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ASTER

WP1 | R-Strategies

and their use in ASTER

DEFINITIONS AND UNDERSTANDING

A guideline through the Activities

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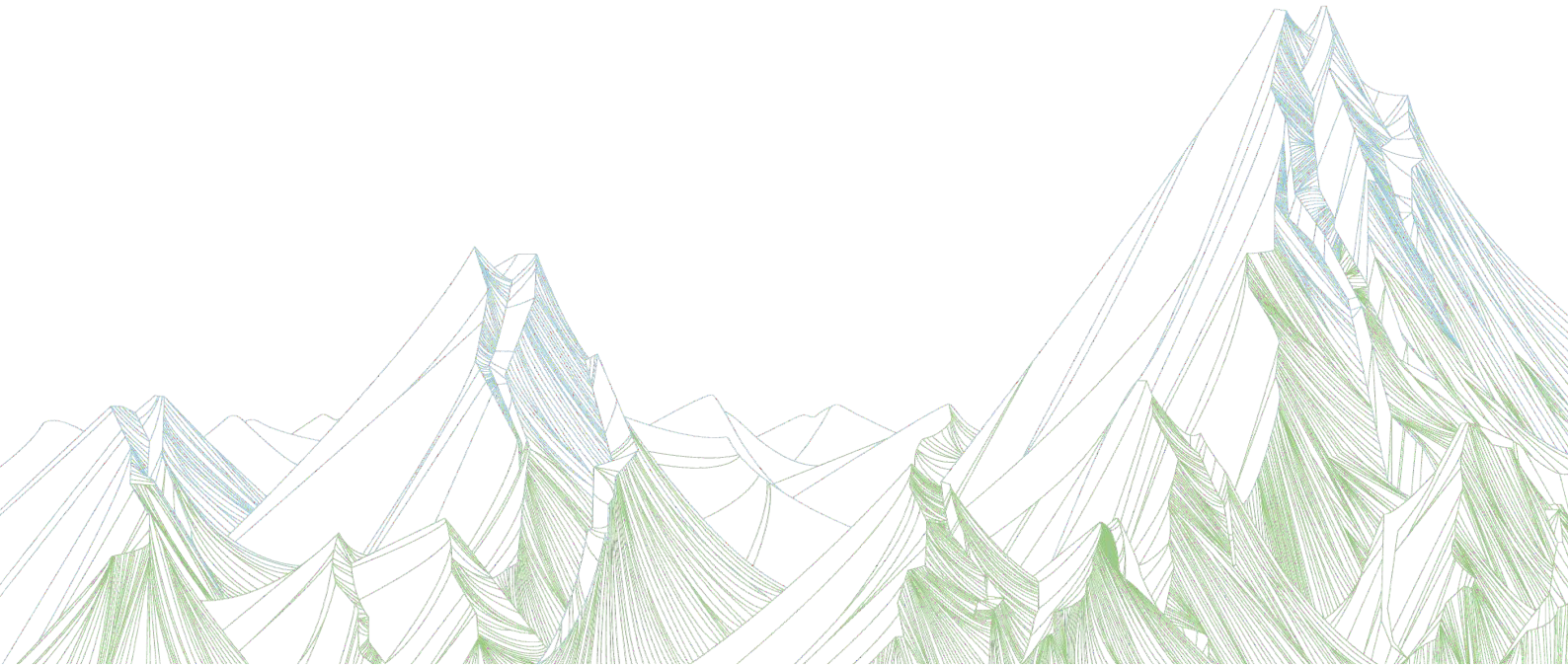

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This Input paper is a result of the Interreg Alpine Space project ASTER (https://www.alpine-space.eu/project/aster/).

It provides the basis for work package 1 (WP1) reports and structures the understanding in the testing and implementation phases in WP2 and WP3 of the project.

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INTRODUCTION

The EU funded ASTER project aims to harmonize waste reduction efforts in the Alps, focusing on outdoor products by improving policies, raising awareness, and facilitating practical solutions through tools, training, and regional cooperation. The projects' overall objective is to shift towards a circular and resource-efficient economy in the outdoor sport sector, contributing to carbon neutrality and a resource sensitive Alpine region. As a main tool, the ASTER project suggests implementing the 5R strategy to minimize waste before (refuse, reduce) and after (reuse, recycle, repair/repurpose) it´s creation (Interreg Alpine Space, 2024). Within the ASTER project application, the 5R strategies used have not yet been standardised (Figure 1).

