# State of Play in Australian Sustainable Fashion Research: Current and Future Directions

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## Introduction

Clothes enable people to express their identity, interests, and values. They play an active role in how we relate to the world by instilling confidence, dignity and independence (Crane 2000). Although the personal and social benefits of clothing are often positive, the fashion industry is defined by overproduction and consumption and has resulted in increasing levels of textile waste that is environmentally damaging (Ellen MacArthur Foundation 2017). Concern over the sustainability of the fashion industry has grown in recent years, with the recognition that the fashion industry is one of the most wasteful consumer industries in the world. The fashion industry accounts for 20 per cent of global wastewater and 8-10 per cent of global carbon emissions, with a truckload of textile waste produced every second (Niinimäki et al. 2020; UN Environment Program 2018). With 70 million workers globally involved in garment production, the human impact is also significant, with dangerous conditions recently coming to the fore of public consciousness with the tragedy at Rana Plaza in Bangladesh in 2013 and other industrial workplace incidents and revelations, such as the use of forced labour in the UK garment sector revealed in 2020. Exploitation of workers, child labour and extremely low pay rates have also highlighted social unsustainability that has come to define much of the industry (ILO 2019). To address these complex social and environmental issues, a wide range of research is needed to understand systemic issues and to consider the whole supply chain.

The UN Sustainable Development Goals (SDGs) provide a framework for action towards a more sustainable future. In particular, SDG 12 focuses on sustainable consumption and production whereby a number of its specific targets include a range of issues pertinent to fashion. These include targeting: efficient use of natural resources; environmentally sound management of chemicals and wastes; reducing waste generation through prevention, reduction, recycling and reuse; encouraging companies to adopt sustainable practices; raising consumer awareness; supporting developing countries capacity; and minimising adverse impacts on the poor (United Nations 2021). The adverse impact of climate change is particularly felt in poor countries because it threatens social, economic and cultural self-determination, and is a source of inequalities between rich and poor countries as the amount of greenhouse gasses emitted is unequal (Levy and Patz 2015). In addition to displacement of people caused

by extreme weather conditions (UNHCR), the direct effects of textile waste export to landfills in places like Ghana is the primary cause for environmental and social imbalances, such as landfill burning, sea pollution and gender imbalance within the local secondhand trade (Manieson and Ferrero-Regis 2021). While researchers have been investigating the industry's impacts and working on solutions, there is still significant progress to be made with regards to research and practice to drive a sustainability transition in the sector. Thus, the sustainability crisis facing the fashion industry is complex and multi-faceted and therefore requires attention from researchers in a diverse range of disciplines, from fashion design to geography to engineering, and throughout the whole supply chain.

**Australian focus of this paper**
This paper explores fashion sustainability research undertaken in Australia over the past decade (2010-2020) as well as research that is underway from a diverse, interdisciplinary group of researchers reflecting different parts of the fashion supply chain. The authors of this paper represent multi- and interdisciplinary perspectives on fashion supply chains, cutting across design, governance, industry and scientific perspectives. Through this paper we seek to identify the key strengths and gaps in fashion sustainability research in Australia. Specifically, we identify how current research aligns with the SDGs and where there is focus or gaps in research across the supply chain. In considering the current context and Australia's position in global fashion, we seek to develop a research agenda that will support collaboration and help to drive change towards sustainability during the present decade to 2030.

Australia provides a novel case to study the development of sustainable fashion, as a primary producer of fibres (Payne and Ferrero-Regis 2019; Mellick et al. 2021), and a major consuming country which utilises offshore production (Lindgren et al. 2010; Stringer et al. 2021). As a close neighbour of Asian production houses with a small but distinctive domestic fashion industry (Brydges et al. 2021; Tuite 2019; Piller 2022), Australia occupies a unique, albeit paradoxical, position, as the largest producer in the world of Merino wool, and the third producer of quality cotton (Boersma et al. 2022; Payne and Ferrero-Regis 2019), while fashion and textile manufacturing has declined significantly (Brydges et al. 2021). Despite having a robust garment manufacturing sector through the mid 1950s (Potter and Reiger 2017), Australia was one of the first countries in the world to delocalise manufacturing in the 1980s as the fashion industry was deemed as a low value industry (Craik 2015; van Acker and Craik 1997).

Since the postwar period, fashion in Australia has moved through three distinct phases, from importing international style, to creating an Australian fashion identity with local designers in the 1970s and 1980s, to integration with global fashion systems from the

1990s (Brydges et al. 2021). While this integration occurred, domestic garment manufacturing declined significantly (Craik 2015). Despite the smaller presence of domestic manufacturing in the country, Australia currently has a strong independent fashion scene, with a number of domestic and internationally successful fashion brands, and many of whom compete on design and quality rather than cost (Brydges et al. 2021). Some of these brands design and produce their clothing in Australia, while others design locally and work with overseas manufacturers. Alongside independent and designer fashion brands, there are also a number of Australian fast fashion brands tapping into consumer desire for newness and trends rather than environmental or social sustainability concerns (Lee et al. 2013; Payne 2016; Stringer et al. 2021).

Australia is also home to one of the oldest living cultures[i] in the world (Rasmussen et al. 2011), and Indigenous Australian knowledge has become an important part of managing landscapes (Von Bibra 2018), with Indigenous knowledge and culture providing important directions for increasing the sustainability of Australian fashion. Indigenous Australians play a role in the fashion supply chain, from working with wool growers in Tasmania around the protection and burning of grassland to the design of textiles (Hamby and Kirk 2014), to textile and print design, fashion design and marketing. Australia is also not immune to the growing waste issue in the industry. According to national statistics, 786,177 tonnes of textiles, leather and rubber (excluding tyres) were sent to landfill across Australia during 2016-17 (DEE & Blue Environment 2018).

