MCAD × UNDER ARMOUR

Kilchis Fishing Shoe Eco Redesign

Collaborative Product Design | Fall 2025

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Under Armour Kilchis Fishing Shoe : SS25

Extend lifespan

Minimize synthetics

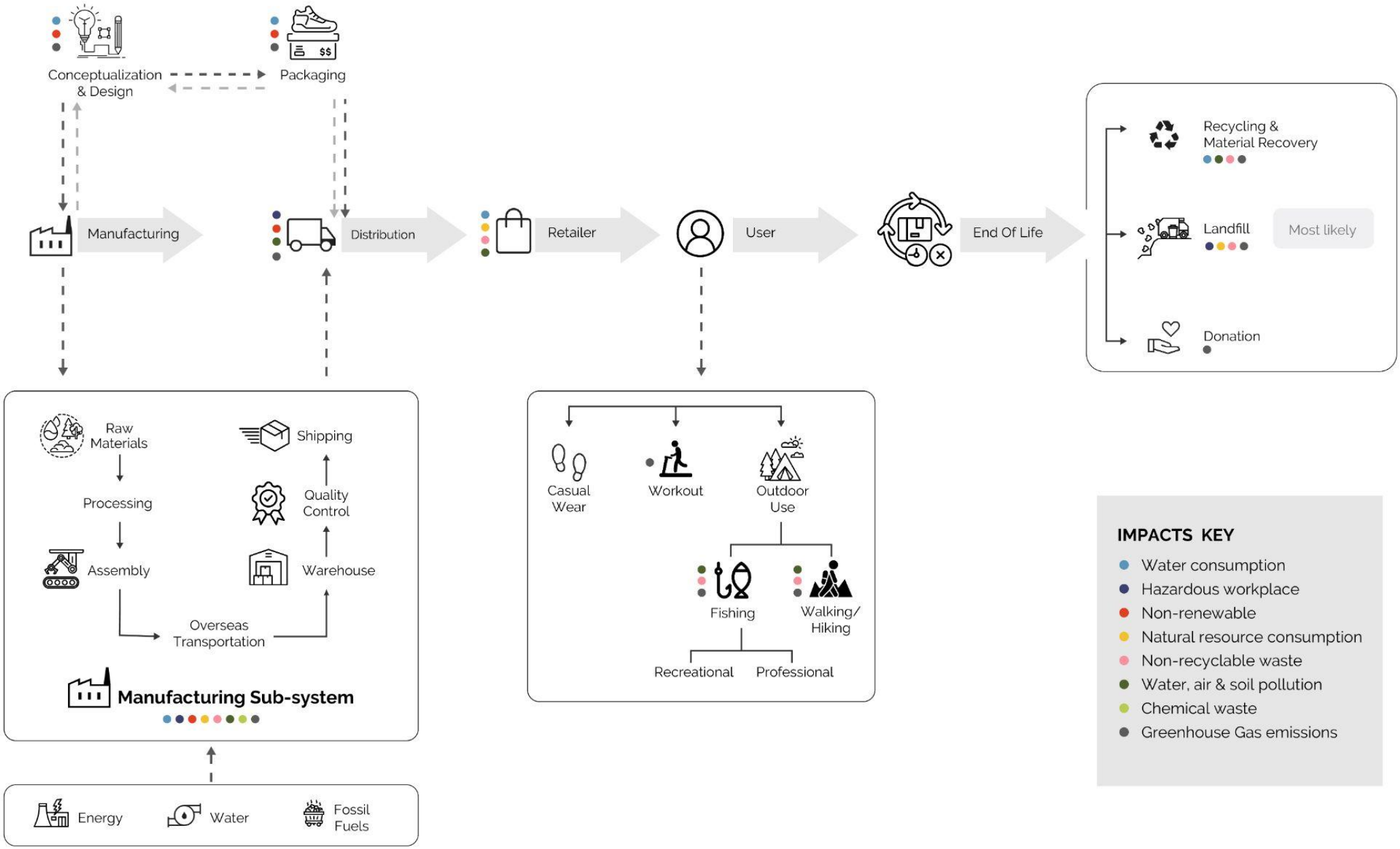
Maintain performance

Improve end-of-life outcomes

REDESIGN GOALS


Tongue: PU Plastic, nylon
Lace Eyelet: Polypropylene (PP), Steel - High Carbon
Lace: Polyester (RPET)
Vamp: Polyurethane, TPU, polyester (RPET)
Sockliner: Polyester, elastane
Adhesive: TPU
Collar Lining: Polyester, elastane, bio-based styrene rubber, PBT
Midsole: EVA
Quarter: Polyester, polyurethane, polyethylene
Toe Cap: TPU, polyester
Outsole: Rubber

Whole System Map



Baseline LCA Results

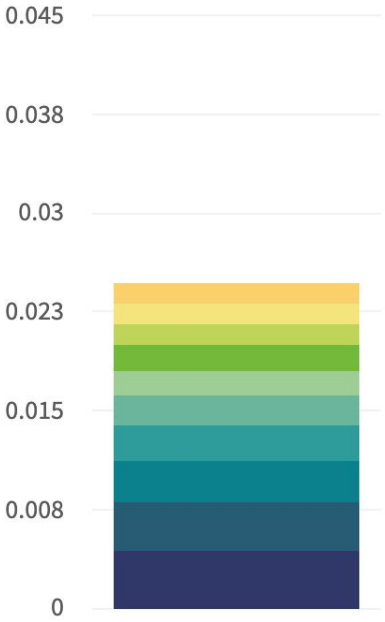
.045 mPts/func unit

TOP IMPACTS

Material: Polyester fabric
Impact category: Global warming
Lifecycle stage: Manufacturing

Functional Unit	1 shoe, 3 years of use
Estimated Usage	100 days max.
Scope/ Boundary	Cradle to grave
Est. Transportation	6,500 nautical miles

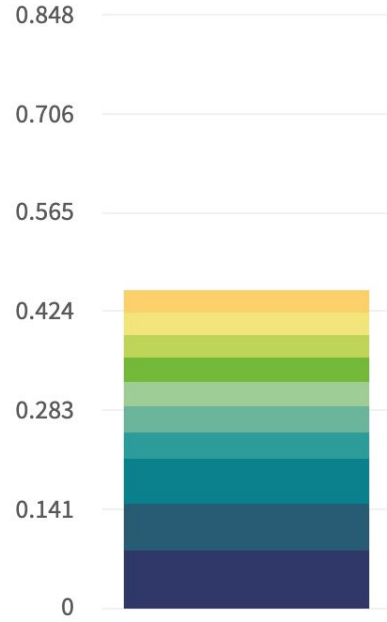
Total Impact by Component



Total = 0.045mPts/func unit

Input	mPts/func unit
Polyester fabric	$4.39x10^{-3}$
Textile refinement, synthetics	$3.82x10^{-3}$
Polyester fabric	$3.24x10^{-3}$
Ethylene vinyl acetate copolymer, EVA	$2.68x10^{-3}$
Polyester fibers (global average)	$2.24x10^{-3}$
Polyester fabric	$2.04x10^{-3}$
Polyester fabric	$1.87x10^{-3}$
Polyester fabric	$1.64x10^{-3}$
Styrene Butadiene Rubber, SBR	$1.61x10^{-3}$
Polyester fabric	$1.60x10^{-3}$

Carbon Footprint by Component



Total = 0.85 CO_2 eq. kg/func unit

Input	CO_2 eq. kg/func unit
Polyester fabric	0.0843
Textile refinement, synthetics	0.0668
Polyester fabric	0.0622
Polyester fabric	0.0392
Polyester fabric	0.0359
Incineration, plastics, mixture	0.0358
Ethylene vinyl acetate copolymer, EVA	0.0352
Bio-based styrene-butadiene-styrene (SBS)	0.0324
Polyester fibers (global average)	0.0318
Polyester fabric	0.0315

Design Objectives

1 : EXTENDED LIFESPAN

Metric: 10 year lifespan

Extending the shoe's lifespan from 3 to 5 years during the LCA increased the overall environmental impact by 40%, indicating that durability is one of the most effective levers for sustainability. Based on this finding, our goal is to redesign the shoe to last 10+ years, emphasizing durability through material selection and repairability through modular design.

