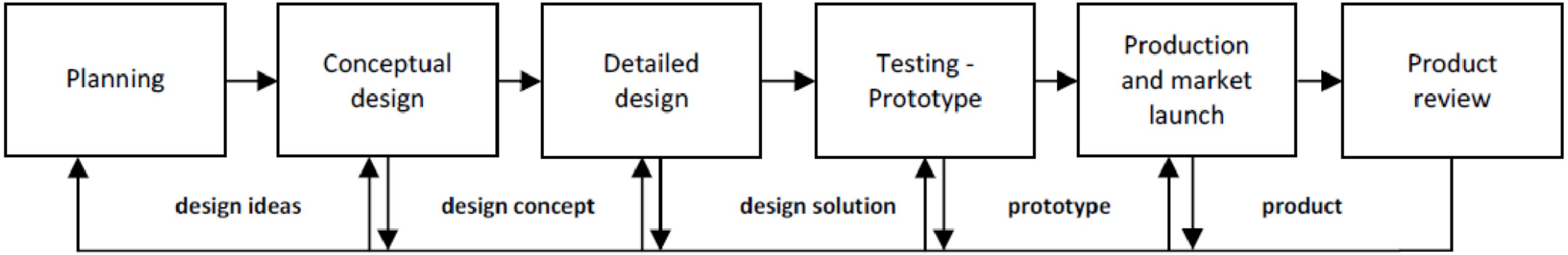

Feedback and continuous improvements:
Evaluation of results against environmental goals, specifications and reference products

The integration of the environmental dimension and evaluation of the environmental performance of the product can be performed at different stages of the product design and development process.

An early evaluation can be very beneficial since the designer has the freedom to make all necessary changes and adjustments to improve the performance of the product

Fonte: Methods and tools for environmentally friendly product design and development www.eco2.vheicledesign.se

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When performing eco-design three main types of trade-off situations are introduced and described in the ISO 14062 standard although a large variety of combinations may exist within these categories:

- Trade-offs between different environmental aspects
- Trade-offs between environmental, economic and social aspects
- Trade-offs between environmental, technical and quality aspects

It can therefore be very important for the companies and more specifically for the product designers and developers to have the means to identify and overcome such situations by evaluating the different options and making the more effective compromises.

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Optimization of products and product systems when applying the eco-design approach may lead to different levels of innovation and efficiency improvements that can be achieved. H. Brezet (1997) suggested a model that presents four levels of eco-design innovation:

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- **Level 1: Product improvement**
  Optimization of existing products by applying incremental changes

- **Level 2: Product redesign**
  The concept of the product remains the same but some of the parts of the product are changed or optimized.

- **Level 3: Function innovation**
  Re-design of the product's concept: new concepts are introduced to fulfil the same function

- **Level 4: System innovation**
  Refers to a holistic innovation of the product system: new products and services are developed.

The level of eco-efficiency in this model increases proportionally with the level of innovation achieved.
It has to be mentioned though that all levels depend also on time which means that greater changes require longer time frames to be achieved and implemented (Brezet H. , 1997).

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List of selected requirements for the eco-design tools

Requirements on methodological and implementation aspects	Requirements on the outcome	Other Requirements
Simple and easy to implement	Provide objective, valid and reliable results	Easy to find and obtain
Time efficient	Provide quantitative results	Low cost
Suitable to be used early in the product development process	Show the optimal direction to the designers	Low set up time requirements
Standardized and uniform		User friendly
Able to support decision making		Low education requirements
		Adjustable to different product and context requirements
		Easy to communicate benefits
		Include easy to understand terms

Sources: (Lofthouse, 2006; Luttropp & Lagerstedt, 2006; Lindahl, 2005; Bras, 1997)

