

RECYCLING SHOE

THE ROADMAP FOR CIRCULAR TRANSFORMATION OF THE FOOTWEAR INDUSTRY

podnadpis

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1 INTRODUCTION AND PURPOSE OF THE ROADMAP

The European footwear industry is facing an important transition towards more sustainable and circular production and consumption patterns. This transition requires changes across the entire footwear value chain, including product design, material selection, manufacturing processes, product use, repair, collection and end-of-life management. It also depends on the ability of companies, research organisations and educational institutions to respond to evolving regulatory requirements, technological developments and changing market expectations.

The transition towards a circular footwear industry is particularly challenging due to the complexity of footwear products, which often combine different materials and components that are difficult to separate and recycle. Addressing these challenges requires a coordinated approach that connects product design, material innovation, recycling technologies, environmental assessment, digitalisation and new business models.

This Roadmap has been developed within the framework of the Erasmus+ project Recycling Shoe. It builds on the results of the project's Work Package 2, which examined the regulatory environment, research findings and exemplary approaches to footwear recycling, and established an evidence-based framework for identifying key areas of knowledge and action. The subsequent validation of proposed study programme topics through feedback from industry and sectoral stakeholders provided additional insight into the relevance and priorities of the identified themes.

1.1 Purpose and Objectives

The main purpose of this Roadmap is to provide a strategic framework for supporting the transition towards a more circular and sustainable European footwear industry over the period 2025–2035.

It identifies the key areas in which progress is needed and outlines directions for action that can help industry stakeholders address current barriers and make use of emerging opportunities. Rather than focusing exclusively on recycling, the Roadmap adopts a broader life-cycle perspective, recognising that circularity must be considered from the earliest stages of product design through to the management of products at the end of their useful life.

The specific objectives are to:

- identify the main technological, regulatory, environmental and organisational challenges affecting circularity in the footwear sector;
- define strategic priorities for improving product design, material use, recycling and end-of-life management;
- highlight the role of digitalisation, life-cycle assessment and supply chain traceability in supporting more transparent and informed decision-making;
- identify opportunities for developing circular business models and strengthening cooperation across the footwear value chain;
- outline recommended directions for action and areas requiring further development, investment and collaboration;
- highlight the knowledge and skills needed to support the industry's circular transition.

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1.2 Scope and Target Audience

The Roadmap addresses the European footwear industry, taking into account the diversity of its stakeholders, technological capabilities and national contexts. Its scope includes footwear manufacturers and suppliers, material producers, recycling companies, research and technology organisations, industry associations, educational institutions and relevant public-sector stakeholders.

Particular attention is paid to the needs of small and medium-sized enterprises, which play an important role in the European footwear sector but may face limitations in terms of financial resources, technical capacities and access to specialised knowledge.

The Roadmap is intended to serve as a reference for:

- footwear companies seeking to improve the circularity and environmental performance of their products and processes;
- research and technology organisations developing new materials, design approaches and recycling solutions;
- industry associations and sectoral organisations supporting cooperation, knowledge exchange and the adoption of innovative practices;
- policymakers and other stakeholders involved in shaping the regulatory and support environment;
- universities and vocational education providers developing the knowledge and competencies required for the future footwear sector.

1.3 Evidence Base and Approach

The Roadmap builds on the findings of the desk research and stakeholder analysis conducted within Work Package 2 of the Recycling Shoe project. It combines an assessment of the regulatory environment, technological developments and exemplary practices with insights into the needs and priorities of the European footwear sector.

The Roadmap is structured around five interconnected strategic pillars:

1. Eco-Design and Design for Disassembly
2. Advanced Recycling Technologies and End-of-Life Management
3. Material Innovation and Chemical Compliance
4. Digitalisation, Life-Cycle Assessment and Supply Chain Traceability
5. Circular Business Models and Extended Producer Responsibility

These pillars represent key areas for supporting the transition towards a more circular footwear industry. They are intended to provide a strategic orientation for future activities, cooperation and investment, while allowing stakeholders to adapt the recommended directions to their specific conditions and capacities.

The Roadmap combines evidence from regulatory and sectoral analysis with identified technological developments, exemplary practices and stakeholder perspectives. It translates these findings into strategic priorities and recommended directions for action, while also recognising the importance of education, research and cooperation between industry and academia.

The Roadmap is intended as a strategic and forward-looking reference document. Its recommendations provide guidance for further activities and decision-making rather than a fixed implementation plan applicable in the same way to every company or country. Their practical application will depend on the specific conditions, capacities and development priorities of individual stakeholders.

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2 CURRENT STATE AND KEY CHALLENGES IN THE EUROPEAN FOOTWEAR INDUSTRY

2.1 Current Circular Practices in the Footwear Sector

Current approaches to footwear waste management can be grouped into several main categories, differing in their technological maturity, environmental benefits and business potential.

Reuse and charity collection represent an established route for extending the useful life of footwear. Shoes in suitable condition are collected, sorted and redistributed through charity networks, second-hand markets and other collection schemes. This approach helps delay waste generation, although the quality and traceability of collected products may vary.

Repair and refurbishment provide opportunities to extend product life by restoring the functionality and appearance of worn footwear. Traditional repair services coexist with more organized professional solutions, including cleaning, restoration and maintenance services for individual consumers and business customers.

Mechanical recycling and downcycling involve shredding footwear into smaller fractions and separating materials such as rubber, foam and textiles. The recovered materials are generally used in applications outside the footwear sector, including construction, automotive and sports infrastructure. Although this approach enables material recovery, the resulting materials often have lower value and limited potential for use in new footwear.

Advanced mechanical recycling and upcycling aim to recover more homogeneous material fractions and return them to higher-value applications, including the production of new footwear components. Automated sorting, separation of shoe uppers and soles, and adhesive-free assembly technologies offer opportunities to improve material recovery and support closed-loop solutions.

Chemical and thermal recovery includes processes such as pyrolysis, solvolysis, hydrolysis and devulcanization, as well as the use of footwear waste for energy recovery. While some technologies are being investigated in research and pilot projects, their industrial application remains limited in the countries covered by the desk research.

Overall, the research identifies reuse and repair as established practices, while mechanical downcycling and energy recovery remain important end-of-life routes. Closed-loop footwear recycling is still at an early stage of development.

2.2 Key Barriers to Circularity

The transition towards circular footwear production and consumption is constrained by several interconnected barriers.