As one response, there has been growing momentum and attention to sustainable fashion from the perspective of government policy as well as from research and industry. Clothing textiles were listed on the Federal Waste Minister's priority list in 2021-2022, along with single use plastics, and the federal government is particularly investing in product stewardship for textiles (DCCEEW 2021). In late November 2021, the Commonwealth government announced a $1 million AUD grant for the Australian Fashion Council (in consortium consisting of Charitable Recycling Australia, Queensland University of Technology, Sustainable Resource Use and Waste and Resources Action Program (WRAP)) to create the National Clothing Product Stewardship Clothing Scheme (AFC 2022). The Scheme is currently being co-designed with industry stakeholders.

In parallel there have been a number of centres, programs and new fora established. For example, the Sustainable Fashion Centre of Excellence in Sydney (UTS n.d.), The Circular Stories Working Group led by Monash University in Melbourne (Circular Stories Working Group n.d.), and the Australian Fashion Council's programs including the new Australian Fashion Trademark and FashionTech Lab. In addition, there are a host of

new events and conferences focused on responsible sourcing and opportunities for sustainable fibres. These include: Raw Assembly - Responsible Textile Sourcing Event (May 2022), CSIRO - Threads & Opportunities: Science Engineering Sustainable Fibres for closing the loop in Australia (May 2022), and Sustainable Research & Innovation Congress Oceania (June 2022), as well as a growing number of circular economy conferences for business and industry.

**Conceptual approach**

To capture the focus and direction of fashion sustainability research in Australia in the most recent decade, we examine sustainable fashion research across three key stages in its lifecycle: design and production, consumption, and end-of-life. In particular, the garment lifecycle structure provides a helpful framework to draw in different disciplinary perspectives and to highlight social and environmental impacts at particular parts of the lifecycle. This approach also aligns with circular economy perspectives which promote a shift in practices across the entire supply chain.

However, this comes with the realization that the fashion sector cannot be isolated from wider sustainability challenges of our current economic system, resource consumption and international trading patterns. The diagram in Figure 1 illustrates the broad range of social and environmental issues affecting each part of the supply chain. Then in Figure 2, we have highlighted the three stages of the garment lifecycle which reflect the structure of this paper.

 [Figure 1 about here]

Within the lifecycle, we examine the literature with reference to the SDGs to identify how Australian fashion research addresses sustainability. The seventeen SDGs are shown in the graphic in Figure 2 below. While most are clearly understood from their short titles, some are less descriptive - note that SDG 14 is to 'Conserve and sustainably use the oceans, seas and marine resources' and SDG 15 is to 'Protect, restore and promote sustainable use of terrestrial ecosystems'. In Figure 3 we have integrated Figure 1 and 2, listing the relevant social and environmental issues at each stage of the lifecycle and the relevant SDG(s). Figure 3 is the analytical framework we use to examine Australian sustainable fashion literature.

[Figure 2 about here]

[Figure 3 about here]

**Methodology**

This paper draws on the multi- and interdisciplinary perspectives of each of the authors to assess the current state of research in Australia on sustainable production and consumption of fashion in Australia. To develop this analysis and research agenda, we have assembled a diverse group of researchers who work in many aspects of sustainable fashion and related fields. These include fashion supply chains, sustainable design, ethical and cleaner production, labour standards, transparency and governance arrangement, policy mechanisms and infrastructure for sustainable and circular textiles and garments, as well as circular textile exchange within local regions.

The group of researchers were originally brought together by organizers of a conference (the Sustainability Research and Innovation Congress in Brisbane June 2020 and 2021, and through meetings to organize our session on fashion sustainability we aligned ourselves with the structure of the supply chain and the SDGs. We then used this structure to develop the paper and invite other researchers who presented at another conference in 2020 (Critical Fashion Studies Congress in Melbourne February 2020) to contribute to the paper. Our approach to this paper was then to undertake literature reviews of published research and develop ten 'research narratives' to showcase current research. We formed three groups of researchers, with each group focusing on a different part of the lifecycle from "design and production", "consumption and use", and "end-of-life". The formation of these groups reflected the nature of our research. Each group's aim from the literature review was to summarize the main themes and direction of sustainable fashion research in Australia. Researchers checked databases for keywords starting with Australia, fashion, sustainability between 2010-2020, and for each section narrowed the search to fashion design and production or consumption or textile waste. The intention was to gather the breadth of research at each stage in the lifecycle.

Our literature search in databases was limited to research from Australian institutions, and included research undertaken overseas as well as domestically. We reinforced this approach with an institution-by-institution search for fashion scholars and their research. The team used a list of forty Australian universities and searched for 'fashion' on their websites, then on their research pages, with a follow up search on google for 'fashion' + 'university's name'. The resulting publications were then allocated to one of the three phases of the lifecycle and included in the relevant literature review. The resulting literature was summarized in the three parts of the supply chain and analyzed with reference to the SDGs, in terms of the social and environmental issues that they address (refer to Figure 3 for the relevant SDGs). The resulting analysis highlights strengths and gaps in Australian fashion research and develops initial thoughts on a research agenda.

## Reviewing Australian Sustainable Fashion Research - 2010-2020

**PART I: Fashion design and production research in Australia and contributions to SDGs**

The clothing retail industry, manufacturing and wholesaling of apparel and accessories domestically and internationally is worth 15.7 billion dollars to the Australian economy (Feller 2020). Typically, textile waste is understood as a post-consumer issue, however it is also a consequence of overproduction in manufacturing. Designers are responsible for planning and developing personal apparel, with consideration to historic and contemporary fashion trends and techniques for mass, batch, or one-off production, manufactured offshore or domestically (ABS 2019). As demand moves design and manufacturing trends towards sustainable and ethical practice, research plays a key role in guiding the Australian design landscape. This section includes a survey of sustainable fashion design and production literature in Australia since 2010.

In order to make significant changes to the long-term sustainability of the fashion industry, it needs to begin with thoughtful and considered design built upon socially aware and ethically driven processes (Fletcher 2012; Lin 2018). The fashion system begins with an idea, a concept or a solution to a problem. The design process takes an idea into the reality of a product and as such is the first place where sustainable and ethical practices begin. Designing with a sustainability framework sets up the system to produce favourable long-term benefits for the fashion industry. What is needed is both a transformed approach to design through improved fashion systems (Fletcher 2010; Fletcher and Tham 2019; Fletcher and Tham 2020) and a transformational approach to design for greater sustainable outcomes (Williams 2019).