2 : IMPROVED END-OF-LIFE OUTCOMES

Metric: 50%+ of materials returned to biological or technical cycles

Research shows that most people throw away their shoes when they are finished with them, and recycling opportunities are limited. Our goal is to identify opportunities to reduce material sent to landfills and to extend the use of materials.

3 : REDUCED MICROPLASTICS

Metric: Eliminate or reduce (75%+) shedding during use

Microplastics are a leading contributor to water and soil pollution. Because Kilchis products are designed for on-the-water performance, we aim to reduce polymer shedding throughout the shoe, with a focus on replacing conventional polymers in the midsole and outsole, the primary wear surfaces.

4 : MAINTAIN PRODUCT PERFORMANCE

Metric: Performance checklist aligned with Kilchis design brief

Ratings for the Kilchis line emphasize the product's quick-dry material, comfortable cushioned insole, and slip-proof tread. Our goal is to identify alternative materials that reduce environmental impact while maintaining Under Armour product quality and the customer experience.

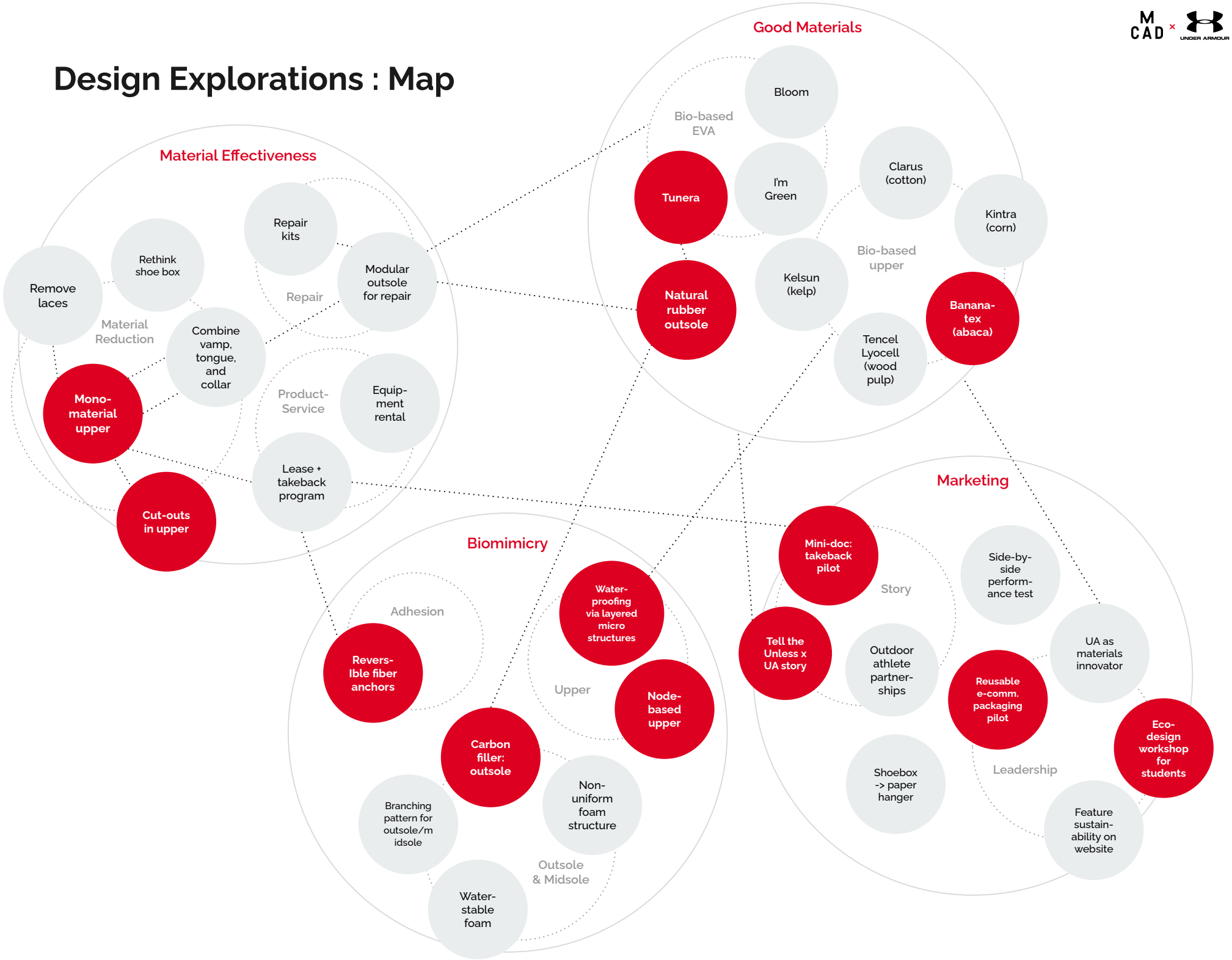
5 : STRENGTHEN UA'S OUTDOOR PERFORMANCE POSITION

Metric: Increase 10-15% sales volume

Sustainability-minded consumers are reshaping the outdoor footwear category. A redesigned Kilchis, built with transparent, responsible material choice, signals Under Armour's commitment to performance and environmental leadership, helping the brand stand out in a crowded market and deepen engagement with the 18–45 outdoor consumer.

Design Exploration

Design Explorations : Map



Design Explorations : List

MATERIAL EFFECTIVENESS

- Remove lace system
- **Mono-material upper**
- **Cut-outs in upper**
- Lease + take-back program
- **Combine vamp, tongue, and collar**
- Equipment rental program
- Repair kits + workshops
- Modular/repairable outsole
- Redesign shoebox

GOOD MATERIALS

- **Bio-based EVA**
  - I'm Green, Tunera, Bloom
- **Natural rubber outsole**
- **Bio-based upper**
  - **Bananatex**, Clarus, Kintra, Kelsun, Tencel Lyocell

MARKETING & COMMUNICATION

- Outdoor athlete partnerships/campaign
- Side-by-side performance test
- Eco-design workshop for students
- **Tell the Unless x UA story**
- **Mini-documentary: take-back program pilot**
- Highlight sustainability on website
- Redesigned shoebox
- **Reusable e-commerce packaging pilot**
- **Position UA as sustainability innovator**

BIOMIMICRY

- **Waterproofing: Micro- and nano-scale layered structures**
  - Porous, non-uniform foam structure
- **Adhesion: reversible fiber anchors**
- **Outsole with soil-supportive carbon filler**
  - Water-stable foam
  - Branching pattern for outsole/midsole
- **Bottom-up, node-based upper**

Top Ideas

1 : Mono-material / bio-based EVA

Replace mixed synthetic materials making up shoe vamp with single, molded bio-based EVA shell that encapsulates the internal components (such as lining, footbed, and midsole interface).