Product design and material complexity

One of the most significant technological barriers is the construction of footwear from multiple materials and components that are often permanently bonded together. A single shoe may contain numerous material

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types, including EVA, PU, leather, textiles and metals. Irreversible adhesives and vulcanization processes make disassembly difficult and prevent effective separation of individual material fractions.

As a result, conventional mechanical recycling frequently produces mixed material outputs of limited quality and value. The limited ability to identify and separate certain materials, including black-pigmented components that pose challenges for conventional near-infrared sorting technologies, further complicates the process.

Economic viability

The economic performance of footwear recycling remains a major challenge. Collection, sorting, dismantling and processing generate costs, while the quality and market value of recovered materials may be insufficient to cover them. The WP2 research highlights the unfavourable economics of mechanical downcycling in the Czech context, where processing costs can exceed the value of the resulting material.

At the same time, less circular end-of-life options, such as energy recovery, may be economically more attractive. This creates a market environment in which material recovery and closed-loop recycling struggle to compete.

Infrastructure and organizational limitations

The availability of dedicated footwear collection, sorting and dismantling infrastructure remains limited. Footwear is frequently collected together with textile waste, which can reduce sorting quality and make subsequent material recovery more difficult.

The lack of sufficient quantities of clean, consistent and properly sorted material fractions also limits the development of industrial recycling operations. Effective circular systems therefore require cooperation between manufacturers, collectors, waste management companies, recyclers and other stakeholders.

Consumer behaviour and market acceptance

The viability of reuse, repair and second-hand markets depends partly on consumer attitudes and purchasing behaviour. Reluctance to purchase used footwear, limited awareness of repair options and inadequate waste segregation can reduce the effectiveness of otherwise promising circular solutions.

These barriers indicate that technological innovation alone will not be sufficient. Progress also depends on the development of appropriate business models, infrastructure, market demand and consumer engagement.

2.3 Regulatory and National Implementation Context

The European regulatory framework provides an important driver for the transition towards circularity in the footwear sector. The WP2 analysis identifies several areas of particular relevance, including ecodesign requirements, environmental performance, chemical safety, packaging and extended producer responsibility.

Key regulatory areas examined in the research include:

- **Ecodesign for Sustainable Products Regulation (ESPR):** establishes a framework for improving product sustainability, including durability, repairability, recyclability and access to product information.

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- **Waste Framework Directive (WFD) and Extended Producer Responsibility (EPR):** provide the framework for strengthening producer responsibility for the management of products at the end of their life.

Chemical legislation (REACH, CLP and POPs): influences material selection, chemical safety and compliance throughout the footwear value chain.

Environmental assessment and product information: including approaches such as Product Environmental Footprint (PEF), environmental labelling and the Digital Product Passport.

Packaging and packaging waste requirements: relevant to the reduction of packaging impacts and the development of more sustainable packaging solutions.

Although the core European regulatory framework is largely harmonised, its practical implementation depends on national authorities, administrative arrangements, support mechanisms and enforcement practices.

The national reports covering Portugal, Germany, the Czech Republic, Poland and Romania identify differences in institutional responsibilities, implementation readiness and the availability of support for businesses. These differences are particularly relevant for companies operating across several European markets, as they must respond not only to common European requirements but also to national implementation procedures.

For smaller companies, keeping up with regulatory developments and translating them into practical changes in product design, material selection, documentation and production processes may represent a considerable challenge.

The regulatory environment should therefore be understood both as a source of new obligations and as a potential driver of innovation, provided that businesses have access to appropriate information, technical expertise and implementation support.

2.4 Emerging Solutions and Opportunities

Despite the barriers identified, the research highlights several promising approaches that demonstrate the potential for more circular footwear systems.

Examples include automated footwear dismantling and material separation, such as the solutions developed by FastFeetGrinded; robotic separation of shoe components in initiatives such as DIS4REC; and the recovery of EVA materials through processes such as those explored by REVALOOP.

Other examples demonstrate the potential of extending product life and developing new circular business models. WoshWosh in Poland illustrates how professional cleaning, restoration and repair services can be developed into organised business activities. KAVE Footwear in the Czech Republic demonstrates the potential for recovering materials from unwearable footwear and using them in new shoe components.

These examples differ in their technological maturity, scale and business context. They nevertheless demonstrate that circular solutions can be developed through different pathways, ranging from product life extension to advanced material recovery.

The research also points to the importance of cooperation between industry, research organisations and technology providers. Such cooperation can help address technical challenges, test new materials and processes, improve access to specialised facilities and create new markets for recovered materials.

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The main opportunity for the footwear sector lies in connecting these individual developments into more integrated circular systems. This requires progress not only in recycling technologies, but also in product design, material innovation, traceability, regulatory compliance and business models.

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3 STRATEGIC PILLARS FOR CIRCULAR TRANSFORMATION

The transition towards a circular footwear industry requires a systemic approach addressing the entire product life cycle. The findings of the WP2 research identify five interconnected strategic pillars that represent the main areas for technological development, regulatory adaptation and changes in business practices.

Together, these pillars provide a framework for addressing the key challenges identified in the footwear sector. They cover the design and construction of footwear, the development and use of materials, the recovery of resources at the end of product life, the management of environmental and product data, and the development of viable circular business models.

The pillars are mutually reinforcing. Circular product design determines the possibilities for repair, disassembly and recycling. Material innovation influences product performance, chemical safety and end-of-life options. Digitalisation and environmental assessment support informed decision-making and transparency, while circular business models provide the organisational and economic conditions for implementing these changes.

3.1 Eco-Design and Design for Disassembly

Strategic direction: Designing footwear for durability, repairability, material separation and recyclability from the earliest stages of product development.

Traditional footwear construction frequently combines different materials and components through permanent adhesives, vulcanisation and other joining techniques. While these methods may provide the required product performance and durability, they can make subsequent repair, disassembly and material recovery difficult or technically unfeasible.

Eco-design and Design for Disassembly (DfD) therefore represent a fundamental starting point for circular transformation. Instead of addressing waste only at the end of a product's life, circular principles need to be incorporated into design and construction decisions from the beginning.

Key development directions include:

- **Modular footwear construction:** developing products with components that can be separated, replaced or repaired without damaging the remaining parts.
- **Material simplification:** reducing unnecessary material combinations and promoting mono-material or more easily separable material structures.
- **Alternative joining technologies:** exploring glueless constructions, stitching, mechanical fasteners, snap-fit connections and other reversible joining methods.
- **Design for durability and repair:** ensuring that footwear maintains its functionality over time and that worn or damaged components can be replaced.
- **Design for recyclability:** considering the compatibility of materials and construction methods with available and emerging recycling technologies.

