



**BIOTEXFUTURE**

# **BIO-BASED TEXTILES AND THE CIRCULAR ECONOMY**

## **THE CONSUMER PERSPECTIVE**

DANIEL BAIER, ALEXANDRA RESE, STELLA RÖSCH,  
ANDREAS KARASENKO, BENEDIKT BRAND  
UNIVERSITY OF BAYREUTH (TRANSITIONLAB, TP C)  
JUNE 27, 2025

The background is an abstract composition of various green and blue tones. It features a mix of textures, including a fine grid pattern on the left, a hexagonal pattern on the right, and a dense, organic pattern of small circles in the upper right. The overall effect is a layered, geometric aesthetic.

# **INTRODUCTION**

# INTRODUCTION

TRANSITIONLAB, TP C: THE TEAM OF THE BAYREUTH WORKSTREAM



## TRANSITIONLAB → TP C (THE BAYREUTH WORKSTREAM)

**WHY?** Tackle the societal challenges for the transformation of the textile industry

**HOW?** Create knowledge about  
- **success factors** as well as  
- **ethical, legal and social implications (ELSI)**  
of this transformation

**Success factors of bio-based textile product innovations**

**Acceptance and communication of bio-based textile product innovations, communication guideline (database of studies)**

**Additional topics: Further applications, **circular economy/regulation****





# INTRODUCTION

## CONTENTS

### Introduction

EU initiatives to empower consumers along the R-ladder

Study 1: Interest in measures along the R-ladder

Study 2: Interest in Repair (R4)

Study 3: Interest in Reuse (R3)

Study 4: Interest in Rethink/Made-to-be-remade (R1)

Summary





### R-Ladder



### Refuse (fast fashion)



### Return/repair/reuse



### Subscription boxes



### Made-to-be-remade

## RESULTS

Consumers are indifferent along most R-ladder waste measures. Their hoped-for active role by the EU still is an illusion.

Refuse measures for fast fashion (fees, bans) are accepted by consumers. Further legislative initiatives could follow.

Return/repair/reuse measures are attractive for many consumers. They can be used to strengthen a company's image.

The market for most fashion subscription boxes (sustainable/not, rental/purchase) is still in its early stages.

If the surcharge for made-to-be-remade is not too high, the concept is attractive to consumers (if understandable).

## IMPLICATIONS

Use cost-conscious activities (e.g., repair instructions, DIY videos, return possibilities, support of second hand platforms) to send positive signals with respect to product quality and company's sustainability strategy.

Support the resistance to fast fashion and the legal initiatives as far as economically justifiable (The digital product pass is of course associated with costs but also a measure to send quality signals).

Use cost-conscious activities (e.g., repair instructions, DIY videos, return possibilities, support of second hand platforms) to send positive signals with respect to product quality and company's sustainability strategy.

The market for fashion boxes in Europe can be neglected at the moment. In contrast to the U.S., German consumers do not accept this business model.

The attractive but also cost-intensive made-to-be-remade concept needs detailed explanations at the point of purchase since consumers are sceptical (green-washing).



# **EU INITIATIVES TO EMPOWER CONSUMERS ALONG THE R-LADDER**

### The European Union's most important circular economy directives for the textile industry

Directive	Objective	Main points	Implementation deadline
<b>EU Circular Economy Action Plan (CEAP)</b>	Promoting a sustainable circular economy in the EU	<b>Measures to reduce textile waste, promote recycling and reuse</b>	Ongoing implementation from 2020
<b>EU Strategy for Sustainable and Circular Textiles</b>	Ensuring Sustainable Textiles and Promoting the Circular Economy	Promoting durable textiles, reducing harmful chemicals, improving consumer information	Planned until 2030
<b>Single-Use Plastics Directive</b>	Reduction of plastics in textiles and avoidance of microplastics	<b>Restrictions on the use of plastics in textiles</b> , reduction of microplastic emissions	In force since July 2021
<b>Ecodesign Directive</b>	Improving the sustainability and recyclability of products	Establishing environmental criteria for durable and <b>easily repairable textiles</b>	From 2025
<b>Extended Producer Responsibility (EPR)</b>	Producers' responsibility for the disposal and recycling of textile waste	Introduction of <b>recycling programs, take-back obligations for used textiles</b>	National implementation by 2025
<b>Waste Framework Directive</b>	Promoting waste prevention and recycling throughout the EU	Commitment to separate collection of textile waste and <b>strengthening reuse and recycling infrastructure</b>	Implementation by 2025
<b>Green Claims Directive (Green Advertising)</b>	Consumer protection from misleading environmental claims and 'greenwashing'	<b>Strict requirements for environmental claims</b> and clarity on the sustainability of textile products	Planned for 2024-2025