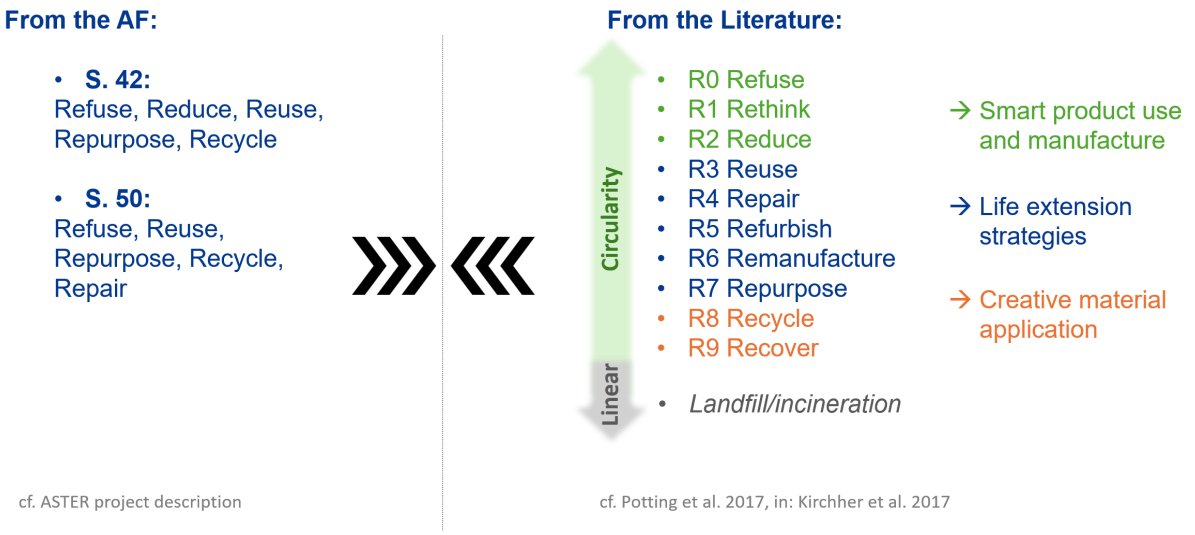

Figure 1: R-strategies from ASTER compared to R-strategies in literature (Source: own illustration)

This input paper aims to create a project internal common understanding of circular economy and definition of the R-strategies. The objective is to be transparent regarding the use of the R-strategies in ASTER.

DEFINITION OF R-STRATEGIES IN CIRCULAR ECONOMY

In the last decade, the concept of circular economy was addressed a lot in science, policy but also in practice. However, definitions are multifaceted and critics rightly claim that the concept and its principles have changing definitions in different contexts (Kirchherr et al. 2017, Wardeberg et al. 2024).

The United Nations Environment Programme (UNEP) provides a circularity approach based on "[…] value retention loops […]" (UNEP 2025), that is shown in Figure 2. The circular processes defined in this approach all follow the guiding principle *reduce by design.* This premise focuses on creating products and services that require fewer materials throughout their lifecycle. The approach aims to decrease raw material extraction, optimize production processes to use less material, and influence consumption patterns and end-of-life considerations, thereby minimizing overall impact and waste. The underlying R-strategies address flows between different actors:

- **User to user:** The consumer can decide through consumption choices whether refusing specific products, reducing the frequency of buying, or reusing things we already have.
- **User to business:** Businesses and consumers have the opportunity to enlarge the lifecycle of specific products. Therefore, the willingness to repair from the consumer side but also the opportunity to refurbish or remanufacture by the industry is needed.
- **Business to business:** The industry must find ways to reintroduce materials into the lifecycle of products. This can be either through recycling processes to gain secondary raw materials or the repurpose of wasted products.