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The research identifies a significant imbalance between the attention given to downstream materials engineering and the development of practical eco-design solutions. Addressing this gap is essential for reducing the structural barriers that currently limit footwear recycling.

The strategic importance of this pillar lies in its upstream position: decisions made during product development influence the possibilities and costs of subsequent repair, reuse, disassembly and recycling.

3.2 Advanced Recycling Technologies and End-of-Life Management

Strategic direction: Developing effective systems for footwear collection, sorting, disassembly and material recovery, with the aim of retaining the value of materials for as long as possible.

The management of footwear at the end of its useful life remains one of the major challenges for the sector. Existing practices include reuse, repair, mechanical downcycling and energy recovery. However, the availability of industrial-scale solutions capable of recovering high-quality material fractions and returning them to footwear production remains limited.

Improving this situation requires both technological development and the establishment of appropriate collection and processing infrastructure.

Key development directions include:

- **Collection and sorting systems:** improving the availability and quality of collected footwear and establishing effective sorting procedures.
- **Automated separation and dismantling:** developing technologies capable of separating soles, uppers and other components before further processing.
- **Advanced mechanical recycling:** improving the recovery of rubber, foam, textiles and polymer fractions through more precise separation and processing.
- **Chemical recycling and material recovery:** advancing technologies that can break down selected polymers or recover valuable material components, while assessing their technical and economic feasibility.
- **Industrial cooperation:** connecting footwear manufacturers and recyclers with other sectors capable of using recovered materials and supporting new material markets.

Examples identified in the WP2 research include automated material separation developed by FastFeetGrinded, robotic component separation explored through DIS4REC, and approaches to EVA recycling investigated by REVALOOP.

These examples demonstrate different technological pathways, but they also highlight the need to consider the entire system surrounding recycling. Collection volumes, material quality, processing costs and demand for recovered outputs all influence whether a recycling solution can become commercially viable.

The objective is not simply to increase the volume of footwear waste processed, but to improve the quality and value of recovered materials and progressively enable more circular material flows.

3.3 Material Innovation and Chemical Compliance

Strategic direction: Developing footwear materials that combine technical performance, environmental responsibility, safety and suitability for circular use.

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Material selection has a direct influence on the environmental performance, durability, functionality and recyclability of footwear. The transition towards circular production therefore requires innovation in both primary and secondary materials, together with improved knowledge of their chemical composition and environmental characteristics.

Research and development activities increasingly explore bio-based materials, recycled polymers and alternative material composites. Examples identified in the WP2 research include mycelium, bacterial cellulose and recycled EVA and TPU materials.

Key development directions include:

- **Bio-based material development:** exploring renewable material sources and their potential applications in footwear components.
- **Recycled material integration:** increasing the use of secondary raw materials in soles, uppers and other footwear components, where technical requirements can be met.
- **Material performance and durability:** ensuring that innovative materials meet the functional, mechanical and quality requirements of footwear applications.
- **Chemical safety and compliance:** improving knowledge of chemical substances, material composition and relevant regulatory requirements, including REACH and CLP.
- **Material compatibility and end-of-life considerations:** assessing how material choices affect repair, disassembly, recycling and potential recovery routes.

Material innovation should not be understood simply as replacing conventional materials with bio-based alternatives. New materials must be assessed in terms of their actual performance, durability, environmental impacts, chemical safety and compatibility with existing or emerging production and recycling processes.

An important challenge is therefore to balance innovation with the practical requirements of the footwear industry. Materials that offer environmental benefits in one area may create technical or end-of-life difficulties elsewhere. Their development should consequently be linked to product design, life-cycle assessment and recycling considerations.

3.4 Digitalization, LCA, and Supply Chain Traceability

Strategic direction: Improving the availability, quality and transparency of product and environmental data throughout the footwear value chain.

The transition towards circularity requires reliable information about the materials, components, production processes and environmental impacts associated with footwear. Such information supports better product design, regulatory compliance, supply chain management and the development of circular solutions.

Digitalisation and environmental assessment provide tools for collecting, managing and evaluating this information. They are particularly relevant in complex international supply chains involving multiple suppliers, materials and manufacturing stages.

Key development directions include:

- **Life-Cycle Assessment (LCA):** assessing environmental impacts across relevant stages of the footwear life cycle and identifying areas with the greatest potential for improvement.

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- **Environmental footprinting:** developing the capacity to measure and evaluate indicators such as carbon and water footprints, using appropriate methodologies including Product Environmental Footprint (PEF).
- **Digital Product Passport (DPP):** preparing the product data and information systems needed to support digital access to relevant product and material information.
- **Supply chain traceability:** improving the ability to identify and document the origin, composition and movement of materials and components throughout the supply chain.
- **Digital data management:** strengthening the systems and competencies required to collect, process, exchange and maintain reliable product information.

These developments are closely connected. Life-cycle assessment requires reliable data, while traceability and digital product information can support more accurate environmental assessment and better-informed decisions.

For footwear companies, the challenge is not only to introduce digital tools, but also to ensure that information is consistent, accessible and sufficiently reliable to support practical business decisions and regulatory requirements.

This pillar therefore represents an important enabling condition for the other strategic pillars, particularly eco-design, material innovation and circular business models.

3.5 Circular Business Models and EPR Navigation

Strategic direction: Developing economically viable approaches that extend product life, support material recovery and integrate producer responsibility into footwear value chains.

Technological solutions alone cannot ensure the transition towards a circular footwear industry. Their successful implementation also depends on business models that make repair, refurbishment, reuse, collection and material recovery economically viable.

Traditional footwear business models are primarily based on selling new products. Circular approaches seek to complement or gradually transform this model by retaining the value of products and materials for longer and creating additional services and revenue opportunities.

Key development directions include:

- **Repair and refurbishment services:** expanding opportunities for restoring footwear and extending its useful life.
- **Reuse and resale models:** developing systems that enable suitable footwear to be redistributed and used by subsequent owners.
- **Take-back and collection schemes:** establishing effective arrangements for collecting footwear after use and directing it towards appropriate recovery options.
- **Reverse logistics:** developing the organisational and logistical systems needed to move used footwear from consumers and businesses to sorting, repair and recycling facilities.
- **Extended Producer Responsibility (EPR):** preparing for the financial and organisational responsibilities associated with the collection and management of products at the end of their life.
- **Cross-sector cooperation:** establishing partnerships that create demand for recovered materials and support economically viable circular value chains.