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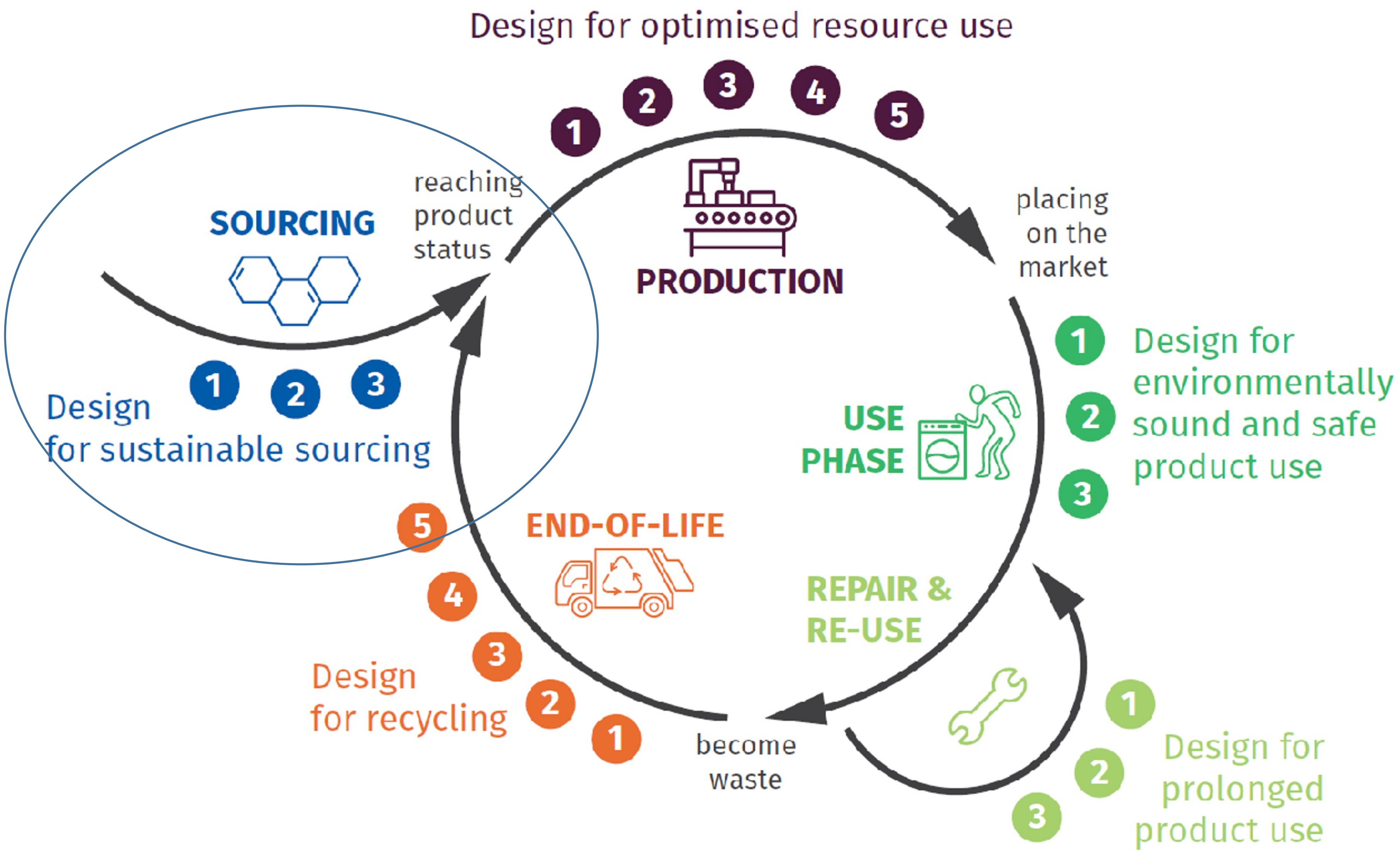

Fonte: Report di European Environmental Citizens' Organisation for Standardisation

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DESIGN for sustainable sourcing

1. Virgin raw materials from sustainably managed production processes

1. Sourcing renewable raw materials from sustainably managed sources

1. Traceable recycled materials as secondary raw materials

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3 Close the loop through recycled content

To date, the only legislative tool that foresees mandatory recycled plastic content targets is the recently adopted Single Use Plastics Directive. Minimum recycled content requirements should be introduced widely to allow for multiple lives for recycled plastics. The traceability and verification of recycled content should be ensured through the development of reliable tools based on third-party assessment.