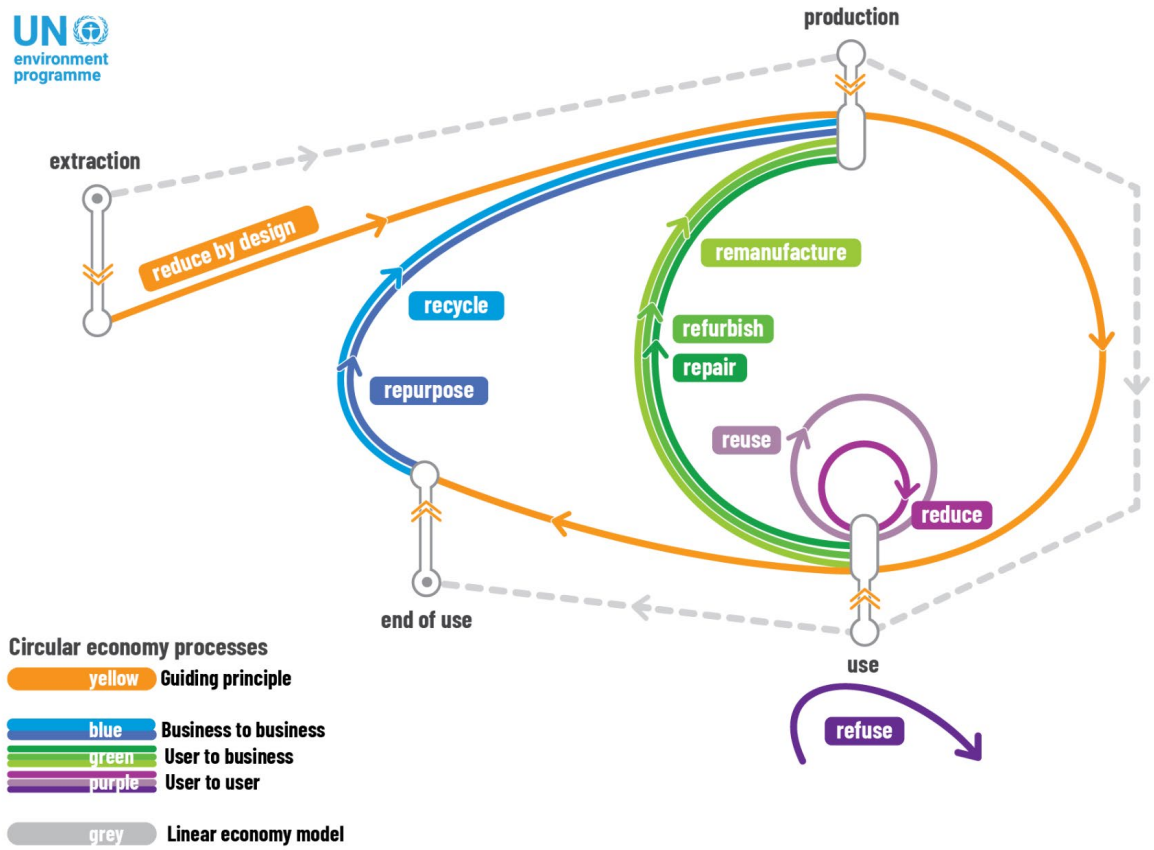

Figure 2: UNEP circularity approach (source: UNEP 2025)

In the various research publications and approaches for circular economy models, there are different numbers occurring when it comes to R-strategies. This is strongly depending on the context and the sector the study is referring to (Kirchherr et al. 2017). As ASTER is focusing strongly on the textile sector, and in particular on outdoor products, our definition follows a 10R approach as presented amongst others by Schnatmann et al. (2023) or Schimper (2025) for the textile sector. It is important to emphasize that this 10R approach is cross-sectoral, and thus applicable to other sectors, such as the plastics industry.

As part of his research, Schimper (2025) has produced a very accurate and comprehensive overview of the textile production chain. In addition to the R-strategies, he refers to their target, possible implementation variants and initial calculations on the influence on value creation. We took this overview as a basis and further developed some of the content. It is particularly important to highlight, that circular textile production streams involve an effective collection system for used textile waste and requires sor-

ting capacities and solutions. Today, most of the production is linear and is less depending on sorting of used textiles and waste. Nevertheless, to expand the lifespan of textile and plastic products and its parts the current extent and economic feasibility varies across the world.