Key Benefits: Material reduction, drainage, lightweight

2 : Cut-outs in upper

The design minimizes upper material usage and reconfigures the shoe to emulate a sandal-inspired concept. This approach incorporates cutouts along the rear and side of the upper while maintaining top-of-foot coverage.

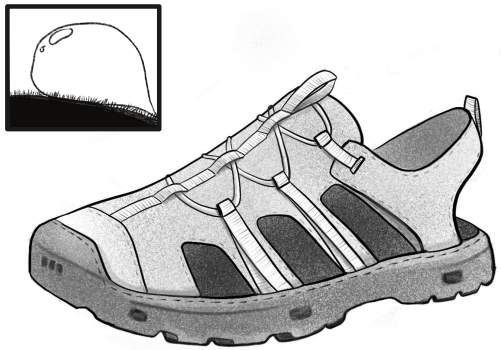
Key Benefits: Reduces material impact, improves drainage

3 : Bio-based midsole + carbon-infused natural rubber outsole

Replace synthetic materials in the midsole and outsole with natural rubber (with soil-supporting carbon filler) and 100% bio-based EVA.

Key Benefits: Reduces material impact, minimizes microplastics

Top Ideas



4 : Bananatex + waterproofing

Replace mixed synthetic materials making up shoe upper with organic Bananatex Abacá material, incorporating textile waterproofing strategies inspired by springtails' water repellency.

Key Benefits: Reduce material impacts while maintaining quick-dry performance

5 : Mechanical adhesion

Recycled-PET tabs along the upper margin slide into micro-grooves in the existing midsole, creating a strong, glue-free bond that performs better in wet, high-flex environments.

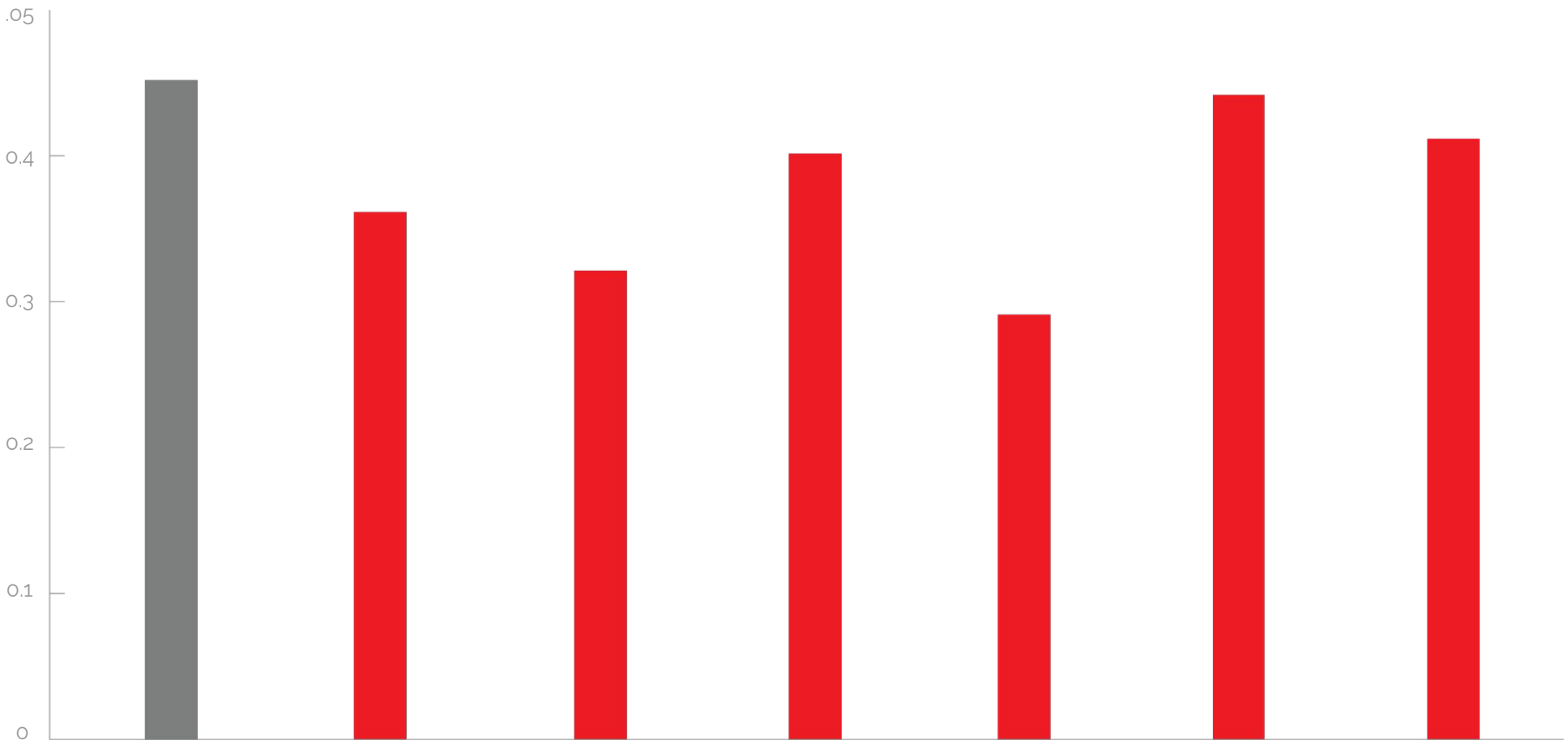
Key Benefits: Reduced material redundancy, improved durability, easier disassembly

6 : Node-based design + Cirql Midsole

This redesign replaces all welded TPU reinforcement overlays with a node-based upper architecture, where strategically placed TPU nodes form the direct structural connection between the upper and the sole.

