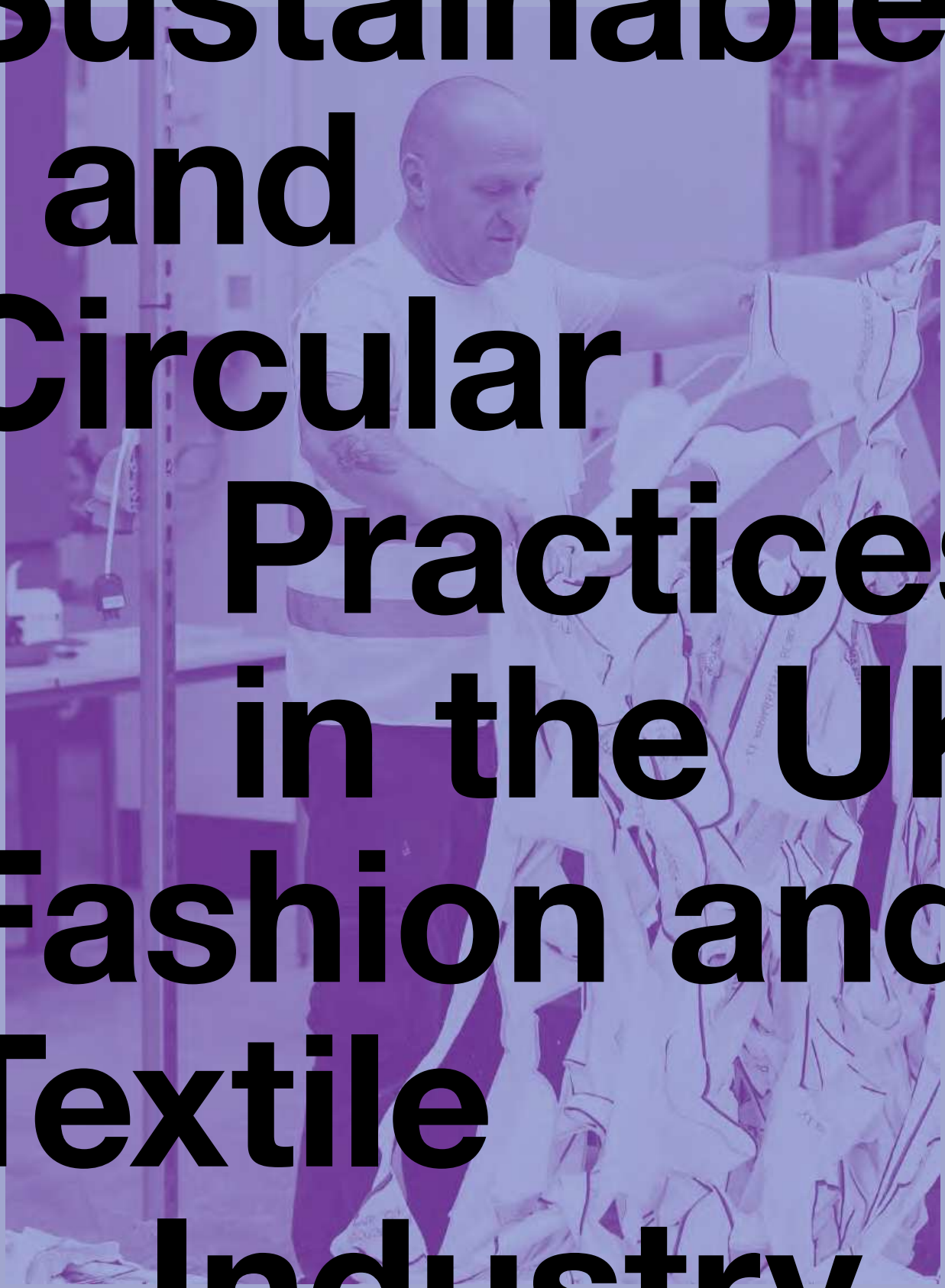
Sustainable and Circular Practices in the UK Fashion and Textile Industry



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Sustainable and Circular Practices in the UK Fashion and Textiles Industry

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This report is based on joint research by the Business of Fashion, Textiles and Technology (BFTT), University of the Arts London, and the Future Fashion Factory (FFF), University of Leeds.

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The Business of Fashion, Textiles and Technology
The Business of Fashion, Textiles and Technology (BFTT), a £6m creative research and development (R&D) partnership led by the University of the Arts London (UAL). BFTT operates at the intersection of design, STEM, cultural anthropology and business practices, to support circular and sustainable collaborative research and development, led by industry.

A multi-disciplinary partnership, BFTT has led R&D in collaboration with Loughborough University, University College London, University of Leeds, Queen Mary University of London, University of Cambridge, and the Victoria and Albert Museum. Key industry partners include leading fashion and textile brands, online retailers, emergent design companies, sectoral business trade associations, including the UK Fashion & Textile Association, the British Fashion Council, and regional partnership from GLA, LEPs and SHIFT. BFTT is part of UAL's Fashion, Textiles and Technology Institute (FTTI) based at the new UAL East Bank campus, at the Queen Elizabeth Olympic Park, convening interdisciplinary expertise to deliver sustainable research and innovation, and curriculum development across the global apparel and textile value chain, and adjacent sectors.

Find out more about the Business of Fashion, Textiles and Technology at **https://bftt.org.uk/** and UAL FTTI at **https://www.arts.ac.uk/ual-fashion-textiles-and-technology-institute**.

The Future Fashion Factory
The Future Fashion Factory (FFF) is a £6.1m industry-led collaborative R&D programme. It brings together designers, manufacturers and retailers, to co-develop and implement advanced textile and industrial digital technologies (IDTs) to create new products and enable shorter lead times, increased global competitiveness and sustainability.

Led by the University of Leeds in partnership with the University of Huddersfield, the Royal College of Art and Manchester Metropolitan University, industry partners include the UK Fashion and Textile Association, the Textile Centre of Excellence, and over 500 businesses. Future Fashion Factory is part of the Leeds Institute of Textiles and Colour (LITAC), a collaborative, multi-disciplinary research institute, built on a 150-year history, that addresses global challenges in textiles, fashion and colour through research and innovation, as well as teaching.

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Find out more about Future Fashion Factory at **https://futurefashionfactory.org/** and LITAC at **https://www.leeds.ac.uk/leeds-institute-textiles-colour**.

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1 Executive Summary

Dr Ioana Taylor, Research Technician, at the Wet and Melt Processing Lab, University of Leeds. ©University of Leeds

1.1 Background

This report builds on previous research (Hemingray et al, 2023) to further explore how UK fashion and textile companies are developing sustainable and circular practices, including their response to regulatory change associated with green growth and the transition to net zero.

Qualitative evidence was obtained via in-depth interviews with senior UK SME and large scale business representatives, including PLCs within the UK fashion and textile sector, with questions informed by insights gained in the previous report. Where appropriate, information gathered from previous interviews has been included, and reference is made to company reports and additional data sources.

1.2 Definitions

The scope of **Fashion and Textiles** is defined as covering the designer, fashion, apparel, retail and wider textile industries, ranging from fashion to technical textiles, and including sustainable materials innovation and technology, including, for example, digital systems and processes for advanced manufacturing to augmented reality.

The **metaphor of an ecosystem** is used to refer to both an established and embryonic network of many interconnected fashion, textile and technology businesses and intermediaries that affect each other. Ecosystems comprise the competition, co-evolution and coexistence of various stakeholders and complementary services – including the natural environment (via cultural ecosystem services).

Research and Development (R&D) is covered by the definition for all knowledge domains proposed by NESTA in its 2017 policy document Defining R&D for the Creative Industries (Bakhshi, 2017, p. 6).

'Research and experimental development (R&D) comprises creative and systemic work undertaken in order to increase knowledge – including knowledge of humankind, culture and society – and to devise new applications of economic, cultural or social value of available knowledge.'

The **acronym SME** refers to small, medium and micro-sized enterprises. Micro enterprises are also included to provide an accurate picture of the UK's fashion and textile ecosystem. SMEs and micro businesses dominate the industry, with 82% of companies employing fewer than 10 people, according to the previous BFTT survey (Harris et al, 2021). Business size definitions are taken from the widely used current description provided by the European Commission (Recommendation 2003/361/EC) (European Commission, 2003), which defines SMEs based on their headcount and turnover as follows:

LITAC Chemistry Lab at the School of Design, University of Leeds

- Micro business: fewer than 10 employees, turnover under £2m
- Small business: fewer than 50 employees, turnover under £10m
- Medium business: fewer than 250 employees, turnover under £50m

1.3 Methodology

Literature Review – A review of relevant and available industry, academic and policy related literature was made as part of this research with two key aims:

- To determine how UK fashion and textiles companies are approaching sustainability and circularity and integrating sustainable and circular principles into their business models.
- To identify what fashion and textile companies require to accelerate the pace of change towards sustainability and circularity as standard practice.

The literature review surfaced several themes that guided the structure and detail of the interviews with businesses, along with the structure and analysis of the report.

Interviews – Interviews were conducted with fifteen company representatives from SMEs and large businesses (including PLCs) in the UK fashion and textile sector operating in different parts of the supply chain. This included designers, fabric and apparel manufacturers, consultants, NGOs, and recycling facilitators. The interviews aimed to retrieve qualitative data that would offer insight into the actions, challenges and opportunities faced by organisations when building sustainability and circularity into their business models.
Participants of the interviews were given the option of four forms of disclosure:

1) Full disclosure.
2) Full anonymity for the company and for interviewee.
3) Full anonymity just for the company.
4) Full anonymity just for interviewee.

Where appropriate, the name of the company appears in this report, otherwise reference to a company is defined by their place within the supply chain and geographical location.

Analysis – To identify common themes from the interviews, data were coded using QSR NVivo software. The software facilitated sharing of categorised data and allowed the research team to integrate raw data not previously utilised. The themes focus on sustainability and circularity; specifically relating to technology (including digitalisation), transparency, business models, the value chain, communication, greenwashing, legislation, policy, consumers, and equity. The findings provided in-depth insights on key developments within the UK fashion and textile ecosystem.

1.4 Summary of key findings and recommendations

Sustainability

- Sustainability strategies vary across the sector, depending on the position within the supply chain, company ethos and the availability of resources.
- Data availability and quality is currently variable, making it difficult to enable accurate assessment of environmental impacts, e.g. GHG (greenhouse gas) emissions, especially Scopes 2 and 3[1], associated with specific textile products.
- There are cost barriers to achieving sustainability, especially for SMEs, including the cost of financing full life cycle assessments (LCAs) for company products, and costs associated with responding to EU regulatory changes, including the introduction of extended producer responsibility (EPR).
- There is a lack of UK-specific incentives, e.g. an EPR scheme that financially incentivises transitional change consistent with environmental/climate targets.

Circularity

- Uncertainty around definitions of 'circular' or 'sustainable', is leading to unintended greenwashing and reticence by some businesses to disclose sustainable practices.
- Realising full product-level circularity is challenging due to lengthy global supply chains, and a geographical mismatch between where post-consumer waste accrues, i.e. in the UK, and where the bulk of textile manufacturing currently takes place, i.e. Asia.
- Additional challenges include limited markets for non-rewearable textile waste collected in the UK, as well as the lack of scaled-up recycling infrastructure capable of valorising mixed textile waste in the UK.
- There is a need to further articulate the nature of a circular economy for fashion and textiles, including fostering cultures of repair and long-term value of products.

Materials

- There is a lack of consensus on what constitutes a "sustainable fibre" in relation to specific products, with current eco-metrics for fibres based on oversimplified assumptions, or cradle-to-gate LCAs, rather than the full life cycle of specific products.
- Improved data and science-based eco-credentials are required to enable informed decision-making about feedstocks based on renewable, recycled, used, deadstock materials, biobased materials based on regenerative agriculture, or recyclable biopolymer feedstocks, including bioplastics.
- The compatibility of materials with likely end-of-life waste management processes, including reuse and recycling, should be a criterion when initially choosing materials.
- Systems-level consideration of a material's place in the sustainable and circular economy is needed. This includes rational decision-making on an individual product basis about whether biobased materials should be recyclable - keeping resources in circulation - biodegradable, or both, to prevent the release of biogenic carbon (GHGs).

Longevity

- A focus on producing well-made, high-quality products, as defined by quantitative, measurable technical specifications could potentially reduce resource use by extending the service life of products This product-level approach should work in tandem with business services such as repair, refurbishment, leasing, or resale, to facilitate longer service lives for fashion, apparel and textile products.
- Social and cultural narratives promoting quality and longevity are needed to motivate consumers to keep and care for items for longer, enhancing both perceived, and monetary value of products.

Digital

- Digital technologies, including AI and machine learning, are being used to align product design and production with consumer preferences; concepts such as right first-time design, and make-to-order personalisation offer potential to reduce inventory levels and waste.
- Digitisation of production processes and the integration of robotics into textile manufacturing show potential to optimise efficiency and promote reshoring, through decoupling cost efficient manufacturing from low labour cost locations.
- Digital track and trace technologies, and evidence-based product level data, could improve supply chain transparency, as well as engage consumers.
- Regulatory pressure including the introduction of Digital Product Passport (DPP) legislation in the EU (Thomas, 2022) is accelerating the demand for accurate product-level environmental impact data, with complete digital solutions still under development.

People

- A lack of accurate information in marketing and at the point of sale is a key barrier to supporting informed decision-making by consumers of fashion, textile and apparel products.
- The existing use of eco-metrics associated with the Higg Materials Sustainability Index (Higg, 2023) and the EU's Product Environmental Footprint (European Commission, 2013), provide limited full-product life cycle impact information.
- More research and new tools are required to improve consumer knowledge about how their own purchasing behaviour affects climate impacts, as well as upskilling consumers and the sector workforce in product care and repair skills.
- Fair and equitable treatment of employees, partners and suppliers is a crucial part of building socially and culturally sustainable international supply chains.

Certification

- There is a proliferation of sustainability certification schemes for the fashion and textile industry, the majority of which involve fee payments.
- Participation in schemes is considered desirable, but resourcing is expensive and unachievable for many start-ups and SMEs. • Large retailers

making such certification a prerequisite for suppliers has a knock-on effect on the competitiveness of SMEs.
- Concerns have also been raised about the alignment of some certification schemes to Net Zero targets, as well as the resourcing demands, which can lead to opportunity costs.

Investment
- Targeted support for fashion and textiles R&D for sustainable development in the UK, including through AHRC's £120m Creative Industries Clusters Programme (CICP, of which c.£12.5m supported fashion and textiles clusters) (UKRI, 2023) and UKRI's £15m Circular Fashion and Textile initiative (Fiddian & Sabreen, 2022) has made a significant impact in driving increased industry-academic collaboration in the UK, forging a vibrant innovation ecosystem and necessary infrastructure, involving companies previously not engaged in major research programmes, supported by multidisciplinary expertise.
- Many businesses find R&D application processes time-consuming, and require input from experts, necessitating further targeted resourcing of University infrastructures to support this activity.
- R&D funding in some key areas is still lacking, e.g. citizen engagement, consumer psychology, education and skills, and systems-level approaches to sustainable materials.

Regulation
- Businesses generally welcome policy, such as Extended Producer Responsibility (EPR) if it provides a level playing field, and to create a business case for sustainable/circular practices and business models.
- There is an important opportunity to financially incentivise pro-environmental consumer behaviour and decision-making aligned with Green Growth and Net Zero targets.
- Developments such as the EU's Strategy for Sustainable and Circular Textiles (European-Commission, 2022), come at a cost to companies (particularly SMEs), making it more difficult to compete.
- Lack of industry consultation also risks current policy taking a one-size-fits-all approach that does not sufficiently account for individual business features such as size, sub-sector market activities and product range.

Key Recommendations and Opportunities for policy-makers and private sector

For policymakers
- **Include the full life cycle of products (not just cradle-to-gate) in the sustainability and eco-credentials of textile materials**: quantification should involve experts in the fields of design, polymer and textile science, textile manufacturing, waste management, and consumer behaviour.
- Continue to **develop guidance to promote evidence-based sustainability claims**, avoiding misleading descriptions about the eco-credentials of products, and **promote clear definitions of sustainability and circularity**.
- **Streamline any planned UK extended producer responsibility scheme to create a 'level playing field'** for SMEs and start-ups.
- Continue efforts to bridge current data and evidence gaps to **determine an accurate environmental footprint generated by the UK's fashion and textile industry** (onshore and offshore), enabling the industry to agree baseline data on the impact of specific product categories across the entire value chain, including waste management and end of life.
- Scaffold **regulatory change that rewards companies for positive behaviour and decision-making, and removes financial penalties for sustainable business choices** such as shifting to sustainable or renewable materials, or investment in sustainable processes and products.
- Fund **research to identify where countries and companies can build greater resilience in supply chains** and safeguard the wellbeing of fashion and textile workers in the face of climate-related challenges.
- **Invest in the UK's textile waste management infrastructure, as well as innovation,** to develop new economically attractive markets for low grade, non-rewearable UK generated waste, including incentivising companies and the public to collect and manage end-of-first-life textiles.
- **Reduce the UK's dependency on fibres made from fossil-based plastics, by developing renewable biopolymer alternatives**, including melt-processable bioplastics, for example by harnessing UK biotechnology expertise to manufacture recyclable (not just biodegradable) bioplastics, e.g. bio-PET, made from UK-sourced renewable secondary biomass.
- Promote **immersive education tools and behaviour change strategies to support informed decision-making by the public in relation to personal carbon footprints and environmental impacts** associated with fashion and textile product purchases, as well as **upskilling initiatives to extend the life of clothing through resale, upcycling or repair**.
- Shift from negative language to the **language of opportunity, where 'waste' becomes 'resource', and 'penalty' becomes 'incentive'**.
- Develop **new education and skills initiatives which bridge gaps in skills pipelines** to achieve sustainable and circular practices.
- Continue to invest in the UK's collaborative fashion and textile R&D and innovation network.
- **Endow Universities with grant-making responsibilities and associated infrastructure**, to support business development and sustainable growth.

For the private sector

- **Support suppliers to decarbonise energy supplies and reduce GHG emissions**, establish transparent materials sourcing and effective waste management. Ensure **full Life Cycle Design is an integral part of new product development**.
- Minimise the overall quantity of products manufactured, or held as inventory, and **explore additional or alternative business models**, e.g. service-based models, and beyond point-of-sale customer engagement, including reverse logistics, and take-back schemes.
- Provide science and **evidence-based data to customers about eco-credentials and provenance** of the products they are buying.
- Consider bringing in-house or building new commercial partnerships with maintenance and repair services to extend the service life of products and **incentivise consumers to use repair services**.
- Reduce fossil-based plastic content and **be explicit about the source and proportional compositions of recycled plastic content** where it is present.
- Use **clearer language in marketing and advertising** to ensure that consumers have accurate information about products.
- Invest in **data gathering technology and infrastructure to accurately collect supply chain and product-level data** to support the transition to new regulatory requirements.
- Minimise environmental impacts by **leveraging data-based design and manufacturing** of textile products, automation and digitisation of textile manufacturing operations, greater traceability, and embedded digital passport capabilities.
- **Maximise the spillover benefits to other adjacent sectors,** where innovation in fashion and textiles could drive advances in fields such as healthcare, automotive, and aerospace.

Conclusion

Both fashion and textile CRDPs worked with UK sectoral bodies, resulting in heightened visibility for the sector and increased understanding of the global nature and complexity of fashion and textile supply chains. The availability of commissioned R&D funding enabled significant academic-industry collaboration opportunities resulting in some exciting sectoral developments and stronger linkages between fashion and textile companies, sectoral bodies, academia and government. **Consistent feedback has been received, from across the two CRDP industrial networks, that further high-value, large-scale R&D initiatives of this kind are required in order to sustain progress and strengthen the UK fashion and textile innovation ecosystem.**

There is a clear imperative for the UK fashion and textile industry to reduce its environmental impacts, and t**his research shows that companies are investing in a range of sustainability strategies**, including but not limited to:

(1) adoption of eco-certification.
(2) measurement of carbon footprints.