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The WP2 research identifies examples of circular business practices, including professional repair and refurbishment services such as WoshWosh and take-back and reuse initiatives. These demonstrate that extending product life can create business opportunities alongside environmental benefits.

However, the economic feasibility of circular models depends on several factors, including collection and processing costs, consumer acceptance, product quality, market demand and the availability of suitable infrastructure. Different national EPR arrangements may also create additional administrative and operational challenges for companies active in multiple markets.

The strategic objective is to move beyond isolated circular initiatives towards business models and cooperation structures that connect product life extension, collection, material recovery and the use of secondary resources.

3.6 Interconnections Between the Strategic Pillars

The five strategic pillars should be understood as parts of one interconnected system rather than as separate areas of activity.

Eco-design influences the possibilities for repair, disassembly and recycling. Material innovation provides new solutions for reducing dependence on primary resources and improving material performance. Recycling technologies depend on suitable product construction, effective collection and the availability of materials that can be processed. Digitalisation and life-cycle assessment support the collection and evaluation of information needed to improve decisions across the value chain. Circular business models provide the economic and organisational structures that enable these solutions to operate in practice.

The relationship between the pillars highlights the need for coordinated action. Progress in one area may be limited if the corresponding developments in other areas are missing. For example, advanced recycling technologies cannot achieve their full potential without products designed for separation and effective collection systems. Similarly, the introduction of new materials does not automatically result in improved circularity unless their performance, chemical composition and end-of-life options are properly considered.

The five pillars therefore provide a common strategic framework for guiding the development of a more circular European footwear industry. Their practical implementation requires cooperation between manufacturers, material suppliers, research and technology organisations, recyclers, educational institutions, industry associations and policymakers.

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4 ROADMAP PATHWAYS AND RECOMMENDED ACTIONS

The transition towards a circular European footwear industry requires coordinated action across the entire footwear value chain. The strategic pillars identified in the previous chapter provide the basis for a set of practical pathways and recommended actions.

The recommendations below build on the WP2 research findings, including the analysis of existing practices, identified barriers, exemplary initiatives and stakeholder-validated curriculum priorities. They are intended to provide guidance for companies, research and technology organisations, industry associations, educational institutions and other relevant stakeholders. They do not constitute a binding implementation plan or assign formal responsibilities to individual organisations.

4.1 Strengthening Eco-Design and Design for Disassembly

Product design has a decisive influence on the possibilities for repair, reuse, dismantling and material recovery at the end of a shoe's life. Current footwear construction often combines different materials through permanent adhesives and other difficult-to-reverse joining methods, limiting the potential for effective recycling.

Recommended actions:

- Promote the integration of circularity principles into footwear design from the earliest stages of product development.
- Encourage modular construction, material simplification and the use of components that can be separated more easily.
- Support the development and testing of alternative joining methods, including reversible adhesives, mechanical connections and glueless constructions.
- Improve cooperation between designers, material suppliers, manufacturers and recyclers to ensure that design decisions reflect actual end-of-life requirements.
- Include durability, repairability, disassembly and recyclability criteria in product development and evaluation processes.
- Strengthen practical knowledge of Design for Disassembly (DfD) among footwear designers, product developers and technical staff.

The priority is to reduce the technical barriers that prevent footwear components and materials from being recovered and reused. Design for disassembly should therefore be considered not only a design issue, but also a prerequisite for more efficient end-of-life management.

4.2 Developing Advanced Recycling and End-of-Life Management

The research identifies a gap between the growing need to manage post-consumer footwear and the limited availability of dedicated collection, sorting and recycling infrastructure. Mechanical downcycling and energy recovery remain established pathways, while advanced separation and closed-loop recycling are still developing.

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Recommended actions:

- Improve the separate collection of used footwear and explore collection systems that make footwear easier to identify and sort separately from other textile waste.
- Strengthen cooperation between footwear producers, retailers, municipalities, waste-management operators and recycling companies.
- Support the development and testing of automated sorting and dismantling technologies, including optical and hyperspectral identification and robotic separation.
- Improve the quality and consistency of recovered material fractions to make them more suitable for further processing and industrial use.
- Encourage mechanical recycling and upcycling solutions that can return recovered materials to footwear production where technically and economically feasible.
- Support research and pilot projects in chemical recycling, polymer depolymerisation and rubber devulcanization, while assessing their technical feasibility, environmental performance and economic viability.
- Develop cross-sector partnerships to create markets for secondary materials that cannot be reused directly in footwear production.

Examples identified in the WP2 research, such as FastFeetGrinded, DIS4REC and REVALOOP, demonstrate different approaches to improving material separation and recovery. They also highlight the importance of linking technological development with industrial applications and viable markets for recovered materials.

The development of recycling infrastructure should be accompanied by realistic assessments of material quality, processing costs, available volumes and potential end markets. Technological solutions alone will not ensure that footwear recycling becomes economically sustainable.

4.3 Promoting Material Innovation and Chemical Compliance

The transition to circular footwear requires materials that combine appropriate technical performance, durability, safety and improved end-of-life potential. Research into recycled and bio-based materials offers opportunities, but their industrial application needs to be assessed in relation to the requirements of footwear products and production processes.

Recommended actions:

- Support the development and testing of recycled materials and secondary raw materials suitable for footwear components.
- Explore the potential of bio-based materials, including mycelium-based materials and bacterial cellulose, while assessing their durability, performance and end-of-life characteristics.
- Improve cooperation between footwear manufacturers, material suppliers, research organisations and recycling companies in the development and testing of new materials.
- Assess material combinations not only in terms of immediate product performance, but also their compatibility with repair, disassembly and recycling processes.
- Strengthen the integration of chemical safety and regulatory compliance into material selection and product development.
- Improve access to practical knowledge concerning chemical requirements, material composition and the implications of restricted substances.

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Material innovation should not be understood simply as replacing conventional materials with new alternatives. New materials need to be assessed across their life cycle, including their technical suitability, chemical safety, durability and potential for recovery or safe treatment after use.

4.4 Improving Digitalization, Life-Cycle Assessment and Supply Chain Traceability

Reliable information about product composition, material origin and environmental performance is essential for informed decisions throughout the footwear value chain. Digital tools and life-cycle assessment can support better product development, regulatory compliance and end-of-life management.