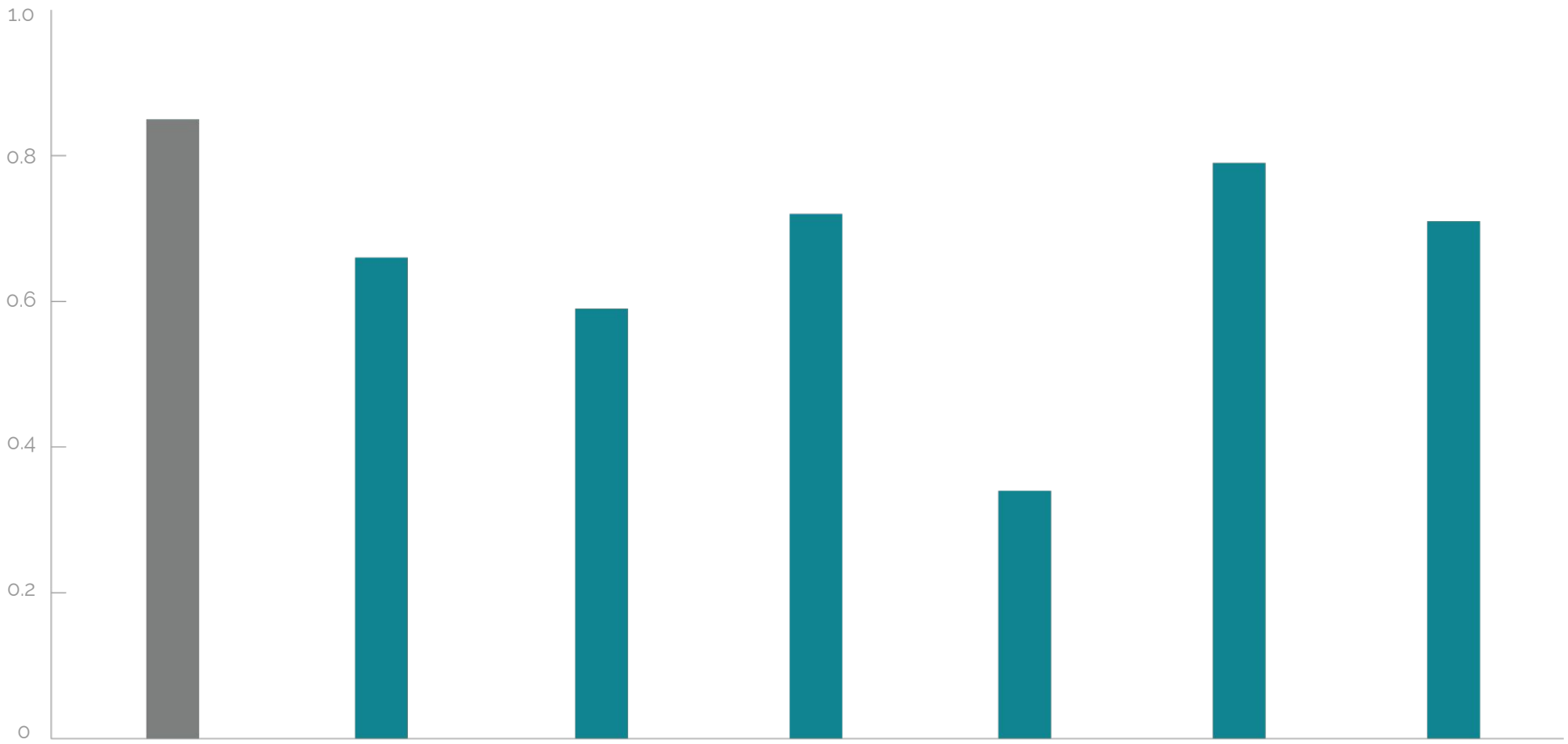
Key Benefits: Reduced material redundancy, enhanced durability, easier disassembly

Lifecycle Analysis: Impact Score



Baseline Kilchis SS25	1: Mono-material: bio-based EVA	2: Cut-outs in upper	3: Bio-based midsole + natural rubber/carbon outsole	4: Bananatex upper with waterproofing	5: Mechanical adhesion	6: Node-based design + Cirql midsole
	21% improvement	**30%** improvement	**11%** improvement	**37%** improvement	**3.6%** improvement	**9.9%** improvement

Lifecycle Analysis: CO2 Equivalent



Baseline Kilchis SS25	1: Mono-material: bio-based EVA	2: Cut-outs in upper	3: Bio-based midsole + natural rubber/carbon outsole	4: Bananatex upper with waterproofing	5: Mechanical adhesion	6: Node-based design + Cirql midsole
	22% improvement	**30%** improvement	**15%** improvement	**60%** improvement	**7%** improvement	**16%** improvement

Next-Gen Materials Overview

Image: Bananatex


Image: Lubrizol

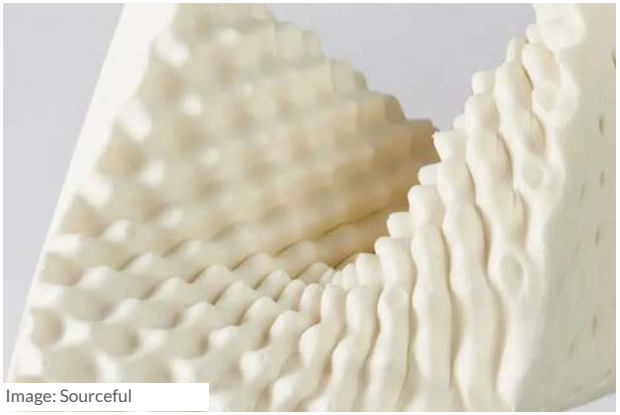


Image: Sourceful

1 : Bananatex®

A fully bio-based textile made from the fibers of the Abacá plant, grown without pesticides or irrigation. It delivers a strong, tear-resistant material ideal for structured uppers while offering a high-impact **sustainability story rooted in regenerative agriculture.** Bananatex is naturally water- and odor-resistant and can be finished with a bio-based wax waterproof coating.

2 : Recycled TPU

A durable polymer sourced from **post-industrial or post-consumer waste streams**, providing strong structure and protection for footwear components. Through a **closed-loop material initiative**, this material is **100% recyclable**, reinforcing a circularity narrative and offering a clear advantage over conventional polyester, which is typically downcycled rather than fully recyclable.

3 : Bio-Based EVA Foam

Bio-based foam replaces a portion of traditional petroleum inputs with **plant-derived content, reducing overall carbon footprint** while maintaining modern cushioning performance. It offers a soft underfoot feel, consistent comfort, and an aligned story with **next-gen renewable materials.**

Path to 100% circularity...

- Expand take back program
- Explore new partnerships
- Research innovative adhesive alternatives
- Design with end-of-life in mind

- Create a marketing campaign to promote UA's circularity initiatives, establishing UA within sustainable outdoors brand space

Path to reduced microplastics...

- Introduce bio-based materials into product lines
- Invest in innovative solutions
- Balance purpose and performance

- Create a campaign to promote UA's partnership with Unless brand, exploring how the brand will use lessons learned from the Unless shoe to reduce plastic use and make their products more sustainable