The landscape of fashion design research in Australia is varied. Human ethics, labour practices, environmental adherence, and sustainable supply chain management are at the forefront of concern for designers who mass (or batch) produce offshore (Marshall 2018; Shumon et al. 2019; Yadlapalli et al. 2019). Equally, craft and creative culture have long been part of the discussion with independent design, new-localism and inclusivity also potential areas of growth in a post-COVID-19 landscape (Brydges et al. 2021; Tuite and Horton 2019; McQuilten and Spiers 2020). Innovative textiles technology research, while extensive, is predominately focused on medical or performance outcomes (Houshyar et al. 2019; Islam et al. 2012). There is significant textiles research that focuses on natural fibres and dying processes (Ratnapandian et al. 2013; Houshyar et al. 2019), but less about wool production and its social and cultural links with national identity (Ferrero-Regis 2020). For example, since 2002, the Australian Wool Innovation, representing Australian wool farmers, has been developing research along the world's wool supply chain, investing in R&D and marketing, through

its globally recognized brand Woolmark. Emerging areas of research for adoption and innovation include: fashioning-futures via waste-reducing digital design and manufacturing; textiles for wearable technology (Cai et al. 2020); textiles traceability through blockchain (Heim 2021), and engaging consumers through VR and social platforms. Also emerging in the Australian literature is the need to more meaningfully integrate Indigenous perspectives, increase Indigenous participation in fashion design and decolonize design methodologies (Bedford 2020).

This review of the design and production literature addresses a cross-section of the SDGs. Research regarding human ethics and labour concerns relate to SDG 8 in terms of enabling decent work and improving agriculture and animal welfare relates mostly to SDG 15 of protecting terrestrial ecosystems. However, the majority of research in this part of the lifecycle relates to SDG 12, which is responsible consumption and production. This includes research into sustainable supply chain management, natural fibre production and dying processes, sustainable design principles, digital design for waste reduction, and textiles traceability through blockchain. Some of these topics also relate to SDG 9 in fostering innovation and sustainable industrialisation, along with the development of innovative textiles and wearable technology. Finally, efforts to integrate Indigenous perspectives and decolonize design are relevant to SDG 10 in reducing inequalities within and among countries.

In the following sections, we present current research narratives from Australia relevant to the design and production phase. Considered design and product development can contribute to a better approach to transparent and effective sustainability in the future. In this section, we look at how innovations in design education might lead to improvements in long term sustainability; at how local fashion designers who are adapting circular economy models through small-scale networks; and how the complexity of environmental regulatory systems influences the textile and garment sector in four key production centres in Asia. We also highlight the importance of incorporating cultural sustainability in design.

**Research narrative 1: Design education and activism**

Deborah Fisher has been investigating considered design as an avenue for linking design thinking with activism in fashion education, linking to SDG 4 with respect to education and SDG 12 of responsible production and consumption. With undergraduate students, Fisher explores how the use of design thinking and activism, when applied to wicked sustainability issues, might help resolve them in the future. Design thinking implies a human-centred approach whereby the solution to a problem is driven by the needs and wants of the end user. The process leads the student through a series of

activities that encourage them to consider their responsibility to social, economic and environmental sustainability throughout every step of the supply chain, manufacturing and distribution cycle. The student is challenged to account for the transparency of their decisions through reflective practice. Framing design activities as activism provides opportunities for fashion to make significant changes in the future of fashion around ethical issues such as positive body image, ageism, and racism, which links to SDG 10 in relation to reducing inequality. It could also include environmental and social sustainability issues. Fisher argues that it is important to innovate fashion design education practices so graduates apply new approaches that lead to positive and impactful changes within the fashion industry. By harnessing design thinking together with design activism, the next wave of fashion designers may emerge with a more considered approach to consumption and an embedded culture of sustainability and ethical practice.

**Research narrative 2: Mapping local textile ecosystems for circular economies**

Moving now to the role of design within the circular economy, and in relation to SDGs 11, Sustainable cities and communities, Tiziana Ferrero-Regis has been investigating the fashion and textile ecosystem in the Greater Brisbane Region through mapping independent fashion designers, artisans, SMEs and medium industry within a circular economy framework. Several studies have now pointed at the concept of the circular economy as having been largely appropriated by big industry, technology, and financial business, eventually leading to a capitalist ideal of zero waste (Blühdorn 2011; Valenzuela and Böhm 2017; Hawkins et al. 2019). The techno-industrial approach to the circular economy is increasingly involving start-ups and large waste recyclers, leading up to the formation of consortia and conglomerates in the circular economy, supported by state government policies, with R&D in expensive patented technology. This approach to circular economy focuses on resources and their transformation, whereas Ferrero-Regis focusses on alternative practices that emphasize a social and collective ecology of textile within a horizontal and democratic access to pre-consumer textiles, clothing and fashion such as end of bolts, dead and excess stock, cut-offs and left-overs generated through the design and designers at a micro level, where people, practices and human values instead of materials are at the centre of networks and communities of cloth exchange.

Ferrero-Regis' investigation of local, urban, and independent fashion takes at its core people's relationships and entanglements with materials, as modelled in Norris (2017). This study continues an investigation of Brisbane's historical fashion districts where makers, retail and community formed fashion neighbourhoods (Ferrero-Regis 2014), and existing small independent designers in Brisbane (Heim et al. 2020) to that of local sustainable fashion districts as a way of illustrating collaborations between place,

community, consumers, artisans and industry. One outcome has been the co-design of the prototype for a digital tool that gives designers, artisans, not-for-profit organizations and companies access to virgin materials.