# EU INITIATIVES TO EMPOWER CONSUMERS ALONG THE R-LADDER

## WASTE MANAGEMENT HIERARCHY OF STRATEGIES (AND RELATED MEASURES)



### The EU initiatives (and the R-ladder of strategies)

- ... are based on Lansink's 1980 waste management hierarchy,
- ... support the move from a linear to a circular economy,
- ... motivate companies and consumers to search for **better strategies (= higher on the ladder)**,
- ... **empower consumers to demand waste reduction from companies (= giving them an active role)**.

Circular economy	Design phase (most sustainable, most preferred)	<b>Refuse (R0):</b> Avoid products that will create waste (e.g. reject fast fashion)
		<b>Rethink (R1):</b> Reevaluate design/consumption (e.g. bio-based, made-to-be-remade)
		<b>Reduce (R2):</b> Cutting down the quantity of materials used (e.g. durability)
		<b>Reuse (R3):</b> Using products repeatedly for the same purpose (e.g. second-hand)
↑	Consumption phase (pre-serve and extend life of products)	<b>Repair (R4):</b> Fixing broken or damaged products (e.g. repair sets and services)
		<b>Refurbish (R5):</b> Restoring and improving used products (e.g. smartphones)
		<b>Remanufacture (R6):</b> Restoring used products to like-new condition (e.g. printers)
		<b>Repurpose (R7):</b> Using products for other functions (e.g. bottles to vases)
Linear economy	End-of-life or return phase	<b>Recycle (R8):</b> Processing waste to products/materials (e.g. bottles to sneakers)
		<b>Recover (R9):</b> Extracting energy from non-reusable waste (e.g. waste-to-energy)
		<b>Landfill/Incineration:</b> Deposal or open burning of waste
	Loss phase	





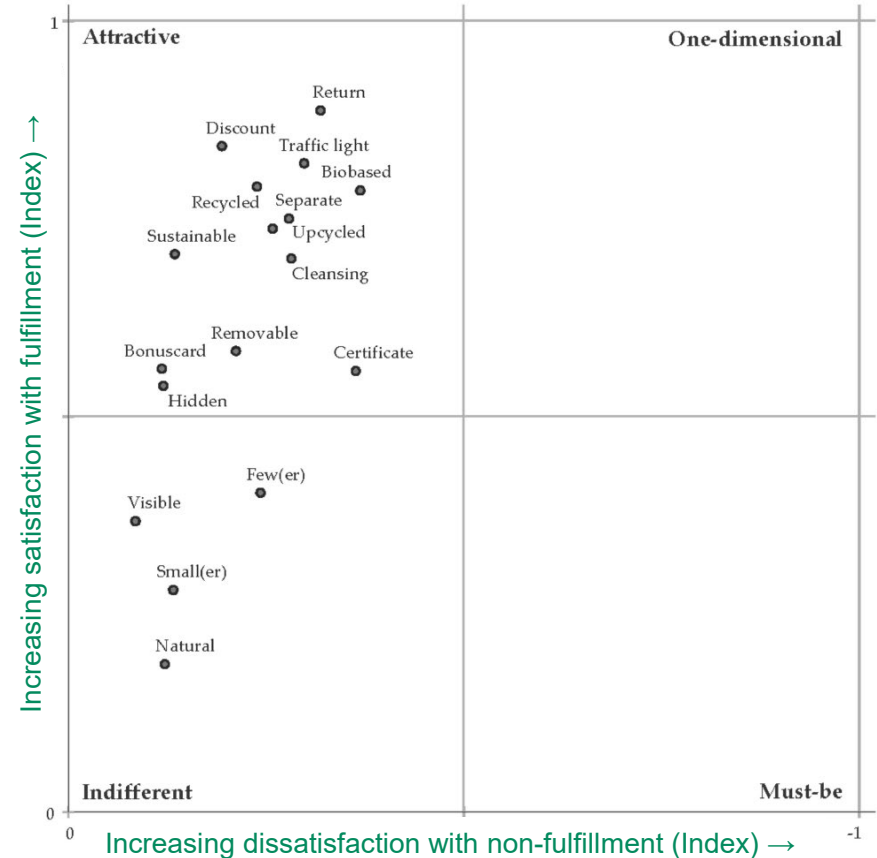
# **STUDY 1: INTEREST IN MEASURES ALONG THE R-LADDER**

