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For waste's sake – A stakeholder mapping of circular economy approaches to address the growing issue of clothing textile waste

Abstract

By now, it is well-established that the fashion industry faces several social and environmental sustainability issues, including the growing problem of clothing textile waste. In recent years, the concept of the circular economy has been put forth as a solution to drive the industry towards a more sustainable future, including as a strategy to reduce clothing textile waste. However, currently there is a gap in our understanding of how circular approaches are enacted by different stakeholders and if/how stakeholders are working together, especially when it comes to post-consumer clothing textile waste¹. To remedy this gap, this conceptual paper draws on a wide range of secondary resources to propose a conceptual framework based on stakeholder mapping. The framework aims to help understand who is responsible for post-consumer textile waste and how they interact and work together, driven by three key questions: where do responsibility(ies) lie in addressing the growing challenge of textile waste, what actions are currently being taken across supply chains and stakeholders to address textile waste, and what are the opportunities and challenges in conceptualizing circular economy practices through a stakeholder mapping approach. In exploring actions across four key stakeholder groups (policymakers, fashion industry, clothing textile recyclers, and actors from the non-for-profit sector), the need for engagement and collaboration across stakeholders, investment in recycling technology and infrastructure, and policy leadership are identified as key challenges facing the industry as it seeks to redress social and environmental challenges.

1. Introduction

The fashion and textiles industry, claimed to be one of the most wasteful consumer industries globally (Leal Filho et al., 2019; Niinimäki et al., 2020), is dominated by a take-make-use-dispose paradigm and is criticised not only for its wastefulness in terms of resources used, but also for fostering a throw-away culture of consumption that devalues the worth of garments and apparel (Brydges et al., 2020; 2021), and risks compromising the labour rights of workers. While notions of sustainability encompass both social and environmental challenges facing the sector, it is increasingly recognised that issues surrounding sustainability (or the lack thereof) point to why it (fashion and textiles industry) has been cited as the fourth most polluting and greenhouse gas (GHG) intensive lifestyle domain within the Europe Union (EU) (including the UK) (EEA, 2019). With an estimated 87% of all textiles ending up in landfill or incineration (World Bank, 2019), and global consumption of textiles growing, there is increased urgency to address this complex issue (Leal Filho et al., 2019).

Circular economy (CE) approaches seek to counteract environmental challenges, by re-looping materials back into the supply chain, making more use of already existing resources (EMF, 2017). CE approaches align closely with existing reduce-reuse-recycling environmental frameworks for consumption and waste management (Dagilienne et al., 2021). Yet, with current estimates claiming only between 1-12% of materials are being recycled (Beall, 2020; WRAP,

¹ Post-consumer clothing textile waste will be interchangeably used with textile waste, unless explicitly stated otherwise.

2020), the proverbial attempt of putting a square peg into a round hole may come to mind. As Liboiron (2021) has shown, pollution must be understood not solely as environmental degradation, but as “the enactment of ongoing colonial relations to Land.” (2021: 6). Programs, policies, and initiatives aimed at mitigating pollution risk reinforcing structural violence, as “colonial relations are reproduced through even well-intentioned environmental science and activism” (Liboiron, 2021: 6). CE approaches fostered by a new type of systems thinking require heavy reflexive investment to move beyond simply trying to retrofit circularity as an ‘add on’ to conventional linear (take-make-use-dispose) models.

CE is an umbrella concept that describes a range of closed-loop recycling and reuse policies and strategies to address production and consumption of goods across the supply chain (Kirchherr et al., 2017; Geissdoefer et al., 2017). Closed-loop recycling implies that garments and/or textiles, once they have reached their end-of-life, are collected, recycled, and kept within the same value chain, to be made into another garment and/or textile (Payne, 2015; Greenblue, 2017). However, re-looping these materials can be seen as a challenge, due to the increase in fast fashion consumption and the production of lower quality items. When textiles and garments are designed to have a short life, where quality (in terms of longevity) and performance are not a priority, recycling and re-use have not been considered. Therefore, the rise of fast fashion is said to contribute to the increase in post-consumer clothing textile waste (Niinimäki et al., 2020).