Recommendations

1 : 100% Bio-Based Material

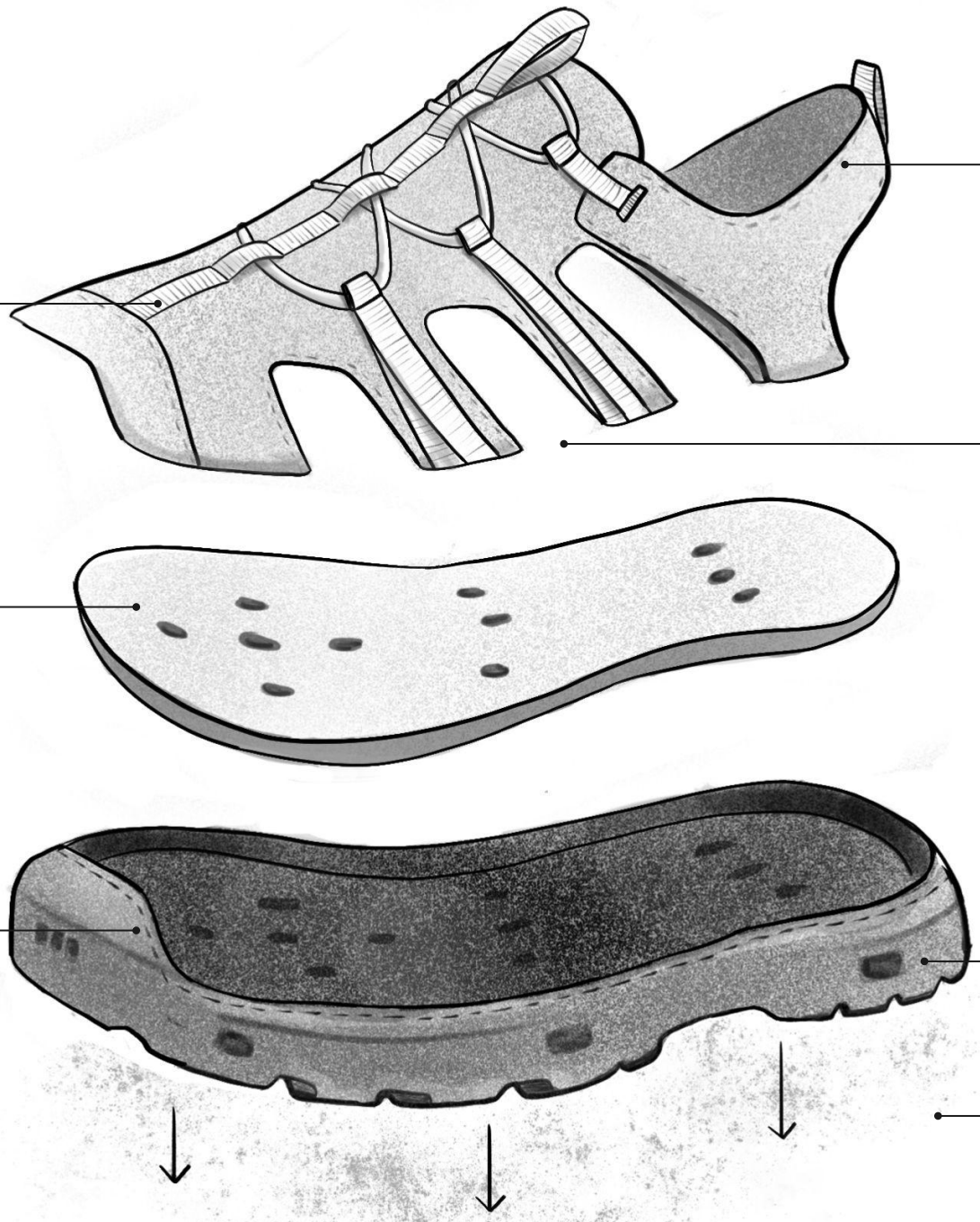
Envisioning the Kilchis as a bio-based, fully compostable shoe

Fully bio-based design eliminates negative impacts from synthetic materials, including polyester

Bananatex upper with natural waterproofing, removable bio-based EVA midsole, & carbon-infused natural rubber outsole

The entire shoe can be composted at end-of-life, without disassembly

Lifespan	●●●○○
End of Life	●●●●●
Microplastics	●●●●●
Performance	●●●○○
Differentiation	●●●●●



Bananatex Upper
Produced from sustainably-grown Abaca plants. Quick-drying and naturally antimicrobial. Treated with Bananatex's all-natural bio-based wax coating

Bananatex or Hemp Findings & Laces

Sandal-Style Cut-Outs
Improved drainage and drying while maintaining top-of-foot coverage. Lightweight design reduces material impacts.

Removable Bio-EVA Foam Midsole
NFW Tunera compostable EVA with drainage holes. Removable, replaceable design nests inside outsole.

Linen Stitching
Linen stitching attaches the upper to the outsole, eliminating the need for synthetic adhesives.

Natural Rubber + Carbon Outsole
Natural rubber outsole infused with carbon filler (from Made of Air), which adds grip and supports soil health as it sheds (inspired by Pyrogenic carbon).

2 : Node-Integrated TPU

Envisioning the Kilchis as a recycled, recyclable, mono-material TPU system

Global Recycled Standard

Engineered for closed-loop recycling, with the aim of meeting Global Recycled Standard requirements for verified recycled content and responsible processing.

TPU nodes rise from the recycled midsole to form a supportive skeletal framework, replacing traditional overlays and reducing glue through mechanical attachment.

A unified recycled-TPU upper, strobel, midsole, and outsole creates a true mono-material system, improving drainage, repairability, and recyclability.

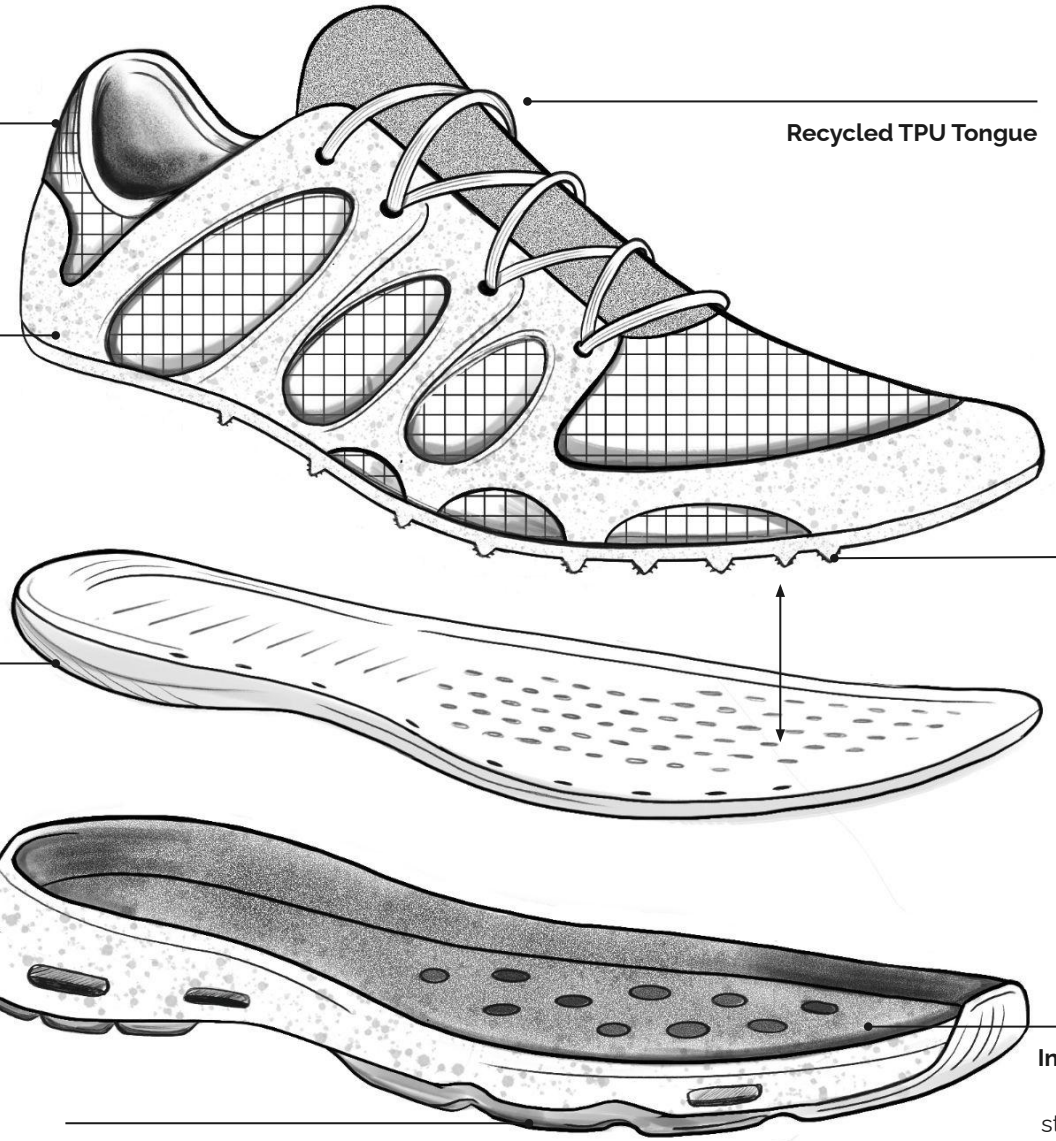
Lifespan	●●●●●
End of Life	●●●○○
Microplastics	●○○○○
Performance	●●●○○
Differentiation	●●●○○