Recommended actions:

- Improve the availability and quality of data on footwear composition, components and material suppliers.
- Encourage the use of Life Cycle Assessment (LCA) and environmental footprinting methods in product development and sustainability assessment.
- Strengthen cooperation across the supply chain to improve the exchange of relevant product and material information.
- Prepare companies to manage product-related information in a structured and accessible digital form, taking account of the development of the Digital Product Passport (DPP).
- Improve knowledge of relevant environmental assessment methods, including Product Environmental Footprint (PEF) approaches.
- Support SMEs in adopting proportionate digital tools and data-management practices that reflect their capacities and business needs.

Digitalisation should serve a practical purpose: making information about products and materials more accessible, reliable and useful for design, production, compliance, repair and recycling. Particular attention should be paid to the ability of SMEs to collect, maintain and exchange the necessary data. WP2-reports(1).pdf

4.5 Supporting Circular Business Models and Extended Producer Responsibility

Circular business models can extend the useful life of footwear, reduce the volume of products becoming waste and create additional services and revenue opportunities. Their development depends on consumer acceptance, service availability, effective reverse logistics and suitable organisational and economic conditions.

Recommended actions:

- Promote repair, maintenance and refurbishment services as practical ways of extending footwear product life.
- Encourage footwear brands and retailers to explore take-back schemes and other arrangements for collecting used footwear.
- Develop cooperation between manufacturers, retailers, repair providers, collection organisations and recycling companies to establish effective reverse logistics.
- Explore business models based on reuse, resale, refurbishment and service provision, taking account of the different types and conditions of footwear.
- Improve awareness among companies of the operational and financial implications of Extended Producer Responsibility (EPR).

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- Encourage cooperation between producers and relevant waste-management organizations in the development of collection, sorting and treatment systems.
- Assess the potential of cross-sector partnerships to create demand for recovered materials and support economically viable circular solutions.

The WP2 research identified repair and refurbishment services, including WoshWosh, as examples of approaches that can extend product life. It also highlighted take-back and shoe-to-shoe recycling initiatives as possible routes towards more circular material flows. These examples demonstrate that circular business models can take different forms and should reflect the characteristics of the products, markets and available infrastructure.

4.6 Cross-Cutting Actions to Enable the Transition

The five strategic pillars are interdependent. Progress in one area can be limited if the necessary conditions in other parts of the value chain are missing. For example, improved product design will have limited impact if suitable collection and recycling systems are unavailable. Similarly, investments in recycling technologies require sufficient volumes of appropriately sorted materials and markets for the recovered outputs.

The following cross-cutting actions can support progress across the five pillars:

- Strengthen value-chain cooperation. Establish and develop links between footwear manufacturers, material suppliers, research organisations, recyclers, waste-management operators, retailers and public authorities.
- Support SMEs in the transition. Improve access to practical guidance, technical expertise, relevant regulatory information and cooperation opportunities. Particular attention should be paid to the financial and organisational capacities of smaller companies.
- Connect research with industrial practice. Encourage pilot projects, technology testing and demonstration activities that allow companies to assess the practical applicability of new materials, design approaches and recycling technologies.
- Improve access to reliable information. Share examples of good practice, technical findings and practical guidance in a form accessible to companies and other stakeholders.
- Strengthen consumer awareness and participation. Communicate the value of repair, reuse, separate collection and responsible end-of-life treatment of footwear.
- Integrate circular economy competencies into education and professional development. Ensure that training reflects the combined technical, environmental, regulatory, digital and business knowledge required by the sector.

The WP2 research points to the importance of cross-sector industrial cooperation, particularly where recovered materials cannot be absorbed by the footwear industry alone. It also identifies skills development and cooperation between higher education, vocational education and industry as important enabling conditions.

4.7 Translating the Recommendations into Practice

The implementation of the recommended actions will depend on the maturity, resources and position of individual stakeholders within the footwear value chain. A single approach cannot be applied equally to all companies or countries.

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For companies, the transition can begin with a review of product design, material composition, production processes and existing arrangements for repair, collection and waste management. Research and technology organisations can contribute through material testing, technology development and pilot projects. Industry associations can facilitate knowledge exchange, cooperation and access to relevant information. Educational institutions can support the transition by developing the skills and competencies required by the sector.

The selection and sequencing of actions should take account of:

- the technical and economic feasibility of the proposed solutions;
- the availability of suitable technologies, infrastructure and partners;
- the regulatory context and the capacity of organisations to respond to it;
- the potential environmental benefits across the product life cycle;
- the specific needs and capacities of SMEs.

The transition should be approached as a continuous process of improvement. Practical experience, technological progress, regulatory developments and feedback from stakeholders should inform the further development of circular practices in the European footwear industry.

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5 IMPLEMENTATION PERSPECTIVE AND STAKEHOLDER ROLES

The transition towards a more circular footwear industry requires the involvement of stakeholders across the entire value chain. Individual companies cannot address all challenges independently, as circular solutions depend on cooperation between product designers, manufacturers, material suppliers, retailers, consumers, waste-management operators, recyclers, research organisations and public authorities.

The implementation of the recommendations outlined in this Roadmap will therefore depend on the ability of these stakeholders to establish effective cooperation, share knowledge and develop solutions that are technically, economically and environmentally viable.

This chapter outlines the main stakeholder groups and their potential contributions to the transition. The roles described are indicative and should be adapted to national circumstances, sectoral structures and the capacities of individual organisations.

5.1 Key Stakeholders and Their Potential Roles

Footwear manufacturers and brands

Footwear manufacturers and brands play a central role in integrating circularity principles into product development, production and business strategies.

Their potential contributions include:

- incorporating eco-design and Design for Disassembly principles into product development;
- assessing material choices in relation to durability, repairability, chemical safety and recyclability;
- improving information about product composition and material origin;
- exploring repair, refurbishment, take-back and reuse schemes;
- cooperating with recyclers and material suppliers to improve the recovery and use of secondary materials;
- preparing for relevant regulatory and information requirements.

Material suppliers and component manufacturers

Material and component suppliers influence the environmental and technical characteristics of footwear products and the possibilities for their recovery at the end of their useful life.

Their potential contributions include:

- developing and supplying recycled and bio-based materials;
- improving transparency regarding material composition and chemical substances;
- supporting the development of materials compatible with repair, disassembly and recycling;
- cooperating with footwear manufacturers and research organisations in material testing and validation;
- providing reliable product and material data to support traceability and environmental assessment.

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Recycling companies and waste-management operators

Recycling companies and waste-management operators are essential for establishing effective systems for collection, sorting, dismantling and material recovery.