Comparable to the concept of *sustainability*, the term *circular economy* (CE) has become a buzzword of the 21st century that has received increased interest from academics and practitioners and within local, national, and supranational governmental institutions (e.g., Bergamin, 2020). As research and literature on sustainability and transitions has been critiqued for its role in perpetuating “scholarly bullshit” (Kirchherr, 2022) Kirchherr et al. (2017) outline that it is vital to define what is meant by the circular economy, as definitions may vary. When referring to CE in this paper, we follow the most prominent definition (Schut et al., 2015; Geissdoefer et al., 2017), provided by the Ellen MacArthur Foundation (EMF, 2012):

an industrial system that is restorative or regenerative by intention and design. It replaces the ‘end-of-life’ concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models.

What becomes apparent here is that CE, and more specifically circular systems thinking, assumes that multiple key stakeholders (e.g., consumers, businesses, governments) are working together to create new approaches of operating across fashion and textile businesses. Yet circularity can neither be addressed in isolation, nor through tokenistic efforts. Rather, engagement with CE requires nuanced and interdisciplinary approaches that are attuned to the complex relationships between a multitude of diverse, and sometimes divergent, stakeholders.

A growing range of actors, from policymakers, industry, academia and beyond (EMF, 2017; EC, 2020a, 2021) have argued there is a need for the industry to embrace the transition to circularity across supply chains through various approaches, from designing more circular products (EC, 2021b) to embracing circular materials (ECAP, n.d.), as well as innovating with new forms of more sustainable consumption (e.g., Khitous et al., 2022) and exploring new ways of engaging with recycling and materials recovery strategies (Textile Exchange, 2020). Whereas the concept of CE intrinsically assumes collaborations across supply chains, these relationships remain poorly understood and undertheorized. There is currently a gap in research aimed at

understanding how circular approaches are enacted by different stakeholders and if/how stakeholders are working together, especially when it comes to post-consumer clothing textile waste².

This paper develops a conceptual framework based on stakeholder mapping by drawing on a wide range of secondary resources to understand the dynamics of responsibility for post-consumer textile waste and how stakeholders interact and work together, driven by three key questions:

1. Where do responsibility(ies) lie in addressing the growing challenge of textile waste?
2. What actions are currently being taken across supply chains and stakeholders to address textile waste?
3. What are the opportunities and challenges in conceptualizing circular economy practices through a stakeholder mapping approach?

2. Defining post-consumer textile waste

Within the fashion and textile industry, pre- and post-consumer textile waste is compartmentalised into two distinct categories, with the former capturing waste created prior to reaching consumers and thus, within the manufacturing process, and the latter comprising of waste which occurs once consumers discard a piece of clothing and/or textile (EC, 2021c). Over the past decades we have seen a sharp increase in post-consumer textile waste (DeVoy et al., 2021). One explanation is the fast fashion phenomenon, which sees garments sold at very low prices (Sinha et al., 2021). It has been argued that this in turn has fostered a throw-away culture, making fashion items disposable and replaceable (e.g., Iran et al., 2022).

It is important to note that ‘textile waste reuse’ and ‘textile waste recycling’ are two different approaches. Textile waste recycling can be defined as taking textile waste and converting it into a reusable material. Closed-loop recycling of textile waste is typically carried out mechanically or chemically, with recent approaches incorporating bio-based processes to open-loop recycling (Ribul et al., 2021). In the process of mechanically recycling textiles, machinery is used to tear and physically break down the garment or fabric into shredded material, shredded further into fibres. Whereas chemical recycling is only applicable to synthetic fibres, where it breaks down the polymers in the textile, to then be re-polymerised and recycled into new fibres. Contrarily to recycling, textile waste reuse focuses on extending the ‘useful’ life of an item, by means of transferring ownership or granting access to it (Sandin et al., 2018) through either second-hand shopping, renting, or swapping (borrowing and/or exchanging).

3. Stakeholder mapping: Whose responsibility is it to address textile waste?

In order to gain a better understanding of the key stakeholders involved, we conducted a keyword search on four databases (Google Scholar, Science Direct, Scopus, Emerald), which are commonly used for systematic literature reviews (Athwal et al., 2019, Henninger et al., 2021). The keywords chosen comprised three categories, which are summarised in Table 1. We note that this paper is

² Post-consumer clothing textile waste will be interchangeably used with textile waste, unless explicitly stated otherwise.

not a systematic literature review, but instead used some of the techniques, commonly applied to review key articles and better understand, who the key players are within the literature.

Table 1: Keywords used to conduct search

| Keyword A | Keyword B | Keyword C | Reference |
|---|--|-------------|--|
| Textile Clothing Fashion Garment | Recycling Waste Circular Economy | Stakeholder | Niinimäki, 2017; Becker-Leifhold & Iran, 2018; Hu et al., 2018; Henninger et al., 2020 |

Publications included into the review were peer-reviewed articles, books, and book chapters written in English, whilst student thesis, conference papers, reviews, commentaries, and editorials, as well as publications not written in English were excluded.