100% recycled TPU mesh
Provides fast drainage, flexibility, and water resistance.

100% recycled TPU Node Skeleton; wraps the upper, replacing stitched/welded overlays with a continuous structural frame.

Strobel board made from 100% recycled TPU

Cirql rTPU30 midsole: 30% recycled TPU content in a foam optimized for energy return and resilience while remaining fully recyclable.



Recycled TPU Tongue

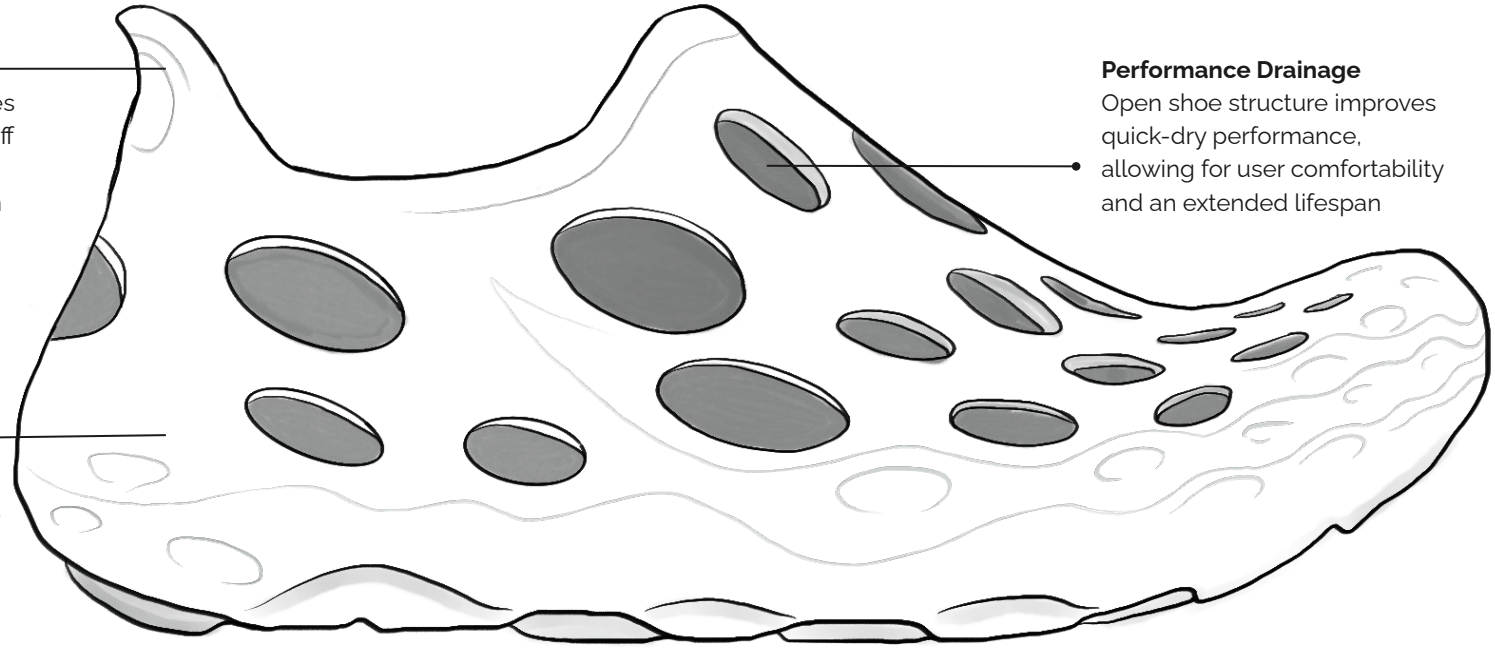
Micro "zip-tie" teeth that expand once pushed through the strobel slots, creating a snap-fit mechanical connection that can be released for easy disassembly.

Internal cavities and drainage channels that align with the strobel perforations to support rapid water release.

Thin TPU outsole layer uses a high-traction grade (such as a wet-grip Elastollan) designed for abrasion and slip resistance.

3 : 100% Mono-material

A Kilchis made up of 100% bio-based EVA foam



Pull-On Collar
Elevated shoe collar makes shoe easy to pull on and off while also keeping feet secure and comfortable in the water

Performance Drainage
Open shoe structure improves quick-dry performance, allowing for user comfortability and an extended lifespan