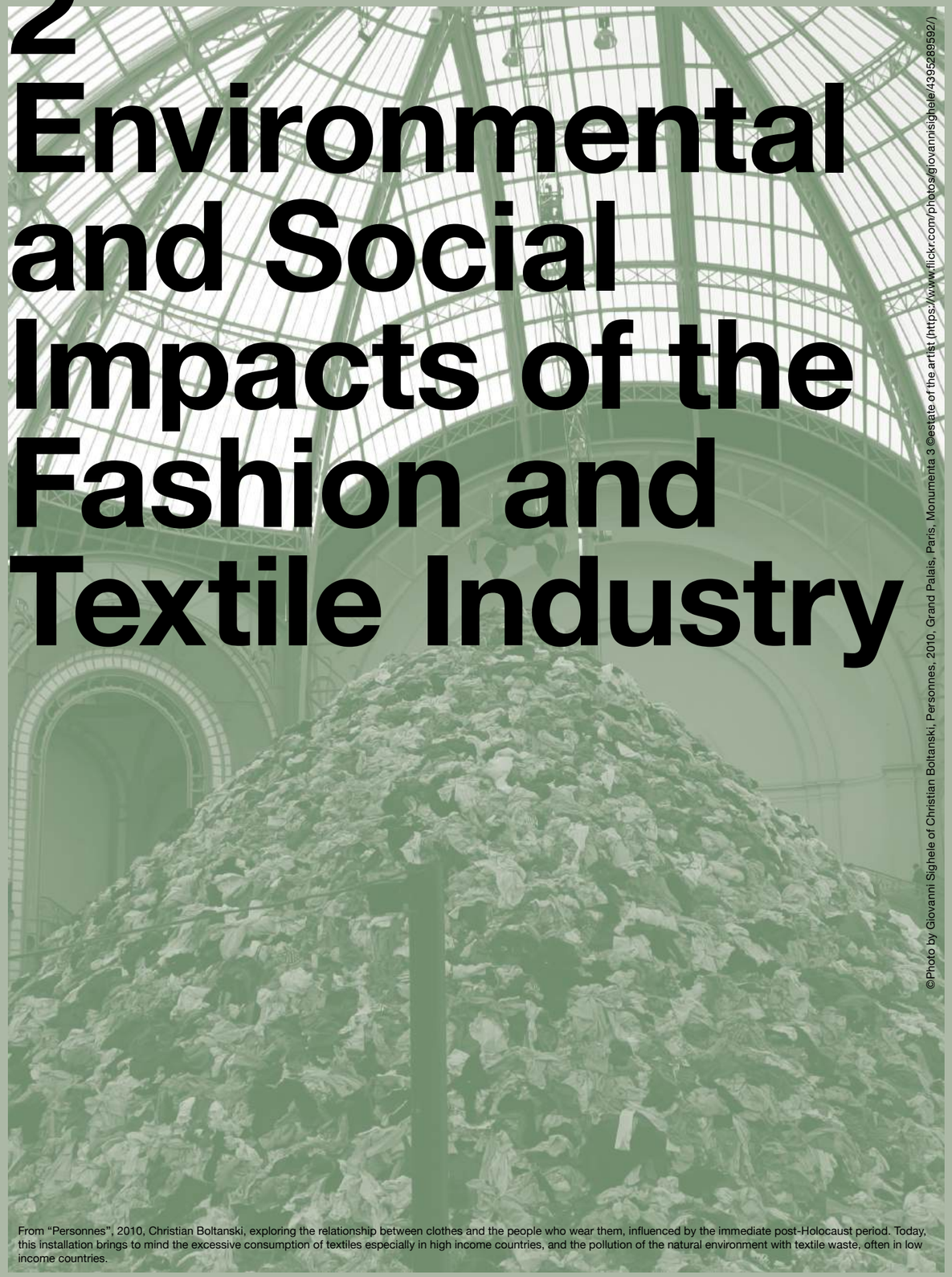
(3) switching to preferred/alternative fibre materials.
(4) reducing waste.
(5) harnessing digital technologies across the value chain; and
(6) reverse logistics, new collection infrastructure or post-purchase repair services, with the aim increasing product longevity. **Fair and equitable treatment of people in supply chains should also be considered** alongside environmentally conscious practices.

However, this progress is associated with additional cost, making it more difficult to compete with others in the international marketplace, at least in the short term, until regulatory change is fully operational in regions such as the EU. **This study highlighted the need for new policy to reward sustainable practices, and to create a 'level playing field'**. New policy would also forge the business case for firms to invest in gathering detailed supply chain data to obtain product-level carbon footprints, as well as launch new circular business models. Furthermore, **clearer definitions of 'sustainability' and 'circularity' terminology are needed** to help ensure emergent legal frameworks, and address issues around greenwashing. While certification is helping to provide improved certainty on specific sustainability claims, it usually involves fees and significant resourcing, such that participation is prohibitively costly, particularly for start-ups and SMEs, affecting their competitiveness. **More research is needed into supportive policy instruments that centralise and incentivise certification**.

Additionally, **the need for increased consumer awareness and engagement was highlighted to further support the mandate for sustainable practices to become more widespread**. This may be scaffolded by enabling consumers to more readily access details of the provenance and environmental impacts of their clothing, as well as appropriate product use-phase care, repair and end-of-life arrangements. This requires an upskilled workforce able to deliver care and repair services.

Sustainability in the fashion and textile industry is moving in the right direction, but measurable progress is too slow and needs to accelerate. There is a need for systemic change, including wider recognition of the opportunities for the UK apparel and textile sectors, with increased sustainable investment: reductions in the environmental impact at product-level are currently overshadowed by increases in unit consumption overall. This may partly be the result of a rebound effect, whereby consumption increases as products are made more efficiently and therefore more cheaply. Furthermore, there persists the **fundamental challenge of the misalignment of climate targets with linear economic growth models**. SMEs and larger firms sharing the costs of innovation will be key to developing new circular economies, where brands need to establish supply chain collaborations with business partners further downstream as well as upstream to manage the flow of their used products beyond the point of sale. Further research is needed to determine the most economically viable, environmentally sustainable, socially equitable, and culturally acceptable ways of achieving this.

2 Environmental and Social Impacts of the Fashion and Textile Industry



©Photo by Giovanni Sighele of Christian Boltanski, Personnes, 2010, Grand Palais, Paris, Monumenta 3 ©estate of the artist (https://www.flickr.com/photos/giovannisighele/4395288592/)

From “Personnes”, 2010, Christian Boltanski, exploring the relationship between clothes and the people who wear them, influenced by the immediate post-Holocaust period. Today, this installation brings to mind the excessive consumption of textiles especially in high income countries, and the pollution of the natural environment with textile waste, often in low income countries.

2.1 Emissions

The fashion and textile industry makes a significant contribution to global greenhouse gas emissions (GHGs), reflecting its status as one of the world’s largest manufacturing industries, serving a growing global population of consumers. The emissions principally result from the industry’s energy-intensive raw material extraction and manufacturing processes. These include agricultural, or industrial production of basic raw materials, to the manufacturing of intermediate, as well as finished textile products (including but not limited to fibre, yarn and fabric production, dyeing and finishing and garment assembly), along with its substantial energy, water and chemical usage, globalised transport networks, and the generation of waste at multiple stages, including end-of-life products (Maiti, 2023). A large proportion of fashion and textile manufacturing supply chains are located in countries that rely heavily on carbon intensive energy supplies.

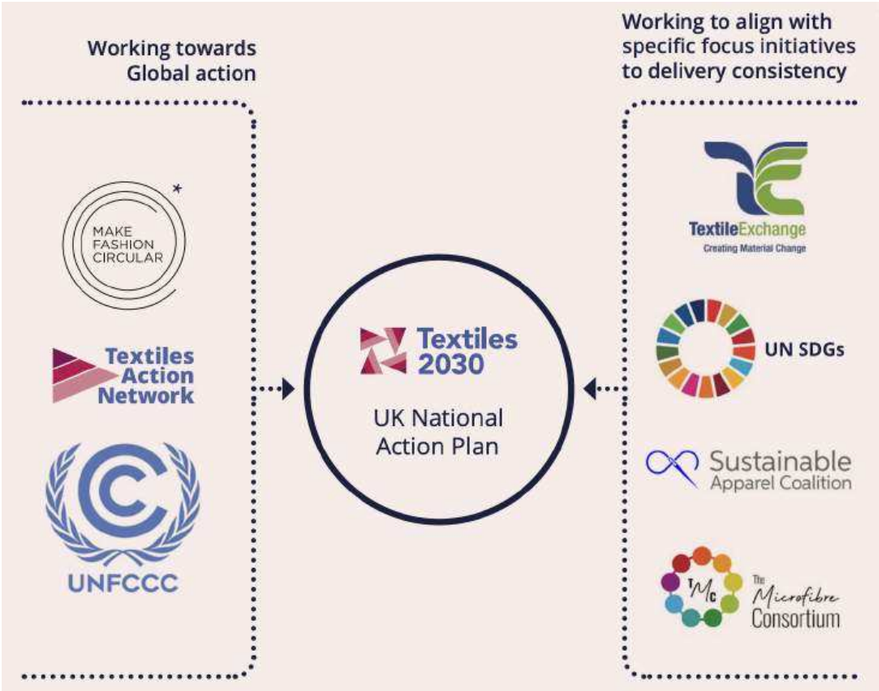
No reliable set of baseline data is available to provide an accurate assessment of the environmental footprint of the industry and there are large differences in the claimed impacts in published studies. It is often claimed that the fashion industry is responsible 8-10% of global carbon emissions (Ro, 2020). This widely quoted figure originates from a report produced by Quantis (Chrobot et al, 2018) on measuring the environmental impact of the global apparel and footwear industries. According to this report, the apparel and footwear industry generate approximately 8.1% of global climate impacts, totalling 3,990 million metric tons of CO2eq. However, only a limited range of conventional textile materials were considered as a representation of all fibre materials to avoid complicating the data analysis beyond the scope of the study. No agreement has since been established on the contribution of the fashion and textile industry to global GHGs, with figures ranging from <2% -10% depending on the assumptions used, and where system boundaries for the analysis are placed. As a result, a major research gap remains in respect of calculating the environmental footprints of real-world fashion and textile industry products, globally, as well as in the UK.

More recently in 2023, the Apparel Impact Institute (Apparel Impact Institute, 2024) reported the latest estimates for emissions from the apparel sector based on data from 2021. This report suggested the apparel sector accounts for approximately 1.8% of annual global greenhouse gas (GHG) emissions (Sadowski, 2023). The study used proxy data for parts of the environmental footprint calculation due to the lack of transparency in the supply chain, with accuracy heavily impacted by COVID-19, as most countries and their businesses did not fully recover in 2021. Consequently, the global apparel emissions data for that year may not accurately reflect the footprint under normal operational conditions (Abdulla, 2021; Balchandani et al, 2021; Hemingray et al, 2023; Sharpe et al, 2022).

Measuring the precise environmental footprint of the entire fashion and textile industry is particularly challenging due to the number of different products, market sectors and complexity of global supply chains. The complexity includes, but is not limited to, the utilisation of many different raw materials,

substantially different resource consumption requirements depending on the geographic location and methods used in production, as well as differences in type of textile product being manufactured, levels of waste generation, and the need to consider the entire product lifecycle (Li and Ding, 2019; Li et al, 2021; Luo et al, 2021). The complexity of global supply chains makes it difficult to accurately track the industry's environmental impact, and the use of various materials, each with their own unique environmental effects, complicates standardisation efforts (Peters et al, 2015). Resource-intensive production and waste generation further add to the complexity of measurement and management (Arias-Meza et al, 2022; Palamutcu, 2015). Alongside these challenges, social impacts and the lack of transparency within the industry are also significant obstacles to sustainability (Goncalvas, 2021).

In line with the UK government's target to achieve Net Zero by 2050, reports published in 2019 outlined related strategies and plans for building a green industrial revolution (Walker and Carrrington, 2019; BEIS, 2020). These



WRAP's Textiles 2030 intiative, bringing together global sector leaders across fashion, textiles, and the Sustainable Development Goals ©WRAP, 2021

included guidelines and recommendations for managing carbon usage and reducing emissions across the economy to facilitate the transition to Net Zero based on innovative solutions, green investments, and climate actions. Furthermore, since 2019 further policy documents have been released by UK government to support the goal of reaching Net Zero by 2050, encompassing the Green Finance Strategy, British Energy Security Strategy, Transport Decarbonisation Plan, Industrial Decarbonisation

Strategy, and the Heat and Buildings Strategy (Carver, 2023). These policies provide comprehensive strategies for reducing greenhouse gas emissions and addressing climate change. The Net Zero target has the potential to stimulate increased investment in research and innovation in the fashion and textile industry, including the development of new sustainable fabrics, manufacturing processes and recycling techniques (Tanim, 2023).

The UK fashion and textile industry has undergone a substantial transformation in response to the Net Zero target, with significant progress achieved in reducing greenhouse gas emissions and advancing sustainable practicality in recent years. A noteworthy example of this transformation is the Textiles 2030 initiative, launched by WRAP (Waste and Resources Action Programme) in 2021, which has sought to coordinate efforts across a large section of the UK's industry. This initiative has now garnered the commitment of over 130 signatories, representing over 65% of the UK clothing market. These signatories pledged to actively reduce their carbon footprint, work towards climate goals, and embrace the principles of a circular economy (WRAP, 2021).

WRAP's Annual Progress Report, highlighted the continued momentum of the Textiles 2030 initiative. Over 110 businesses and organisations have joined this sustainability effort, and there have been reports of cross-sector collaborations aimed at fostering a circular approach within the fashion and textile industry. These developments signify a promising start toward shifting the industry towards a more sustainable and circular model (WRAP, 2022b).

2.2 Climate-related disasters and their impacts on textile and apparel industries

Human influence has warmed the globe to unprecedented levels. September 2023 was recorded as the hottest September on record, with an air temperature nearly 1°C higher than the average for the period between 1991 and 2020 (Copernicus, 2023). In August 2023, the Copernicus Climate Change Service revealed the highest-ever sea surface temperature (SST) at 21.02°C, surpassing the previous global SST record of 20.95°C set in March 2016 (Copernicus, 2024). Global warming at this scale has wide reaching impact, accentuated by a series of devastating climate disasters across the globe (Oxfam International, 2024). The Intergovernmental Panel on Climate Change (IPCC) reported a 15-fold increase in human mortality from natural disasters such as floods, droughts, and storms in highly vulnerable regions compared to low vulnerable regions between 2010 and 2020 (IPCC, 2023). The World Meteorological Organisation also highlighted that, in 2022, 81 natural hazard events were documented in the Emergency Events Database (EM DAT), of which over 83% were attributed to flood and storm disasters, resulting in more than 5,000 fatalities, with flooding being responsible for 90% of these deaths (WMO, 2023).

Climate-related disasters affect the resiliency of the UK's fashion and textile industry because of the heavy reliance on outsourcing raw material

sourcing and production to low wage countries. Devastating floods in Pakistan, and extreme heat conditions in India, have disrupted production, impacted workers' well-being, and exacerbated global textile supply chain challenges. A report by the Global Labor Institute highlighted the industry's vulnerability to climate change, with a particular focus on countries like Bangladesh, Cambodia, Pakistan, and Vietnam, where a lack of measures to address climate impacts at the factory level raises concerns about workers' rights (Judd et al, 2023).

2.3 Sustainability of Materials

Generally, bulk production of synthetic and natural fibres used as feedstock for the fashion and textile industry has significant planetary impacts (Stanton et al, 2019). This is connected mainly with the extraction and manufacturing of raw materials, which includes intensive agricultural systems in the case of cotton, and other natural fibres, as well as extraction and processing of non-renewable materials, in the case of polyester and other fossil-based plastics. Over 110 million metric tons of fibres are manufactured globally (Palacios-Mateo and Seide, 2021), and fibre consumption (particularly synthetics) is projected to increase, not decrease in future years.

Fibres manufactured using fossil-based polyester account for over 51% of all textiles, with cotton at 26% (Palacios-Mateo and Seide, 2021). It is estimated that 342 million barrels of oil are used to produce plastic-based fibres each year (Ellen MacArthur Foundation, 2017). Although synthetic fibres account for only a small proportion of total oil production, fibres manufactured using fossil-based feedstocks, are non-renewable and contribute to natural resource depletion (Tuladhar, 2019). Whether for processing of synthetic or natural fibres, a further contribution to resource depletion and GHG emissions is the burning of fossil fuels to power textile manufacturing facilities (Textile Exchange, 2024).

Ubiquitous in affordable clothing because of its low cost and attractive physical properties, polyester terephthalate (PET) as it is currently produced for textile fibres, has wide-reaching environmental impacts. This is evident along its entire value chain including throughout its production, use, and end-of-life phases, impacting land, water, air, ecosystems and human health (Palacios-Mateo and Seide, 2021). As with many other fibres, a significant quantity of microplastics are released in the air and water during manufacturing and in laundering (De Falco et al, 2020). The European Environment Agency (EEA) (EEA, 2024b) estimates synthetic fibres in clothing are responsible for up to 35% of microplastics in the world's oceans (Manshoven et al, 2022), negatively impacting aquatic life and polluting the food chain. Note however that it is not just PET and synthetic fibre microplastics that leak into the environment, so too do natural fibres (Stanton et al, 2024). After dyeing and finishing treatments, natural fibres contain synthetic chemistry, e.g. dyes, pigments, chemical finishes and coatings, that are not present in their native state (Stanton et al, 2024).

While fossil-based synthetic textile materials involve extraction of non-renewable resources and negatively affect the environment if they are allowed to leak, natural fibres also have major environmental impacts linked mainly to the agricultural systems used in their production. Production of cotton for example is land intensive and uses large quantities of water, pesticides and fertilisers, impacting local ecosystems and human health (Kazan and Kerc, 2020; Chen et al, 2021a). Effluents associated with downstream textile dyeing, printing, as well as for the pre-treatment and finishing in textile processing can also pollute waterways unless appropriate waste management is in place (Yaseen, 2018) which depends to an extent on where the manufacturing site is globally located. Insecticides, nematicides, fungicides, herbicides, desiccants, and defoliants used during cotton fibre production have been linked to a variety of environmental and health issues (Blackburn, 2019).

The selection of 'sustainable materials' for textile products is an important priority for many fashion and textile firms, but considerable confusion still exists about what a sustainable material really is. This understanding has not been helped by the introduction of quantitative eco-metrics and LCA studies that attempt to compare different fibres based on oversimplified assumptions, leading to misleading conclusions. This is because for all fibres, including man-made synthetics such as PET, no single environmental impact figure or eco-metric can reliably represent reality due to the complex diversity of real-world textile products (Madumali, 2023). Methods of resource extraction, agriculture, materials processing and manufacturing, sources of energy (fossil vs. renewable) and waste treatment practices (for example) vary from factory to factory, and from country to country. Siloed operations, lack of data integration, unwillingness, and lack of incentive, for operators to share data also hinders understanding (UKFT, 2021)

Specifically, in the production of natural fibres, agricultural systems and the associated environmental impacts differ from grower to grower, and from country to country, even if the fibre being produced is the same. Comparisons of environmental impacts associated with individual fibres also ignore the nature of different products that fibres are incorporated into, which have very different modes of use, longevity and prospects for reuse and recycling. The environmental impact of fibres should therefore be considered in terms of the specific supply chains in which they were made (not generalised ones) and the final products into which they are integrated (the final product as the functional unit), such that the full product life cycle is considered when assessing sustainability (Millward-Hopkins et al, 2023).

2.4 Waste

Internationally, increased clothing production and consumption is driven largely by population growth, an increase in world GDP and a growing middle-class (Ellen McArthur Foundation, 2017). Also important in developed countries such as the UK, is the increasingly low-cost of clothing compared to average disposable incomes and business models that encourage over-consumption. Consumers buy on average 60% more items of clothing

than 15 years ago (Amed, 2019), but only keep items of clothing for half as long (Remy, 2016). As a result, fashion brands are producing almost twice as much as they did 20 years ago, while at the same time product usage has decreased and more than 50% of wardrobes are simply not worn (Benkirane, 2022).

Waste occurs at every part of the product life cycle, from all stages of manufacturing, to shipping and retailing, to the end-of-life. Consumers also dispose of items in different ways, which governs prospects for sorting, followed by recycling or reuse:

1. Donation

Generally, recycling and reuse are enabled if consumers donate waste garments to an organised collection system, e.g. doorstep collection or clothing bank, where items are later sorted into reuse or recycling grades. Alternatively, peer-to-peer selling platforms, e.g. Vinted, eBay, Vestiaire Collective, allow direct sale of items to second users if products are rewearable. For consumers, there is a feel-good factor associated with donating clothing to charities however only ca. 10-20% of these donated textiles may be resold in the UK market. The remainder is either exported, where a proportion is re-sold, with other items being recycled, incinerated or sitting in landfill for hundreds of years until decomposition, generating greenhouse methane gas and leaching toxic chemicals and dyes into the groundwater and soil (Chen et al, 2021b; Echeverria et al, 2019).