**Research narrative 3: Environmental regulation of production in Asia**

To investigate garment production in more detail, we move to the work of Samantha Sharpe and Monique Retamal who have been investigating environmental sustainability in garment supply chains in Bangladesh, Cambodia, Indonesia and Vietnam**.** The textile and garment sector in Asia provides low skilled employment for large numbers of workers with opportunities to move from informal to formal work, particularly women (ILO 2016). However, the sector also brings major environmental impacts, which are predominantly felt by local communities including significant water consumption and pollution through untreated wastewater discharges (Niinimaki et al. 2020). The communities surrounding these facilities are significantly impacted in terms of health, quality of life, and in many cases, impacts on livelihoods from farming and fishing (Prihandono and Religi 2019; Price 2017). Hence this research relates both to SDG 12 on responsible consumption and production as well as SDG 8 on decent work.

While a significant barrier to enhancing environmental sustainability in production centres for the sector is the perceived lack of environmental regulatory systems or their "emerging" nature (Greer et al. 2010; Martin 2013), Sharpe and Retamal's research into environmental regulations and environmental impact assessments in four textile and garment producing countries - Bangladesh, Cambodia, Indonesia and Vietnam - published for the International Labour Organisation (ILO 2021), have found that differing, but relatively extensive environmental safeguards, are in place. A gap exists in compliance with these regulations - both actual and nominal compliance (as assessed by published data). Environmental impact assessment and environmental permit issuance is treated as a mere formality, rather than an opportunity for environmental controls. Assessors may lack skills and funds to undertake adequate EIA. Responsible governments lack funding and, consequently, capacity to undertake monitoring, and penalties for non-compliance are rare (ILO 2021). Increasing compliance requires additional support to build awareness, knowledge and technical capacity. This has a cost, and further highlights the tension of value creation in the sector; firms need higher prices and/ or longer contracts to be able to meet higher environmental standards.

**Research narrative 4: Cultural sustainability in design**

Rimi Khan is challenging notions of "creativity" and "ethical" fashion in non-Western contexts such as Bangladesh (2019). She examines how the call to "do good",

circulated by ethical and sustainable fashion advocates in Australia, often reiterates a hierarchy in which it is the responsibility of first-world consumers and activists to be the saviours of garment workers in the developing world. This view reflects a hierarchy in which creativity and design talent are seen to come from the fashion centres of the West, while places like Bangladesh are viewed only as sources of cheap manufacturing labour. Rather, this research challenges us to rethink this binary by drawing attention to the creative innovation of sustainable fashion entrepreneurs in Bangladesh and, in doing so, addresses the frictions between conflicting notions of ethics, empowerment and creativity. This research connects to SDG 10 in reducing inequalities between countries and fostering creative innovation in SDG 9.

## PART II: Challenging contemporary fashion consumption practices

The second stage in our fashion supply chain framework is consumption and use. As the production of clothing continues to grow, and consumers follow fast fashion trends, the amount of waste produced in this system also continues to grow. While recognition of the significant environmental and social implications of mass garment production, consumption and disposal has been driving sustainability initiatives up and down the fashion supply chain, this situation emphasizes the importance of addressing the sustainability of consumption patterns in addition to production. Research conducted through Australian universities regarding sustainable fashion consumption and use explores the potential for changing consumption through consideration of wearing and using practices as well as studies of behaviour and values. This section presents a survey of Australia fashion consumption literature since 2010.

In reviewing this literature, there are several notable texts that have led the field in Australia. For example, the work of Gwilt and Rissanen (2010) in exploring the potential for sustainability in the fashion supply chain have highlighted the transformative potential of slow fashion consumption. Alternatives to clothing disposal as waste are explored in order to boost grass-roots approaches to second-hand, repair and product service systems such as renting (Gwilt 2013). Adding to this critique, is a recognition of the gendered obligations and responsibilities of both fast fashion and the turn towards ethical consumption (Horton 2018). Drawing on the social practice approach, "wearing" practices have been explored as a continuation of the clothing design process which can be value creating, and critically important in the development of a sustainable material culture, including through practices of maintenance, repair and care (Gill et al. 2016). Mellick-Lopes and Gill (2015) draw on social practice theory to highlight the importance of unsustainable use practices and their structural nature, and the need to consider every day contexts in fashion design. Heinze (2017) also draws on social practice theory when exploring sustainable fashion consumption in Australia and

critiques the common focus on consumer behaviour as the pathway to sustainable fashion and calls for a greater recognition of the social and culturally dynamic practice of fashion. Each of these examples are also illustrative of practices whereby consumers are embracing more meaningful material culture relationships (Peters 2014).

In relation to wearing practices and care, Jack (2013) explored laundering practices in Australia, and the sustainability implications of inconspicuous consumption and the performance of cleanliness by challenging research participants to continuously wear their jeans for several months without laundering. Also with a focus on laundering and resource consumption, Retamal and Schandl (2017) looked at the resource use of different laundering practices in the Philippines, comparing hand-laundering, machine laundering and laundry services. The most recent study on wool and sustainability commissioned by Australian Wool Innovation assesses the fibre's lifecycle within the use phase (Laitala et al. 2018). In relation to sharing practices and platform use, Sands et al (2020) surveyed users of sharing and rental platforms in Australia with respect to a range of products including clothing. They found that people using retail sharing platforms were "power-platform" sharers that had high levels of engagement across all types of sharing platforms including for mobility and tourism, with indications that sharing was a strong part of their identity. Brydges et al (2020) explored the potential impacts of the pandemic on the use of fashion rental platforms, particularly with regards to the precarity of start-up businesses, the gendered nature of fashion entrepreneurship and the challenges of hygiene and sharing in a pandemic. Indeed, consumer purchase and clothing disposal methods have become an important sub-category in the investigation of business models and consumer preferences (Bianchi and Birtwistle 2010). Stringer et al. (2020) from QUT investigated the relationship between ethical concerns and fashion purchasing in the United States, and then examined Australian perspectives (Stringer et al 2021). A study examining the impact of the modern slavery act in Australia showed that consumers find it challenging to navigate what is truly ethical or sustainable. It also found that awareness of modern slavery in Australia was low (Richards and Lusty 2020).