# STUDY 1: INTEREST IN MEASURES ALONG THE R-LADDER

A LOOK BACK AT THE BEGINNING OF TRANSITIONLAB (BAIER ET AL. 2020)

BIOTEXFUTURE

	Measure	Description (abbreviated)
Range	Sustainable	Only sustainable products are offered.
	Natural	Only products in natural colors are offered.
	Separate	A separate section with sustainable products is offered.
	Small(er)	A small(er) range is offered.
	Few(er)	Few(er) fashion cycles are launched.
Label	<b>Traffic light</b>	<b>Products are classified with a traffic light.</b>
	Removable	Products are tagged with a removable seal.
	Hidden	Products are tagged with a hidden seal.
	Visible	Products are tagged with a visible seal.
	Certificate	Products are ocially certified by an ecolabel.
Process	<b>Return</b>	<b>A discount is offered for returns.</b>
	<b>Discount</b>	<b>A discount is offered for sustainable purchases.</b>
	Bonus card	Bonus points are collected when buying products.
Material	Upcycled	Products are made of upcycled materials.
	<b>Biobased</b>	<b>Products are made of biobased materials.</b>
	<b>Recycled</b>	<b>Products are made from returned products.</b>
	Cleansing	A repair and/or cleaning service is offered.



# STUDY 1: INTEREST IN MEASURES ALONG THE R-LADDER

## LITERATURE REVIEW (BASED ON SELECTED RECENT STUDIES)

Strategy	State of the art (References)
<b>Rethink (R1):</b> bio-based, made-to-remade	<p><b>Functional product attributes and social sustainability are more important than circular product attributes</b> for purchasing decisions (Fuchs, Hovemann 2022 and many others). Nevertheless, product durability and the proportion of recycled material are the most relevant circular attributes.</p> <p><b>Environmental awareness, gender, and age influence the importance</b> (Baier et al. 2020).</p> <p><b>Consumers need reduced, understandable information</b>, market supervision requires detailed data (Adisorn et al. 2021).</p>
<b>Reuse (R3):</b> second-hand	<p><b>Younger consumers prefer rental&amp;subscription models, while older consumers prefer longevity services</b> (Armstrong et al. 2015).</p> <p><b>Second-hand shopping is particularly popular among young women</b>, with rental models only accepted for special occasions.</p> <p><b>Drivers of usage are environmental awareness, variety of styles at low cost, low risk of mistakes</b> (Becker-Leifhold, Iran 2018).</p> <p><b>Barriers of usage are hygiene concerns, social risks, loss of ownership</b> (Lang et al. 2019, Becker-Leifhold, Iran 2018).</p>
<b>Repair (R4):</b> fixing products	<p><b>There is a low willingness-to-repair, especially among younger consumers</b> (skill, time, Diddi et al. 2019; Goworek et al. 2012).</p> <p><b>Fast fashion is rarely perceived as "worth repairing"</b> (McCollough 2009).</p> <p>Emotional attachment and high price promote repair behavior (McNeill et al. 2020).</p> <p><b>Repair services increase brand trust</b>, success factors are communication, convenience, and costs (Pham, Kanijal 2023)</p>
<b>Recycle (R8):</b> waste to products	<p><b>Environmental knowledge triggers return for recycling and reuse</b> (Goudeau, Lee 2021).</p> <p>People with a high consumption/purchase volume show a lower participation in recycling measures (Joung 2014).</p> <p><b>Take-back is central to the circular economy</b>, but hampered by infrastructure, low awareness of options, and a lack of incentives (Sandvik, Stubbs 2019, Hashemi Petrudi, Sharifpour Arabi 2025). <b>Convenience is crucial</b> (Joung, Park Poaps 2013).</p> <p><b>Preferred are return containers</b> next to recycled glass, open to deposit systems or collection services (Vehmas et al. 2018). Incentive models with discounts are particularly effective (Baier et al. 2020).</p>