Most non-rewearable clothing is technically recyclable, even if damaged or worn out, but from an economic perspective, attractive new markets are still needed for low-grade textile waste, e.g. mixed synthetic waste, to incentivise its collection and processing. Despite being the first country to industrialise closed loop fibre-to-fibre mechanical recycling of wool in the first part of the nineteenth century, the UK's current fibre-to-fibre recycling capacity for all fibre types is limited to very small-scale operations. The bulk of textile waste recycling in the UK is currently confined to open loop recycling using mainly nonwoven manufacturing to make industrial non-clothing products.

2. Domestic Disposal

About 50% of apparel and textile products are discarded as domestic waste (Guest, 2024), which in the UK is normally destined for incineration (84%) coupled with energy generation, with a reducing proportion (currently 11%) going to landfill every year (WRAP, 2024).

Over the past 20 years, the textile industry has doubled its production to a global average of at least 100 million tonnes (Shirvanimoghaddam et al, 2020). For economic reasons most textile manufacturers attempt to minimise pre-consumer textile waste to maximise production efficiency, and various means of recycling within their own, or other, manufacturing operations are in use. However, it is claimed by others that of the textile waste generated during production (pre-consumer waste), a relatively modest proportion is resold, recycled and reused in new products (18%), but the

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remaining waste (25%) is either incinerated in a carbon intensive process, leading to higher carbon footprint, or is destined for landfill (57%) (LABFRESH, 2020).

2.5 The Social Impact of the Fashion and Textile Industry

Alongside the environmental challenges of transitioning to sustainable practices, consideration of the human impact is often overlooked. This includes working practices and management approaches in global fashion and textile industry supply chains. The linear economy and consumption model of most fashion and textile companies focuses on continued growth, and the complexity and fragmented nature of international supply chains, particularly in developing countries can create an environment where the rights and needs of workers are adversely affected.

Generally, the challenges include illegal, discriminatory and poor working practices across the supply chain abroad as well as at home (Guy, 2023), ranging from reports of modern-day slavery, withheld or low and insecure wages (Milne, 2020), unsafe working conditions, discrimination and reports of abuse (Terrado, 2024).

Much of the way in which clothing is produced is invisible to consumers. Traceability is repeatedly highlighted as a pressing need in relation to understanding the impacts of materials and processes, as well as the effects on people involved in production. There are further benefits to investing in traceability, including promoting the value and view of companies with consumers, an improvement in responsible decision-making and investment opportunities for businesses (fairlymade.com, 2024b). Such investment can be best sustained if transparency enhances the profitability of firms making genuine commitments to ethical sourcing and sustainability through the exclusion of competitor firms making dubious claims through 'greenwashing'. If transparency is accurate, data and evidence-based, there are opportunities to align business objectives with sustainability goals.

3 Circular Economy

Shredded knitwear fibres, ready to be processed and eventually re-spun into high quality recycled cashmere yard and fabric, at iinouiio's facility in West Yorkshire. ©Alys Tomlinson (2024)

3.1 Towards a Circular Economy

The central aim of a circular economy is to reduce utilisation of virgin raw materials and maximise use of those already in circulation, by designing products so they can be re-used, or made into something new, of comparable quality. Design is integral to achieving circularity, which centres on the following three core principles:

1. Eliminate waste and pollution, through adoption of emerging innovation and the redesign of manufacturing, production, finishing and end of life processes.
2. Extend the lifecycle of products and materials, through repair, reuse, repurposing and recycling to keep products and materials in the loop for longer.
3. Regenerating the environment, reversing the impacts of fashion and textile operations on the environment and harnessing renewable energy for all production processes.

To successfully move away from the linear 'take, make, waste' model (Ellen MacArthur Foundation, 2017), and for the full potential of circular business models to be reached, systemic change is required with businesses, consumers and policy-makers working in concert. In this way businesses will need to redesign products, supply networks, processes and performance indicators and measures of success, consumers change their buying behaviours and policymakers to enact effective policies and invest in appropriate

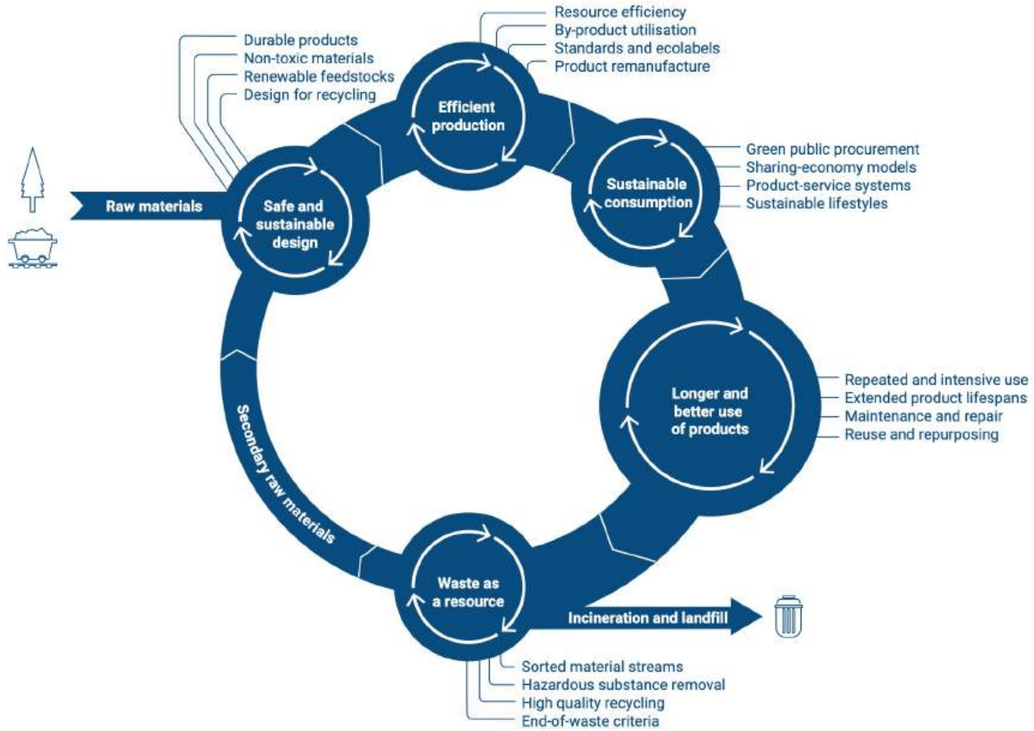


Fig.1: The Circular Economy Concept, European Environment Agency (p.4)

supportive infrastructure that supports a circular economy transition (Fig.1). Moving to a circular economy has potential to preserve valuable global resources, reduce negative environmental impacts and achieve Net Zero targets (EEA, 2024a). However, this is unlikely to be achieved without an associated decrease in global levels of textile production and consumption.

In discussions with businesses, most refer to embedding circularity principles by extending product life cycles by, for example, designing for longevity, or introducing rental and repair services, or establishing new approaches to recycling. One example is Worn Again Technologies Ltd, which is a business pioneering fibre-to-fibre chemical recycling techniques and whose foremost goal is to replace virgin materials by using existing textile waste in a way that can be continually recirculated.

Meanwhile, not-for-profit organisations and NGOs in the UK are among those advocating for circularity by design. This requires a change from linear to circular business models and a change in supply chains, with a new focus on working to understand what practices can be adopted to change attitudes towards circularity.

WRAP's Textile 2030 initiative compliments such an approach to circularity, by supporting brands and retailers to adopt circular practices as part of their strategy, and most importantly to scale these up. WRAPs vision for a future fashion industry is one where new products are of inherently lower environmental impact and are designed to be consumed within a circular system, such that the embodied materials remain in longer-term circulation. In so doing, the aim is to decouple the industry's reliance on virgin resources for production and to intensify the role of recycling to provide valuable feedstocks relevant to industry's needs. Growth of circular business models therefore requires an increase in the scale of waste collection, sorting and recycling infrastructure for waste textiles in the UK. Development of plausible and economically attractive markets for low grade and mixed synthetic waste that is collected in the UK is also required, and consideration of where the waste needs to be transported for it to enter an appropriate textile manufacturing supply chain, which may be onshore or offshore.

3.2 Overconsumption and Overproduction

Overconsumption and the excessive use of natural resources in the fashion and textile industry has multiple impacts related to, for example, raw materials extraction, water use, carbon emissions and waste.

Internationally, one important driver of increased production and consumption of fashion and textile products is global population growth, which between 2000 and 2015 grew by approximately 21% equating to 1.28 billion additional people who needed to be clothed (Walter, 2024). Additionally, the 'fast fashion' model, as a particular driver of consumption, has supported rapid growth of certain businesses within the industry and

although there is some evidence that the planetary impact per garment has reduced, overall impact continues to increase linked to higher production (Peters and Lenzen, 2021). A further issue relates to the way in which many supply chains are configured.

Long international supply chains, a feature of the textile industry for the last several decades, inaccurate demand forecasting, and over-ordering can create mismatches between demand, and what is produced, creating deadstock and unsold inventory (Gabriel, 2021). Such structural features also drive overproduction in related manufacturing organisations. Seasonal fashion trends lead to highly volatile consumer demand, which can leave firms holding significant inventories, or with spare production capacity at various points within lengthy supply chains. Price and cost fluctuations compound these effects, leaving firms exposed to significant risk. Waste associated with overproduction meanwhile adds to the environmental impacts of overconsumption. It is claimed that unit production of textile garments doubled between 2000 and 2015, while the average number of wears for each garment halved (Ellen MacArthur Foundation, 2017). Efforts to create sustainability through circularity appear forlorn in the face of these trends of increasing production. In business sustainability strategies, it is rare for reduced consumption and production to be part of the objectives (Payne and Mellick, 2022). A recent report by the Textile Exchange, however, highlights the need to redefine value creation beyond traditional financial metrics, prioritising environmental and social sustainability over perpetual growth (Textile Exchange, 2024)

Of course, producing and selling more while minimising costs to maximise margins is a traditional operating model and reducing production is unattractive. Herein, research participants, including Project Plan B, Amphico and Wanner Label, highlighted the difficulty of tackling this problem, such that it is unlikely that companies currently pursuing the sale of large unit quantities per annum will adopt new models of operation. This disconnect between company growth targets and climate targets was also apparent in interviews with iinouiio and WRAP. Even if the environmental footprint of an individual product is reduced, by for example selecting lower impact raw materials, the overall environmental impact will not improve if more products are manufactured and sold.

"Everything we do has some environmental impact – even the recycling operation itself. Using increased quantities of recycled fibres instead of new fibre will lower the overall impact, but the drive should be to reduce consumption, especially of 'throw-away priced' products" **– iinouiio**

WRAP's annual report (WRAP, 2023) highlighted a 2% absolute reduction in carbon emissions per tonne in the UK's industry (the aim by 2030 is for a 50% reduction), but paradoxically there was a 13% increase of new products being placed on the market. The challenge of shifting to a circular

system by replacing new products with purchases made through a different model such as rental, recycling or resale remains unresolved at a sufficiently large scale.

"The missing link is that business haven't quite connected their growth targets with their climate targets. Brands and retailers are doing all this good stuff to improve the sustainability of products, but if they keep selling more of them, we're still going to have bigger impacts." **– WRAP**

A commonly expressed view from UK businesses in this research is that the basic ratio of the cost of clothing, relative to the disposable income of consumers has fallen too low in the UK, due to competition in the market. The increased affordability is encouraging consumers to buy more, and discard items more readily feeding a consumption loop. Consumers shopping online have expectations of free delivery and returns which has led to an estimated £7 billion of online purchases being returned each year, a return rate of around 20% (Tait, 2023). Think Circular suggested that this encourages consumers to place too little value on low-cost clothing, similar to a disposable commodity.

"[Clothing is] just a commodity item, isn't it? It's actually cheaper than a coffee" **– Think Circular**

Meanwhile, consumers that donate unwanted apparel to charity shops may be unknowingly contributing to these issues. As noted by Save Your Wardrobe, charity shops are not able to sell all of the donated items they receive, and in some cases over 80% (Franklin-Wallis, 2024) are redistributed, including to countries in Africa where different waste management infrastructure exists. This can mean that only 10-20% of returned items of clothing are resold in the UK, with a large proportion of the residual, non-reusable waste being directed to incineration or landfill.

The role of the consumer is often highlighted as a key driver in concerns about overconsumption, although a toxic mix of peer pressure and brand marketing is also a key factor (Gabriel, 2021). Community Clothing Ltd explained that as a business they encourage customers to be sustainable in their approach to purchasing clothing, and to view items as an investment to be looked after. Many companies contributing to this report suggested that education is key in reducing over consumption, as consumers are currently overwhelmed with information that is conflicting and confusing. There are now over 50 'sustainable' or 'ethical' certifications, from the production of fibres, e.g. wool production and the RWS (Responsible Wool Standard) and organic cotton, e.g. GOTS (Global Organic Textile Standard) to fair wages, e.g. Fairtrade, and many others, each focusing on a different part of the supply chain. With the proliferation of certification schemes, coupled with a lack of understanding

about what they signify, and patchy levels of participation among businesses (due in large part to the costs of being certified), it is understandable that consumers are not able to make fully informed purchasing decisions. Businesses also highlighted the need for education on how and where clothing is produced, its impact on the environment, and the role of people in its production, to influence consumer behaviour change. How to maintain and repair clothing to retain its appearance and performance is another education gap. WRAP's 'Love Your Clothes' campaign (WRAP, 2020) was highlighted as an example of how educating and upskilling citizens could be influential, but this initiative was archived due to funding limitations.

3.3 Sustainable Materials

The topic of sustainable materials in fashion and textiles poses many questions including: what is the definition of a sustainable material or fashion product? Is it better to use a synthetic material that may have a longer life and can be recycled? Are natural fibres the better option? Should fibres be biodegradable or recyclable, or both? The language of marketing, rather than data and evidence, continues to influence perceptions about sustainable materials selection (Goncalvas, 2021).

Fundamentally for fibres to have maximal industrial utility, they must be (1) compatible with installed fibre extrusion and textile manufacturing capacity, whether in the UK or internationally; (2) possess physical properties that ensure resulting products function properly; and (3) be available on an appropriate scale. Frequently, in deliberations about sustainable materials and fibres, such practical considerations are overlooked.

Selection of sustainable fibre materials is a priority among textile designers, manufacturers and retailers, but rational selection of sustainable materials remains challenging because there is a lack of agreement on what constitutes a "sustainable fibre", and further complicated by product specific supply chain impacts (Wiedemann et al, 2023). This is partly because there is insufficient science-based data on the environmental impact of fibres from specific suppliers (rather than generalised data) to inform decision-making, and too much emphasis on cradle-to-gate, rather than full life cycle, cradle-to-cradle assessments of specific final products containing fibres (i.e. the 'final product level' as the functional unit) (Wiedemann et al, 2020). A further concern is that life cycle assessments on individual fibres and products have become very expensive, and often need specialist consultants to conduct them, which particularly disadvantages start-up companies and SMEs. Major data gaps also exist, particularly when it comes to cradle-to-cradle life cycle assessments (Fonseca et al, 2023).

Efforts to create reliable eco-metrics, e.g., the Higg MSI comparing the sustainability or environmental impacts of different fibres in simple terms, have often been based on oversimplified assumptions, or cradle-to-gate life cycle assessment data, rather than the full-life cycle of specific products,

Shredded textile waste from UK knitwear brands, at iinouiio's facility in West Yorkshire. ©Alys Tomlinson (2024)

leading to concerns about their validity. Easily accessible data and science-based eco-credentials are required to enable informed decision-making about the environmental impacts of feedstocks based on all fibres.

This includes renewable, recycled, used, or deadstock materials, or biobased materials based on regenerative agriculture, or recyclable biopolymer feedstocks, including bioplastics. Rational decision-making is also required on an individual product basis about whether biobased materials should be recyclable (keeping resources in circulation), biodegradable, or both, to prevent release of biogenic carbon (GHGs).

It is also important to assess the potential for synthetic polymers such as PET to be replaced by bioplastics, based on renewable resources (Ali, 2023). In this regard, there is an opportunity to harness UK biotechnology expertise to manufacture recyclable (and not just biodegradable) bioplastics, e.g. bio-PET, made from renewable secondary biomass (not competing with food production). Making such materials efficiently, retaining their biogenic carbon content, and ensuring their compatibility with existing recycling infrastructure, e.g. thermomechanical recycling, has potential to make a significant impact (Rosenboom et al, 2022). In developing eco-credentials for all fibres, consideration is also required on end-of-life waste management arrangements for specific fibres and products to capture and prevent environmental leakage of the constituent fibres. Until the issue of reliable, and accessible ecometrics is resolved, making evidence- based environmental claims will continue to be challenging.

Companies are increasingly addressing such questions to achieve sustainability outcomes, although transition rates are quite slow (Textile Exchange, 2023). John Lewis PLC uses natural and synthetic materials in their products, and during interviews highlighted sustainability pledges within the group which focus on the origins and supply of seven types of materials, including timber, cotton, feather and down, cashmere, viscose, polyester, and leather (John Lewis Partnership, 2024). Large brands are setting quantitative targets to develop more sustainable versions of current materials, including the types of packaging being used within store, and for home deliveries and are working towards plastic-free packaging where possible. Other companies claim using natural fibres, such as wool and cotton instead of synthetic materials, such as polyester (PET) is more sustainable. As an example, Burberry PLC, Community Clothing Ltd and Wanner Label all prefer natural fibre selection within their product ranges. Furthermore, Burberry announced that by 2025, 100% of the cotton sourced for their garments will be organic cotton.

Burberry is aware that organic cotton production still consumes large quantities of water (Textile Exchange, 2018), but efforts are being made to source cotton that consumes less water, e.g. via hydroponically grown fibre, which uses 1/10th of the water compared to conventional cotton practices (HKRITA, 2023).

It was also suggested that fossil-based synthetic material utilisation within the industry, particularly for use as single use plastic packaging should stop to prevent further accumulations of waste. A weaving mill in Huddersfield, West Yorkshire spoke of how they find it frustrating that PET is considered more sustainable than 100% wool (with reference to the Higg Material Sustainability Index and the EU's Product Environmental Footprint (PEF) methodology) because of reliance on generalised data, and not taking account of full product life cycles (Klepp et al, 2023). Regulations introduced in the future should consider the sustainability of textile materials based on the full life cycle of products (not just up to the point of production) and should involve experts in the fields of polymer and textile science, textile manufacturing as well as waste management.

Think Circular spoke of how there is a drive within the industry to demonise PET from the perspective of wool and cotton producers, however, deciphering if PET is more sustainable than natural fibres is not a straightforward task. It was suggested that penalising companies for using PET would not be the right approach, since PET is deemed necessary to ensure the functionality of some types of clothing such as swimwear and outdoor wear. In discussions about the selection of materials, the basic requirement for the product to perform is paramount, and this is a function of material properties.

It is therefore naïve to believe that all synthetic fibres can be replaced with natural fibres if real-world textile products are to remain functional and to perform properly in their intended end-use. This highlights the need to develop fibres that are not derived from virgin fossil-based sources. Think Circular also commented on how there is a distinct lack of knowledge and misinformation within the industry on material choices. The company recently worked with another firm that was confused about the relative environmental impacts of organic cotton vs conventionally grown cotton, and it was influencing corporate decision-making. It was claimed that misinformation about the environmental credentials of textile materials is repeated in the media and industry on a regular basis, which confuses both brands and consumers.

Community Clothing use predominantly natural materials in the production of their garments, such as wool and cotton, including cotton and wool yarns spun in the UK, as they believe natural materials are better for the environment. They also strive to use British wool and are conscious about how far their materials travel, ensuring they limit their carbon footprint. Likewise, Wanner Label prefer to use natural materials, such as cotton, linen and silk, including second hand silk, which is easy to source.