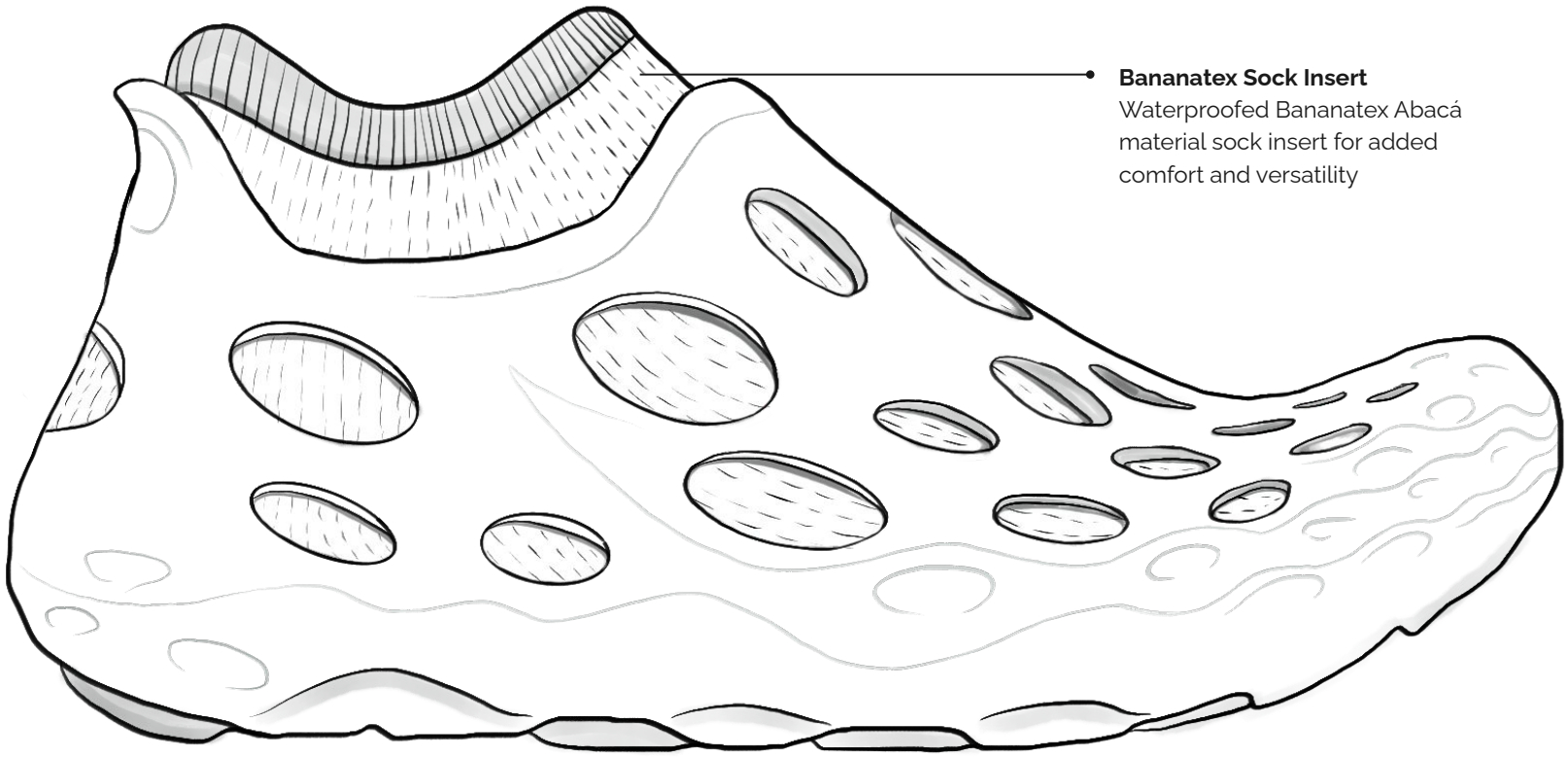
Bio-based EVA
100% EVA foam shoe manufactured using bio-based, injection-molded EVA

Replace mixed synthetic materials making up Kilchis shoe with single, molded bio-based EVA shell

100% compostable material significantly reduces microplastics and improves end of life outcomes

The entire shoe can be composted at end-of-life, without disassembly

Lifespan	●●●○○
End of Life	●●●●●
Microplastics	●●●●●
Performance	●●●○○
Differentiation	●●●●○



Bananatex Sock Insert
Waterproofed Bananatex Abacá material sock insert for added comfort and versatility

Marketing


UNDER ARMOUR
OUTDOORS

Launch UA Outdoors sub-brand to position Under Armour as an innovative outdoor brand, one that combines technical performance with a commitment to environmental responsibility.

UA Outdoors: Core Messages

Performance with Purpose

Outdoor gear that delivers performance while reducing impact

Designed for All

Accessible, inclusive, and welcoming for all people and all levels.

Made to Protect What You Love

Safeguarding the places that make outdoor performance possible.

UA Outdoors: Launch Campaign

Launch UA Outdoors with the release of the redesigned Kilchis, kicking off a campaign focused on sustainability.

Performance in Nature

UA gear supports confident movement outdoors with a lighter footprint.

Material Innovation

Show UA's use of lower-impact materials and responsible design.

Durability as Sustainability

Emphasize that long-lasting gear is better for the planet.

Sustainability Leadership & Storytelling

Activations and storytelling to position Under Armour as a sustainability leader

Take-back program pilot + mini-documentary

Pilot and film a return-and-recycle initiative to openly share process, successes, and challenges

Sustainable design workshops for students

Workshops for high school and college, with a goal of inspiring future sustainability innovation.

Reusable e-commerce packaging pilot

Pilot a reusable packaging program for e-commerce, showing leadership in a new and growing space.

Sustainability as a core brand message

Create more visibility around UA's existing sustainability initiatives, build on UA's reputation for innovation & performance.

Thank you.

Appendix

LCA Sensitivity Analysis

After completing a baseline LCA for the Charged Kilchis fishing shoe (based on the bill of materials provided by the UA team), our group identified four scenarios for sensitivity analysis:

Boundaries: Cradle-to-grave life cycle of one shoe
Functional unit: 1 year of use (assuming 3-year lifespan)

1 : Recycled polyester

Because Sustainable Minds shows zero impact for recycled polyester, our group chose to model the baseline scenario using virgin polyester for all components. This scenario tested the impact of that choice by updating components to recycled polyester per the BOM.

2 : Extending years of use from 3 to 5

This scenario tested our assumption for the shoe's lifespan by extending from 3 years (in the baseline scenario) to 5 years.

3 : Recycled EVA foam

Although the Kilchis shoe does not use very much EVA foam, we wanted to be able to better understand how this material affects the shoe's overall environmental impact. In this scenario, the baseline virgin EVA foam (Ethylene Vinyl Acetate) was replaced with recycled EVA.

4 : Testing an alternate outsole material

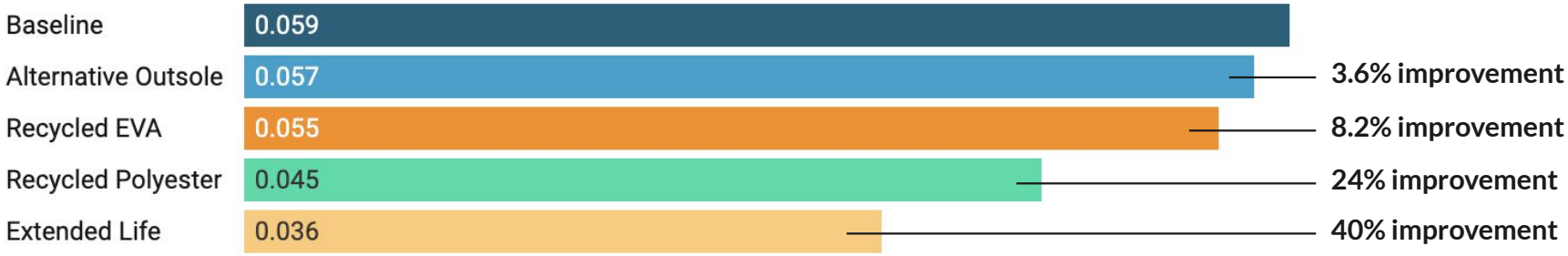
Because the exact synthetic rubber used in the outsole was uncertain, this scenario evaluated how the outsole material affects the shoe's overall impact. In this scenario, the baseline synthetic rubber (styrene-butadiene rubber) was replaced with natural rubber.

Sensitivity Analysis Results

Extending the shoe's lifespan had the greatest effect on the overall LCA score, highlighting both the promise of durability-focused strategies and the importance of accurate lifespan assumptions. Replacing virgin polyester with recycled polyester also produced a meaningful improvement, underscoring the potential of recycled materials to reduce impact.