# STUDY 1: INTEREST IN MEASURES ALONG THE R-LADDER

## RESEARCH QUESTION AND INVESTIGATED MEASURES

**Research question:** Which measures along the R-ladder (which regulations) are acceptable from a customer perspective?  
**Investigated measures** (a selection based on the EU directives and the literature review):

Strategy	Measure	Description (abbreviated)
<b>Refuse (R0)</b>	Fees	Surcharge (e.g. 5 € per piece) on ultra-fast fashion to promote sustainable alternatives
	Bans	Ban or restriction of advertising for non-sustainable fashion
<b>Rethink (R1)</b>	Support	Transparent sustainability data (material, CO <sub>2</sub> ) to support the purchase decision
	Score	Rating system (A-F) that indicates the environmental friendliness
	Information	Extensive information in an interactive format (detailed reports)
<b>Reuse (R3)</b>	Rental	Temporary use of clothing for special occasions instead of buying
	Boxes	Regular exchange of garments in the subscription model
	Platform	Brand owned platform for buying/selling used clothing
<b>Repair (R4)</b>	In-store repair	Possibility to have clothes repaired in-store
	Warranty	Free repairs within two years of purchase
	Kits	Brand self-help kits with materials and instructions for small repairs
<b>Recycle (R8)</b>	In-store return	Take-back boxes in shops
	Containers	Recycling containers in residential areas
	Discounts	Loyalty points or discounts on returns
	Deposit	Reimbursement of a deposit amount on return



# STUDY 1: INTEREST IN MEASURES ALONG THE R-LADDER

## METHODOLOGY AND RESULTS

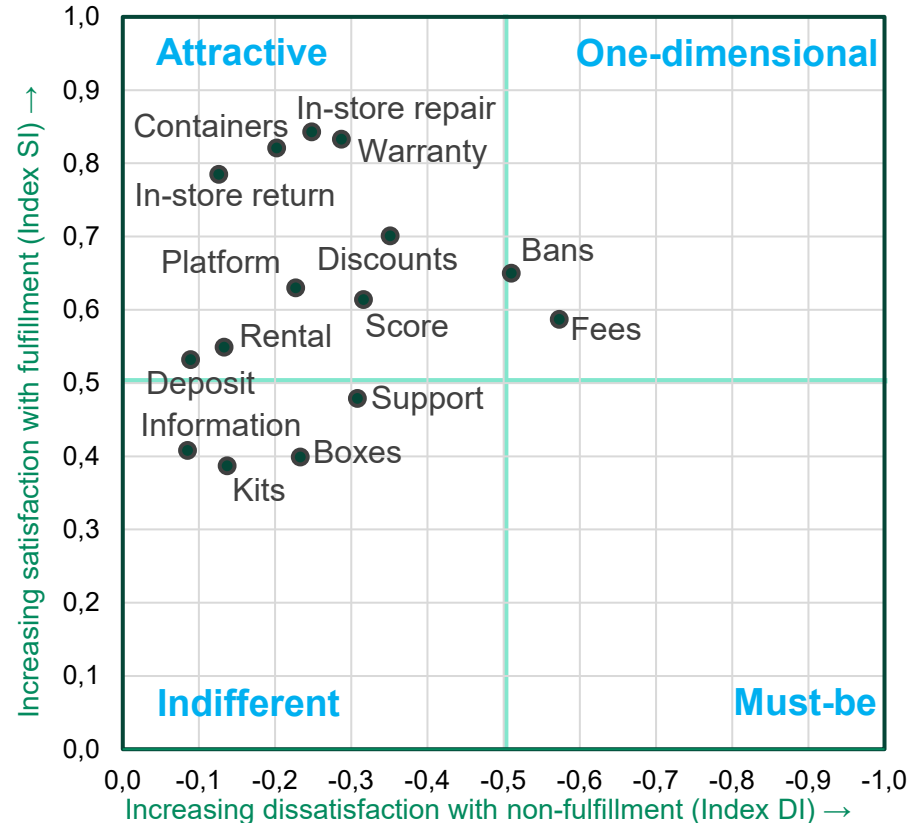
### Main study (Kano-survey with two samples: young/old)