One observation here is that although China is not only one of the largest producers of fashion and textile items and also faces challenges in terms of textile recycling, we found limited recycling initiatives. One reason may be the exclusion criteria of any texts that were not written in English. Moreover, this may be related to cultural contexts: within China, using recycled (including second-hand) items may have a stigma attached to it (Bloomberg News, 2020; Lin, 2020).

Based on the search conducted, we reviewed 134 papers and found that recycling initiatives are facilitated either through supranational organisations, on a national or local level, with four key stakeholder groups: policymakers, fashion industry stakeholders, clothing textile recyclers, and actors from the non-for-profit sector. We further conducted Internet searches to find prominent examples to support the discussion.

3.1. Policymakers and Governments

Policymakers at different levels of government (supranational to local) have increasingly recognised the environmental impact of the fashion industry and clothing textile waste on the environment and have responded by developing policies to divert textile waste from landfill. We will highlight several key developments here.

Beginning with the supranational, in 2020, the European Commission adopted a Circular Economy Action Plan which included the development of an EU Strategy for Textiles (EU Parliament, 2021). This plan was opened to the public for consultation (EC, 2021b) and amended in February 2021. In accordance with feedback provided, it now includes a new resolution which requires additional commitments to achieve a “carbon neutral, environmentally sustainable, toxic-free and fully circular economy by 2050” (EU Parliament, 2021).

Framed in the context of a post-COVID-19 recovery, the EU Strategy for Textiles “will help the EU shift to a climate-neutral, circular economy where products are designed to be more durable, reusable, repairable, recyclable and energy-efficient” (EC, 2021b). It aims to support a more competitive, circular fashion industry in Europe built on investment, research, and innovation (ibid). The EU Strategy for Textiles will serve as the legal framework for CE interventions across supply chains and incorporate a range of actors and practices, including more sustainable production, changes to the design and consumption of garments, and improved waste collection (Interreg Europe, 2021).

With the EU Commission’s adoption of the strategy anticipated in the first quarter of 2022, further research is needed to assess the impact of this strategy (EC, 2021b). This approach is an example of stakeholders working together through a public consultation, whereby members of the public, NGOs, businesses, and others with an interest in the EU Strategy For Textiles, were able to voice their concerns and/or raise aspects that they felt needed to be incorporated.

National policy leadership is also playing an important role in supporting innovative policy solutions to address textile waste, with several examples of this emerging from the Global North. Table 2 provides an overview of a selective number of initiatives available.

Table 2: Summary of selected national textile strategies to divert them from landfill

| Country | Program | References |
|--------------------|---|---|
| Australia | <ul style="list-style-type: none"> • Development of an industry-led Product Stewardship Scheme for Clothing Textiles • Consortium of partners headed by the Australian Fashion Council (AFC) and funded through the National Product Stewardship Investment Fund managed by the Department of Agriculture, Water and Environment • Introduced in May 2021, to be completed in 2023 • Goal: “to improve the design, recovery, reuse and recycling of textiles, providing a roadmap to 2030 for clothing circularity in Australia” (AFC, 2022). | AFC, 2022; Australian Government, 2021 |
| Finland | <ul style="list-style-type: none"> • Carbon neutral by 2035 • Government plan to fulfil EU Circular Textile Strategy 2 years earlier • Finish textile producers named CE pioneer • Goal: Find solutions to reuse and recycle textiles | Levon, 2021; Pavarini, 2021; UNDP, 2021 |
| France | <ul style="list-style-type: none"> • Extended producer responsibility (EPR) legislation • Supported through the National Programme for Textiles Recovery • Established in 2008 | Knowledge Hub 2021; Wilson 2021 |
| Netherlands | <ul style="list-style-type: none"> • Dutch Circular Textile Valley • Key goal: to support a ‘significant’ amount of circular textiles by 2030 • Avoid re-bounce effects based on technology/efficiency failure to deliver environmental promise | DCTV, 2021; Siderius and Poldner, 2021 |

There are two key observations that can be made from Table 2: first, a common goal is to divert textile waste from landfill by means of either reuse or recycling; and second, the initiatives vary quite dramatically, not only in length - some are only running for two years, whilst others highlight a long-term commitment - but also in terms of the regulation imposed. There also appears to be

differences with respect to responsibility. On the one hand, we see Extended Producer Responsibility (EPR), which puts responsibilities onto the producers “for the treatment or disposal of post-consumer products” (OECD, n.d.) and can be either in the form of financial or physical effort. On the other hand, we observe a push back of responsibility to consumers to ensure they take ownership of their actions. As some initiatives only just began, their impact remains unknown.