This review of consumption relevant literature from Australia has highlighted a strong orientation towards SDG 12 (responsible consumption and production). This includes research on fashion practices such as: slow fashion, second-hand purchasing, repairing, renting, maintaining, cleaning and caring. The structural aspects of consumption, including the social and cultural dimensions are also relevant to SDG 12. Research on the gendered nature of fast fashion and ethical consumption and entrepreneurship also relates to SDG 5 which is gender equality. The growing body of work with regard to modern slavery and ethical consumption also points to SDG 8 with regard to enabling decent work. In the following sections, we highlight emerging

research from Australia related to changing consumption behaviours, including an exploration of sustainable fashion and the 'everyday', the emergence of fashion rental platforms, and the effectiveness of social media campaigns aimed at encouraging fashion supply chain transparency.

## Research narrative 5: Everyday fashion consumption

Contributing to our understanding of SDG 12, the work of Lisa (Heinze) Lake has been examining how people consume fashion at the level of their everyday lives to understand how to support transitions toward sustainable fashion on a mainstream scale. Utilizing the lens of social practice theory (cf Shove 2010), Lake conducted wardrobe examinations (in-depth interviews at the site of participants' wardrobes) to understand consumer practices of buying, wearing and disposing of clothing. The resulting mapping offers an understanding of which elements integrate in unsustainable performances of fashion consumption and how they might be re-imagined, altered or removed to enable a sustainable transition of the practice that moves beyond common calls to consumers to "buy less stuff". Rather, identity-driven motivations overlap with the realities of everyday life (lifestyle, physical and financial accessibility, comfort, brand recognition and time) to all play a role in the practice of fashion consumption. The sustainable fashion movement must recognize and address this complexity in order to fruitfully engage with fashion consumers and support a sustainable transition (Holgar 2022).

## Research narrative 6: Social media campaigns

Through social media campaigns consumers are also being challenged to confront SDGs 12, addressing their everyday fashion consumption behaviours. Katie Roberts investigated social media communication and content co-creation within the landscape of fashion via a case study of #fashionrevolution, an annual digital disruption campaign designed to promote a global call to action for supply chain transparency. Social media platforms (SMPs) are used for the promotion and adoption of pro-environmental and sustainability behaviours as they are accessible, affordable and offer a broad audience reach. Building upon a review conducted by Pearson et al (2016), Roberts systematically reviewed a range of literature regarding SMPs (n=799) for comprehensive and replicable methodology to measure the message receiver's real-world behavioural outcomes and subsequent desire to act sustainably[ii]. The results found that one specific campaign approach, the #haulternative, a digital disruption call-to-action asking for participation in the co-creation of digital video content, was successful in engaging SMP users in reflective-cognitive thought processes that, 1) identified the awareness of the issues associated with traditional fashion haul videos, 2)

promoted self-motivation and empowerment, 3) demonstrated personal sustainability knowledge, and 4) highlighted SMP users skillful means to put their knowledge into real-world behavioural practice via the co-creation of their #haulternative video.

**Research narrative 7: Fashion rental platforms**

Finally, turning to new forms of consuming, in her work, Taylor Brydges has also been exploring themes relevant to SDG 12 by investigating the potential of fashion rental platforms to support more sustainable fashion consumption behaviours. Drawing on qualitative case studies of fashion rental platforms in Canada, Sweden and Australia, her research takes an interdisciplinary approach to issues related to the platform economy, including: (gendered) entrepreneurship, alternative consumption practices and the impact of digitalization on the fashion industry. Research is ongoing to investigate the environmental impact of rental, whether it be through life-cycle assessments of greenhouse gas emissions associated with renting versus owning clothes, as well as understanding the geography and demographics of rental customers. This aligns with Australian research conducted in Southeast Asia, where sharing platforms were primarily targeting niche upper middle-class consumers (Retamal 2017). Rebound effects, such as additional transportation or the incentive to use more clothes if access barriers are reduced, remain concerns (Iran and Schrader 2017). Crucially, the majority of these platforms fail to address the significant human and environmental impact of clothing production and may allow consumers to consume the way they always have, without questioning where clothing comes from or how it was produced. The convenience of rental and not needing to store clothing may also conceal the materiality of clothing waste. Thus, fashion rental platforms may only go so far in terms of challenging the status quo and if the sustainability benefits of intensifying clothing use are to be realized, sustainability needs to be a central consideration for platforms and users.

**PART III: Beyond consumption: considering the sustainability impacts of end-of-life and garment recycling**

As highlighted earlier, the systemic over-production and over-consumption of textiles have resulted in significant amounts of textile waste. There are clear cultural drivers for this waste: the inherent change and desire for newness that characterizes Western fashion means it is 'waste-making' by design. Alongside, a stigma of dirt (following Douglas 2003 [1966]), poverty and even ill-fortune can exist around second-hand clothing (discussed further in Binotto and Payne 2017; Wong and Leong 2019). These cultural drivers promote the continual throughput of garments in the system, with new rapidly replacing old, inhibiting effective garment reuse. Textile waste occurs in garment

manufacturing in the form of fabric offcuts (Rissanen and McQuillan, 2020) as well as the 'deadstock' that retailers cannot sell. As part of the response to over-production and over-consumption of textiles generating waste, a range of studies, government papers, centres and initiatives by universities, charities and NGOs have surfaced in Australia regarding waste generation, disposal and/or transformation. The following review summarizes major studies conducted in Australia regarding fashion's end-of-life. In this section, we present a survey of Australian fashion literature since 2010 relevant to the end-of-life phase, which includes second-hand use, recycling and waste management.