4 Focus on chemicals for circular products and materials

Addressing chemicals in plastic requires a structured policy focus. Substances of concern should be excluded more systematically through a circular approach to product policy and REACH regulation (Registration, Evaluation, Authorisation and Restriction of Chemicals). Information on additives in plastic should be gathered and used to make more informed design decisions to reduce exposure to harmful substances. Strict chemical content limits should be part of end-of-waste criteria for plastic and quality requirements for recycled plastic.

Fonte: Report di European Environmental Citizens' Organisation for Standardisation

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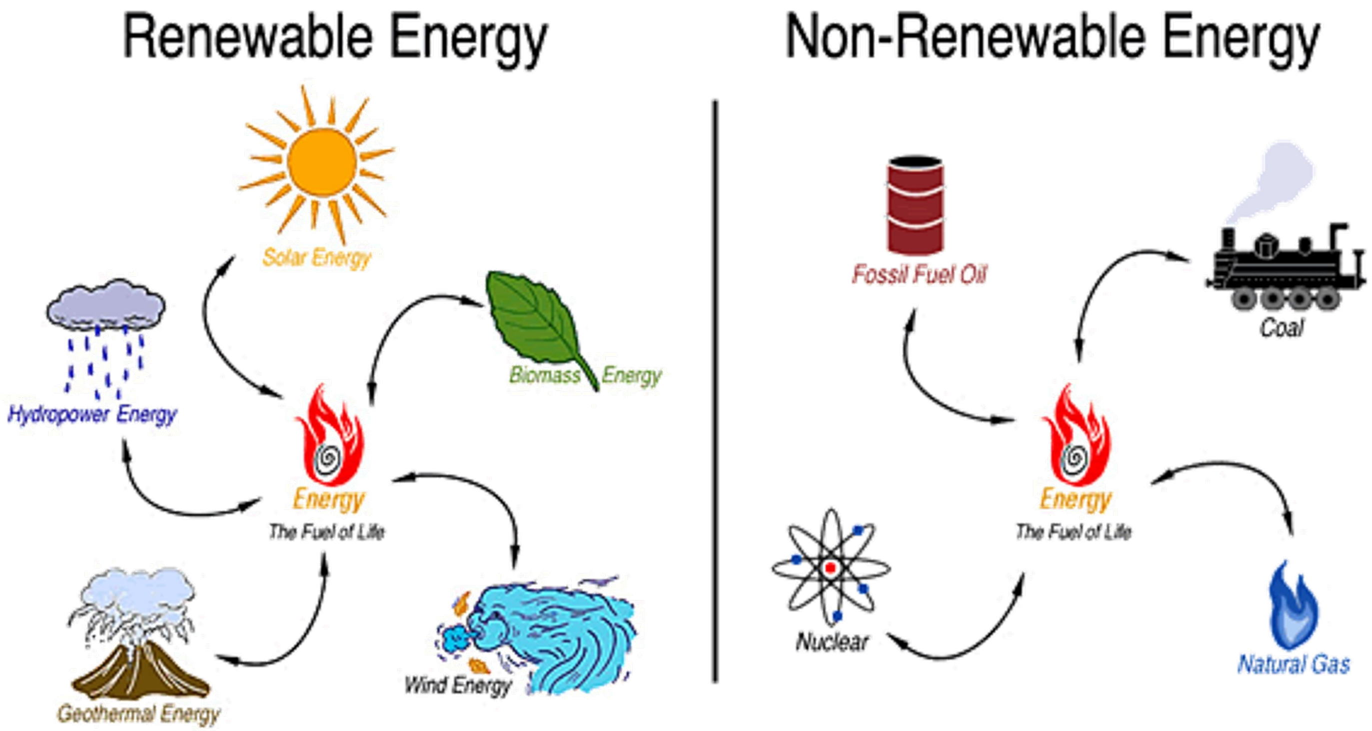
1. Lectures: *The importance of materials source*

There is a difference between a renewable resource and a renewable material. Wood, paper and board and some biopolymers are derived from crops, **a renewable resource**.

Glass and metals are derived from non-renewable resources. They can be reprocessed into new materials without loss of quality, though with some melt losses, so these are **renewable materials.**



Find out where your raw materials and energy come from. You will then know if you can obtain them from a more sustainable source.