There are also examples of policy contexts where despite growing policy discussions regarding on addressing waste from the fast fashion industry through levies and EPR legislation (e.g., UK), strategies have not yet been implemented (Batha, 2021). This remains, at least in the UK context (Gov.UK, 2021), in somewhat early stages, with a public consultation to take place in the last quarter of 2022. Current plans seem to align with the approach France has taken, to incorporate an EPR scheme. Exploring this policy context in more detail reveals several challenges around enabling policy action to support the transition to a CE for fashion.

Whereas national legislation to support CE principles to address textile waste is often the ‘big picture,’ in many country contexts, it is the municipal or local government which is directly responsible for the day-to-day collection and management of textile waste, which offers a different perspective to this issue (Christensen, 2021; Dagiliene et al, 2021). Christensen (2021) highlights how municipalities are key players in addressing textile waste as they are at the end of linear material flows and tasked with managing the growing amounts of textile waste.

However, there are several barriers at the local level to engaging with textile recycling. First, local governments may be unclear about their roles and responsibilities or may not have the capacity or political means to enact CE approaches (Christensen, 2021). Historically, local governments have taken “soft approaches” to managing textile waste, such as public awareness campaigns (Dagiliene et al, 2021, p. 8). Yet, with growing levels of textile waste, there is an increasing need for municipalities to take a more meaningful approach. This relates to another challenge regarding power dynamics across and within the relationships between industry, individuals and communities, and governments in supporting textile waste collection (Payne, 2015). This not only creates a barrier in terms of waste collection, but also in terms of having appropriate waste streams readily available that allows recycling and/or diverting textiles to be collected. Thus, in order for schemes to be meaningful it is essential to have strategies in place that support waste collection, as well as the facilities to manage the logistics of distributing this ‘waste’ to either be resold for reuse or recycled (chemically, mechanically, biologically), with support from local stakeholders.

Given the diversity of governance structures at the municipal or local level around the world, diverse approaches have been taken to address textile waste (Christensen, 2021). Table 3 highlights several different approaches within North America and Europe. These were chosen purposefully, as each of these campaigns have received high media attention and/or awards.

Table 3: Summary of selected municipal textile diversion strategies

| City | Program | References |
|--------------------|---|--|
| New York City, USA | <ul style="list-style-type: none"> • #WearNext Campaign • Duration: 4th March - 9th June 2019 • Multiple stakeholders: New York City Department of Sanitation (DSNY), New York City Economic Development Corporation (NYCEDC), Ellen MacArthur | Reflow, 2021; Sustainable Brands, 2020 |

| | | |
|-------------------------------|--|--------------------------------------|
| | <ul style="list-style-type: none"> Foundation, fashion brands, collectors, recyclers • Achievement: Interactive map outlining 1,100 publicly available collection points • Outcomes: Awareness raising, collection volume increased 15% | |
| Markham, Canada | <ul style="list-style-type: none"> • Initial discussions started in 2011 • Timeline: <ul style="list-style-type: none"> ○ 2011: Creation of Sub-committee supported by MEAC and York Region ○ 2012: 10 initiatives approved ○ 2013: Clear bad campaign ○ 2015: Markham Textile Recycling Program - public consultancy • Achievements: <ul style="list-style-type: none"> ○ Award-winning program diverted more than 20 million pounds of textile waste from landfill ○ Started with 53 donation points (2015), now 160 (2022) • Summary: This is a distinctive approach from many municipalities in Canada, which is defined by pilot projects developed in partnership with local charities • Note: Only reuse (no actual recycling processes mentioned) | FTA, 2021; Markham, 2017; 2021, 2022 |
| Amsterdam, Netherlands | <ul style="list-style-type: none"> • Reflow Project • H2020 Funded project • Pilot project to increase recycling % of textiles • Short term goal: educate stakeholders through lecture series • Long term goal: create exchange system platform, enhance circular flow and cycles • Variety of stakeholder included: business, citizens, government | DLT4EU, 2021; Reflow, 2021b |

Similar to the findings in Table 2, Table 3 also highlights that local initiatives vary in terms of length, goals set, and outcomes. Moreover, the term ‘recycling’ may have a different meaning in that it literally focuses on recycling garments through promoting reuse, donations, reselling, and/or repairing and thus, diverting garments from landfill. This is opposed to the meaning of recycling in the sense of mechanically, chemically, or biologically breaking down fibres to be reused as new raw materials. As noted above, it is important to consider distinctions between ‘textile waste reuse’ and ‘textile waste recycling’.