- n=177 consumers (53% female, 47% male; 42% up to 29 years, 58% from 30 years) were asked to rate 15 potential measures with respect to **(a) satisfaction if offered** and **(b) dissatisfaction if not offered** on 5-point-scales („I dislike it“, „can tolerate it“, „neutral“, „expect it“, „like it“).
- The answers can be transformed for each respondent to categories **“must-be”**, **“one-dimensional”**, **“attractive”** or **“indifferent”** and the categorizations visualized as a chart.

$$SI = \frac{\#A + \#O}{\#A + \#O + \#M + \#I} \quad DI = -\frac{\#M + \#O}{\#A + \#O + \#M + \#I}$$

### Results

- **Refuse** (R0: bans, fees) **received highest acceptance** (one-dimensional), independent from the respondent age.
- **Repair** (R4, especially in-store repair and warranty) received **second best results** („attractive“).
- Recycle (R8, especially containers, in-store return) was also rated as acceptable, however, **deposit received mixed answers** (was rated by older respondents as unacceptable).



## **STUDY 2: INTEREST IN REPAIR (R4)**

# STUDY 2: INTEREST IN REPAIR (R4)

## RESEARCH QUESTION, METHODOLOGY AND RESULTS

### Starting point

- Some textile companies (e.g. **Patagonia** but also GoreTex, Jack Wolfskin) actively promote an almost free repair service for textiles.
- Most of them also offer DIY repair instructions and videos (e.g., youtube).
- Advantages (for comp.): Image, loyalty, feedback, NPD integration
- Disadvantages (for comp.): Lack of cost coverage, peaks, sales reduction

### Research question

- **Should companies (Adidas) offer repair for, e.g., Terrex?**

### Main study

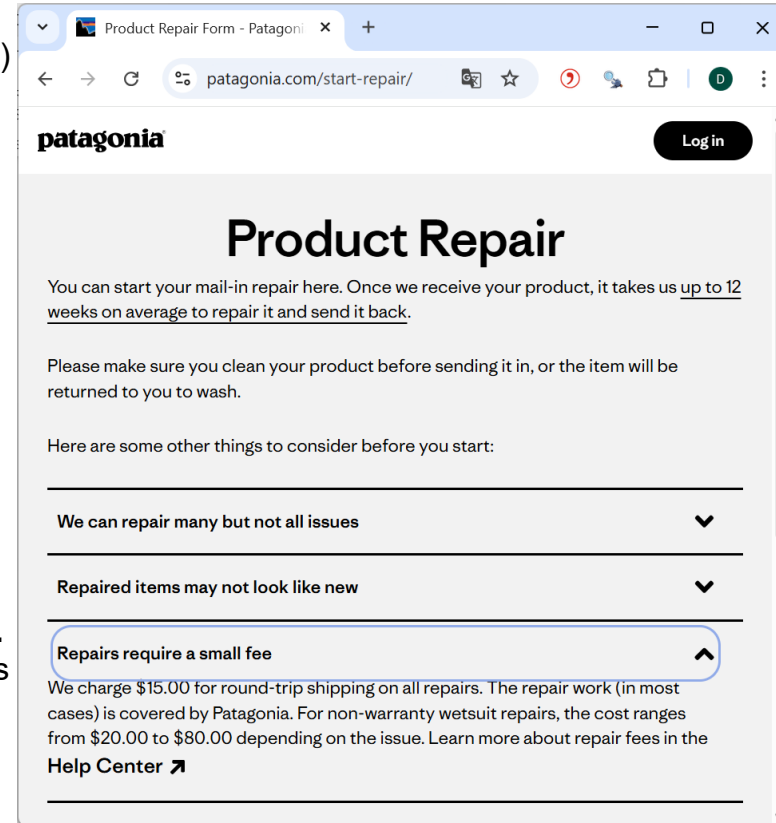
- **30 min. interviews with n=16 hikers in December 2024** (contacted via hiking clubs, social media, topics: repair/repair service needs, experience, preferences), analysis via jobs-to-be-done methodology / grounded theory

### Results

- **Repair needs depend on the quality/price of the product and service.**
- **DIY is an acceptable alternative** (need for instructions and videos, hikers seem to be uninformed). Repair is a **positive signal** („can be repaired“).

### Implications

- Companies should at least offer DIY instructions and videos (quick wins).