End-of-life may be defined as the point a garment is discarded and enters a new supply chain for reuse or recycling or is discarded to landfill. From a circular economy perspective, following the '9 R's' to facilitate a circular economy for fashion, the entire lifecycle of garments must be examined. Payne (2011) conducted one of the early qualitative studies on the Australian mass market fashion lifecycle at the point of design, following this with an analysis of open- and closed-loop approaches to textile and apparel recycling (Payne 2015). Studies of textile waste include those that examine the impact of fashion and textiles on the environment (land care and impact of consumption) and assess alternative ways to reduce waste (Shirvanimoghaddam et al. 2020). Technical aspects to effectively recycle waste textiles, whether for use within new textiles or other industries, are an important area of ongoing research around Australia. This research includes fibre separation of blended textiles such as wool and polyester (Navone et al. 2020) and cotton and polyester (De Silva 2020). Extensive research by Deakin University's Institute for Frontier Materials includes extracting dyes from waste denim for reuse in other textile applications (Gan et al. 2020), upcycling waste textiles into regenerated cellulosic fibres (Ma et al. 2020) and reclaiming cotton from waste denim (Ma et al. 2019). Other research from University of New South Wales includes transforming waste textiles for use within building materials (Echeverria et al. 2019), and reuse of fashion textile waste as flame retardant mattress filling (Nayak et al. 2020).

A critical conceptual approach to waste and its properties from an ethical and philosophical point of view is to be found in Gay Hawkins' ground-breaking work (2006). Hawkins had already interrogated cultural and social implications of waste in her study on creation and destruction of value (2002). Other contributions to the ethics of waste are to be found in Payne (2012), Binotto and Payne (2017) and, specific to the Australian context, Payne and Binotto (2017). These major sub-categories of research often intersect, each contributing to a better understanding of where change can be driven more efficiently. In Australia, the collection, sorting and resale of used clothing is managed largely by charitable recyclers such as St Vincent de Paul, the Red Cross and The Salvation Army, with the profits from sales supporting the social mandate of these

charities. Charitable Recycling Australia (formerly NACRO) estimates that 88,000 tonnes of textiles are reused each year in Australia (NACRO 2020) which, when considered beside overall textile waste volumes, represents about 11 per cent of end-of-first-life textiles (DEE & Blue Environment 2018). Numerous Australian brands and retailers have committed to employing a circular economy for fashion, which includes a commitment to greater use of recycled fibres as well as to extended producer responsibility schemes.

Research on textiles and garments at their end-of-life is predominantly focused on sustainable consumption and production (SDG 12) and fostering industry and innovation (SDG 9). The impacts of textile waste on the environment is relevant to SDG 15 - life on land. Activating the partnerships required for deploying technologies such as fibre separation and dye extraction technology speaks to SDG 17, partnership for the SDGs. A local circular economy will require partnerships throughout the value chain, from manufacturing, retail, use, charitable collection and reuse. In the following sections we draw attention to research currently being conducted on second-hand markets through mapping existing textile flows in the city of Brisbane and Australia more generally, along with the exploration of pathways of surplus stocks to be redistributed to disadvantaged people in society. We also highlight a number of ongoing research projects examining technologically-innovations aimed at addressing fashion's waste problem.

**Research narrative 8: Redistributing surplus clothing**

First, we have the work of Alison Gwilt, who has been exploring both the personal and environmental benefits of redistributing surplus clothing stock in the community through the AnglicareSA and Thread Together programs which distribute surplus stock clothes to people in low income and marginalized communities in South Australia. This qualitative research found that clients used the service to find products for a specific need or occasion. Moreover, it also found that volunteers play an important role in providing advice and support. For example, volunteers helped with appropriate garment selection and fit with garments from brands that were usually considered unaffordable and out-of-reach. This highlights the impact of price on the acquisition of good, quality clothing products, which may be provoking a persistent market for low-cost, poor-quality garments. This research combines research interests in reducing inequalities (SDG 10) and enabling sustainable consumption (SDG 12).

**Research narrative 9: Mapping textile waste**

A second example of the ways in which the industry is attempting to extend the life of garments is through clothing take-back schemes. Monika Holgar has considered this process as part of a *Mapping Textile Waste* project being conducted in Brisbane, Australia. Over the past 15 years clothing take-back schemes, offered by fashion brands as an approach to Corporate Social Responsibility and/or product stewardship, have emerged as an alternative avenue for consumers' clothing disposal, beyond the established local charity network. They form important additional nodes and levers in post-consumer textile waste flows and the circular economy and are highly relevant to SDG 12 in enabling sustainable consumption. These schemes take a number of forms including partnering with charities or commercial service providers who buy and resell clothing collected by their brand partners, or alternatively assist them in the recycling or upcycling of their collected garments, or collect for in-house recycling. Beyond schemes offered by fashion brands, cities have also staged collaborative clothing take-back events such as Hong Kong's *Get Redressed Month* (2022), London's *Love Not Landfill* (2018), and New York City's *#WearNext* campaign (2019). These city-wide events present a refreshing take on textile recycling. They hold potential to increase consumer access/opportunity, education, perception, motivation and know-how, while making a private, often burdensome act a shared communal one, and an example of inclusive community resource management.

Take-back schemes initiated by brands expand the contexts of textile recycling also, this time into the 'sanitized' space of mainstream fashion retail, and as a consequence can likewise increase consumer access/opportunity, awareness and perception, as well as alleviate pressure on the swamped charity network. However, they also allow big players to recapitalize on the garment lifecycle, and consumer donations are often coupled with discounts on future purchases. In these instances, the motivations or rewards for textile recycling become more complex and entangled with continued consumption. Clothing take-back schemes are increasingly altering the clothing disposal landscape, thus how they are helping to foster a healthy circular economy requires greater exploration.