Their potential contributions include:

- developing and improving collection and sorting systems for used footwear;
- testing technologies for material identification, separation and dismantling;
- improving the quality of recovered material fractions;
- identifying suitable applications and markets for recovered materials;
- cooperating with manufacturers and research organisations to develop economically viable recycling processes;
- providing feedback to designers and manufacturers on the practical limitations of current footwear constructions.

Research and technology organisations

Research organisations and technology centres can support the transition by developing, testing and validating new materials, technologies and processes.

Their potential contributions include:

- conducting research into advanced mechanical and chemical recycling technologies;
- developing and testing new materials and material combinations;
- assessing environmental performance through LCA and related methods;
- supporting pilot projects and technology demonstration;
- providing technical expertise to companies, particularly SMEs;
- facilitating cooperation between industry and academia.

Retailers and repair service providers

Retailers and repair service providers are in direct contact with consumers and can contribute to extending the useful life of footwear and improving the collection of products after use.

Their potential contributions include:

- providing repair and maintenance services or facilitating access to them;
- supporting refurbishment and resale activities;
- participating in take-back and collection schemes;
- communicating information about product care, durability and repair options;
- providing feedback on consumer behaviour and market acceptance of circular services.

Industry associations and cluster organisations

Industry associations and cluster organisations can act as intermediaries between companies, research organisations, educational institutions and public authorities. Their position within the sector allows them to facilitate cooperation and support the dissemination of knowledge.

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Their potential contributions include:

- identifying common sectoral needs and barriers;
- organizing knowledge-sharing activities, workshops and networking opportunities;
- connecting companies with research and technology partners;
- disseminating information on regulatory developments and funding opportunities;
- supporting collaborative projects and international cooperation;
- representing sectoral interests in discussions concerning relevant policies and regulatory measures.

Educational and training institutions

Educational and training institutions contribute to the long-term transformation of the sector by preparing students and professionals for the technical, environmental, regulatory and business challenges associated with circular footwear.

Their potential contributions include:

- integrating circular economy principles into footwear-related education and training;
- developing interdisciplinary learning opportunities;
- cooperating with companies and research organisations in practical training and applied projects;
- updating curricula in response to technological and regulatory developments;
- supporting lifelong learning and professional development.

Public authorities and policymakers

Public authorities influence the conditions under which circular solutions are developed and implemented through legislation, policy instruments, public procurement and support programmes.

Their potential contributions include:

- providing clear and accessible information on regulatory requirements;
- supporting the development of appropriate waste-management and collection infrastructure;
- encouraging research, innovation and cooperation across the value chain;
- considering the specific needs and capacities of SMEs when designing support measures;
- promoting circular economy principles through relevant public policies and procurement practices.

5.2 Cooperation Across the Footwear Value Chain

The implementation of circular solutions requires cooperation that goes beyond individual organisations and traditional sector boundaries.

For example, the development of footwear products suitable for recycling requires designers and manufacturers to understand the technical requirements of recycling processes. Recyclers, in turn, need information about product composition and access to sufficient quantities of suitable waste materials. Material suppliers and research organisations can help bridge these requirements by developing and testing materials and technologies that support circular applications.

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Cooperation is equally important in the development of collection and reverse logistics systems. Manufacturers, retailers, municipalities, waste-management operators and recycling companies need to coordinate their activities to ensure that used footwear can be collected, sorted and directed towards appropriate treatment options.

Cross-sector cooperation can also create new opportunities for recovered materials. Where secondary materials cannot be reused directly in footwear production, cooperation with other industries may help identify alternative applications and improve the economic viability of material recovery.

Industry associations, clusters and research networks can facilitate these connections by providing platforms for knowledge exchange, identifying common challenges and supporting collaborative initiatives.

5.3 Supporting SMEs in the Transition

Small and medium-sized enterprises represent an important part of the European footwear value chain. However, their financial, technical and human resources may limit their ability to respond independently to complex regulatory requirements and invest in new technologies or circular business models.

The transition should therefore take account of the specific circumstances of SMEs and provide practical support that enables gradual progress.

Relevant support measures may include:

- accessible guidance on circular design, material selection and chemical compliance;
- practical information on relevant EU and national regulatory developments;
- opportunities to participate in collaborative research and pilot projects;
- access to technical expertise, testing facilities and demonstration activities;
- support in assessing the feasibility and potential benefits of circular business models;
- training opportunities focused on practical skills and the implementation of circular solutions;
- cooperation platforms that allow SMEs to share experience and access external expertise.

Industry associations, cluster organisations, research institutions and public support bodies can play an important role in making such support accessible. Cooperation can help smaller companies benefit from expertise and infrastructure that would be difficult to develop individually.

5.4 Conditions for Effective Implementation

The successful implementation of circular footwear solutions depends on several interconnected conditions. Technological development needs to be accompanied by suitable infrastructure, market demand, regulatory clarity and cooperation across the value chain.

The following conditions are particularly relevant:

- **Technical feasibility:** proposed solutions need to be tested under real production and operating conditions, taking account of product performance and material quality.
- **Economic viability:** investments in new technologies, collection systems and circular services need to be assessed in relation to costs, available volumes and potential markets.
- **Regulatory clarity:** companies need reliable information about applicable requirements and their practical implications.

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- **Access to knowledge and expertise:** stakeholders need opportunities to develop the technical, digital, environmental and organisational competencies required for circular practices.
- **Market acceptance:** circular products and services need to respond to consumer expectations and demonstrate practical value.
- **Availability of cooperation partners:** many circular solutions depend on partnerships between organisations with complementary expertise, infrastructure and resources.
- **Continuity of development:** pilot activities and research results need to be translated into practical applications and further developed where they demonstrate potential.

These conditions should be considered when selecting and implementing actions under the strategic pillars of this Roadmap. Their relative importance will vary depending on the type of organisation, the maturity of the proposed solution and the national or regional context.

5.5 An Adaptive Approach to Implementation

The transition towards circular footwear should be understood as an ongoing process rather than a single coordinated intervention. The maturity of technologies, availability of infrastructure, regulatory requirements and market conditions will continue to evolve.

Stakeholders should therefore regularly assess their progress, identify new barriers and opportunities, and adapt their activities accordingly. Pilot projects, practical experience and cooperation between industry and research can provide valuable evidence for further development.

The Roadmap is intended to support this process by providing a shared strategic reference for stakeholders across the European footwear value chain. Its recommendations can be used as a basis for developing company-level initiatives, collaborative projects, research activities, sectoral strategies and educational programmes.