## **STUDY 3: INTEREST IN REUSE (R3)**

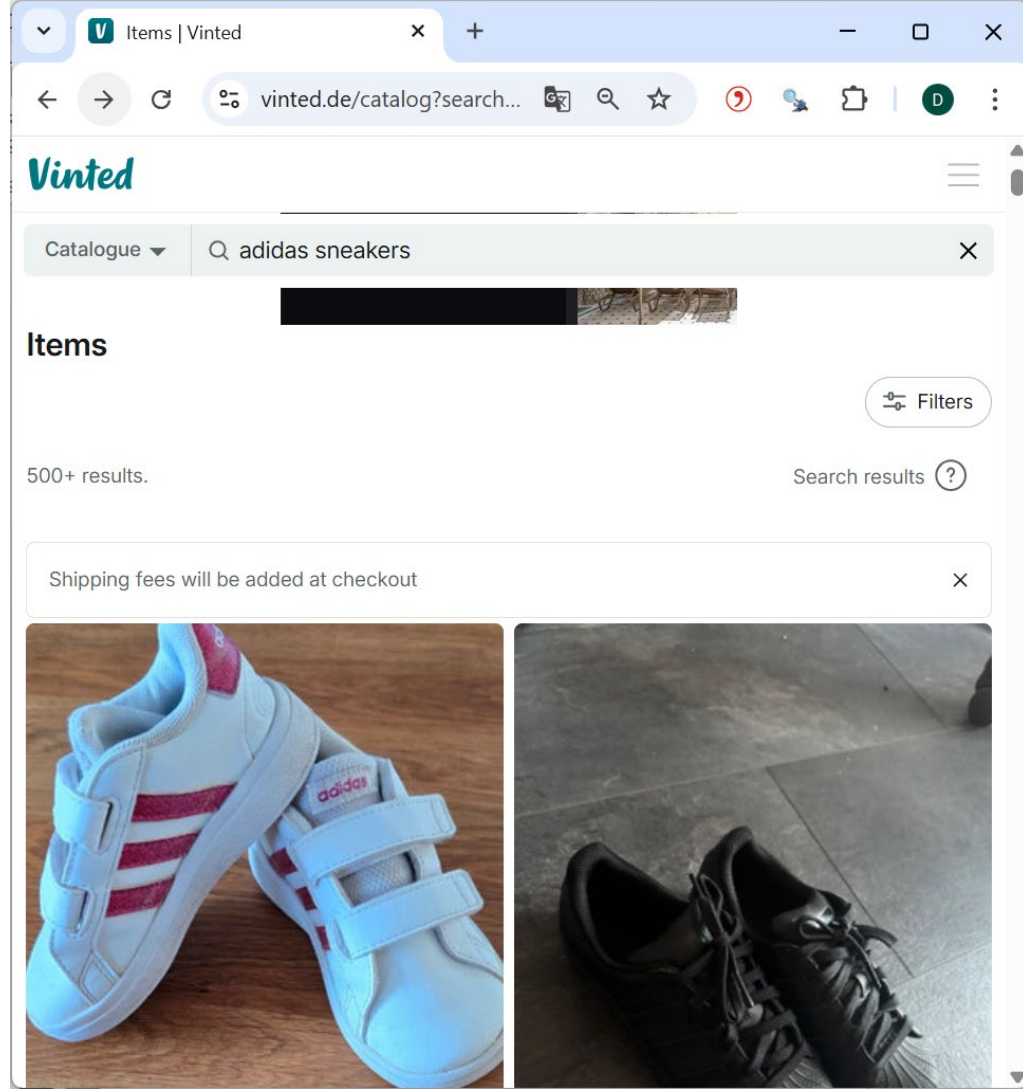


## STUDY 3: INTEREST IN REUSE (R3)

### BACKGROUND

#### Starting point

- The **second-hand market in Germany** (fashion, electronics, furniture) is exploding: **HDE estimates a volume of 9.9 bill. € in 2024** (+7.2% vs. 2023).
- Main reasons are the consumers' wish to act sustainable and to save money but also the growing availability of platforms (IFH Köln 2025, WiWo 2025, BCG 2025).
- **For fashion**, the platform **Vinted is the market leader** in Europe (2024: 813 mill. €), also Zalando ("Pre-owned") and About you/Momox ("Second love") are active. Typically (Vinted), selling is free, but the buyer has to pay a fee (0.70 €) per purchase plus 5% of the purchase price.
- **Other reuse business models**
  - **Rental (instead of buying) on a one-time basis**,
  - **rental subscription models** (curated or self-curated): Customers receive monthly a box that has to be returned monthly (**very successful in the U.S.**), (small) providers in Germany are, e.g., Myonbelle, Modami, Fairnica, Unown.