**Research narrative 10: Interventions and technologies**

In recognition of the complexity of these issues, Zoe Nay and Dr Alice Payne at the Queensland University of Technology in the TextileR research group (QUT 2021) explore a range of interventions needed, which are relevant to SDG 12. Payne's work looks at ways to improve the existing fashion system ('taming' fashion) as much as how to propose alternative, out-of-system approaches ('rewilding') that challenge the dysfunctional underpinning of the current system (see Payne 2019, 2021). This has led to the recognition that the interventions needed for sustainable fashion are whole-of-system, requiring practice change from fashion's brands and retailers as much as from

wearers, fibre producers and policy makers. Nay, as a legal researcher, has examined the policy framework for managing textile waste with colleagues (Payne et al. 2021). Payne is also involved in a range of research projects examining the processes and technologies needed to rein in fashion's excesses of production and waste (cf Payne 2015). One example in collaboration with scientists in biotechnology and polymer chemistry is a technology to separate blended fibres of wool and polyester through enzymatic breakdown (see Navone et al. 2020) as well as in textile waste utiliz ed in new battery technologies (Pham et al. 2021). A current project explores another needed intervention in the system - robotic garment sorting and disassembly - which may serve to help create an effective circular system by sorting and repurposing the abundant second-hand market textiles as a substitute for virgin resources (TextileR 2021). Other projects examine opportunities for sustainable fibre production through an understanding of the relationships between stakeholders in the cotton value chain (see Simpson et al. 2019).

Aside from these 'taming' approaches, other work focuses on the fashion cultures of wearing and making that exist outside of industry control and offer alternative approaches to the ways we make and use garments. Examples include the Beaudesert Project, an examination through exhibition and video of one woman's wardrobe and wearing practices in rural Queensland (Payne 2021), as well as an examination of the poetics of waste textiles renewed through fashion practice (Binotto and Payne 2017). One speculative design project examines biotextiles grown from living bacteria, allowing independent makers to grow their own biodegradable material (Payne et al. 2017). These diverse projects represent multiple points of intervention towards a more just and sustainable fashion system.

**Discussion**

**Design & production**

Australian sustainable fashion design and production research between 2010-2020 related mostly to responsible consumption and production (SDG 12). Reflecting on the relevant SDGs in Figure 3, Australian research has given greater focus on fostering innovation with respect to design as well as in new materials and recycling processes. This includes some research regarding decent work (SDG 8), fostering innovation (SDG 9), reduced inequalities (SDG 10) and terrestrial ecosystems (SDG 15). The current research narratives are more diverse in thinking about sustainability education (SDG 4) and fashion design as activism. New localism and social networks for circular economies relates to sustainable cities and communities (SDG 11). Investigating the potential for localiz ed sustainable design and production to expand and the potential

for localiz    ed circular economies seem logical directions for garment design and production research in Australia, especially given Australia's considerable production of quality natural fibres. However, these are currently relatively small areas of research. Current research is also investigating the prospects for decent work and environmental governance of mainstream garment supply chains in Asia, which links to enabling decent work and a stronger focus on SDG 8.

With respect to research gaps, the framework in Figure 3 also lists health and safety which is relevant to SDG 3 - good health and wellbeing, in which research is lacking. This issue may overlap with decent work, but also highlights health and wellbeing as an important area for new research. Recent Australian research has largely ignored the environmental impacts of production, largely because it happens offshore and this may have been covered in international research. A further consequence of this gap is that there has been less focus on the impacts of production on biodiversity, energy, and greenhouse and aquatic environments. In terms of topics gaining traction, this includes research relevant to reducing inequalities (SDG 10) may be growing, particularly with regard to Indigenous perspectives and sustainability perspectives from the Global South. Indigenous Australian perspectives are lacking and are an important avenue for future education and research. These emerging areas emphasize the importance of the social dimensions of sustainability, which can be overlooked. This analysis also suggests that SDG 9 and SDG10 can also be added to the list of relevant SDGs in Figure 3.

## Consumption & use phase
Research on consumption and use of fashion has explored alternative fashion use practices such as "slow" consumption, second-hand purchasing, repair and renting as well as the importance of wearing practices and care for sustainability. The research in this phase is more focused on SDG 12 (responsible consumption and production). In particular, there has been a focus on consumer practices rather than their sustainability impacts.The current research narratives also relate primarily to SDG 12. The research narratives continue a focus on social practices as a means of understanding consumption and include more research in relation to online platforms such as social media and fashion rental and this is expected to be a continuing theme as digital enabled fashion consumption becomes increasingly important and may dominate in the future. The human dimensions such as ethical consumption/decent work and gender equity also feature in consumption research and relate to SDG 5 and 8. This highlights the need to add gender equity (SDG 5) to our framework with reference to the use and consumption phase. Outside of the SDGs, the Australian research refers often to the socio-cultural dimensions of fashion sustainability and recognizes culture as an important driver of change. The SDGs appear to miss this important dimension of

sustainability transformation. One implication of these dominant research trajectories means there is less research looking directly at the greenhouse (SDG 13) or water implications (SDG 14) of consumption practices for example.

**End-of-life**

The literature on end-of-life fashion research in Australia is primarily focused on responsible consumption and production (SDG 12) and fostering innovation (SDG 9). Research has examined textile waste generation and opportunities for open and closed loop approaches to recycling, and there has been significant technical research on textile recycling with regard to fibre separation, dye extraction, upcycling and reclaiming materials. Some of the research narratives continue this focus with technological interventions and also highlight some of the socio-technical dimensions of waste clothing distribution and reuse, and consider the potential to address inequality (SDG 10). This section highlights a lack of focus on some of the social dimensions of textile end-of-life, for example with regard to SDG 3 (good health and wellbeing), SDG 4 (education), SDG 8 (decent work), and SDG 11 (sustainable cities and communities). The climate and energy dimensions of textiles end-of-life (SDG 13) also appear missing against our framework. It could be suggested that fostering industry and innovation (SDG 9) has been preferred in Australia over research linked to other SDGs and may reflect the funding opportunities that are available. Beyond the technical research, there is also research examining the challenges of recycling in Australia, with regards to cost, and the complex network of actors needed to enable recycling, including the important role of charities and clothing take-back schemes. Research in mapping textile waste and the potential for extended producer responsibility highlights the importance of fashion system governance for sustainability. The SDGs refer to environmental governance through the development of strong institutions in SDG 16 and partnerships for implementation in SDG 17.