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6 SKILLS, KNOWLEDGE AND EDUCATION REQUIREMENTS

The transition towards a circular footwear industry requires new and evolving competencies across the entire value chain. Technical knowledge of footwear materials and production processes needs to be complemented by expertise in environmental assessment, regulatory compliance, digital technologies, recycling and circular business models.

The WP2 research highlights the interdisciplinary nature of these requirements. Effective circular solutions depend on the ability to connect materials science, product design, manufacturing, environmental knowledge, reverse logistics and business management.

Education and professional development therefore play an important role in preparing current and future professionals to address the challenges of circular footwear production and end-of-life management.

6.1 Key Competence Areas

Based on the WP2 research and the stakeholder validation of the proposed educational topics, the following competence areas are particularly relevant to the footwear sector.

Circular Design and Design for Disassembly

Professionals involved in footwear design and product development need to understand how design decisions influence product durability, repairability, disassembly and recyclability.

Relevant competencies include:

- applying circular design principles throughout product development;
- selecting materials and components with regard to their compatibility and end-of-life potential;
- designing modular products and constructions that facilitate disassembly;
- understanding alternative joining methods and their implications for recycling;
- assessing product durability, repairability and material recovery potential.

Footwear Materials and Chemical Compliance

The development and use of recycled and bio-based materials require knowledge of material properties, production requirements and chemical safety.

Relevant competencies include:

- understanding the properties and applications of conventional, recycled and bio-based footwear materials;
- assessing material compatibility and performance in footwear applications;
- understanding the principles of chemical safety and relevant regulatory requirements, including REACH and CLP;
- evaluating the durability and end-of-life characteristics of new materials;
- cooperating with material suppliers and research organisations in material testing and validation.

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Advanced Recycling and Waste Management

The development of effective end-of-life solutions requires technical knowledge of collection, sorting, dismantling and material recovery processes.

Relevant competencies include:

- understanding the composition and material complexity of footwear products;
- identifying suitable collection, sorting and pre-treatment approaches;
- understanding mechanical recycling and emerging chemical recycling technologies;
- assessing the quality and potential applications of recovered material fractions;
- understanding the technical and economic limitations of different recycling pathways;
- cooperating across the footwear and waste-management value chains.

Environmental Assessment and Life-Cycle Thinking

Environmental assessment is important for identifying the impacts of footwear products and comparing alternative materials, technologies and production approaches.

Relevant competencies include:

- understanding the principles and applications of Life Cycle Assessment (LCA);
- interpreting environmental assessment results and identifying relevant impact categories;
- understanding Product Environmental Footprint (PEF) approaches;
- applying life-cycle thinking in product development and material selection;
- assessing potential environmental trade-offs between different circular solutions.

Digitalisation and Supply Chain Traceability

The increasing importance of product information and digital data management creates new competency requirements for companies and their supply-chain partners.

Relevant competencies include:

- collecting and managing information about product composition and material origin;
- understanding the principles and potential applications of the Digital Product Passport (DPP);
- supporting traceability and information exchange across supply chains;
- working with digital tools for product and material data management;
- understanding how reliable data can support environmental assessment, regulatory compliance and end-of-life management.

Circular Business Models and Reverse Logistics

Circular business models require a combination of business, organisational and operational knowledge.

Relevant competencies include:

- understanding business models based on repair, refurbishment, reuse and resale;
- developing and assessing take-back and collection schemes;
- understanding reverse logistics and the organisation of material flows;
- recognizing the operational and financial implications of Extended Producer Responsibility (EPR);

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- identifying opportunities for cooperation between manufacturers, retailers, repair providers and recyclers;
- assessing the economic feasibility of circular services and business activities.

6.2 Competencies Across Different Professional Roles

The required knowledge and skills will vary depending on the position of individual professionals within the footwear value chain. Not every employee needs to master all areas in equal depth. However, a basic understanding of circular economy principles and their implications should be shared across relevant professional roles.

Examples of different competency needs include:

- Designers and product developers: circular design, material selection, durability, repairability and Design for Disassembly.
- Production and quality specialists: material properties, chemical compliance, production processes and quality requirements for recycled materials.
- Sustainability and regulatory specialists: environmental assessment, LCA, PEF, chemical legislation, EPR and product information requirements.
- Recycling and waste-management specialists: footwear composition, sorting, dismantling, material recovery and reverse logistics.
- Managers and business developers: circular business models, investment considerations, supply-chain cooperation and regulatory developments.
- Research and development professionals: material innovation, recycling technologies, testing methods and environmental performance assessment.

For SMEs, the development of these competencies may require access to external expertise, shared technical resources and practical training opportunities rather than the creation of specialised internal teams.

6.3 The Role of Higher Education and Vocational Training

Higher education and vocational education and training (VET) have complementary roles in preparing the workforce for the circular transformation of the footwear industry.

Higher education can provide advanced interdisciplinary knowledge, support research and innovation, and prepare specialists capable of addressing complex technical, environmental and organisational challenges.

Vocational education and training can focus on practical skills and their application in footwear production, repair, material processing, quality control and recycling operations.

Both educational pathways should maintain close links with industry to ensure that learning outcomes reflect actual sectoral needs and technological developments.

The WP2 research identifies several relevant educational approaches:

- **Interdisciplinary learning:** connecting materials science, footwear technology, environmental knowledge, digitalisation and business management.
- **Challenge-Based Learning:** using practical industry challenges as a basis for learning, problem-solving and cooperation.

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- **Train the Trainer:** supporting teachers and trainers in developing and transferring up-to-date knowledge and practical competencies.
- **Industry cooperation:** involving companies, research organisations and technology centres in educational activities, practical assignments and project-based learning.
- **Lifelong learning:** providing opportunities for current professionals to update their knowledge in response to regulatory, technological and market developments.

6.4 Stakeholder-Validated Educational Priorities

The WP2 validation process collected feedback from 58 stakeholders from the industrial and sectoral environment in the five partner countries. The assessment focused on eight proposed topics for a Master's degree study programme addressing circular economy in the footwear industry.

All eight topics received positive assessments, although their perceived importance differed.