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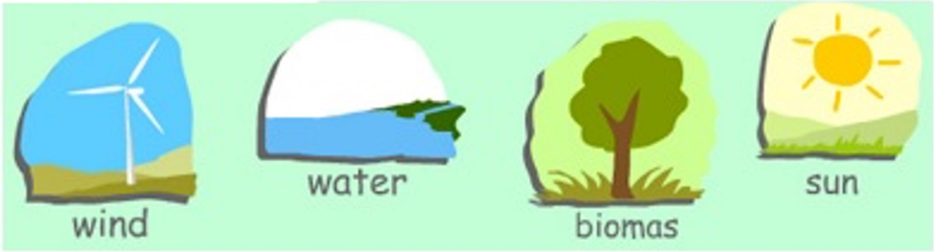
If you plan to use biopolymers, check the source of the material.

Biopolymers are polymers derived from biomass. They may be natural polymers, such as cellulose, or synthetic polymers made from biomass monomers, such as polylactic acid, or they maybe synthetic polymers made from synthetic monomers derived from biomass.

- What is the source of the energy used in the production processes for your packaging?

- Can you source clean energy?



- Could you do more to use the heat generated in your production processes?

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In Europe, there are three EU strategic lines which, followed together, may prove contradictory:

- strengthening and increasing European industrial activities (COM, 2007),
- moving towards a circular economy, i.e. a “recycling society”, (EU, 2008), based first and foremost on recycled or re-used materials
- giving priority to reducing quantities of waste rather than recycling (EU, 2006; EU, 2008).

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The purpose assigned to recycling and waste reduction in the system dynamics is often poorly clarified:

is waste production reduction to be understood in the regulatory sense (including waste that benefits from recycling), or in the environmental sense (only waste discharged in landfills or the natural environment)?

Should the aim be to decouple economic growth from total raw material consumption (primary + recycled), or from primary raw material consumption (only what is extracted from natural deposits)?

we will tackle these issues with three objectives in mind:

- establishing the physical conditions for sustainable material growth in order to do so, including material consumption growth in modeling a circular economy
- proposing a hierarchy of public priorities in the area of sustainable management of raw materials that are compatible with economic development.

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The sustainability of non-renewable material management is mostly approached on the basis of the following principle:

"Consumption of non-renewable resources should be limited to levels at which they can either be replaced by physically or functionally equivalent renewable resources or at which consumption can be offset by increasing the productivity of renewable or non-renewable resources."

(von Gleich, in von Gleich & al, 2006).

Recycling non-renewable raw materials avoids carrying out two technical operations

- disposing of them in landfills as waste on the one hand
- producing an identical quantity of primary raw materials from ore on the other.