Target	Smarter product use and manufacture			Expand lifespan of products and its parts					Useful application of materials	
R-number	R0	R1	R2	R3	R4	R5	R6	R7	R8	R9
R-name	Refuse	Rethink	Reduce	Reuse	Repair	Refurbish	Remanu-facture	Repurpose	Recycle	Recover
Action	Deny problematic products, use e.g. rental services	Design Phase	Dead stock, less chemicals & production of waste	Re-sell	Get it repaired	Make it nice	Use parts again	Make something new	Produce raw materials	Energy recovery
Linear Textile Production	Raw material production and manufacturing			Involves **collection**, less sorting (extent and economic feasbility varies across the world)					-	Energy Recovery (>75%)
Circular Textile Production	Add recycling and remanufacture to virgin material			Involves **collection** and **requires sorting** (extent and economic feasbility varies across the world)					Recycling	Energy Recovery (<75%)

Figure 3: R-strategies in textile production (own illustration based on Schimper 2025)

Following the UNEP circularity approach and also known research in the topic of circularity and textile production as presented before, the ASTER project, defines the R-strategies as follows (i.e. Kirchherr et al. 2017, Schnatmann et al. 2023, Schimper 2025, UNEP 2025):

A) SMARTER PRODUCT USE AND MANUFACTURE:

- **R0, refuse:** Refusing means choosing to buy or use less by saying no to unnecessary products and services from the customer's side. This includes rejecting packaging and hazardous substances in product design. In the textile industry, the refuse principle emphasizes replacing problematic and wasteful materials, such as plastic packaging, PVC, and PFC. This promotes the production of slow fashion with fewer collections that have a longer lifespan. Additionally, the establishment of rental models for textile products is another way to refuse waste.
- **R1, rethink:** Rethinking involves extending the use phase of products through multifunctional designs and to rethink the design phase and innovate business models that consider environmental and social impacts.
- **R2, reduce:** Improving production efficiency, minimizing waste, and using recycled and bio-based materials instead of virgin materials are all ways to reduce resource usage.

B) EXPAND LIFESPAN OF A PRODUCT AND ITS PARTS:

- **R3: Reuse** refers to repeatedly using a textile product that is not waste for its intended purpose, without needing to repair or refurbish it. It involves users handing over intact, used textiles to another user, typically without modification. Unlike repurposing, reused items maintain their original function, as seen in secondhand sales and reselling.
- **R4, repair:** Repairing involves fixing faults in a product and replacing defective components to restore its full functionality and intended purpose, thereby extending its lifetime. Methods used in this process include cobbling, sewing, and darning to address issues with buttons, zippers, seams, and the textile structure.

- **R5, refurbish:** Refurbishing involves modifying a product to enhance or restore its performance and functionality. This ensures that the product meets applicable technical standards and is fully functional for its original purpose. This process extends the product's service life.
- **R6, remanufacture:** Remanufacturing means use parts or components from defect textiles again to produce new products with same function. This process involves disassembling, inspecting, cleaning, and repairing multi-component products. The result is fully warranted products with a lower environmental impact and cost for both producers and customers. In the textile industry, remanufacturing involves producing new products from industrial and consumer waste. However, it faces greater challenges than conventional manufacturing due to the variability in the quality and quantity of returned textiles.
- **R7, repurpose:** Repurposing involves reusing discarded goods or components for a different purpose, thereby extending the life cycle of materials and allowing them to retain some or all of their value. Examples of repurposing include converting old materials into useful items, such as creating handbags from plastic or transforming textile waste and surplus materials into new products.

C) MATERIAL OR THERMAL RECYCLING:

- **R8, recycling:** Recycling refers to operations to process textiles to obtain secondary raw materials. In the textile industry, recycling involves sorting pre- and post-consumer waste and processing it using chemical, mechanical, or thermal techniques. Although single-material textiles are easier to recycle, companies often prefer high-quality raw materials to recycled ones to maintain product quality, creating challenges. Additionally, recycled fibers are generally lower quality than original materials, emphasizing the need for new models to improve the quality of recycled products.
- **R9, recovery:** The recovery of textiles through incineration for energy recovery is considered a last resort for extracting value from used textiles. Nevertheless, many textile materials are incinerated when no other disposal option is available, serving as an alternative to landfilling.

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APPLYING R-STRATEGIES IN THE ALPINE TEXTILE SECTOR

According to the UNEP circularity approach (Figure 2), achieving a circular economy and implementing R-strategies requires the participation of two groups: users and businesses. However, this approach should be broadened to include manufacturers and authorities, ensuring the involvement of all stakeholders in the textile sector. It is important to note that not all four groups contribute equally to each of the R-strategies. In the ASTER project, the role of users in the 10R process will be excluded due to the challenges of obtaining reliable data on consumer behavior, which would require extensive and detailed surveys to accurately assess.