**Conclusions: Where do we go from here?**

This review has highlighted a number of key themes in Australian sustainable fashion research, as well as important and emerging gaps which should be addressed in the future. In this regard, there is a lot of momentum around the circular economy for textiles and this research, along with associated issues such as reshoring and localisation, which warrant continued focus. In addition, the socio-cultural changes required to enable sustainability and First Nations perspectives on sustainability are a gap that requires much greater attention. Finally, governance, strong institutions and partnerships for sustainability (SDGs 16 and 17) are a growing area of research which are critical for enabling transformations. In terms of other areas for future research, the concept of the circular economy is emerging in Australian fashion research and

warrants further focus, with increasing global interest in enabling a circular fashion industry (European Environment Agency 2019; Ellen Macarthur Foundation 2017) and a national interest in addressing the problems of textile waste (Australian Government 2021; Minister for the Environment 2021). The initial focus for a textile circular economy in Australia is chiefly on reuse and recycling, which will demand research to improve collection, sorting and recycling technologies and reduce the costs of remanufacturing. However, even a transition to clothing recycling will require large scale system development to enable take-back and recycling logistics as well as institutional arrangements and new collaborations in supply chains.

While developing a recycling economy for textiles, much more research will be needed to facilitate other circular economy practices, including enabling long-lasting design and recyclability; facilitating networks for reuse; driving practices for slower consumption; improved care and repair; as well as alternative means of acquisition through renting and sharing, and overall ensuring that a circular economy is also good for people. Our analysis also found a much greater focus of the circular economy on end-of-life, rather than the design phase. In this regard, more experimental design is needed in fashion education to reduce waste and foster the creativity required for redesign and remanufacturing. Importantly, current approaches to the circular economy in Australia tend to be techno-industrial and miss the social and cultural dimensions - they are largely focused on 'waste as a resource' and sidestep the important conversations about reducing overall consumption of materials (Sharpe et al. 2022). Grassroots approaches to re-designing and re-making have been emerging across the country, ranging from neighbourhood clothing and textile exchanges to small designers' and refugee workshops. The community led aspect of the circular economy is also an important area for future research as they can enable more inclusive approaches, and higher priority interventions that occur before textiles become waste.

Recognition of culture is largely missing in the SDGs, yet cultural sustainability is a vital 'fourth pillar' of sustainability. Aboriginal textiles emerged in the 1980s and 1990s with collaborations between Aboriginal women artists and designers (Ambi and Kirk 2014), however today Aboriginal fashion and textiles are emerging powerfully as a distinctive cultural expression of the nation (The Guardian 2020). Such work is at the edge of the new wave of fashion sustainability. This Indigenous engagement in fashion is part of a renaissance in Australian fashion that offers new vitality to the onshore industry. Indigenous Australian voices are lacking in sustainable fashion education and research and more plural perspectives are needed in the future. Yatu Widders-Hunt offered her perspective on future research needs[iii]. She proposed several avenues for greater research, including: exploring the true size and scale of the Indigenous fashion industry

in Australia and mapping activity across the nation; and exploring how indigenous communities define and understand the Indigenous fashion industry in their own terms. Widders-Hunt highlights that "fashion is interwoven with so many aspects of life, and this can be through acknowledging cultural, spiritual and ceremonial practice as well as through reflecting community and kinship". Defining an Indigenous worldview of what fashion is and what it encompasses would strengthen understanding. Finally, Widders-Hunt recommends that, "it would be exciting to explore or better understand how cultural values of caring for Country can be embedded into contemporary practice and what we can learn from tens of thousands of years of sustainable design." (Widders-Hunt 2021).

Localisation of fashion is also emerging as a sustainability theme, with respect to enabling the circular economy and reshoring and community-led sustainability initiatives, in addition to the legacy of Covid-19 and the volatility of international supply chains. As the Australian fashion industry continues to recover from the economic impacts of Covid-19, there are indications that local garment manufacturing will take on renewed importance (Brydges et al. 2021). Research into reshoring manufacturing is essential, as without the demand from local manufacturing networks for recyclate, it may be cost-prohibitive to recycle textiles onshore. The Australian Fashion Council noted the need for 'reshoring' and 'rightshoring' in their recent report (Ernst and Young Australia, 2021). Reshoring and rebuilding local circular supply chains needs more than infrastructure: it requires skills and education. Universities and vocational education institutions have a vital role to play in the transition, remembering that this includes both reviving traditional skills (in garment construction and repair) as well skills in new technologies. Alongside, universities can channel the creative intelligence of emerging designers towards designing new and desirable products and services around repair, remanufacture, reuse, and restyling.

In this paper, we have highlighted key topics for further collaboration and interdisciplinary research to further progress towards the SDGs. Partnerships and governance are emerging as critical enablers for sustainability transformation in the fashion industry. The Australian Fashion Council (AFC) is currently building momentum to develop a product stewardship scheme for fashion in Australia. Strong engagement from the AFC signals a step change in the industry and an era where much greater collaboration is needed. Studies and experiments are needed to establish appropriate institutional arrangements to facilitate this 'closing of the loop'. Across the three key stages of the fashion lifecycle, we see that the social and environmental impacts of fashion are interwoven and complex and require a multitude of approaches to address sustainability. This highlights the need for interdisciplinary collaboration to identify and target systemic issues and to consider the broader barriers and enablers for change towards sustainability.

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[i] Scientific research estimates Australia's First Nations people have lived in Australia for 62,000-75,000 years. They are widely understood in Australia as the 'oldest continuously living culture', including by the Australian Human Rights Commission.

[ii] Following the review, Roberts developed models and frameworks to fill gaps identified within the review of literature. These frameworks and models were designed to: 1) help researchers clearly define the messaging actions taken within the social media landscape, 2) identify the message motivation/architecture regarding the desired action-based outcomes of the message recipient, and 3) theoriz    e the behavioural considerations of the viewer acting on social media campaign messages. These models were tested using the #fashionrevolution (2018) campaign.

[iii] Yatu Widders-Hunt is the General Manager of Indigenous social change agency, Cox Inall Ridgeway. She is on the Boards of the Australian Fashion Council and First Nations Fashion and Design and also runs an influential online social media community, Australian Indigenous Fashion.