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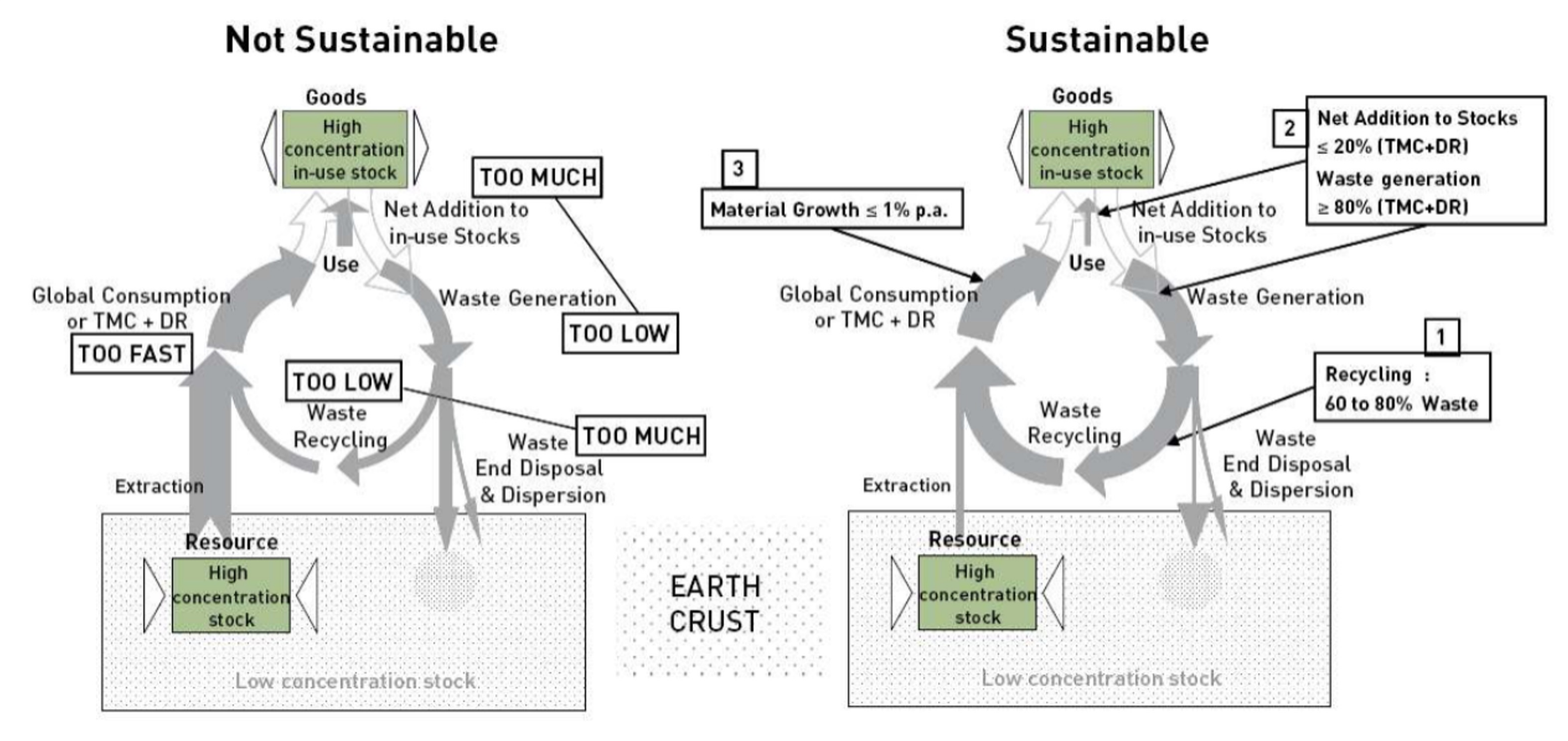

Non-compliance with the three sustainability criteria:

- Too much accumulation and too little waste in relation to material consumed
- too little recycling in relation to the amount of waste generated,
- too great an increase in the need for raw material between two cycles

Compliancy with the three criteria, does not stem the circular flow and limits drawing on non-renewable resources

Fonte: S.A.P.I.EN.S, 4.2 | 2011

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DESIGN FOR ENVIRONMENTALLY SOUND AND SAFE USE PHASE

Communication on the interface between chemical, product and waste legislation in order to improve the traceability of chemicals and to address the issue of legacy substances in recycled waste streams.

existing overarching chemical legislation such as REACH and the Persistent Organic Pollutants (POPs) Regulation as well as sector- or product-specific legislation (e.g. construction products, medical devices or toys) rely on two basic mechanisms:

- The restriction of substance use for polymer production or functionalization of plastic materials;
- The limitation on the maximum content of hazardous substances.

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The impurities originating from the raw materials used for plastic production are a first source of hazardous substances

Hazardous substances are also used during the production of polymers: monomers gained from crude oil on the one hand, are used to form new molecules of the later plastic; processing agents, on the other hand, facilitate the polymerization process and are either bound to the polymer or are dissolved in the virgin polymer matrix

Technical properties of polymers can be adapted to the specific functional needs (e.g. UV resistance) by including specialized additives. Besides their functional benefits, many of these additives also have hazardous

properties.

Hazardous substances can enter the polymer matrix of plastic products as a result of their use (e.g.packaging of hazardous chemicals) In this case the hazardous substances can migrate into the polymer matrix and make plastic recycling problematic.

The cross-contamination between waste streams during the collection of plastic waste can also lead to the inclusion of hazardous substances.