"We make sure everything is sustainably sourced. We know where every aspect of everything comes in our in our clothing."
– Community Clothing

Community Clothing prioritise using natural fibres, such as cotton and wool, in their garments. ©Community Clothing

Other businesses are trialling innovative materials and technologies, which they believe will be less harmful to the environment and deliver a more sustainable product. Grenson Ltd built trials involving innovative materials and products into their business model to effectively test the market in real time. One example is a partnership with Doppelhaus Ltd, utilising Cloudwool, a fabric made using waste British wool and nonwoven technology. Grenson and Doppelhaus worked together on the technical innovation to improve the material to be suitable for use in footwear and launched a limited range of Cloudwool shoes in 2023. Grenson also explored alternative tanning treatments for leather that use less water, chemicals and metals in the process. Traditional tanning processes create chromium salts and sulphides, increasing the risk of toxic pollution and requiring large quantities of water (Leather International, 2021). They

recently experimented with a leather that was tanned with the extract of olive leaves.

Similarly, start-up company Amphibio Ltd [trading as Amphico], is developing next generation outdoor clothing materials to remove the need for water repellent per- and poly-fluorinated chemicals (PFAS/PFC), as well as ensuring full recyclability at end of life. Amphico explained that most windproof, waterproof and breathable outdoor clothing is made up of several different layers, making it difficult to recycle. However, Amphico's new technology focuses on single layer materials made from a single polymer, therefore recycling should be much easier. There is also potential to make their product from a recycled version of the polymer they are using, however, the infrastructure to do this is not yet available in the UK. A weaving mill in Huddersfield, West Yorkshire have been working towards removing the need for PET yarns from their fabrics, such as the selvedges, which are now produced with wool and nylon to permit full recyclability at end of life. They were recently challenged by one of their customers to eradicate all virgin plastic packaging by 2025. However, when they investigated alternative materials, the cost of changing to these more sustainable materials came at a higher price, making it unaffordable.

"We are developing a new type of waterproof textile which is used to make waterproof jackets, tents, shoes and we have new technology which allows us to create a high performing textile which is circular and easy to recycle."
– Amphico

The eco-credentials of fibres should be decoupled from marketing language and unsubstantiated green claims. Informed data-based material selection needs to be based on scientifically robust information, but this remains challenging for the fashion and textile industry, with oversimplified assumptions and generalisations being made in life cycle assessments (LCAs) about the environmental impact of different fibres. 'Beauty contests' comparing the impacts of one fibre against another are highly questionable, because in global supply chains, raw material production systems, resource and energy inputs in different countries and methods of manufacture vary considerably for the same fibre in different places. On top of that, the same fibre may be used in many different types of products, all of which have very different use phases, lifecycles and prospects for reuse and recycling. The final product focus is therefore essential to avoid the real-world complexities being overlooked.

3.4 Reducing Waste and Recycling

The UK has seen a slow shift towards more sustainable materials however strategies for reducing waste and recycling are still in active development (Douglass, 2023). UK Governments own 'Resource and Waste

Burberry announced that by 2025, 100% of the cotton sourced for their garments will be organic cotton. ©Burberry, 2024

Strategy' includes an aim to reduce textile waste by 50% in 10 years, suggesting legislation to reduce waste is a matter of 'When, not if" (Yodomo, 2023). Waste in the UK fashion and textile Industry can be categorised as either:

A Industry or Pre-consumer Waste
B Post-consumer waste

Companies in the UK fashion and textile industry interviewed in this research confirmed that they are seeking to reduce waste generated during manufacturing processes (pre-consumer waste), and some are recycling this waste into alternative products, such as Abraham Moon and Sons Ltd, who recycle 95% of their waste into thermal insulation. Others such as Farzane Fox Ltd, use an external company to collect and recycle their waste material and they have an online entity selling old samples, vintage clothing and excess stock, which would otherwise have been disposed of. Locharron of Scotland Ltd sell unused wool online to crafters and they also recycle plastic waste via a local company that collects it and palletizes it. Melin Tregwynt Ltd, a Welsh woven fabric manufacturer, recycles scrap material into toy stuffing made on-site, or it is woven into rugs on peg looms and pre-used warp yarns are reprocessed into knitting wools. A weaving mill in Huddersfield, West Yorkshire interviewed in this work use

an external company to recycle waste woollen yarns as a feedstock for weaving other fabrics. Grenson recycle 75% of their waste produced in the factory through a third-party company. Meanwhile, John Lewis is undertaking research across sixty departments investigating which products can be recycled.

Project Plan B has pioneered the development of a textile-to-textile recycling system in Europe, helping companies reduce their waste and giving them an opportunity to recycle their polyester (PET) products into new polyester products. They explained that more companies, including large, well-established businesses are engaging with this process due to the increasing pressures of extended producer responsibility (EPR) legislation that is becoming mandatory in Europe. Worn Again is another company developing a recycling technology, focused on chemical recycling of polyester (PET) and polyester-cotton (poly-cotton) blends. The process can separate the polyester-cotton waste, recapture the PET and convert it into pelletised form ready for reprocessing back into a new PET fibre. Worn Again spoke of how the business is currently in the process of setting up a 1,000 ton per annum demonstration plant in Zurich. They hope this plant will establish the industrial process to enable them to formulate the information required to produce a licensing package for other plant operators around the world. They plan to locate recycling plants where there is a high consumption of clothing and where EPR is helping shape and support recycling technology.

“And now they’re going. What can you do? How can you help? [...] So we’re really lucky that we’ve come at the right time, but we are years ahead of everybody else because it’s really difficult developing a recycling system.”
– Project Plan B

Meanwhile, Vivobarefoot are investing in the recyclability of both synthetic and natural materials. They refer to these innovations as ‘technospheric circularity’ and ‘biospheric circularity’, the former relates to keeping technical nutrients in use through mechanical and chemical recycling and the latter relates to borrowing materials from nature and then being able to give this back to nature by composting.

Using traditional mechanical recycling methods iinouiio Ltd in West Yorkshire recycle postconsumer wool waste into new woollen yarns suitable for the manufacture of high value textile products, including clothing. iinouiio partnered with global fabric manufacturer Camira Fabrics Ltd in 2022 to produce their first recycled yarn called ‘Revolution’ which was exhibited at the Stockholm Fashion Fair. ‘Revolution’ is made from post-industrial yarn waste obtained from used weaving cones at Camira. Apart from recycling, other small firms are using deadstock and off-cut fabrics to make new products to minimise costs and circumvent minimum order quantity restrictions.

“That’s the direction we need it to go in: decoupling the industries reliance on virgin resources, keeping materials in use for longer and being able to recycle them at the end of their life.” **– WRAP**

3.5 Designing for Longevity

Extending the life of apparel by design is claimed to be one of the most effective methods of reducing negative environmental impacts the fashion and textile industry (McLaren et al, 2016). Along with repairing and recycling apparel, designing apparel to last (designing for longevity), can reduce the amount of waste generated from post-consumer waste. Designing for longevity relies on the use of high-quality and robust materials, however there is no standard that sets out what ‘high-quality material’ is (Benkirane, 2022).

The value people place on their clothing, along with how it fits and performs as well as social and cultural contexts all contribute to how long garments are kept and worn (Chapman, 2021). Research suggests that consumers associate longevity with value, particularly when associated with labels that signal quality (McLaren, 2016). Designing for longevity was a common theme for many companies engaged in this research.

Burberry, the luxury heritage brand, centre design around producing a garment that lasts for many years. The company explained that owning a product that can be worn many times displaces the carbon footprint compared to a fast fashion product, where the item is worn a handful of times before being discarded. An example was given of a customer who contacted Burberry to refurbish a garment from the 1940s, remarking how the carbon footprint of that particular garment had been spread over eighty years. Similarly, John Lewis spoke of how the quality of a garment is linked to sustainability, and the design phase is important when creating a durable product. Grenson manufacture shoes that are well made and timeless in style, selling to customers who want to buy something that lasts 10 to 15 years longer than an average pair of shoes. A luxury handbag brand believes that making good quality products that will last is one of the most sustaiable practices that can be achieved in the industry.

“So the starting point is the longevity of the product, by making a shoe that lasts as long as we possibly can. And we say, are there any things that we could do differently to make it even stronger, to make it last even longer?”
– Grenson

Community Clothing place longevity of a garments at the core of their business model, differentiating themselves from the fast fashion model. They do not create seasonal fashion items or conform to fast fashion practices. The company commented that designers need to consider the end of a products life at the beginning of the design process to achieve longevity. Wanner Label produce garments that are timeless, can be adjusted so the same garment can be worn if a customer changes body size and are reversible, allowing the consumer to maximise the garments potential.

"We encourage people to be sustainable in their approach to purchasing clothes to see it as an investment, to see it as something that has longevity that will be looked after"
– Community Clothing

3.6 Repair, Resale and Rental

Practices of repair and reuse are key to ensuring a product can be used for the longest possible time. Participants in this research including Burberry, Grenson and a luxury handbag brand based in Somerset are among the UK fashion and textile brands offering a repair service as part of their circularity practices. There are significant barriers to repair, arising from poor product design and perceptions of cost and accessibility of repair services. Working with consumers, through training and the provision of repair services can overcome these barriers (Zhang and Hale, 2022).

The luxury handbag brand has repaired over 10,000 bags over the past 35 years, yet it has only marketed this concept of 'made to last' for the past two. Customers nationally and internationally wishing to have their bag repaired, send them to the repair centre in Somerset, UK. To reduce carbon emissions associated with transport, they are actively working to identify localised repair centres. The same company offer an exchange service, allowing customers to swap damaged bags for a gift card related to the value of the return. The bag is repaired and resold via their website, allowing long-term reuse. The returns-and-resale approach has also been adotped by John Lewis via their FashionCycle scheme (Fig. 2). Fashioncycle forms part of a commitment (John Lewis Partnership, 2022a) to offer a buyback, or takeback option for every range by 2025. John Lewis believes that offering the customer a financial incentive to bring products back (such as money off a new product or reward vouchers) is an opportunity to extend the life of used apparel and find ways to repurpose raw materials. Wanner Label also offers customers an incentive to return unwanted items. Customers collect stamps for each item they return, once 10 stamps are accumulated the customer receives £10 off their next purchase.

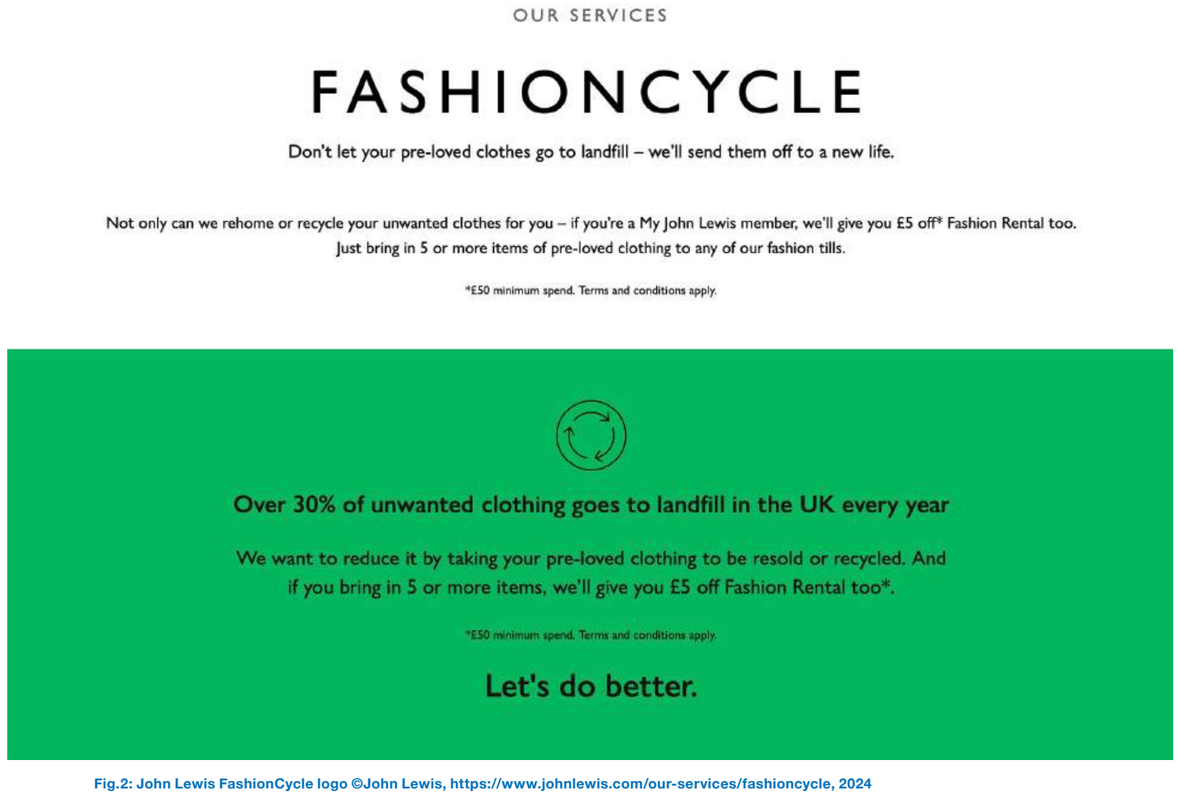


Fig.2: John Lewis FashionCycle logo ©John Lewis, https://www.johnlewis.com/our-services/fashioncycle, 2024

"It's incentivising customers to bring back products, you either give them money off, or give them reward vouchers"
– John Lewis

Burberry has been offering a repair and after care service on their trench coats for many years and are now offering the same service for bags and scarfs. Burberry mitigated the challenge of a centralised repair location by installing repair facilities in multiple stores worldwide. In late 2023, Burberry partnered with Vestiaire Collective, providing customers the opportunity to trade in Burberry products in exchange for a gift card and a 15% bonus. Returned products are then repaired or resold. This is part of the ReBurberry initiative, a commitment to becoming a more circular business, reducing landfill waste and prolonging the life of garments (Burberry, 2024).

Grenson has been offering a repair service on their shoes since the company was founded. Customers can have their shoes rebuilt by Grenson's skilled staff, who will strip the shoe back to the sole and rebuild the entire product. While this approach is costly, it offers customers a chance to repair products they already own, reduces the full-life-cycle carbon footprint and prevents constituent materials from being discarded as waste. Grenson's 'Back on the Road' initiative further extends the life of Grenson shoes

their shoes have reached the end of their life. Grenson request customers to donate such shoes, whereupon simple repairs are performed prior to resale at a lower price point than a vintage item.

“Back on the Road is about just extending the life even for when they’re actually on the verge of going into the bin, then to landfill” **– Grenson**

Save Your Wardrobe used AI to create an app that connects consumers with an ecosystem of aftercare services. Along with creating a digital wardrobe, the app enables users to reconnect with their clothing and view it as an asset. Consumer attitudes towards second-hand clothing are changing with 68% of Gen Z & Millenials reporting that they bought a pre-loved item recently (Koutsou-Wehling, 2024). Digital technology, coupled with the pandemic accelerated growth of the used clothing market with reCommerce sites such as Vinted, Depop, eBay, Rubylane and the Real-Real, are bridging the gap between affordability and sustainability.

“[The app] enables people to reconnect with what they have and see their clothes as assets and something they need to cherish” **– Save Your Wardrobe**

New rental services for apparel are emerging from some UK brands, including Burberry through their partnership with Wardrobe HQ (Maguire, 2021), John Lewis also see potential in the approach and expect it to gain more popularity. Apparel rental services are a niche but growing part of the sustainable fashion and textile industry, increasingly being adopted by designer and high-end brands such as Selfridges and Flannels along with companies that have utilised technology to provide digital versions for example Wardrobe HQ (MyWardrobeHQ, 2024) and RentTheRunway (Rent-TheRunway, 2024). However utilising apparel rental services requires a change in consumer behaviour, because having to plan ‘purchases’, and wait for items to become available (Mukendi and Henninger, 2020), is in direct contrast to the immediate consumption enabled by fast fashion. However, reliable evidence is still needed to robustly evaluate the environmental impact savings made by renting garments compared with ownership, including the extent to which it displaces the consumption of new clothing.

3.7 Key Findings

Findings

1. Confusing and misleading claims are common about the sustainability of different fibres. Often, these claims are not based on data or science-backed evidence but rather, mixed opinions about synthetic and natural fibres.
2. Science-based data and evidence on the environmental impacts of fashion and textiles at a final 'product level' is lacking and needs to be addressed in terms of investment in life cycle assessments (LCAs) or alternative quantitative methods, to provide a basis for informed decision-making. A major barrier is the cost and complexity of conducting LCAs, particularly for SMEs, as well as companies with large product ranges.
3. There is a need to ensure oil-based plastics, e.g. PET are not used inappropriately, i.e. to make single-use products, packaging or indeed clothing that is not managed in a manner consistent with ensuring it is recycled at the end-of-life.
4. Many UK businesses are exploring opportunities to shift to alternative lower impact fibre materials and technologies to reduce their environmental impacts. Use of recycled materials from the textile industry, and dead stock fabrics is becoming more prominent.
5. Plausible new economically viable markets for low grade, non-rewearable UK-generated waste textiles are required. Renewable, bio-based polymer materials that have physical properties equivalent to PET and other synthetics are required to enable materials substitution, without incurring final product performance deficits.
6. Some companies are supplementing their business offering by introducing repair and resale services, with the aim of prolonging the life of garments and maintaining a longer-term relationship with their customers.
7. Rental services are starting to gain traction, but outside the corporate clothing industry, development in mainstream fashion and textiles is still nascent and challenges the current consumer mind set of ownership. More research is needed on the extent of which rental activity displaces the purchase of new clothing.

Challenges

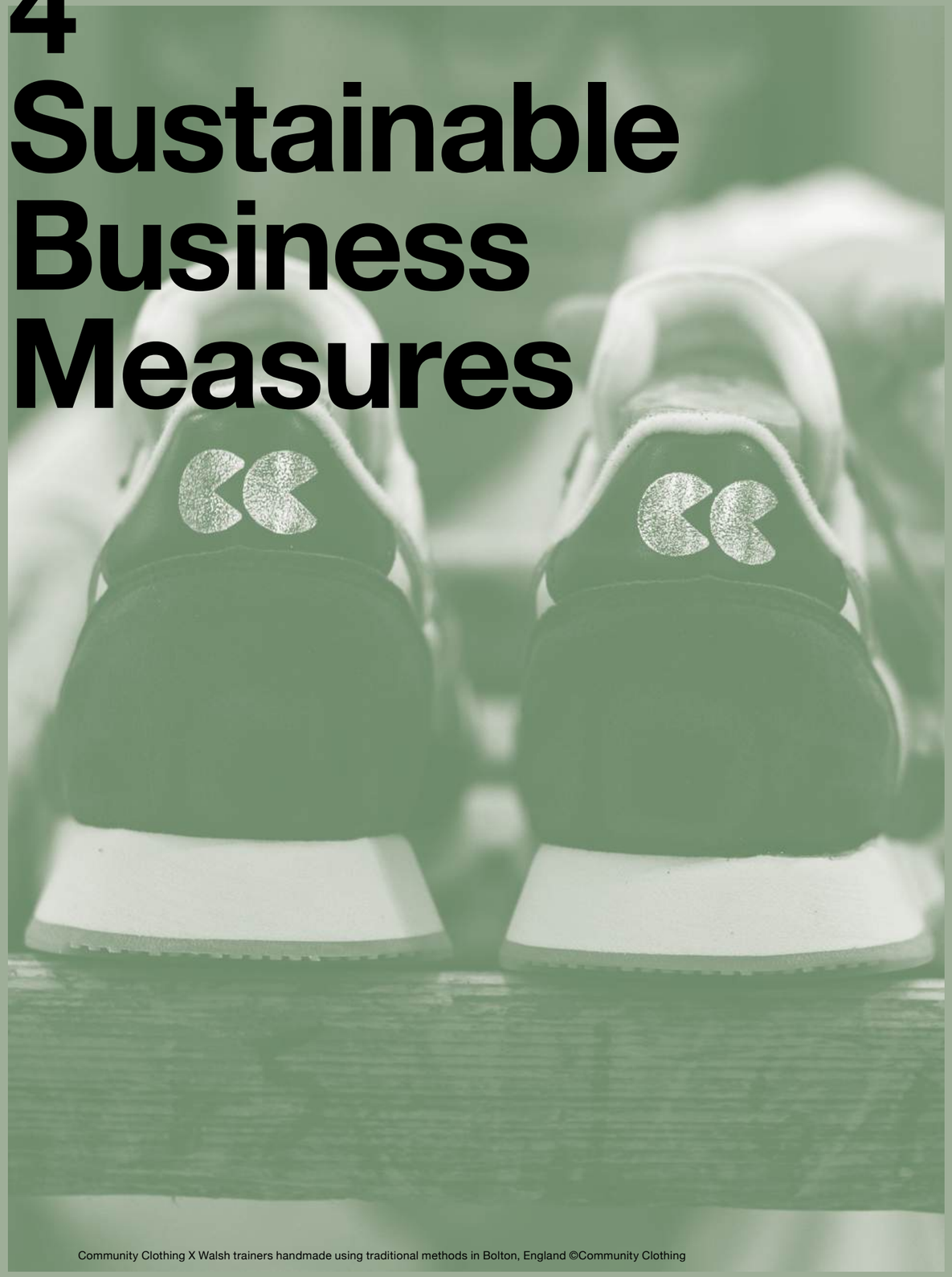
1. Science-based evidence is lacking for manufacturers and consumers to make informed choices about products containing different fibre materials.
2. How can businesses produce less whilst remaining profitable?
3. Cost differentials disincentivise shifts to 'more sustainable' material options.
4. Changing the consumer mindset to buy resales or consider rental services.