We further see a considerable variation in policy approaches that are taken to address the growing issue of textile waste. Whilst there are some examples of policy implementations on a city and/or municipal level (Table 3), these are largely inconsistent and thus, vary quite dramatically. We have highlighted examples of campaigns that lasted for about 3 months (e.g., #WearNext Campaign, NY), whilst others have started almost two decades ago (e.g., Markham,

Canada). Here, we also see the importance of collaborating with a range of partners (non-profits/charitable recyclers, fashion brands) in developing initiatives.

In summary, at national level, a range of policy responses emerge. In some contexts, such as Australia and France, we found examples of governments that appear to be very proactive when it comes to textile waste, evidenced by the growing number of discussions around this waste stream and the momentum this issue has gained in recent years. Overall, we see a growing number of governments developing CE policies, or improved circularity, on their priority list. Even though the textile sector has been identified as one of the four key pressure categories in terms of GHG emission and pollution within the EU (EEA, 2019) and other countries, it seems to be lagging behind other industries and their recycling policies (e.g., e-waste).

3.2. Industry initiatives

In this section, we look within the fashion industry at a range of initiatives aimed at promoting circularity and addressing clothing textile waste. We will trace key initiatives identified in the literature across supply chains, recognising that to support industrial change, there is a need to embed circularity across businesses, rather than solely as an end-of-life consideration (Brydges, 2021). In order to illustrate our argument, we will draw on a variety of different brands, all of which were chosen, as they are seen to be pioneers in the area, with some having received awards for their efforts.

Table 4: List of brands discussed in this section

| Brand | Country | Award/Justification | Reference |
|------------------------|----------------|---|------------------------------|
| Stella McCartney | UK | Special Recognition Award for Innovation | BFC, 2017 |
| Asket | Sweden | FastCompany Honourable mention for Full Traceability Standard | FastCompany, 2020 |
| Nudie Jeans | Sweden | Drapers 2020 Fashion Award | Nudie Jeans, 2022 |
| Patagonia | USA | UN Champions of the Earth Award | UNEP 2019 |
| MUD Jeans | Netherlands | Sustainable Fashion Award 2018 | MUD Jeans, 2018 |
| KITX | Australia | Advocated by Livia Firth and Emma Watson | Press, 2018 |
| Birds of North America | Canada | Different recycling programs through the ReNesting initiative | Birds of North America, 2022 |

Within the industry, we notice an emphasis on designing for circularity. Designing for circularity is based on transforming the fashion and textile industry from a linear to a circular system that is less (and eventually, not-at-all) reliant on the use of ‘new’ raw materials (virgin), but rather is built upon low-waste design principles such as quality and durability that keeps garments and other textile materials in use for as long as possible (Leal Filho et al., 2019). By this definition, designing for circularity marries the production processes that are built upon circular materials with an aesthetic that supports longevity (Keßler et al., 2021; Moorhouse and Moorhouse, 2017; Skjold, 2021).

A key practice that aligns with circular design strategies is the use of innovative materials (Luo et al., 2021). This can take several different forms, including the use of recycled materials, a practice that has been championed by brands such as Stella McCartney who uses, for example, recycled cashmere, nylon, and polyester, across a range of product categories (Stella McCartney, 2022). Leadership from brands such as Stella McCartney signals to the industry that working with new materials not only reduces waste but can serve as a unique selling point for a brand (e.g., Henninger et al., 2022).

At various stages of the linear supply chain, materials can be re-looped and recycled, to address both pre- and post-consumer clothing textile waste. In addition to materials, product design plays an important role in supporting circularity. Slow fashion design principles, including classic or ‘timeless’ designs, can support longevity and circularity with garments that are in fashion for more than one season (e.g., garments that can be ‘worn forever’) and will retain value both to their initial purchaser and on second-hand markets (Brydges, 2018).