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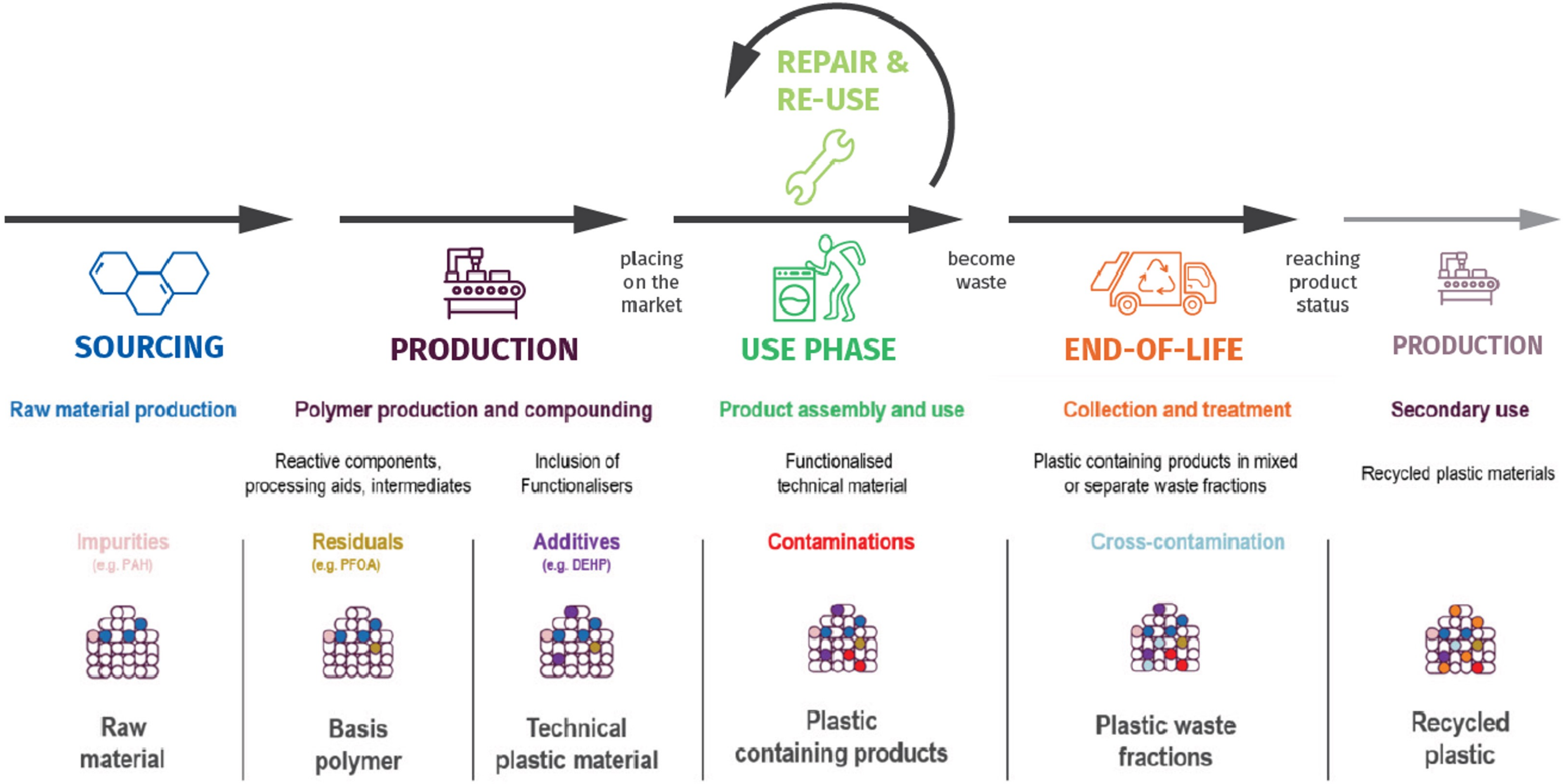
DESIGN FOR ENVIRONMENTALLY SOUND AND SAFE USE PHASE



Fonte: Report di European Environmental Citizens' Organisation for Standardisation

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Several EU tools on products and waste have started to integrate considerations relating to the eco-design approaches on sustainable sourcing of raw materials and optimized resource use.

The iconic Plastics Strategy includes a dedicated set of EU measures to implement its objectives which include the uptake of recycled plastic.