Opportunities

1. Designing for longevity is being encouraged by companies to tackle overconsumption and there are opportunities to refocus on quality specifications. Simultaneously, marketing messages that promote overconsumption should be eliminated.

2. Engaging consumers to improve awareness of how to care for and promote the longevity of products, whilst building brand loyalty and new circular business opportunities arising from repair, resales, exchange and swap services.
3. Valorisation of UK-generated textile waste to provide new feedstock for manufacturing. Project Plan B, Worn Again and iinouiio are among a group of companies offering UK fashion and textile businesses a way to recycle waste and use recycled materials in their collections, but there are many other opportunities for the UK to lead the design and production of new sustainable materials for the industry as well as increasing capacity to sort and recycle textiles.

4 Sustainable Business Measures



Community Clothing X Walsh trainers handmade using traditional methods in Bolton, England ©Community Clothing

4.1 Carbon Footprint and Net Zero

In 2019, the UK government set the climate change target for reaching Net Zero greenhouse gas emissions by 2050, with legislation being put into place to achieve this in line with recommendations from the independent Climate Change Committee (CCC) (Stark, 2019). Sustainable business strategies also need to be developed in the context of the United Nations target of achieving Net Zero by 2050 with an interim target of a 45% reduction by 2030 (United Nations, 2023b). Since 2019, larger companies have been required to report on their energy use and greenhouse gas emissions (HM Government, 2019) including greenhouse gas (GHG). Such emissions are categorised according to a scheme first developed in 2001 by the Green House Gas Protocol of 2001.

Scope 1
refers to a firm's direct greenhouse gas emissions.
Scope 2
refers to indirect emissions arising from energy bought in for use within the business (for example electricity purchased for heating buildings).
Scope 3
refers to indirect emissions in the firm's value chain arising from the purchase of supplies and the consumption of its outputs by customers.

Indirect emissions under Scope 3 are likely to be the focus of increasing regulatory scrutiny (Mundy and Temple-West, 2024).

Views on achieving Net Zero and approaches taken by businesses to tackle their carbon emissions were surprisingly varied. Amphico, a start-up company developing a new waterproof breathable material for the outdoor industry explained that they have undertaken an initial life cycle assessment (LCA) to understand which processes can help reduce their carbon footprint. The results were counterintuitive: showing that by keeping all the manufacturing in Asia and only shipping the finished product into Europe this appears to reduce their carbon footprint, this compared to manufacturing in several European countries. Like many other businesses there are external factors involved which are out of their direct control. Community Clothing Ltd explained a similar situation, whereby the main component imported into the UK is the denim material used in their production of jeans, all other manufacturing processes take place in the UK, keeping their carbon footprint relatively low.

John Lewis has engaged several consultants to help plot their carbon footprint in line with the Science-based Targets Initiative (Science Based Targets, 2023). They are working on Scope 1 and Scope 2 mainly within the food category but will focus on Scope 3 shortly. In relation to achieving Net Zero, the company commented that an internal target date of 2030 is in place for separate operational functions such as warehousing, shops and equipment. Information on figures and targets is available online in the John Lewis Ethics and Sustainability Report 2022/2023 (John Lewis Partnership, 2024) which states the aim to achieve Net Zero across the

Polyester textile waste, collected by The Salvation Army and other textile collection partners, to be recycled by Project Plan B through their Project Re:claim facility ©Alys Tomlinson 2024

entire value chain by 2050. They have targets in place to electrify all store heating systems by 2035 and plan for all vehicles to run on biomethane fuel by 2028. Likewise, a woven textile manufacturer in Huddersfield, West Yorkshire has invested in consultants to help monitor all the processes within the factory and calculate their carbon footprint. They must report all their energy usage figures monthly into an online portal, which is monitored by their biggest customer. As a result, the company has implemented new systems to enable a more energy efficient factory including recycling 80% of their water and developing a waterless finishing technology. Where possible, they have been developing fabrics with British wool instead of New Zealand and Australian fibre, which is also contributing to reducing their carbon footprint.

Burberry is working towards a carbon positive target by 2040 (Burberry, 2022). The company is following the UN SDGs (United Nations, 2023a) relating to 17 different goals and is transparent about progress, which can be viewed online as a public report. Likewise, Worn Again, a company that has developed a polymer recycling technology for PET and poly-cotton blends, described the 17 goals set by the UN as helpful for companies by providing clear incentives to drive improved business practices. The company highlighted how important it is to monitor the LCA of their process throughout the development of the technology to ensure an environmental benefit over virgin PET production can be demonstrated. However, inconsistent results have been obtained from different consultancy firms making

it challenging to confirm the carbon footprint. Worn Again plan to use their new recycling plant, which is being built in Switzerland, to gather accurate measurements of the carbon footprint, which will be a useful indication of the environmental benefits of a full industrial scale plant. They explained that the technology should allow other businesses in the industry to make reductions in their own carbon footprint, as companies will be able to source Circular PET (cPET) and Next Generation Cellulose rather than virgin fibre. Similarly, Project Plan B commented that due to the relatively small size of their business, the carbon saving impact of the current PET recycling operation is small. However, carbon savings will improve as the operation scales, and the quantities of post-consumer clothing being recycled increases. In many cases, companies are asking Project Plan B to work with their supply chain directly to help them make better decisions about raw material selection and circular practices.

“Where we will make the biggest difference is getting more clothing recycled and that’s where the carbon savings come from and in their thousands, if not millions of tons” **– Project Plan B**

In relation to Net Zero, Vivobarefoot is taking a balanced approach and is focusing on tackling waste as an immediate issue. Concerns were raised by some companies that creative carbon accounting was taking place within the industry and that there is more talk than action. Wanner Label commented that as a small start-up, the availability of resources was a major issue in relation to researching their carbon footprint, and this is an issue affecting many small businesses. It was suggested there should be a Net Zero policy structure and carbon accounting approach that accounts for the size of business organisations, so that start-ups and very small businesses can cost-effectively engage.

“There should be policies that should be pushed, but on different levels. So small brands do this, medium sized brands do this and big brands do this.” **– Wanner Label**

4.2 Business Strategies

Fashion and textile companies are independently developing strategies and their own approaches for achieving sustainable and circular business models. Worn Again commented on the words ‘sustainable’ and ‘circular’, indicating that the concept of circularity has in some ways superseded the word sustainability. There is a developing understanding that sustainability is about doing things better, whereas circularity is about doing things differently, which will enable so many benefits for the environment but also for the economy.

“The industry needs to increase its use of circular business models and displace revenue from new production into circular revenue opportunities, for example from resale and hire; working within the same business framework, but decoupling growth from sustainable impact.”
– Think Circular

Sustainability has been a part of Grenson’s business strategy since it was founded in 1866 by William Green. The company has always believed in making products that last. There are three areas within the business where attention is focused: (1) designing for longevity, (2) repairing products, and (3) taking responsibility for the workforce to ensure they look after their people. This focus on people is mirrored within Vivobarefoot, where the health and happiness of the people employed are key to ensuring the business success. This is demonstrated through their business practices of regenerative leadership; self-managing teams, non-hierarchical structures, a focus on rewilding the environment and conducting meetings in the calm environment of nature. Vivobarefoot believe that the only way to make sustainable footwear is to make products that support both human health and planetary health, at every step of the process. However, the company openly acknowledge they have a long way to go to achieve this.

Similarly, John Lewis spoke of how John Spedan Lewis, the founder of the business spent an abundance of time in nature, writing books on nature and believed that a business should care for nature too. Therefore, John Lewis has always strived to limit their impact on the environment. The company spoke of how sustainability within the business has many aspects to it, and like Grenson and Vivobarefoot, they care for their employees, partners and suppliers, and strive for a democratic culture.

“[Regenerative leadership] is effectively looking to nature for natural systems for how to run the business. So it starts at a business level, and then the outer is your value to society. You want to be creating products and services that are making society better.” **– Vivobarefoot**

It is common for businesses in the fashion and textile industry to use business measurement systems or key performance indicators (KPIs) as a tool to measure and effectively communicate their success. Think Circular, a consultancy offering circular solutions to businesses, believes that businesses should start to use metrics of success when tackling sustainability. They commented that most businesses have measurement systems in place to monitor sales, for example, and therefore using the language that is familiar in business for measuring other functions, such as sustainability is an effective way to include sustainability in the business strategy.

The ownership of intellectual property (IP), the protective nature of different brands, and concerns about copying ideas and designs is still a challenge for the industry. WRAP also point to collaboration being an important enabler of circularity. Examples of this are evident in brands and retailers working with rental platforms as well as the current collaboration, Project Re:claim (The Salvation Army, 2024), between Project Plan B and The Salvation Army (one of the UK’s largest collectors of waste clothing in the UK) to develop national recycling infrastructure.

4.3 Greenwashing

Greenwashing is defined as ‘misleading publicity or propaganda disseminated by an organization, etc., so as to present an environmentally responsible public image; a public image of environmental responsibility promulgated by or for an organization, etc., regarded as being unfounded or intentionally misleading’ (OED, 2024). As public perception of the importance of the environment has increased, products claiming sustainability features have commanded a premium price. Consequently, companies with weak claims to sustainability have incentives to exaggerate, placing an onus on consumers and regulators to distinguish the genuine from the untrue. Companies with stronger claims have incentives to signal the distinctive features of their products, where these are specific and quantifiable and therefore more directly verifiable by customers and regulators (de Freitas Nett et al, 2020).

Greenwashing, and how it has been used by some to misleadingly market commitments to sustainability, was a topic mentioned during the interviews by some companies. Community Clothing commented that there are businesses in the UK’s industry that are creating reports claiming that they are making a difference, with little evidence to support the content.

Companies and brands engaged in this research agree that certifications and sustainable trademarks can be taken at face value by consumers, who don’t necessarily engage with the meaning and limitations of associated trademarks. Coupled with a lack of understanding, rules around product labelling are not robust. An example, shared by Project Plan B is where companies are claiming a product is made from recycled fibres such as PET, yet they do not specify the proportion or compositional source, which can be misleading. A well-known high street brand label their products as recycled, with only a maximum of 35% recycled content. Only certain names can be used in labelling for textile fibres, according to the Textile Product (Labelling and Fibre Composition) Regulations 2012 (HM Government, 2012). Recycled content and fibres are not currently included in the approved fibre content regulation, and regulation does not require fibres of the same origin, for example PET and Recycled PET to be differentiated.

In 2021, the UK Government strengthened its focus on greenwashing by developing the Green Claims Code (HM Government, 2024; YouGov, 2023), a set of six key points for companies to check their claims are ‘genuinely

green'. Companies agreed that this additional legislation has been effective in discouraging greenwashing claims, but the fear of scrutiny has made some firms more cautious about making disclosures, even when genuine sustainability improvements have been made.

"[We] think it could be holding some businesses back from talking about what they are doing or even making progress because they are scared about putting anything [about sustainability]." **– WRAP**

Think Circular indicated that companies do not necessarily, actively plan to greenwash, however, limited understanding around sustainability coupled with lack of communication between departments can lead to misleading marketing.

"There is a current disconnect, the work needs to be done and shared internally first, before airing it with the consumer" **– Think Circular**

Companies should communicate more effectively and try to engage all stakeholders with the same use of language around sustainability, so messages to the consumer can be portrayed consistently and in the correct format. Furthermore, WRAP believe that a clear statement for brands on the definition of a truly sustainable or circular product, is required.

4.4 Key Findings

Findings

1. Large companies are calculating GHGs (Greenhouse Gases) and other impacts connected with business operations, with the support of external consultants, and creating strategies to reduce their carbon footprint, however many SMEs struggle to resource such external assistance.
2. Life Cycle Assessments (LCAs) focused on specific products made by companies are necessary to evaluate the environmental impacts of a product or process, but data access, quality and consistency of results, remains challenging, as does the cost of analysis for a single LCA. An accessible and consistent way of measuring carbon footprint is required that recognises the size of a company and adjusts the approach to measurement accordingly.
3. Increasing use of renewable energy and biofuels are among the decarbonisation methods being used by UK fashion and textile businesses.
4. Companies are using the UN SDGs (United Nations, 2023a) to guide their sustainable business development.
5. Net Zero and reducing the carbon footprint are key goals of some companies, while others view waste reduction as the priority.
6. Employee inclusivity and a democratic culture are felt to be of vital importance in many companies' sustainability strategy documents.
7. Consumers are not properly informed by marketing claims on current products that relate to the product's sustainability.

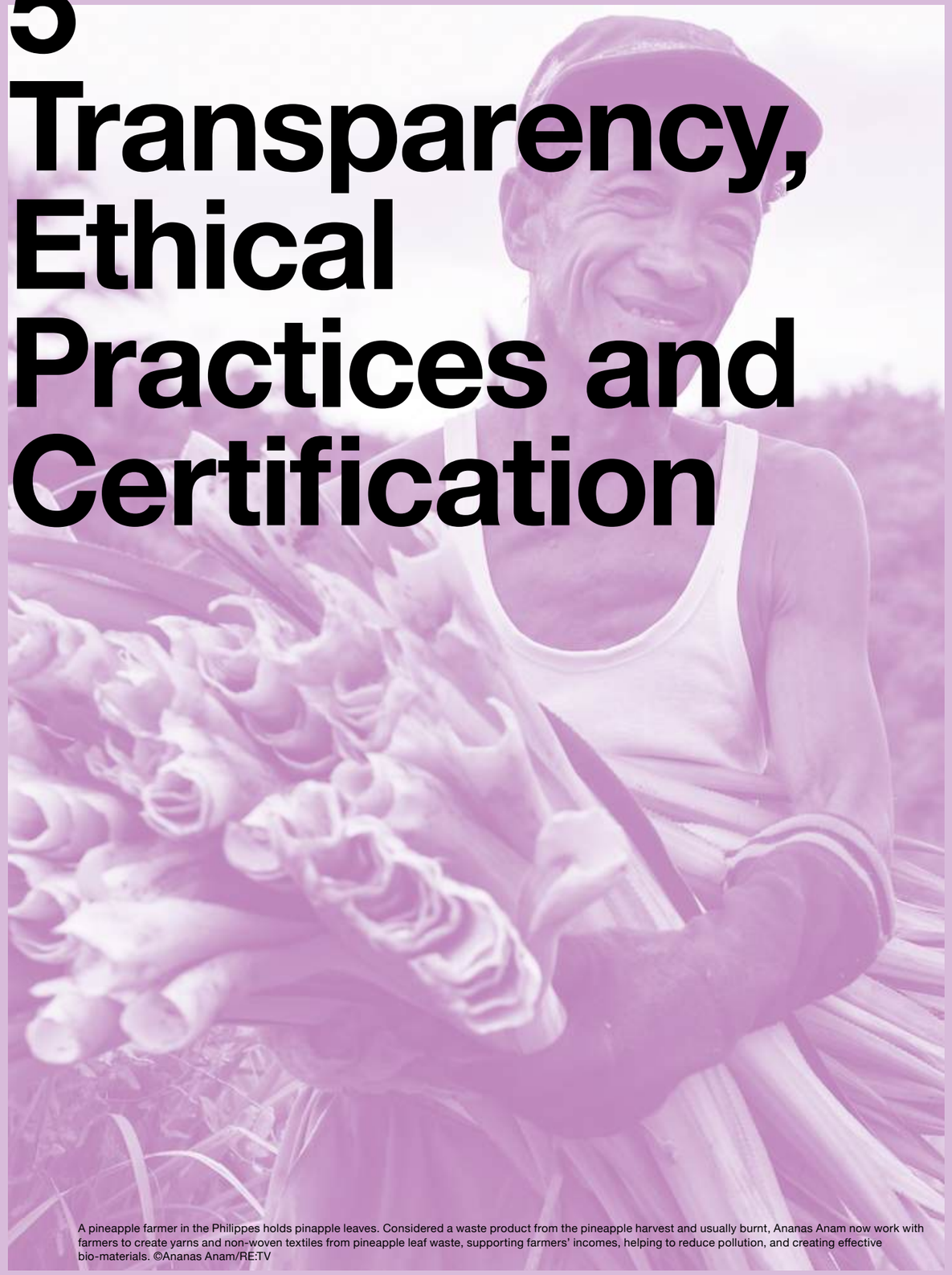
Challenges

1. Small firms are unable to fund carbon footprint/LCA assessments carried out by expert consultants.
2. Conflicting LCA results are complicating informed decision-making.
3. Companies are becoming more hesitant to discuss or disclose sustainability claims due to potential greenwashing penalties.
4. Lack of communication and knowledge relating to sustainability and circularity between stakeholders in businesses can unintentionally result in misleading marketing claims.
5. There is a lack of clarity on defining sustainability and circularity in relation to fashion products.

Opportunities

1. Encourage effective communication between different stakeholders within a business to ensure the correct use of marketing language in relation to green claims.
2. NGOs and Industry to work together to agree on working definitions/ consistent language, which can in turn influence policy.
3. Streamlined LCA methodology to support accessibility for SMEs.
4. Training for staff in companies to support sustainability measures.

5 Transparency, Ethical Practices and Certification



A pineapple farmer in the Philippes holds pinapple leaves. Considered a waste product from the pineapple harvest and usually burnt, Ananas Anam now work with farmers to create yarns and non-woven textiles from pineapple leaf waste, supporting farmers' incomes, helping to reduce pollution, and creating effective bio-materials. ©Ananas Anam/RE:TV

5.1 Supply Chain Transparency

Transparency in the supply chain is built on the practice of sharing information so consumers know where and how goods are produced. Companies that publish information about the flow of materials, parts and finishes products keep their stakeholders informed, and comply with laws that aim to protect workers and the planet (Jackley, 2023). To achieve transparency requires disclosure and verification, which may necessitate further legislation (Jestratijevic et al, 2022).

Transparency in the supply chain, and with customers, was a dominant theme when collecting data for this research. In this research, a luxury handbag brand commented that the industry has a responsibility to address this considering new legislation, e.g. the EU's digital product passport, due to commence in 2025 governing transparency and traceability. Other brands within the sector have already started to be transparent via their own published web resources and reports, with reference to their supply chain practices. For example, Marks and Spencer publish supplier information on their website. Burberry and Grenson have been working with their suppliers for a long time, from 30 years – 120 years. These long-standing relationships have built trust and confidence to trace the products to the source and share this information with consumers.

Part of Community Clothing's ethos is to make all their clothing in the UK, and they widely promote this approach. They are campaigning to bring the only remaining underwear factory in Wales back into full-time production. To compliment this on-shoring approach, Community Clothing share names of the suppliers they use with other companies, to benefit growth in the industry and generate further work for local factories.

John Lewis highlighted the challenge of transparency given the complexity of multiple supply chains and the breadth of products created and sold. In an industry that has healthy competition, gathering information about the source material supplier is a real-world challenge. To address this, and to ensure suppliers are aware of environmental footprints and adherence to best practices, John Lewis use metrics such as the Higg index supported by the Sustainable Apparel Coalition (now known as Cascale) (SAC, 2024), to monitor supplier facilities, processes and effluents. Through this approach, it is possible to break down barriers and build trusting relationships with suppliers that will ultimately help deliver a more transparent business model. A weaving mill in Huddersfield, West Yorkshire has invested in its own spinning plant, which has enabled greater transparency in the yarn supply chain. Although most of the wool used in the factory is from Australia and New Zealand, each batch can be traced back to specific farms.