We also see examples of brands using these principles to guide their business models (e.g., Hill, 2021; Motif, 2022). For example, the Swedish brand Asket is built upon the philosophy that “maximising the use of all garments is the single most efficient way to minimize consumption and ultimately our footprint” (Asket, 2022). Hill (2021) further outlines that “Asket doesn’t design for seasons, it creates for forever”, thus, the brand has been built around the design of a ‘permanent collections’ consisting of a small number of seasonless garments that are meant to be worn for years to come, supported by a care program, repair guides, as well as a take-back program where garments that are no longer wanted will be repaired, renewed, resold or recycled (Asket, 2022). Here we see that a key goal of the brand is to design clothing that has a maximum lifespan and is, ideally, kept out of landfill.

It is becoming increasingly common practice for fashion brands to encourage garment repair and/or the better care of garments to extend their useful life and challenge the disposability of garments, where it has become commonplace to throw out an item because of minor faults (Rodabaugh, 2018). Asket is not the only company that has taken this approach, other companies, such as Nudie Jeans have made *repair* one of their key drivers, even redesigning their retail spaces to make garment care a central focal, and ultimately selling, point (Whelan, 2020; Nudie Jeans, 202).

Brands are also engaging in a range of clothing take-back schemes. This is a practice pioneered by fast fashion brands such as Zara and H&M (Gould, 2017; WRAP, 2021) where garments of any label can be returned to a retail location in exchange for a voucher to be used for future purchases.

Yet, fast fashion brands are not the only ones that are encouraging take-back, we have also seen ‘slow fashion’ brands, including Patagonia and MUD jeans, that are actively fostering recycling through these schemes (Rauturier, 2022). Take-back schemes can be described as a doubled edge sword. Although these take-back schemes are designed with the mind-set of reducing waste and ensuring it (textile waste) is kept out of landfill, whilst incentive vouchers can have a positive impact for consumers especially with a lower income. When it comes to industry-led take-back schemes, some scholars have highlighted how such corporate tactics may incentivise consumers to buy more, potentially fuelling further consumption (Brooks, et al., 2017).

The practice of take-back schemes has evolved to see brands take on greater responsibility for the garments they produce and ultimately reduce the amount of clothing sent to landfill. For example, Sydney-based luxury sustainable fashion brand KITX (2021) and independent, made-in-Canada label Birds of North America (2022), both launched take-back programs for their own

garments which are repaired and resold by the brand itself. Not only is this a CE strategy that aims to keep garments out of landfill, it is also a more transparent way of offering a take-back program where the business is being accountable for the garments they produce.

Take-back schemes have also been scrutinized, where despite program marketing that implied collected garments would be recycled into new garments, in reality the supply chains underpinning these programs were far more opaque, with garments more likely to be managed by third-party recycling companies and potentially sent overseas (e.g., Cernansky, 2021; Sutherland, 2019). One of the biggest challenges facing companies engaged in take-back schemes is identifying which partners to work with to develop transparent approaches. Thus, we see take-back programs more as an example of re-use (as part of the second-hand clothing market) rather than an example of recycling and re-looping materials back into textiles for new garments.

There are also a growing range of innovations with respect to clothing consumption and fashion retailing (both online and offline) aimed at supporting circularity by keeping garments in use longer and/or providing alternatives to clothing ownership (Parker and Weber, 2013). In addition to second-hand, this includes examples such as the recent rise of clothing rental platforms that provide on-demand or subscription access to a range of garments as well as associated informal or non-monetary practices such as sharing or swapping clothing (Brydges et al., 2021; Henninger et al., 2021). There are also a growing number of clothing resale platforms, including charity/thrift stores, consignment, and vintage stores, as well as platforms such as Vinted, Poshmark, eBay, thredUP and Depop which all also aim to keep garments in use longer and out of landfill (Hu et al., 2019). Each of these consumption alternatives also highlight the important role consumers play in supporting the implementations of CE practices in the fashion industry.

In summary, we see a variety of practices that can broadly be identified as operating under the umbrella of circular design, which support recycling (such as re-looping materials back into supply chains), reuse (such as collecting garments to be re-worn or sending to charity shops), and repair. Across the industry, some companies are making dramatic changes in the way they are not only producing garments, but also in the way they are dealing with the end-of-life of their products. We can see challenges and opportunities within the different approaches businesses and retailers are taking to addressing textile waste. Because there are diverse approaches taken, it is challenging to evidence which approach may be the most meaningful in achieving goals. For example, is producing for circularity better than dealing with already existing post-consumer waste? Further research is needed to unpack not only which strategies are more effective, but whether goals set by industry stakeholders are meaningful in the first place, when considered in conversation with other stakeholder groups. We however also see opportunities, in that different approaches may cater to different consumer needs, making textile waste recycling more accessible to consumers.