The highest mean scores were assigned to:

Educational topic	Mean score
Circular Eco-Design and Design for Disassembly	3.93
Footwear Material Innovations: Bio-based and Recycled Composites	3.83
Digital Product Passport and Supply Chain Traceability	3.82
EU Regulatory Frameworks for Circular Footwear Economy	3.78
Life Cycle Assessment and Environmental Footprinting	3.77
Advanced Footwear Recycling and Waste Valorization Technologies	3.74
Circular Business Models, EPR and Reverse Logistics	3.33
Sustainable Packaging and Green Public Procurement	3.19

Source: Data Analysis Report. Part 4: Validation of Master's Degree Study Programme Topics. Mean scores as reported in the stakeholder validation.

The results indicate particularly strong stakeholder interest in circular product design, material innovation, digital traceability, regulatory knowledge, environmental assessment and advanced recycling technologies. Circular business models and sustainable packaging were also considered relevant, although they received lower mean scores.

These findings provide an evidence-based reference for identifying educational priorities. They should, however, be interpreted in the context of the specific stakeholder sample and the validation of proposed curriculum topics. They do not represent a comprehensive ranking of all skills required by the European footwear industry.

6.5 Continuous Development of Skills and Knowledge

The knowledge and competencies required for circular footwear will continue to evolve as new materials, technologies, regulatory requirements and business models emerge.

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Educational institutions, companies, industry associations and research organisations should therefore support continuous professional development and knowledge exchange.

Relevant activities may include:

- regular updates to educational curricula and training materials;
- practical workshops on circular design, material innovation and recycling technologies;
- training on environmental assessment, chemical compliance and product information requirements;
- cooperation between companies and educational institutions on real-world challenges;
- dissemination of research findings and examples of good practice;
- opportunities for professionals to update their skills throughout their careers.

The development of circular footwear competencies should not be limited to specialised technical positions. A broader understanding of circular principles across organisations can support better decision-making, improve cooperation between departments and strengthen the ability of companies to implement circular solutions.

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7 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

The transition towards a circular European footwear industry is a complex process that requires changes across the entire product life cycle, from material selection and product design to manufacturing, use, collection and end-of-life management.

The WP2 research has identified several interconnected challenges that currently limit the development of circular practices in the footwear sector. These include the material complexity of footwear products, limited possibilities for disassembly and material recovery, economic barriers to recycling, insufficient collection and sorting systems, and the need for improved cooperation across the value chain.

At the same time, the research highlights emerging opportunities in circular product design, advanced recycling technologies, material innovation, digitalisation, life-cycle assessment and new circular business models. Developments in these areas can contribute to reducing material losses, extending product life and improving the recovery and use of resources.

The five strategic pillars presented in this Roadmap provide a framework for addressing these challenges:

1. Eco-Design and Design for Disassembly.
2. Advanced Recycling Technologies and End-of-Life Management.
3. Material Innovation and Chemical Compliance.
4. Digitalisation, Life-Cycle Assessment and Supply Chain Traceability.
5. Circular Business Models and Extended Producer Responsibility.

These pillars should not be considered independent areas of activity. Their effectiveness depends on coordinated progress across the footwear value chain. For example, improvements in product design need to be supported by suitable collection and recycling systems, while the development of recycling technologies requires appropriate material flows, reliable product information and viable markets for recovered materials.

The research also confirms the importance of education, professional development and cooperation between industry, research organisations and educational institutions. The stakeholder validation of the proposed educational topics provides further evidence of the relevance of these areas to the sector.

Overall, the transition towards circular footwear requires a combination of technological innovation, changes in business practices, improved information flows, supportive regulatory conditions and the development of appropriate skills and competencies.

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7.2 Key Recommendations

Based on the research findings and strategic priorities identified in this Roadmap, the following recommendations are proposed for stakeholders across the European footwear value chain:

1. Integrate circularity into footwear design.

Give greater consideration to durability, repairability, material compatibility and disassembly during product development. Design decisions should reflect not only production requirements but also the possibilities for product repair and material recovery at the end of its useful life.

2. Strengthen collection, sorting and recycling systems.

Improve cooperation between manufacturers, retailers, waste-management operators and recycling companies to support the collection and appropriate treatment of used footwear. Continue developing and testing technologies that improve material identification, separation and recovery.

3. Support material innovation and responsible material selection.

Promote the development and testing of recycled and bio-based materials while ensuring that their technical performance, chemical safety, durability and end-of-life characteristics are properly assessed.

4. Improve product information and environmental assessment.

Strengthen the availability and reliability of data on footwear composition, material origin and environmental performance. Encourage the use of life-cycle assessment and prepare companies for evolving digital information and traceability requirements.

5. Develop viable circular business models.

Explore opportunities in repair, refurbishment, reuse, resale and take-back systems. Assess their technical and economic feasibility and strengthen cooperation between companies and service providers.

6. Facilitate cooperation across the value chain.

Encourage partnerships between footwear manufacturers, material suppliers, recyclers, research organisations, educational institutions, industry associations and public authorities. Cross-sector cooperation can help address challenges that individual organisations cannot solve independently.

7. Support SMEs in adopting circular practices.

Improve access to practical guidance, technical expertise, training and collaborative opportunities. Support measures should reflect the financial, organisational and technical capacities of smaller companies.

8. Strengthen education and continuous professional development.

Integrate circular design, material innovation, recycling, environmental assessment, regulatory compliance and digitalisation into relevant educational programmes and professional training. Maintain close cooperation between education providers and industry to ensure that competencies remain relevant to sectoral needs.

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7.3 The Roadmap as a Basis for Further Development

This Roadmap provides a strategic reference for stakeholders seeking to support the transition towards a more circular footwear industry. It brings together findings from regulatory and sectoral research, analysis of existing practices, identification of technological and organisational challenges, and stakeholder feedback on educational priorities.

It is not intended to prescribe a single implementation model or a fixed sequence of actions for all countries and organisations. The conditions, capacities and levels of development differ across the European footwear sector. Individual stakeholders should therefore use the strategic pillars and recommendations as a basis for identifying priorities that reflect their specific circumstances.

The Roadmap can support the further development of company strategies, collaborative projects, research and innovation activities, sectoral initiatives and educational programmes. Its recommendations may also serve as a reference for future cooperation between industry, research organisations, educational institutions and public authorities.

As technologies, regulatory frameworks and market conditions continue to evolve, the Roadmap should be regarded as a forward-looking reference that can be reviewed and updated in response to new evidence, practical experience and the changing needs of the footwear sector.

The transition towards circular footwear will require sustained commitment and cooperation. Progress will depend not on isolated technological solutions, but on the ability of stakeholders to connect product design, material innovation, recycling, digital information, business models and skills development into a coherent approach.

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RECYCLING SHOE

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