"Transparency and traceability is a real enabler. Without it, you can't deliver more sustainable raw materials or better, more responsible manufacturing" **– John Lewis**

“Because we’ve owned our own spinning we are a lot closer to where it’s coming from”
– A weaving mill, Huddersfield, West Yorkshire

For other small companies, traceability and transparency can be a major challenge. For example, Wanner Label who run a shop called Trad Collective in Leeds, buys and sells second-hand clothing, state that it is virtually impossible to trace the clothing item back to source. In the future physical track and trace capability, possibly enabled by embedded RFID technology that remains with a garment for its entire life cycle, could improve visibility of a product’s history. Meanwhile, Vivobarefoot, spoke of how they release a yearly CSR report entitled ‘Unfinished Business’ (Vivobarefoot, 2023) that is available on their website. The report details the level of transparency they have at different tier levels based on type of supplier, they have full transparency over Tier 1 and Tier 2, and 30% transparency over Tier 3. For Vivobarefoot this is an on-going process, a fact reflected in the title of their annual update.

5.2 Ethical Practices

The Rana Plaza tragedy in 2013 shone a spotlight on the unethical practices of some parts of the fashion industry (Azizul-Islam, 2023). Forced labour, health and safety violations, poverty wages, child labour, verbal and physical abuse and repression of trade union organising have been commonplace through global supply chains, including in the UK. 80% of garment workers are women who face socio-economic and political challenges that make them more vulnerable than men. The traditional Corporate Social Responsibility (CSR) (Reckmann, 2023) framework is often used as an umbrella for all sustainability issues to manage environmental, social and economic risk. The impact of CSR in encouraging companies to become more sustainable is varied, due to an inconsistent approach, and this has prompted the question by some: “How genuine are the sustainability and CSR practices of fashion companies?” (Thorisdottir, 2020)

For Community Clothing, sustainability goes beyond the impact on the environment, and relates to the relationships they have with their suppliers and workers. Unlike many fast fashion brands with large margins and poorer wages for the workers, they ensure a large portion of ‘pence in the pound’ goes to their makers. Similarly, Grenson take a different approach when faced with a drop in production. Many factories have a rule whereby if there is limited work available, the company does not have to pay staff for up to one and half days per week. Grenson on the other hand stated, *“it is not the workers fault that they’re not busy, if anything, it’s my fault I haven’t sold enough shoes”*. Grenson applied this approach during the COVID 19 pandemic and staff received 100% of their salary.

Transparency, Ethical Practices and Certification

Grenson shoe making process, during the COVID19 Pandemic, Grenson paid their staff 100% of their salaries, despite significant production changes.

Burberry staff in the UK are paid at least a living wage ©Burberry, 2024

"Also being sustainable in terms of the business and how we work with suppliers, and supplier relationships are so important" **– Community Clothing**

A weaving mill in Huddersfield, West Yorkshire commented that employees receive the real living wage (Living Wage Foundation, 2024) and not just minimum wage. Burberry as a business also ensure everyone is paid the living wage or above, rather than minimum wage, not just in the UK, but also their subcontractors working at different facilities overseas. Companies with a human centred approach to managing their staff often also consider how they can be more flexible, provide additional support for childcare and health and wellness. John Lewis is undertaking responsible manufacturing, which looks in detail at human rights within the supply chain and worker conditions, where they are carrying out many projects

as well as auditing their suppliers. The company spoke of the democracy at play within the John Lewis Group, with representatives in different divisions who inform teams every month of any business changes. People can also speak openly in forums where questions will be raised with the Chair of the business.

"I sit down with that representative every month and they talk to me about things that are going on and things that we need to do" **– John Lewis**

Grenson spoke of how the company has been working with factories in India since the 1960s, although recently they switched the factory to a family-owned company and are keen to understand what policies they have in place to look after the workers. Fortunately, they were already adhering to good practices and documenting in detail how they operate due to the education some of the family members had received. However, they do find it more challenging to get this amount of detail from some of their smaller suppliers and are working towards ways in which they can build the relationships and ensure more robust ethical practices are in place.

"Treating people like human beings, not like employees. It's about pay, about treating them fairly with pay. It's about understanding their personal issues with things like childcare and all of that kind of stuff. It's very much an important element of our general policy about being a better company going forwards and having a better impact on the planet." **– Grenson**

During the interviews companies referred to the work they do with communities. Burberry spoke of how they encourage local partners to engage with universities and schools in the UK and around the world. They have run community support programs with cotton farmers in areas such as Peru and Mongolia where they source cashmere, engaging actively with the communities, helping them to prosper and learn about environmental challenges. Likewise, Community Clothing, who are an advocate for all things community related, spoke of the community centres in various cities such as Woodhouse Community Centre in Leeds where they regularly hold swap events for clothing items. Community Clothing believe it is important to know about these events and engage with the people running them, as they have a genuine interest in how people interact with clothing. Vivobarefoot, have an online community platform called 'Vivo Health' where the consumer can learn about natural health with external practitioners, as well as gain knowledge on connecting with nature and nourishment. They hope this will provide the consumer with an understanding to be a better version of themselves and inspire millions of people to reconnect

with nature, bringing vitality to themselves and their communities over the next 10 years. A weaving mill in Huddersfield, West Yorkshire spoke of how they give to local charities and involve people in the local residential areas by inviting them into the mill to explain about any new processes that may add to the level of noise heard by local residents, as they want to ensure the local community is happy.

5.3 Certification

During the interviews, companies commented on certification programmes that are intended to evidence a company's compliance to certain ethical and sustainability standards. There has been a proliferation of schemes and there is no consistency across different companies in terms of the preferred certifications, which in turn can lead to confusion and lack of systemic uptake (Kelly, 2023).

Vivobarefoot use the B Corp framework (B Corp, 2024), which governs factors such as traceability, accountability, social and environmental impacts. They believe that it should be a prerequisite that all businesses are B Corps, as it allows everyone to adhere to a standardised set of criteria which is transparent and measurable. However, due to the cost involved, this is not always feasible for smaller start-up businesses such as, for example, Wanner Label, iinouiio and Worn Again.

"It's unattainable sadly, I looked into some certification programmes, but most you have to pay for, and as a small brand it's not doable". **– Wanner Label**

"A downside from our point of view is it tends to rule out the 'little guys' like us because it costs so much a year to be a member". **– iinuoiio**

Worn Again commented that although they are not B Corp certified, their values align with B Corp principles. Fortunately for iinouiio they have been able to gain certification for some standards such as ISO 9001, ISO 14001 and ISO 45001 due to their relationship with Camira Fabrics, however, there are certain standards such as the Global Recycling Standards (GRS) which iinouiio has not attained due to the expense involved. They commented that this causes issues and loss of potential customers when trying to engage with larger organisations, as some stipulate that they will only work with companies who have the GRS certification. Similarly, when speaking with Project Plan B they discussed how they request to see certificates that prove the origin of the garments or products they are recycling, as this then allows full traceability for the life of the recycled PET fibre when it is upcycled into a new garment or product. Ideally, they would prefer to be recycling products that have been certified through the Circular Textiles Foundation (Circular Textiles Foundation, 2024), where the appropriate systems are addressed as part of the certification.

"We would prefer garments that have been certified through the Circular Textiles Foundation because we build in all of those systems as part of the certification process" **– Project Plan B**

5.4 Key Findings

Findings

1. Transparency is increasingly important, driven partly by impending EU regulation, with some companies already publishing public reports on current status.
2. Some companies are using formal tools and metrics to measure sustainability in their supply chain, including the Higg index (Higg, 2023).
3. Businesses claim sustainability goes further than looking after the environment and that looking after employees is just as important if not more important.
4. Businesses are working with communities to encourage education on the environment and sustainable practices.
5. Larger businesses are committing to certification standards such as B-Corp to evidence sustainability credentials, but smaller firms feel excluded due to the costs of membership.

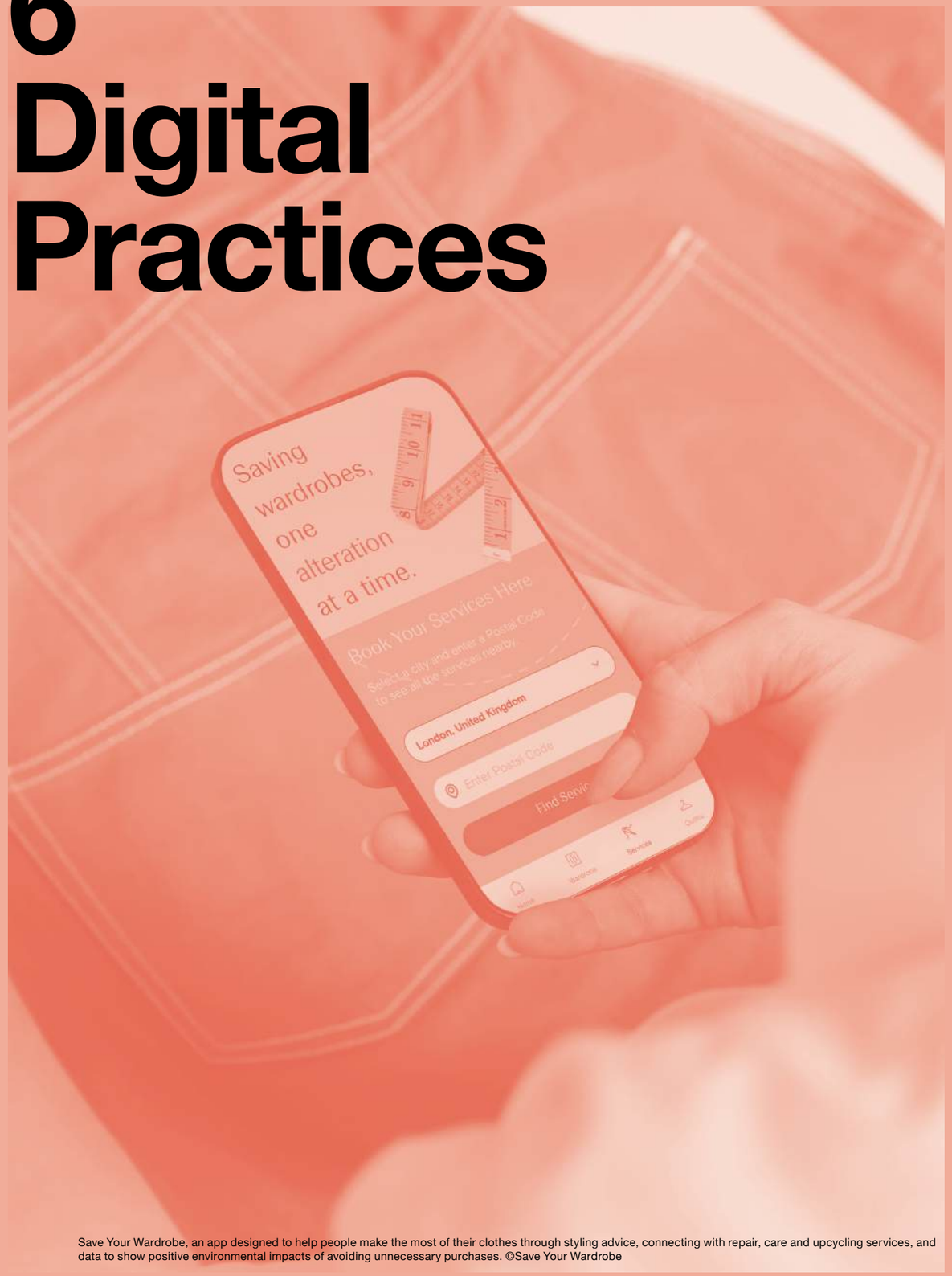
Challenges

1. High levels of complexity within supply chains makes it difficult to be transparent in all areas. There is no such thing as a single supply chain when businesses produce multiple products and data quality is dependent on supply chain relationships.
2. It is particularly difficult to gain full traceability on used clothing prior to resale.
3. Certification is not feasible for small companies due to the costs involved.

Opportunities

1. Emergence of new UK textile manufacturing facilities provides opportunities for greater transparency, as well as more agile, less carbon-intensive supply chains.

6 Digital Practices



Save Your Wardrobe, an app designed to help people make the most of their clothes through styling advice, connecting with repair, care and upcycling services, and data to show positive environmental impacts of avoiding unnecessary purchases. ©Save Your Wardrobe

6.1 Digital Technologies

Many companies believe that digital technology will help to achieve a more sustainable industry by, for example, transforming design decision-making and demand forecasting (harnessing artificial intelligence), improving process and manufacturing efficiency, as well as by enabling increased transparency across the supply chain, including the traceability of products via use of digital product passports (DPPs) (fairlymade.com, 2024a).

Worn Again anticipates its operating plants being part of a recycling ecosystem which digitally connects the raw materials produced in its plants together with end of use textile suppliers, production supply chains and brand/retailers. This will include detail on where the feedstock has come from, how far it has travelled, the impacts at each step and where the reprocessed raw materials travels next. In an aligned development a weaving mill in Huddersfield, West Yorkshire has recently installed new digital machinery in their spinning plant, all of which is run from an iPad that provides valuable, new data to allow optimisation of process efficiencies and energy usage.

"...we get huge amount of data which allows us to monitor speeds, efficiencies and constantly tweak those."
– Weaving Mill, Huddersfield, West Yorkshire

Artificial intelligence (AI) was also a common topic of discussion. Think Circular referred to the work of another firm, Pattern Project Ltd (Pattern Project, 2024), which is helping brands optimise their pattern cutting time and reduce waste using AI. Think Circular commented that this was the first time they had seen an example of AI being used in the fashion industry to reduce waste. John Lewis expect AI to help with management of complex data and allow them to focus on specific areas that can help them make a difference to their business processes, such as internal supply chain transparency and transparency to the customer. They feel that digital design could disrupt decisions on products they buy, as currently they may see a physical sample up to five times before they agree on using it.

Likewise, Burberry believes that digital technology is helping to increase the speed in which decisions can be made and the compilation of data and analysis where multiple stakeholders are working on research projects. Community Clothing pointed to how digital online platforms have allowed the team to work effectively within the business without any disruptions and they see this as a great asset. The business would like to introduce more digital tools to enable higher efficiency and include barcoding on all components to give greater visibility, however as they are a relatively small team they have limited resources and investment to implement this currently.

Fig.3: VivoBiome, scan to print footwear

Likewise, Wanner Label explained that they are only just starting to implement more digital practices in the business, such as greater online presence, since they have recently increased their resources.

“Data on products and supply chains and how you assess that and use that intelligently to make better sourcing decisions about the products that you buy” **– John Lewis**

Vivobarefoot believe that digital technology is important for direct-to-consumer brands, especially as the consumer’s primary touch points are digital forms. The company explained that they have developed a website that will evolve into a service-based platform for the consumer, where the consumer can participate in other activities that benefit their overall health. They envision offering a membership that will reward people not just for buying shoes, but also for participating in activities, returning shoes and taking part in VivoHealth courses. They want to use digital technology to create a seamless high value proposition for society. Vivobarefoot also spoke of another digital technology they are developing called ‘VivoBiome’ (Vivobarefoot, 2024), which seeks to offers customers a more circular on demand system for footwear. This technology will allow the customer to scan their feet on a phone and Vivobarefoot will then make the correct shaped footwear to order using local suppliers, limiting the complexity in offshore supply chains (Fig. 3). It will also give information on how old the shoes are, how many times they have been worn and repaired. Recently

they have implemented a digital system using a company called Revobit that creates an end-to-end digital product in 3D and automatically builds the bill of materials that is sent straight to the factory, this process helps to eliminate human error and optimise efficiency. Likewise, Amphico believes that they have an edge on traditional manufacturing companies since they have insight and exposure to new digital technologies that will help to increase the efficiency in the production process and logistics. Iinouiio also spoke of how they hope to establish a digital supply chain through funding they are applying for and are in discussion with Camira Fabrics, who will help Iinouiio use a digital system to track all their materials.

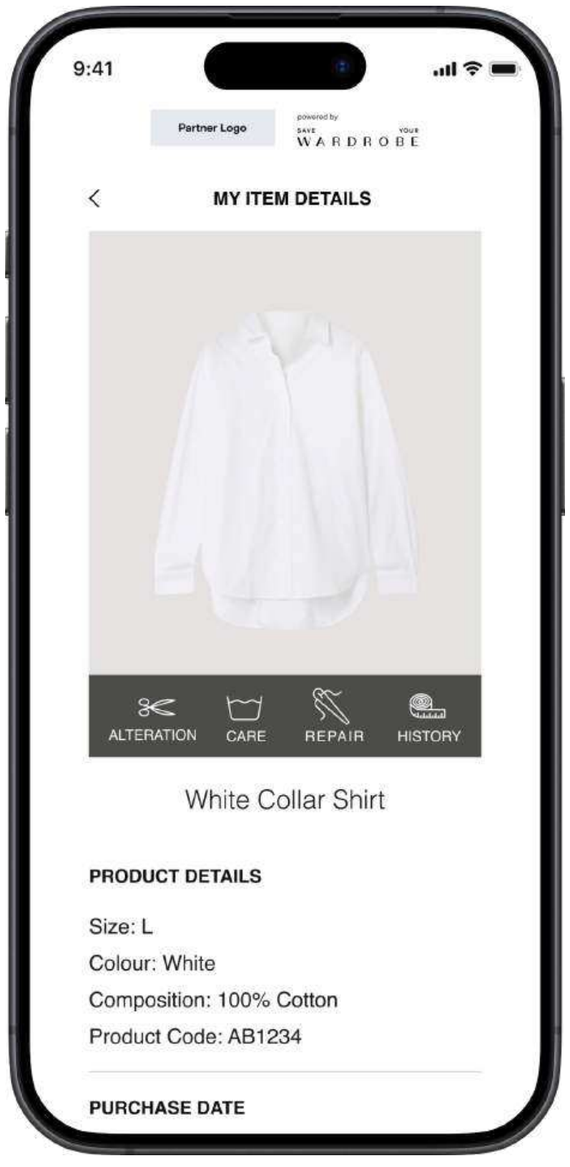
“We have just implemented an end to end kind of digital product creation piece which is using a company called Revobit. […] scan your feet on your phone, you order the shoes on your phone, and we make to order.”
– Vivobarefoot

Save Your Wardrobe won the 2023 LVMH Innovation Award Grand Prize (LVMH, 2023) for developing an app whereby consumers can connect with a brand they have bought an item of clothing from and find a repair shop that can mend that item. The app digitises the whole process from booking to payment to logistics and the consumer can track the progress. The idea is to help extend the life of garments and enable a circular service, while streamlining and managing the process for brands. To begin with the app encourages the consumer to make a digital wardrobe by uploading images of what they own, which reinforces the connection with that item. Fortunately, the Covid-19 pandemic was a time where many people engaged with the concept, and more than 1 million items became digitised with over 200,000 subscribers. Brands began to reach out and ask Save Your Wardrobe to offer this service for them, including Zalando and Hugo Boss. Save Your Wardrobe are also experimenting with virtual reality (VR) experiences for their users where they can potentially view their wardrobes in 3D. They hope this will engage the user further and the consumer will see it as an asset.

“We digitise the whole flow, you know from the booking, the payment, the logistics” – **Save Your Wardrobe**

6.2 Digital Product Passport

By 2030, it will become mandatory for producers in Europe to ensure textile related products possess a digital product passport (DPP). This concept has been designed under the EU Green Deal legislation, specifically the EU Strategy for Sustainable Textiles (European Commission, 2022) and Ecodesign, a part of the European Commission’s Ecodesign



An example of a Digital Product Passport, from Save Your Wardrobe ©Your Wardrobe

for Sustainable Products Regulation (European Commission, 2024). Although the UK falls outside of the European Union, every entity that will manufacture products or place products in the EU market is responsible for the creation and maintenance of the DPP. Therefore, companies within the UK wishing to place their products on the European market need to consider this new regulation and how it can be integrated within their business practices. Finished textile goods are also in scope, and raw materials, chemical substances of high concern and components of a finished product will also need to be identified and disclosed at a level of granularity

which is yet to be confirmed (Thomas et al, 2022). Interestingly, during the interviews, Save Your Wardrobe was one participant to speak of their awareness of this new emerging regulation, although many other companies did speak about the concept of a DPP.