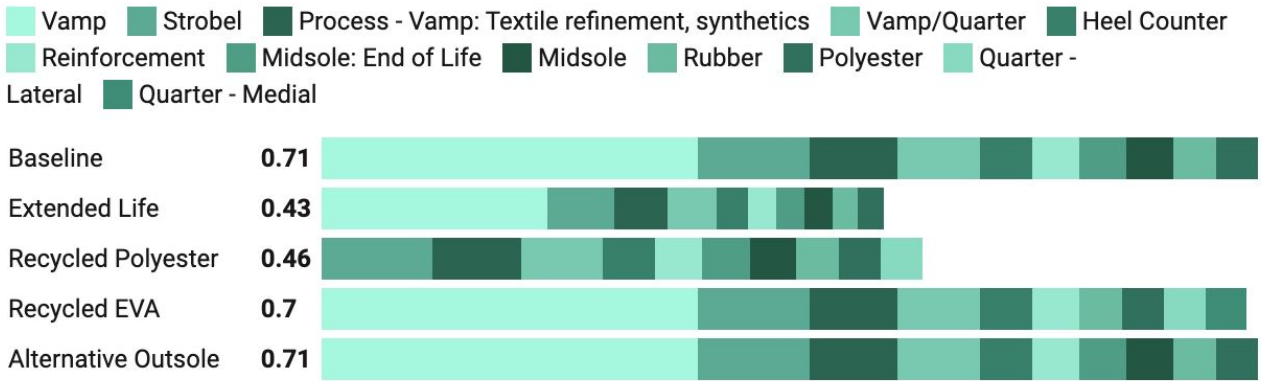
In contrast, substituting virgin EVA in the midsole and natural rubber in the outsole had relatively minor effects. That said, some benefits—such as reduced microplastic shedding—may not be fully captured in the LCA data.

Total Impact by Scenario [mPts/functional unit]

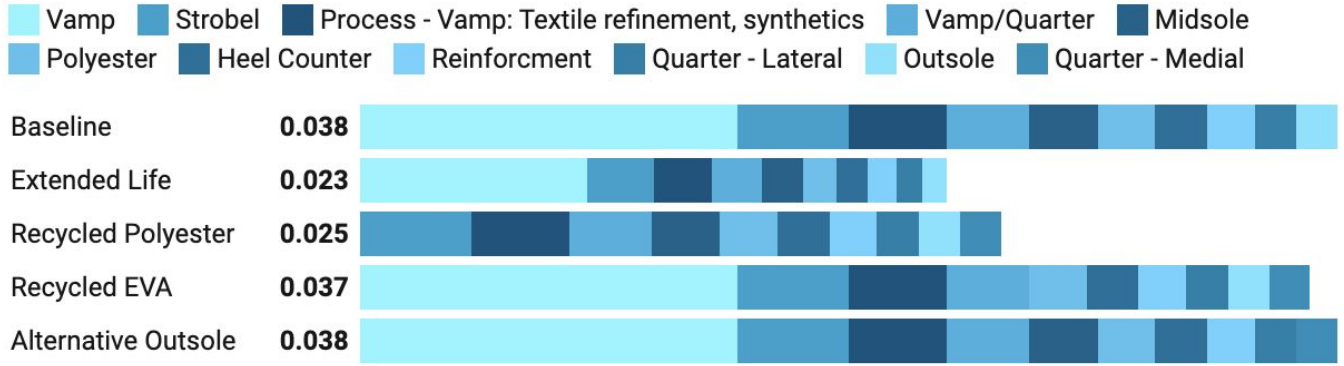


Sensitivity Analysis Results

Carbon Footprint by Component [mPts/functional unit]



Total Impact by Component [mPts/functional unit]



Survey

To guide the redesign of the Kilchis shoe, **a survey was conducted among 856 U.S. consumers** who actively participate in fishing, boating, or water-based outdoor activities and have purchased similar footwear in the past year.

The insights reveal that **consumers have a strong awareness of environmental impacts** and consistently associate responsible footwear with durability, recycled or natural materials, and reduced waste. The survey shows clear **consumer interest in responsibly made products**, highlighting an opportunity to strengthen market differentiation through meaningful sustainability innovations.

Consumer Insights Supporting Our Design Direction

1 : Extended Lifespan

- 83% of respondents have purchased shoes specifically because they were designed to last longer.. [OBJ]
- Average expected lifespan is 1–3 years, with only 11–20% expecting >3 years.

2 : Improved End-of-life Outcomes

- EOL features (recyclable/biodegradable/take-back) selected by 34–37% as top “eco-friendly” indicators.

3 : Reduced Microplastics

- 60% associate footwear with plastic pollution and microplastics.
- 55–61% expect “recycled or natural materials” in responsible footwear.

4 : Maintain Product Performance

- Performance, durability, and comfort rank as the top importance factors for water shoes .
- Consumers choose sustainable options only when performance is equal.

5 : Differentiate Under Armour in the Outdoor Performance Segment

- Nearly 80% of participants reported having paid more for products they believed were responsibly made, and almost half would choose a sustainable option even at a higher price
- 42–48% would choose a sustainable fishing shoe even if it cost $15 more

Decision Matrix

Based on the results of our initial life cycle analysis (LCA) and our work defining impacts across the shoe's lifecycle, our group assigned the weights to our design objectives to establish priorities for redesign. Then, we ranked our top six ideas based on each objective to compare the performance of each concept.

Criteria	Weight	Bio-based EVA	Cut-outs in upper	Bio-based midsole, nat rubber + carbon outsole	Bananatex + waterproofing	Mechanical adhesion	Node-based TPU
Extended Lifespan	*5*	5	5	5	5	15	25
Improved EOL	*5*	25	5	15	25	25	15
Reduced Microplastics	*3*	15	15	15	15	3	3
Maintain Performance	*3*	9	3	9	9	9	15
Product Differentiation	*1*	5	1	5	3	5	3
LCA Score	*1*	5	5	3	1	1	3
Total Rating		**64**	**34**	**52**	**58**	**58**	**64**

5 (best), 3 (mid), 1 (low)

Material Strengths & Limitations

MATERIAL	PROS	CONS
Bananatex	• Fully bio-based & biodegradable • Strong, tear-resistant, good for uppers • Low-impact cultivation • Compatible with bio-based coatings for improved water resistance without heavy solvents	• Higher cost vs synthetics • Limited color and finish options • Can require reinforcement in high-stress zones
Recycled TPU	• Works well for structural components • Strong, durable, and abrasion-resistant • Circularity narrative supported by closed-loop reprocessing of TPU scrap	• Heavier density vs EVA • Recyclate quality and consistency can vary • Yellowing or haze increases with recycled content
Bio-Based EVA Foam	• Lower CO_2 due to renewable monomer replacements • Aligns with bio-preferred materials trend. • Resists water absorption and degradation from chemicals	• Performance varies by supplier • Limited recyclability due to cross-linked structure • Thermal stability challenges

References

1. Bio-based EVA Foam https://www.sourceful.com/explore/materials/bio-based-eva-foam
2. BASF Elastollan: https://plastics-rubber.basf.com/emea/en/performance_polymers/industries/pp_footwear/applications/application_sport_performance
3. Bananatex https://bananatex.info/
4. Made of Air carbon filler: https://www.madeofair.com/
5. Cirql® rTPU50™ https://cirqlinnovations.com/rtpu50/