Examples of measures meant to support the industry's efforts to use more recycled plastic include:

• An evaluation of regulatory and/or economic incentives for the uptake of recycled plastic content, notably as part of revised criteria under the Packaging and Packaging Waste Directive, the Construction Products Regulation and the End-of-life Vehicles Directive;

• An updated framework for Food Contact Materials in order to enable the approval of additional recycled polymer grades;

• The development of quality standards for sorted plastics waste and recycled plastics by the European standards body CEN

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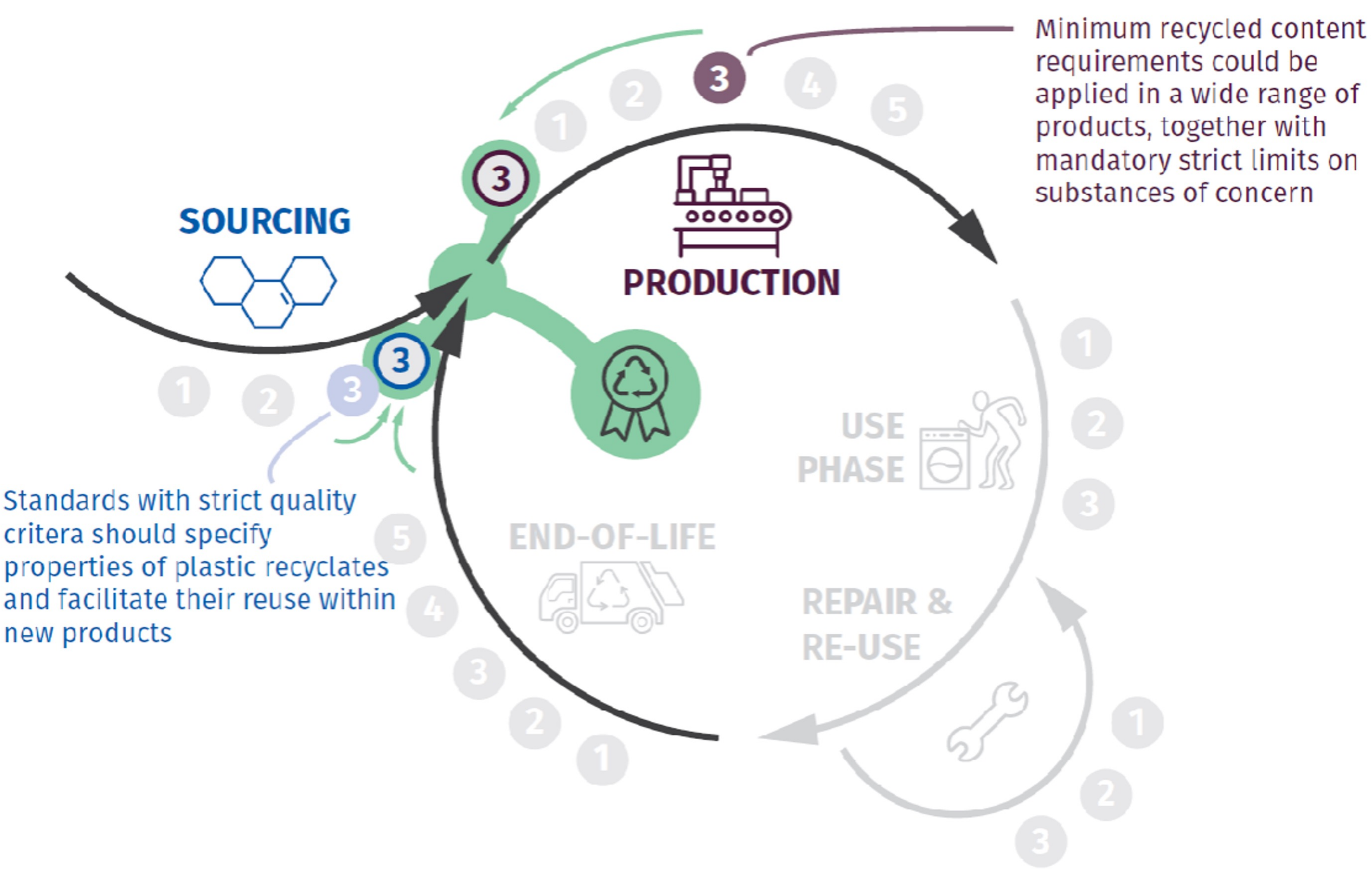

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