“But in Europe what’s happening right now is going to have force the brands …to enable that digital passport”
– Save Your Wardrobe

John Lewis is one company who are trialling a DPP concept which was suggested to them by the Ellen McArthur Foundation. The customer can scan a QR code on the garment or product that gives them full transparency on how the product is made, including where it was made, the origin of the fibres, how to care for the item and what to do with it as the end of life. Burberry has complete traceability for heritage products and are also investing in a digital solution that could be rolled out to the consumer. This will allow full traceability and transparency of all product components in one online platform. Smaller start-up businesses such as Amphico and Wanner Label are aware of this technology, however they are not yet at a stage where they can introduce it within the business. Amphico explained that they are starting to collect all the data which would allow them to utilise this service, but until they are commercially viable it is not something they would use. Wanner Label commented that they had been approached by a company in the past offering this technology, however, at the time the business was only producing 10 garments a season, and therefore it was not relevant at that point in their journey. The company does believe this could now be introduced, not only for newly manufactured garments, but for second hand clothing, which can be tracked in the future.

iinouiio explained that they took part in a project with the University of Leeds that was looking into the feasibility of QR-coding for the textile and fashion industry. They believe that this is a complicated process, as everybody in connected industry supply chains needs to be willing to participate for it to work properly. However, Think Circular believes the DPP is a good idea, as some consumers are becoming increasingly intrigued about their clothing and the DPP provides a way to share this information. They commented that companies need to think carefully about how much information it is reasonable to provide for the consumer.

“I think the DDP can help, but again, I think we just need to be reasonable about how much information the customer can actually handle” **– Think Circular**

6.3 Key Findings

Findings

1. Digital technologies including data analytics and AI have the potential to create end-to-end transformation in the fashion and textile industry, e.g. from the way in which products are designed, to creating highly efficient manufacturing environments, and to enabling full track and trace capabilities for individual clothing items – supporting new levels of transparency.
2. Data-driven design coupled with higher levels of automation in manufacturing provide opportunities to increase personalised product production while minimising waste.
3. Digital technologies are thoroughly embedded in the fashion retail setting, including use of generative AI, data analytics for consumer preferences, digital fashion and gaming, online wardrobes, body scanning tools and quasi autonomous chatbots.
4. Planned introduction of digital product passports (DPPs) requires consideration of their appropriate formats, and clarity about the data to be provided to consumers. Companies are at different stages of readiness for the impending regulation on DPPs.

Challenges

1. Some digital systems and technologies are expensive, restricting access to small companies.
2. Introduction of DPP legislation in Europe will affect UK businesses trading in the EU, but current levels of preparedness vary across the industry.
3. The feasibility of DPP in terms of data conformance for companies trading in second hand clothing as part of emerging circular economies is uncertain.
4. Clarity is required about the extent of data to be shared with the consumer as part of the DPP.

Opportunities

1. The DPP will help to increase the transparency of products, both internally and to consumers, and could improve the competitiveness of firms that can evidence superior sustainability credentials supported by robust data and evidence.
2. The proliferation of data from supply chains, relating to materials, processes and other functions is likely to drive more informed decision-making, not just by consumers, but by designers and producers in UK companies.

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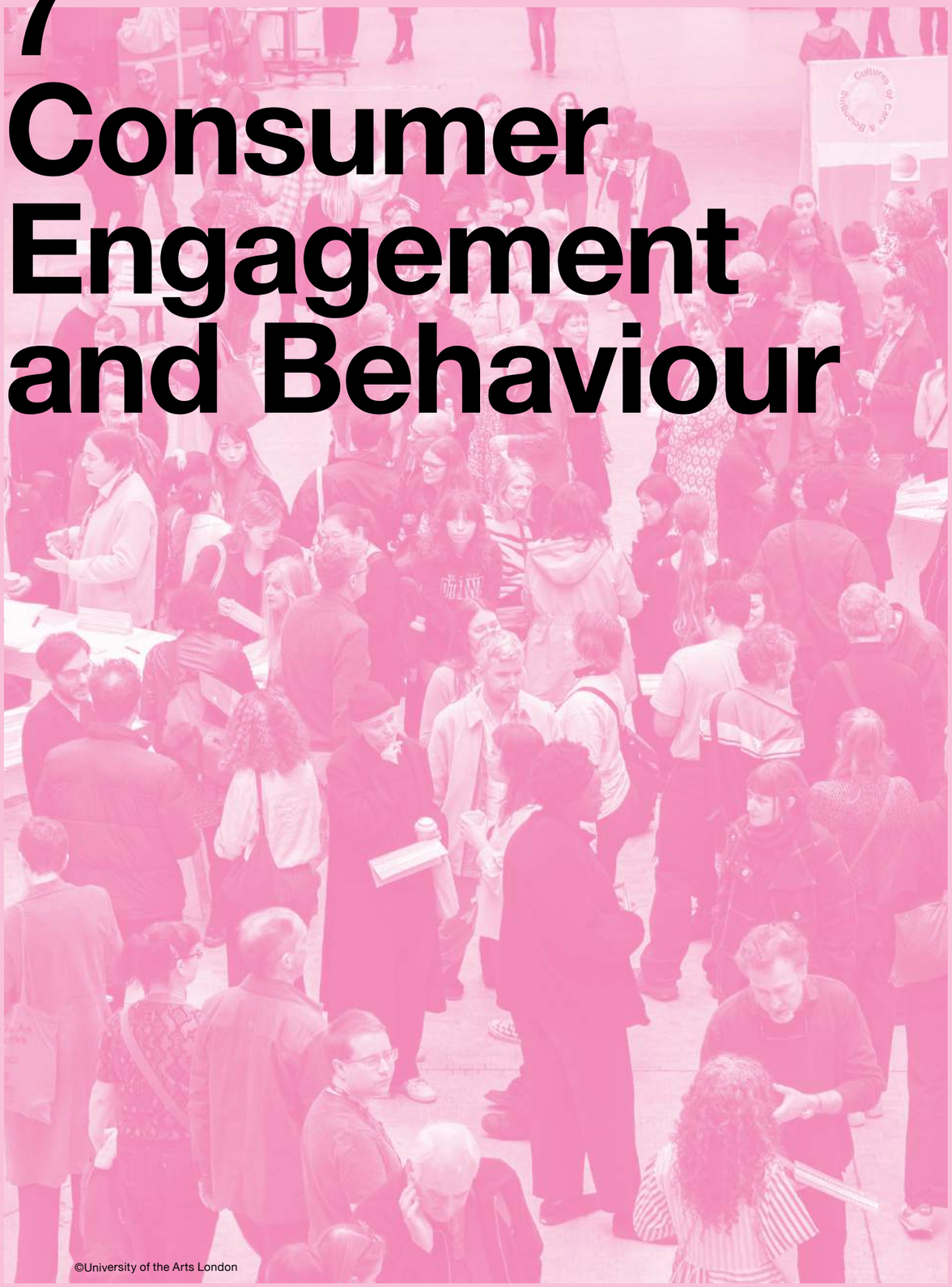
7 Consumer Engagement and Behaviour



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7.1 Consumer Engagement

During interviews, many companies spoke of their consumer engagement activities and the role this plays in shaping the design and manufacture of their products.

Burberry encourage consumers to take part in yearly surveys, to better understand consumer attitudes and decision-making processes associated with buying a garment. Burberry also commission additional, detailed surveys that centre on specific themes, for example, a recent survey asked consumers if they would prefer to buy a garment that was either fully biodegradable or produced for longevity. The result of this survey indicated that 89% of consumers would prioritise a product designed for longevity. John Lewis conducted similar work with McKinsey, where they engaged with consumers to understand preferences (John Lewis Partnership, 2022b). This work took place at the beginning of the war in Ukraine, which may have influenced consumer feedback, however, sustainability ranked towards the middle to bottom of a list of considerations that were important to the consumer. Price and quality ranked towards the top of the list, and John Lewis believes that quality and sustainability are linked. The company commented that while the consumer did not rank sustainability as a top desire, it is because consumers automatically expect this to be delivered, given it is part of what the John Lewis brand represents.

Wanner Label underlined the importance of the consumer's voice, commenting that *"if the consumer doesn't like your product, they will not buy it"*, so customer feedback particularly in-store and in-person is vital to understanding preferences. Wanner Label also noted that consumers do not normally make suggestions, but in relation to sustainability do ask questions about the different brands sold in store, wishing to understand details about the materials or dyes used in specific products. Likewise, Grenson spoke of how consumer engagement is encouraged by frequent updates being provided on the company's social media accounts with information on new materials and how the company is interacting with other companies to develop new products. Sustainability has become a major topic of interest, and because of increasing consumer awareness, there are expectations in relation to product design and materials composition.

"I think that's one of the biggest advantages we would actually have in a store because I get so much interaction with all the customers [to discuss sustainability]." **– Wanner Label**

"Putting stories out there [on social media] about new materials or what we're actually doing with new companies, we can tell them and they can see that a company like us is doing these things" **– Grenson**

©Alys Tomlinson, 2019

Vivobarefoot recently undertook work to explore consumer attitudes in more detail. They discovered that the consumers interested in their brand tend to be questioning the 'normal' and everyday systems, they are conscious thinkers who are intrigued by their own health and often pursue natural health and consume organic foods, are connected to nature and listen to alternative media sources. Vivobarefoot call these consumers 'Conscious Mavericks'. They believe these types of consumers are also interested in brands that are mindful about the choices they make when designing and manufacturing a product in relation to sustainability and associated issues.

Community Clothing regularly receive emails from customers asking questions about the composition of clothing in terms of materials content. Personalised responses are provided to any queries ensuring they have received the exact information required from the suppliers. To help communicate this information, a new website has recently been launched that allows consumers to understand the company and its supply chain operations in more detail. The company commented that educating consumer is immensely important to drive sustainable development in the industry.

In relation to education, Community Clothing is also working with the head of an educational trust that includes thirty-two schools in Lancashire.

Jointly they are developing a new curriculum on sustainability in fashion and textiles. They also noted the lack of understanding among consumers about how to dispose of clothing items. To address this, Community Clothing recently consulted work with Zero Waste Leeds and found that generally, consumers are unaware that disposing of clothing in the domestic household bin can mean it is most likely to be incinerated or landfilled, rather than reused or recycled. Save Your Wardrobe spoke of how educating consumers in a similar way to how the animal welfare issues are communicated to consumers in the food industry, could be an option in the fashion industry. Specifically, this would attempt to address the issues of consumers placing too low a value on items of clothing. Conversely, Wanner Label suggested that care is required when attempting to educate consumers, as aggressive or negative approaches can have unintended consequences in terms of positive decision-making.

"A lot of our customers will get these very personalised responses to their queries around sustainability or traceability" **– Community Clothing**

Worn Again highlighted the vital role consumers play in enabling circularity in respect of clothing, by ensuring unwanted garments are appropriately disposed of, so that later they can be properly sorted into reuse and recycling grades. It was suggested that the definition of the customer in a circular economy will change over time, from someone who consumes to someone who actively engages in a process. Save Your Wardrobe also hopes that consumer behaviour in respect of fashion and textile consumption will change. They explained how the Save Your Wardrobe app is intended to encourage consumers to engage and care for items of clothing in their wardrobe, rather than choosing to buy and sell new items. The company conducted research in collaboration with the University of Glasgow where they followed users on the app over a five-year period. The study revealed a change in consumer behaviour, with more people reselling and keeping items in circulation, although other consumers still purchased new clothing, excessively in some cases. Save Your Wardrobe also highlighted how one disabled customer asked their care assistant to digitise their wardrobe using the app, which allowed them to create an outfit rather than rely on their care assistant to physically assemble every item from the wardrobe each day.

7.2 Key Findings

Findings

1. Companies continue to commission traditional consumer surveys to understand decision-making drivers about sustainability, along with sales data.
2. Consumer engagement using social media channels as well as in-person, is useful to understand attitudes and feedback on sustainability issues.

Challenges

1. Educating consumers to understand what is and isn't sustainable, how to care for clothing, and how to properly dispose of end-of-life products to ensure they enter a reuse or recycling stream.
2. Lack of research and development to encourage citizen engagement and behaviour change in relation to sustainable decision-making and consumption, in relation to circular economies and Net Zero.

Opportunities

1. Creation of new immersive games technology and digital tools capable of increasing consumer awareness of sustainable fashion and textile products, as well as the ability to influence personal decision-making compliant with sustainable development and the minimisation of carbon footprints.

Businesses have pointed to the importance of face to face interaction with customers to discuss sustainability ©UAL Fashion, Textiles and Technology Institute

8 Funding Opportunities

Industry professionals during a workshop hosted through the BFTT ©UAL Fashion, Textiles and Technology Institute.

8.1 Funding Landscape

The Creative Industries as a whole has been the recipient of larger amounts of UKRI funding over the last six-year period, starting with an investment of £120m in the Creative Industries Cluster Programme (CICP) which was initiated in 2018 (UKRI, 2023). Funded through the UK's Industrial Strategy Challenge Fund, and based upon strategic sector thinking (Bazelgette, 2017), this was a programme firmly focused on real world industrial impact and supported nine programmes of tailored interventions across the Creative Industries.

Fashion and textiles, as part of the creative industry structure, secured two Creative Research and Development Programmes (CRDPs), the Future Fashion Factory (FFF) and the Business of Fashion, Textiles and Technology (BFTT). This initial investment stimulated a wide range of academic-industry collaboration across the UK fashion and textile industry as evidenced by the FFF & BFTT 'Commissioned R&D' programmes, badged as Responsive R&D (FFF, 2019) and SME R&D Support Programme (BFTT, 2019) respectively. In total FFF made 55 funding awards across six open calls (FFF, 2022). BFTT made 20 funding awards involving 29 SMEs across 3 open calls (BFTT, 2024), with an additional industry-led programme of interdisciplinary R&D

Guests of the Future Fashion Factory Spring Expo 2024, at NEXUS, University of Leeds ©MOTUS TV.

benefitting a further 12 SMEs (total investment £3.5m). This report, the first in a series of three, has been supported via the Fashion Demonstrator initiative, a follow-on piece of work jointly funded by the Arts and Humanities Research Council and the Department for Culture, Media, and Sport.

Both fashion and textile CRDPs worked with UK sectoral bodies, in varying degrees and contexts, resulting in heightened visibility for the sector and increased understanding of the global nature and complexity of fashion and textile supply chains. Of specific importance, the availability of Commissioned R&D funding enabled significant academic-industry collaboration opportunities resulting in some exciting sectoral developments and stronger linkages between fashion and textile companies, sectoral bodies, academia and government. Consistent feedback has been received, from across the two CRDP industrial networks, that further initiatives of this kind are required in order to keep the UK fashion and textile innovation ecosystem vibrant.

During the course of programme delivery the focus for change has evolved, with shifting environmental and geo-political conditions, and has influenced a range of new funding opportunities, primarily available via the £15m UKRI Circular Fashion & Textiles Programme, which are now in delivery. These are:

- Accelerated KTP: Circular Fashion (IUK, 2024a)
- Automatic-sorting for Circularity in Textiles (ACT UK) (UKFT, 2024)
- The Circular Fashion Innovation Network (CFIN) (CFIN, 2024)
- The Circular Fashion and Textile Network Plus, which comprises three sub-networks
    - IMPACT+ (IMPACT+, 2024)
    - Back to Baselines in Circular Fashion and Textiles (LITAC, 2024)
    - Future Fibres Network Plus (FFN+, 2024)
- Innovate UK Textile Fund (IUK, 2024b)

Together these interventions are funded by a UKRI trilateral intervention by the Arts and Humanities Research Council, the Natural Environment Research Council and Innovate UK working together to maximise impact for the UK Fashion and Textile industry. Some of the initial ideas, which arose from sector body and fashion and textile CRDP outcomes, are being piloted within this programme of work, whilst others have been further developed and highlighted within this report for future attention.

8.2 Funding Opportunities and Challenges

During the interviews with smaller companies, insights were provided about how their business operations had started, and if they received funding to enable start-up. Amphico explained that they are still in their start-up phase and initially received valuable funding towards developing and innovating the product from the Future Fashion Factory (FFF), University of Leeds. They commented that most of the business had been funded by external and private investors and grants, and that soon they will be looking

for further funding and partnerships to support scale up. Amphico felt that it would be useful to have one central database where all funding methods were accessible to businesses in the UK, as this would save on time and resources having to conduct multiple searches. iinouiio, who are a start-up business were fortunate enough to receive capital funding from the Waste and Resources Action Programme (WRAP) to purchase their recycling line and have also received an R&D grant as part of BFTT. iinouiio commented that they had recently applied for funding with UKFT to help develop the technology further but were unsuccessful with that bid. However, Camira Fabrics were successful and won a portion of funding, which may benefit the working processes for iinouiio since their machinery is housed within Camira's facilities.

Worn Again spoke of how attracting investors by demonstrating the growth opportunities in a technology is a real enabler for investment into a business. Fundraising has been at the heart of the business' survival and without it they would not still be operating. They had a strategy to target the brands and companies they believed needed a problem solving and were keen on innovation. Worn Again explained that venture capital was not an option as most investors are not interested if the return on investment is 5 to 10 years away. Fortunately, they were able to raise investment from H&M in 2013, with further investment in 2018 from chemical and engineering partners. However, although H&M were a huge enabler for the business it also discouraged other potential investors, as they believed the business would already have enough financial resource from H&M and therefore it became a challenge to convince further investors to join. The company believes however that in the last decade there has been a shift in the availability of investment and financial options available since the climate change emergency began and that businesses who are in the technology readiness levels (TRLs) of one to three are likely to find it relatively easy to gain funding. Likewise, Save Your Wardrobe commented that people are now starting to invest in companies that prioritise sustainability and circularity, however, the first five years was a challenge as investors struggled to understand the concept of their business and the financial benefits. The company explained that they would often go to investor meetings trying to convince them that Save Your Wardrobe was a serious business. They have had limited success with grants as it is so time consuming to apply and they have limited people in the team with a R&D background, however, since winning the LVMH award they are gaining more momentum with venture capital and Business Angels. Save Your Wardrobe have just secured over £1.6m and are now in a position where they are rejecting investors rather than investors rejecting them.

"Because frankly, what's going to drive or attract them is that they see the financial opportunity from it"
– Worn Again

"People now invest in sustainability and circularity, but that's in 2023. We had to survive five years."
– Save Your Wardrobe

Vivobarefoot explained that the business was privately funded initially by two family members and approximately 10 years ago an additional shareholder, who is a world leading shoe manufacturer in Asia acquired a 10% share. In 2016, Vivobarefoot had to initiate a crowdfund through Crowdcube, which resulted in 6% of the business being owned by 1,000 Crowdcubers. Wanner Label explained that the company has been fortunate with the business receiving private investment from family members and has always been wary of receiving money from external sources. However, they did note their realisation that there is only so much you can do to drive the business forwards with a limited amount of investment.

From the point of view of an NGO, WRAP provided insights relating to funding gaps in the industry more broadly. To enable increased recycling, they identified the sorting and collection part of the value chain as an important area in need of innovation and capacity. Research by WRAP (WRAP, 2022a) had found that around 25% of clothing in British wardrobes have not been worn in the last year. Therefore, a more easily accessible collection system would enable more people to donate their unworn clothing to be reused or recycled. Funding on citizen engagement would need to take place alongside investment in technology to increase collection, sorting and recycling. In addition to the funding gap, WRAP also discussed the skills gap in relation to the technical knowledge required to develop innovations in circular systems as well as the lack of knowledge of citizens more broadly in relation to clothing provenance and care. This provides opportunities for Higher Education, professional development and the education of school-aged children.

"Funding in that space of behaviour change and actually upskilling citizens on textiles and how they can care for their clothes, how they can repair their clothes, how they can just be a bit more of a conscious consumer is a real gap actually and a real gap in funding and a real gap in probably policy as well." **– WRAP**

8.3 Key Findings

Findings

1. A strong R&D and innovation ecosystem of start-ups, SMEs, PLCs and academic research groups operates in the UK, that is internationally, as well as nationally networked.
2. A mix of both private and public finance has been harnessed to build new UK fashion and textile businesses developing sustainable products, enabling investment in the necessary R&D and innovation. This includes academic-industry partnerships that harness specialist academic expertise in HEIs, supported by the fashion and textile CRDPs and responsive mode R&D calls for proposals. Many recent start-ups that have gone on to receive investment focused on sustainable materials development and new recycling technologies.
3. Securing funding to support sustainability/circularity projects and start-ups was challenging, however opportunities have increased in the last 5-10 years, with sources of both UK and international financing being available.