## STUDY 3: INTEREST IN REUSE (R3)

### RESEARCH QUESTION, METHODOLOGY, AND RESULTS

#### Research question

- Are rental subscription models (for sustainable fashion) attractive for the younger generation (up to 34 years)?

#### Main study (discrete choice experiments)

- n=364 consumers (71% female, 29% male; 38% up to 24 years, 51% 25 up to 34 years, 11% older)
- Task: Repeatedly select a most preferred subscription model among three models with varying attributes (fees, total value, labels, # of pieces) in two scenarios (curated or self-curated).

#### Results (via multinomial logistic regression)

- Only about 7 to 8% of the respondents would think of using rental subscription models**, especially young women and people with higher income.
- Boxes are not subscribed to support sustainable behavior, labels are not important. Fees and total value are crucial.**
- The surprise effect (“curated” vs. “non-curated”) makes no difference.

For details see: Rese, A., & Baier, D. (2025). Rental clothing box subscription: The importance of sustainable fashion labels. *Journal of Retailing and Consumer Services*, 83, 104153.

Please select one of subscription model that appeals to you.(1 of 15)

Fees:	39 € per month	49 € per month	49 € per month
Total value:	250 €	250 €	750 €
Labels:	Sustainable	Non-sustainable	Non-sustainable
# of pieces:	4	4	2
	Select	Select	Select

I don't like any of them

Select



## **STUDY 4: INTEREST IN RETHINK (R1, MADE-TO-BE-REMADE)**

# STUDY 4: INTEREST IN RETHINK (R1, MADE-TO-BE-REMADE)

## RESEARCH QUESTIONS AND METHODOLOGY

### Starting point

- Since 2021 Adidas sells dye-less, glue-less fully recyclable performance running shoes “**Ultraboost Made-To-Be-Remade**” for about 180 € (~2.000).



### Research questions

- Do consumers appreciate this concept?
- How should this concept be marketed?

### Preliminary study (expert interviews)

- n=7 expert interviews (2 managers at “Cradle-to-cradle” NGO, 2 sports shop salespersons, 3 consumers)
- Result: “Made to be remade” is ecologically sound, but not economically viable in the near future (price too high for consumers, process not attractive for manufacturers).

### Main study (discrete choice experiments ACBC)

- n=179 consumers (58% female, 42% male; 60% sports students up to 28 years, 40% employees 40-50 years)
- Selection of a most preferred shoe among three Ultra Boost shoes with varying attributes and levels
- Calculation of willingness-to-pay for made-to-be-remade aspects (recycling, reuse of materials, recovering)

UNIVERSITÄT BAYREUTH

Bitte stellen Sie sich aus den nachfolgenden Eigenschaften den für Sie **optimalen** Schuh zusammen.

Merkmal	Ausprägung auswählen
Funktionalität	Bitte auswählen
Materialien	Bitte auswählen
Siegel	Bitte auswählen
Wiederverwertbarkeit	Bitte auswählen
Individualisierung	Bitte auswählen
Herstellung	Bitte auswählen
Preis	Bitte auswählen

Weiter

0% 100%

UNIVERSITÄT BAYREUTH

Hier sind ein paar Schuhe, die Ihnen gefallen könnten. Geben Sie nun bitte bei **jedem Schuh** an, ob er für Sie **in Frage kommt** oder **nicht**.