Table 1: Application of R-strategies in the textile sector and role of different actors (based on UNEP 2025)

	R-strategy	Manufacturer	Business	User	Authority
Smarter product use and manufacture	**R0: Refuse**	Refusing the use of hazardous substances in the design of a product.		Buy or use less, by saying no., e.g., reject packaging, shopping bags, or other products or services that are considered unnecessary.	
	R1: Rethink	Rethink the design phase of a product.	Innovate business models that consider environmental and social impacts.		
	R2: Reduce	Improve process efficiency (e.g., minimizing waste).		Use items and services for a longer time, and buy less frequently.	
Expand lifespan of a product and its parts	**R3: Reuse**		Include secondhand sales and reselling.	Hand over to another user.	
	R4: Repair	Considering repairability during product design	Fixing of a specified fault in an object that is a waste or a product and/or replacing defective components.	Send or give products to repair services.	Create incentives (e.g., Austrian repair bonus).
	R5: Refurbish *Is more easily imagined for other sectors, such as electronics, but not in clothing textiles.*		*Modification of an object that is waste, or product to increase or restore performance and/or functionality, or to meet applicable technical standards or regulatory requirements.*		
	R6: Remanufacture *Is more easily imagined for other sectors, such as electronics, but not in clothing textiles.*		*Standardized industrial process that takes place within industrial or factory settings, in which cores (product or module which has been sold, worn or it is no longer functional) are restored to same-as-new, or better condition and performance. The remanufacturing process is in line with specific technical specifications, including engineering, quality, and testing*		

			standards, and typically yields fully warranted products.		
	R7: Repurpose	Converting old or discarded materials into something useful. Allows to return them into the economy retaining some of its value, or even all its value.	The use of existing material for another purpose (e.g., manufacture of bags from used truck tarpaulins).		
Material or thermal recycling	**R8: Recycling**	Manufacturing new elements (e.g., fibers) with material recovered from waste clothing.	The businesses focused on separate collection of waste textile and their sorting could be included here.		Legislation governing waste collection. Possible legislation could require minimum content of recycled material.
	R9: Recovery				Legislation on legality of using waste as source of energy. Not all countries/regions seem to allow it.

THE ASTER APPROACHES

In the ASTER project, every Activity is dedicated to some of the R-strategies defined in the chapter before. Table 2 provides an overview of the distribution of the Rs to the Activities in the three work packages.

Table 2: Use of R-strategies in the ASTER activities: an overview (The grey boxes highlight the Rs that are addressed in the Activites).

Work Package	Activity	R0 refuse	R1 rethink	R2 reduce	R3 reuse	R4 repair	R5 refurbish	R6 remanufacture	R7 repurpose	R8 recycle	R9 recover
1	**1.1** Mapping of 5R facilitators in the Alps the state of Alpine solutions for circular products				■	■				■	■
	1.2 Mapping of Alpine regulations and economic policies for waste management	■		■		■	■	■	■	■	
	1.3 Waste potential analysis	■		■	■	■				■	
2	**2.1** Collaborative prototyping/eco-design of outdoor textiles and corresponding business models		■	■	■	■				■	
	2.2 Testing business models		■		■	■				■	
	2.3 Pioneering waste solutions	to be concretized									
3	**3.1** Policy brief	to be concretized									
	3.2 Training materials					■				■	
	3.3 From circular models to circular value chains: turning micro business models into Alpine value chains		■		■	■			■	■	
	3.4 Regional multiplier events	to be concretized									
	3.5 Transferring best practices		■		■	■			■	■	
	3.6 Polymer waste management within EUSALP: clustering with EUSALP action groups and EUSALP Youth Council									■	■
	3.7 Polymer waste management within the strategies of regional authorities: fostering exchange with public authorities					■				■	■

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COMMUNICATION ABOUT R-STRATEGIES IN ASTER

The primary goal of the ASTER project is to promote a transition toward a circular and resource-efficient economy within the outdoor sports sector, with a particular focus on the Alpine region. To align with this objective, all R-strategies should be considered. Consequently, in general communications about the project (e.g., on the website or in presentations), the term "R-strategies" should be used to reflect the project's overarching goals. If only specific strategies are addressed, it is important to clearly specify which ones are being discussed and provide relevant details.

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https://www.alpine-space.eu/project/aster/