Challenges

1. Venture capital funding continues to be difficult to secure, given the typical 5-year ROI window. Some businesses in receipt of funding from large organisations struggled to receive follow-on investment because of expectations that the business would scale more rapidly.
2. Applying for R&D grant support requires expertise and resources that not all businesses have, and access to academic support and expertise is invaluable.
3. There is a lack of funding targeted in areas such as citizen engagement, in relation to consumer awareness of sustainable development and circular economies, including climate impacts.

Opportunities

1. Continued investment in the UK's collaborative, R&D and innovation fashion and textile ecosystem is likely to fuel continued development and accelerate progress towards achieving net zero targets.
2. Research funding investment is required in:
   - Citizen engagement projects to raise awareness of sustainable decision-making as part of circular economy development.
   - Sustainable materials and process developments that harness UK-generated feedstocks, e.g. non-food lignocellulosic and organic waste streams.
   - Projects to provide improved levels of data relating to sustainability practices, including the UK's baseline position in terms of GHGs and other impacts.

9 Looking Ahead

Grenson shoe, made with Cloudwool®, an innovative nonwoven wool textile made from British wool that is fully traceable. ©Grenson x Doppelhaus

9.1 Industry Perspectives

One question posed during interviews focused on how business sees the UK's fashion and textile industry becoming more sustainable in general and what would accelerate progress. Comments below are reflective of current industry understanding and provide insight into future requirements to stimulate systemic change.

Grenson believes sustainable development is going in the right direction, but there is too little action at all levels, including large companies that are still producing the same products, in increasing quantities, to satisfy shareholder expectations. Burberry is clear that one of the main areas of focus should be on the end of product life and designing products with this in mind right for the outset, thus ensuring that the full product life cycle carbon footprint is considered, along with product longevity. Burberry commented that materials used in products should be able to be recycled many times and that single use materials should be eliminated. Likewise, Community Clothing confirmed that businesses should consider the likely end-of-life destination of all products, and the associated environmental impacts of these different destinations. A related issue is the extent to which businesses can influence the end-of-life destination of their products, after the point of sale. Even if a textile product is designed to be reused or recycled, recycling or reuse depends on the consumer engaging with the appropriate waste collection system when they dispose of the item. Incentivised take-back schemes or other forms of collection are among the possible strategies to address this uncertainty.

Think Circular spoke of the need for local communities and makers to flourish and hopes that future generations will consider the need for their clothing to last and be cared for. They believe that future designers need to embrace creating story-telling narratives to accompany items of clothing, allowing consumers to appreciate value.

John Lewis reflected on the value of increased regulation for retailers and manufacturers to reduce waste and the role of regulation to encourage positive decision-making to drive change. Similar regulatory incentive would be valuable to make product designs more circular, along with innovation to support end-of-life collection, sorting and recycling of products.

Similarly, Amphico indicated that the UK government should encourage investment in improved onshore recycling infrastructure to provide companies with greater opportunities to recycle products correctly, and that companies producing non-recyclable products should be financially disincentivised. Vivobarefoot stressed the importance of positive incentives being provided by regulatory authorities on a long-term basis to allow companies to plan and implement with confidence, without fear of short-term policy-changes. Reflecting the views of Amphico, they also suggested that businesses producing waste should be financially penalised, based on a standardised measuring system that all companies should adhere to. Wanner Label also believes financial incentives and disincentives are

required (e.g. taxes) but disproportionate impacts on small businesses needed to be avoided, along with rigorous enforcement. However, Think Circular suggested that introducing penalties for companies is not helpful, and that rewarding firms for positive action is a better approach. They commented that as an industry the metrics of success need to change from being based solely on volume and profit to other key factors.

Community Clothing commented on the large variations in the specification of similar garments, and their expected performance in use and lifespan. The company stressed that people should not underestimate the impact that a business leader can have on making a change. Vivobarefoot explained that they are on a mission to change the way business is structured internally by working towards an approach based on regenerative leadership. Inspiration is sought from nature to identify systems on how best to operate a business, such that these systems will ultimately ensure products that are produced are for the benefit of people and the planet.

“The government needs to invest in recycling infrastructures”
- Amphico

“It’s people who are going to effect this change, we can talk about strategies from the government, but unless you have the right people in places who are passionate, a policy on paper won’t do anything”.
– Community Clothing

Save Your Wardrobe believe that extended producer responsibility (EPR) measures such as the Digital Product Passport (DPP) and digitally traceable products could transform the fashion industry. They spoke of the potential for such digitalisation initiatives to encourage different consumption behaviour in future generations, how gamification could change attitudes towards the need for buying a physical piece of clothing, and how AI can contribute to the ‘made to order’ principle, reducing the need for designers and brands to produce mass collections. Similarly, Think Circular commented on the hope that future generations will reflect on current business models to find it unfathomable how the industry made products that are under-valued and considered ‘throw away’. They believe the UK’s future fashion and textile industry needs to be built around collaboration, particularly between the larger and smaller brands innovating together, as often small firms struggle with minimum order quantities, as well as resources. By sharing the costs of innovation or manufacturing, they believe an ecosystem of circularity can be created where companies interested in similar technologies can join forces.

Worn Again also commented that collaboration is key for a transition to a sustainable industry and spoke of how communication and planning between

many different stakeholders within the industry is challenging and needs to improve. In relation to this, they believe industry working groups at all levels, regionally and globally are able to help implement the shift towards viable circular economies.

“I’m a big believer [in] collaboration and the role that industry working groups can play in convening relevant industry players, fostering partnerships and attracting the investment community to innovation and solutions ready for industrialisation.” **– Worn Again**

9.2 Key Findings

Findings

1. Sustainable development in the UK's fashion and textile industry is advancing, but overall progress is too slow. Regulatory change is required to accelerate progress that is compliant with mandated environmental targets, e.g. Net Zero.
2. Future products need to be designed with the full product life cycle in mind at the initial design stages, together with understanding of current and emerging waste collection, reuse and recycling infrastructure.
3. New incentives or disincentives are required to accelerate waste reduction and align business operations to substantially reduce environmental impacts.

Challenges

1. Engaging consumers in the process of making informed purchasing decisions and prolonging the operational service life of garments.
2. Developing UK regulation to accelerate design and production of sustainable products and business practices.
3. Developing the UK's onshore collection, sorting and waste recycling infrastructure to manage larger quantities of nationally generated waste from different sources.

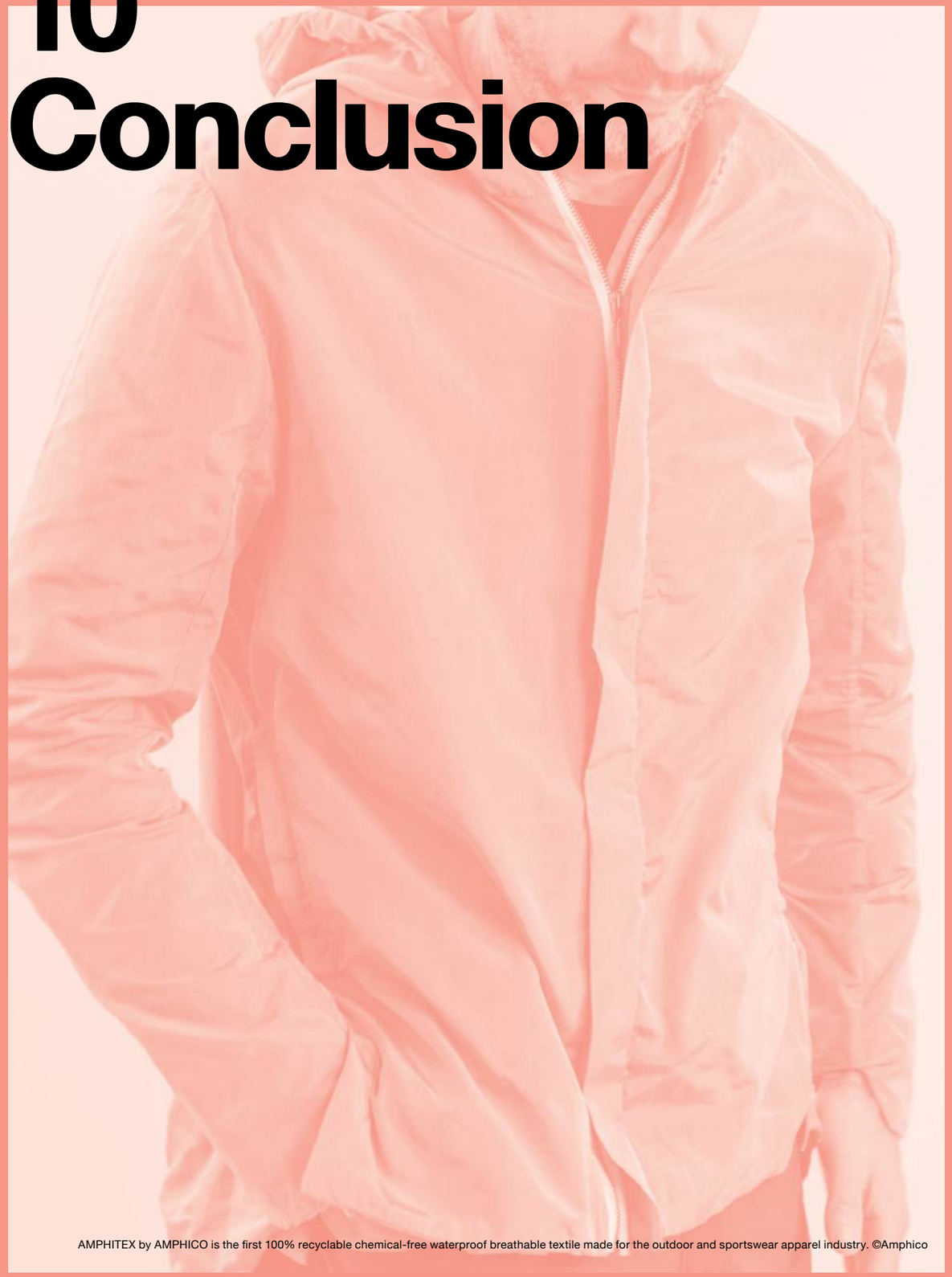
Opportunities

1. Investment in the UK's collaborative fashion and textile R&D and innovation network to support business development and sustainable growth.
2. Create products and digital tools that engage consumers, helping them to understand the inherent value of textile products, improving the connection between items and individuals.
3. Encourage collaborative approaches within the industry that are accessible to SMEs as well as large businesses, aimed at implementing clearly defined sustainability practices.
4. Digital transformation, that enables for example, data-based design and manufacturing of textile products, automation and digitalisation of textile manufacturing operations, full life cycle digital track and trace, and embedded digital passport capabilities – all designed to minimise environmental impacts
5. Regulatory change that rewards companies for positive behaviour and decision-making and removes financial differentials/penalties for shifting to the selection of sustainable or renewable materials, or investment in sustainable processes or products.

The team at Amphico ©Amphico

The team at Amphico ©Amphico

10 Conclusion



AMPHITEX by AMPHICO is the first 100% recyclable chemical-free waterproof breathable textile made for the outdoor and sportswear apparel industry. ©Amphico

There is a clear imperative for the fashion and textile industry to reduce environmental impacts, including along international supply chain operations. Strategic approaches and points of focus in relation to sustainability differ markedly between companies, reflecting differences in the size and operational focus within their own supply chain.

Companies are investing in a range of sustainability strategies, including but not limited to: **(1) adoption of eco-certification; (2) measurement of carbon footprints; (3) switching to preferred/alternative fibre materials; (4) reducing waste; (5) harnessing digital technologies across the value chain;** and **(6) reverse logistics**, new collection infrastructure or post-purchase repair services, normally with the aim increasing product longevity. Fair and equitable treatment of people in supply chains is also viewed together with environmentally conscious practices.

However, this progress is associated with additional costs, making it more difficult to compete with others in the international marketplace, at least in the short term until regulatory change is fully operational in some regions, e.g. the EU. Interviewees highlighted the need for a new policy to reward sustainable practices, and to create a 'level playing field'. The new policy would also forge the business case for firms to invest in gathering detailed supply chain data to obtain product-level carbon footprints, as well as launch new circular business models. Policies currently being implemented in the EU, such as Extended Producer Responsibility (EPR) and Digital Product Passports (DDP), were viewed as positive and something that most interviewed businesses would also welcome in the UK. It was noted that such EU policies will affect UK business exporting to other countries in Europe while also providing consumer-facing opportunities to increase brand transparency. Interviewees stressed the importance of policy being developed in collaboration with industry, and avoiding a one-size-fits-all approach that does not consider the size of a business.

Interviewees recognised that progress also needs to accelerate to ensure compliance with mandated environmental climate targets, but this remains challenging without regulatory adjustment to the current playing field to provide financial incentives and strengthen the business case for change. Consequently, full product circularity is still difficult to realise for many businesses. This challenge is further compounded by the lack of scalable infrastructure and technology for collecting, sorting and recycling UK generated textile waste. The textile recycling businesses interviewed are planning to continue scaling up, in line with increasing demand. Furthermore, clearer definitions of 'sustainability' and 'circularity' terminology are needed to help address issues around greenwashing. While certification is helping to provide improved certainty on specific sustainability claims, it can involve fees and significant resourcing such that participation is prohibitively costly, particularly for start-ups and SMEs, affecting their competitiveness.

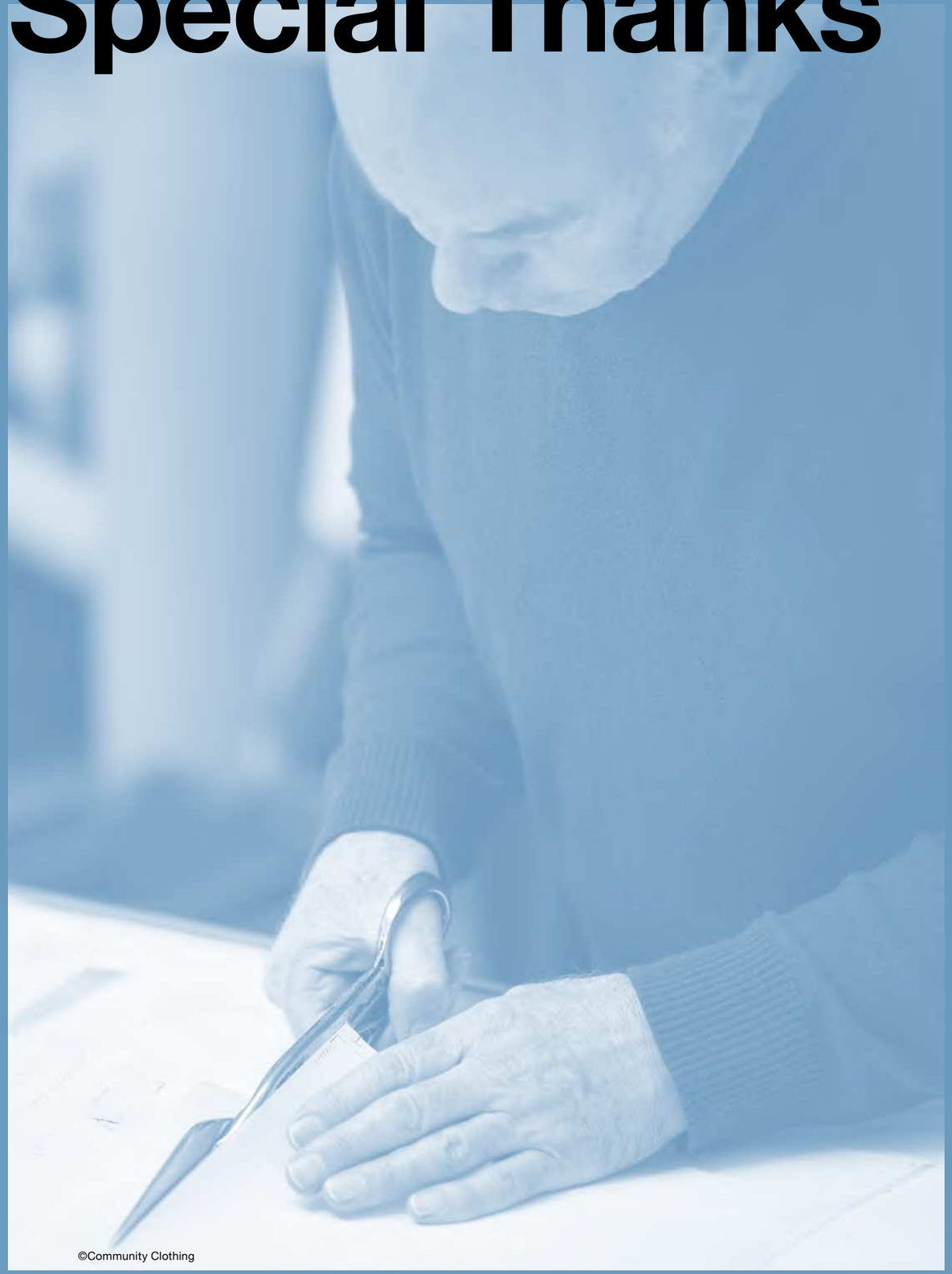
Additionally, the need for increased consumer awareness and engagement was highlighted to further support the mandate for sustainable practices

AMPHITEX by AMPHICO is the first 100% recyclable chemical-free waterproof breathable textile made for the outdoor and sportswear apparel industry. ©Amphico

to become more widespread. This may be stimulated and supported by enabling consumers to more readily access details of the provenance and environmental impacts of their clothing, as well as appropriate product use-phase care and end-of-life disposal (in line with the intent of digital product passports). The need to upskill people in clothing care and repair was also a focus. Meanwhile companies have developed their own approaches to consumer engagement, mostly digital, to promote and educate consumers about sustainability and routes to increasing overall product longevity.

Overall, there was general agreement that progress on sustainability in the fashion and textile industry is moving in the right direction, but quantitative progress is too slow and needs to accelerate. Reductions in the environmental impact at a product-level are being overshadowed by increases in unit consumption overall. This may partly be the result of a rebound effect, i.e. consumption increasing as products are made more efficiently and therefore more cheaply. Furthermore, the classical growth targets of businesses based on volume sales within a linear economy continue to be misaligned and contradictory to climate targets, and this remains a fundamental challenge. Interviewees also spoke of the need for a collaborative approach, with SMEs and larger firms tackling sustainability issues together and sharing the costs of innovation. This is particularly pertinent in developing new circular economies, where brands need to establish supply chain collaborations with business partners further downstream (not just upstream) to manage the flow of their used products beyond the point of sale.

Special Thanks



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Amphico Ltd	https://www.amphico.uk/
Burberry PLC	https://www.burberryplc.com/
Camira Fabrics Ltd	https://www.camirafabrics.com/
Community Clothing Ltd	https://communityclothing.co.uk/
Fazane Fox Ltd	https://www.fazanefox.co.uk/
Grenson Ltd	https://www.grenson.com/
iinouiio Ltd (part of the Camira Group)	https://www.iinouiio.com/
John Lewis PLC	https://www.johnlewis.com/
Lochcarron of Scotland Ltd	https://www.lochcarron.co.uk/
Marks and Spencer PLC	https://www.marksandspencer.com/
Melin Tregwynt Ltd	https://melintregwynt.co.uk/
Project Plan B Ltd	https://projectplanb.co.uk/
Save Your Wardrobe	https://www.saveyourwardrobe.com/
Think Circular	https://www.thinkcircular.co.uk/home/
Vivobarefoot Ltd	https://www.vivobarefoot.com/
Wanner Label Ltd	https://tradcollective.com/
Worn Again Technologies Ltd	https://wornagain.co.uk/
WRAP, Textiles 2030	https://www.wrap.ngo/taking-action/textiles/initiatives/textiles-2030

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Front and back cover images: Polyester recycling process at Project Re:claim, part of Project Plan B. Images: Alys Tomlinson.

The Business of Fashion, Textiles & Technology Partnership

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Future Fashion Factory

schoolofdesign

LTRC Leeds Institute of Textiles and Colour

Creative Industries Clusters Programme

UKRI Arts and Humanities Research Council