When questioning whether these approaches are sufficient to tackle the issues, we restate that collaboration and strong dialogue not only between (supra)national and local governments, but also within the industry and with local stakeholders, are essential.

3.3. Textile recyclers

A related, but standalone segment of the market is the growing number of private clothing textile recycling companies (CBI, 2021; Global Newswire, 2021), as a response to an increase in demand for recycled fibres. In linking back to the introduction there are three commonly used recycling practices: 1) chemical recycling (depolymerisation of material are-polymerised into fibres), 2) mechanical recycling (shredding of garment/textile fabrics into fibres) and 3) biological recycling.

The practices we discuss here are distinct from the practice of fashion brands offering clothing take-back schemes, as they do not address waste prevention, but rather focus on recycling fabrics into new fibres.

Table 5: International examples of textile recycling companies in North America, Europe, Hong Kong, Japan, and Australia

| Country | Company | Type of recycling | Reference |
|-----------|-------------------------|--|--------------------|
| HK | The Green Machine | <ul style="list-style-type: none"> • Hydrothermal treatment method • Can separate polyester fibres from blends • Part of chemical recycling | Planet First, 2021 |
| USA | EVRNU | <ul style="list-style-type: none"> • NuCycle technology • Creation of engineered fibres | EVRNU, 2020 |
| France | Carbios | <ul style="list-style-type: none"> • Enzyme based technology • Bio-based process | Carbios, 2021 |
| UK | WornAgain | <ul style="list-style-type: none"> • Advanced textile recycling • Chemical recycling | WornAgain, 2021 |
| Australia | Blocktexx | <ul style="list-style-type: none"> • Proprietary technology which separates fibres back to their original raw material (cellulose or RPET) | Blocktexx, 2020 |
| Japan | Teijin, JGC, and Itochu | <ul style="list-style-type: none"> • Chemical recycling of discarded polyester textiles into polyester fibres | Itochu, 2021 |

Table 5 indicates that there are a wide variety of technologies used. While each method has benefits and drawbacks that go beyond the scope of the paper, what becomes clear is that different methods are implemented depending on what is being recycled. Although the recycling processes are distinct, what these organisations appear to have in common is that they are seemingly small in scale.

Recycling textiles, is extremely challenging as most garments are made from a mix of materials, which often cannot be separated apart and thus, be recycled. To explain, garments can be made from multiple materials, which not only makes it technically difficult but also time consuming and labour intensive to separate fibres to be recycled (Leal Filho et al., 2019). Another challenge in textile recycling is the colour variation of clothing. Recycling mixed colours would result in grey fibres, and dye removal is an energy-intensive and water-intensive process. Although the H&M Foundation (RE:MAKE, n.d.) and HKRITA (n.d.) have presented a container size garment-to-garment recycling process that allows mixed fibre and mixed coloured garments to be mechanically recycled, the technology remains expensive and niche.

In reviewing developments in this space, we found there are also widespread differences across industry and geography regarding technological innovations for recycling, particularly in the Global South. There is a lack of economic incentives to spur innovation in this area and tackle

these challenges (Remy et al., 2016). This highlights that we are currently far away from actually closing the loop, as recycling practices that can easily be scaled are currently not available. Moreover, there are issues surrounding the logistics of gaining garments for recycling, seeing as currently a molarity of garments used in the Global North flood economies in the Global South, who face challenges in dealing with this issue (Lebreton, 2020; Wohlgemuth, 2022).

Additionally, material that could currently be recycled predominantly stems from the fast fashion industry, which has been criticized for producing low quality materials that are designed to be worn only a few times before being discarded. If garments are to have more recycled content, recycled fibres need to be of high quality to ensure that new products with this recycled content can still be long-lasting (e.g., Beall, 2020; Textile Exchange, 2021).

In a similar line of argument, even if current technology would be readily available to recycle textile waste, there seems to be a lack of infrastructure available that enables the collection of garments. Take-back schemes alone are not sufficient to divert all materials out of landfill. Yet, with a lack of policy supporting the recycling effort, this may not be feasible. And as alluded to previously, may take some time to be fully implemented, seeing as not only businesses and retailers have different approaches to textile recycling, but also local, national, and supranational organisations, and other community stakeholders.

Although recycling is a key part of CE practices, as it shifts the meaning of waste to become a new resource, it does little to address issues raised in the previous section in regard to environmental and social sustainability challenges in the earlier stages of fashion supply chains.