(1 von 8)

Schuh 1	Schuh 2	Schuh 3
<ul style="list-style-type: none"><li>• Leichtes Gewicht</li><li>• Reguläre Passform</li><li>• Optimaler Halt</li><li>• bequemer Tragekomfort</li></ul>	<ul style="list-style-type: none"><li>• Leichtes Gewicht</li><li>• Reguläre Passform</li><li>• Optimaler Halt</li><li>• bequemer Tragekomfort</li></ul>	<ul style="list-style-type: none"><li>• Leichtes Gewicht</li><li>• Reguläre Passform</li><li>• Optimaler Halt</li></ul>
100% synthetische Materialien	≤50% recycelte Materialien	100% synthetische Materialien
kein Siegel	Sozial & Recycling Siegel (Fair hergestellt aus recycelten Materialien)	kein Siegel
Anteilige Wiederverwertbarkeit (Manche Komponenten können wiederverwertet werden)	keine Wiederverwertbarkeit (Der Schuh kann nicht wiederverwertet werden)	Vollständige Wiederverwertbarkeit (Der Schuh kann vollständig wiederverwertet werden)
Mit selbstgewählten Materialien	Keine Individualisierungsoption	Mit selbstgewählten Materialien
Made in Germany	Made in Europe	Made in Europe
150€	180€	180€
<input type="radio"/> Ziehe ich in Betracht <input type="radio"/> Ziehe ich <b>nicht</b> in Betracht	<input type="radio"/> Ziehe ich in Betracht <input type="radio"/> Ziehe ich <b>nicht</b> in Betracht	<input type="radio"/> Ziehe ich in Betracht <input type="radio"/> Ziehe ich <b>nicht</b> in Betracht

Weiter



### Results

- **Adidas is viewed positively as a sustainable shoe manufacturer:** Sustainable (84%), quality-conscious (63%), innovative (44%), trustworthy (36%)
- **Barriers to buy sustainable shoes:** Poor information basis (56%), high price (32%), skepticism/green-washing (27%)
- **Return habits up to now:** Never return sneakers up to now (77%)
- **Usefulness of the term „made-to-be-remade“:** Yes (79%), no (12%), indifferent (9%)
- **Barriers to return:** Green-washing-skepticism (77%)
- **Acceptable surcharges for Ultraboost running shoes** (average additional willingness-to-pay against a basic shoe):
  - **Made in Germany:** +41,38 €
  - **100% made-to-be-remade:** +40,14 €
  - **Made in Europe:** +35,63 €
  - **100% biodegradable material:** +24,79 €
  - **50% made-to-be-remade:** +24,20 €
  - **100% recycable:** +23,54 €
  - **Trustable recycling seal:** +20,80 €
  - **Wearing comfort:** +18,26 €
  - **Water-repellent:** +17,76 €
  - **White:** +17,01 €
  - **50% recycable:** +10,61 €
  - ...



The background is an abstract composition of various green and blue tones. It features a mix of textures, including a fine grid pattern on the left, a hexagonal pattern on the right, and a large, irregular shape in the center. The overall effect is a modern, layered design.

# **EXECUTIVE SUMMARY**



R-Ladder



Refuse (fast fashion)



Return/repair/reuse



Subscription boxes



Made-to-be-remade

RESULTS

Consumers are indifferent along most R-ladder waste measures. Their hoped-for active role by the EU still is an illusion.

Refuse measures for fast fashion (fees, bans) are accepted by consumers. Further legislative initiatives could follow.

Return/repair/reuse measures are attractive for many consumers. They can be used to strengthen a company's image.

The market for most fashion subscription boxes (sustainable/not, rental/purchase) is still in its early stages.

If the surcharge for made-to-be-remade is not too high, the concept is attractive to consumers (if understandable).

IMPLICATIONS

Use cost-conscious activities (e.g., repair instructions, DIY videos, return possibilities, support of second hand platforms) to send positive signals with respect to product quality and company's sustainability strategy.

Support the resistance to fast fashion and the legal initiatives as far as economically justifiable (The digital product pass is of course associated with costs but also a measure to send quality signals).

Use cost-conscious activities (e.g., repair instructions, DIY videos, return possibilities, support of second hand platforms) to send positive signals with respect to product quality and company's sustainability strategy.

The market for fashion boxes in Europe can be neglected at the moment. In contrast to the U.S., German consumers do not accept this business model.

The attractive but also cost-intensive made-to-be-remade concept needs detailed explanations at the point of purchase since consumers are sceptical (green-washing).

# **THANK YOU FOR YOUR ATTENTION!**

DANIEL BAIER, ALEXANDRA RESE, STELLA RÖSCH,  
ANDREAS KARASENKO, BENEDIKT BRAND  
UNIVERSITY OF BAYREUTH (TRANSITIONLAB, TP C)  
JUNE 27, 2025