3.4 The not-for-profit sector

The charity sector has become a key, if not the key, sector responsible for collecting textiles from consumers in many Western contexts (FTA, 2021; Leal Filho et al., 2019; Minters, 2019). For instance, in Canada, the UK, and Australia, charitable organisations play a vital role in facilitating the collection and distribution of textile waste, whether garments are sold through their own charity shops or to recycling firms (Leal Filho et al., 2019), or to sorting and grading companies (FTA, 2021; Minters, 2019). Here we return to a comment made previously of ‘recycling’ and its meaning. Within the not-for-profit sector there seems to be a focus on recycling that can be used interchangeably with reuse and thus becomes an extension of a garments/textiles useful life. In the past we have seen various charities teaming up with high street brands to support their take-back schemes, with examples from Oxfam, who have teamed up with Marks & Spencer and H&M in the UK (Oxfam, 2022), or the Salvation Army’s *Recycle with Michael* scheme, which supports local schools (Salvation Army, 2022). There are also other charities globally that seek garment donations, which can be resold and raise money for their cause.

It is also interesting to note that there seems to be a heavy reliance on behalf of local governments to work with charitable sectors to divert textile waste. Yet, this brings forward various challenges, as charities may not necessarily have the capacity and/or infrastructure to facilitate these collections and thus, garments and textiles may end up in landfill. Similarly, there are growing concerns regarding the globalised trade of second-hand clothing that flows on from donations to the charitable sector, whereby clothing donated in the Global North is shipped around the world (Brooks, 2013; Besser, 2021). This has several effects, including the creation of garment grading and sorting economies around the world, as well as the creation of a highly problematic and polluting waste stream in countries such as Ghana (Besser, 2021) and Kenya (Dahir, 2020).

The latter is not necessarily a well-known fact among Western consumers, who bear little accountability or responsibility (ibid).

While issues surrounding textile waste intensified even more during the COVID-19 pandemic, with people clearing out closets and donating to charities (Brydges et al., 2020), the urgency for responsible waste interventions persists.

4. Discussion: Opportunities and challenges in conceptualising CE practices

Our stakeholder mapping has identified several opportunities and challenges in the implementation of CE practices to address the growing issue of clothing textile waste. We will highlight three key themes here.

First, a key challenge that has emerged is the need to foster collaboration across stakeholders. Given the complexity and magnitude of the challenges facing the industry, and indeed the environment, caused by textile waste, there is a need for collaboration by the multitude of different stakeholders involved. As our review has demonstrated, there are a range of industry, not-for-profit, and governmental stakeholders taking very different approaches to the issue of textile waste, albeit each with their own environmental and economic imperatives. When pollution is understood as a process of colonization, it is clear that meaningful engagement with local stakeholders is essential (Liboiron, 2021). As we have shown, stakeholders are engaged in inconsistent and at times, overlapping, initiatives aimed at reducing the amount of textile waste going to landfill. Currently, we have a limited understanding of how the various stakeholders can and will collaborate to develop CE practices and policies (Christensen, 2021; Dagiliene et al., 2021). There is a lack of leadership and accountability in driving change on this issue.

Second, whereas a key goal of the fashion industry and the stakeholders identified should be to keep clothing in use for as long as possible, when a garment has reached the end of its life, there is a need to have in place the necessary infrastructure to support clothing textile recycling. A key part of this is technology: indeed, a central theme that emerged in the literature and industry cases were challenges around current technological capabilities with respect to textile recycling. However, even before you get to the issue of technology, it is important to have consultations and community engagement, as well as appropriate local collection infrastructures in place to divert clothing textiles from landfill so that they can be repurposed into new materials.

This will require reflexive investment not only in infrastructure but in stakeholder relations, something that is sorely lacking in many geographic contexts. It will also require clear boundaries regarding what is included in definitions of (clothing) textiles: for example, are items such as shoes and accessories, corporate uniforms, household textiles (such as bedding and towels) and/or industrial textiles included in such definitions? This is essential to develop the necessary recycling infrastructure and partnerships (between industry, consumers, charitable sector, private recyclers, municipalities, and local communities) to establish best practices in facilitating the diversion of waste to recycling facilities.

And third, our review has challenged us to reflect on strengths and limitations of the CE as a concept and way forward for addressing textile waste. On the one hand, garment utilisation has been made a focal point and policies and industry initiatives have developed to educate consumers about these practices. Increasingly, more stakeholders have come together to work towards a common goal. With the CE being intuitively understood, and as demonstrated, it is clear there are a variety of different approaches that can be taken. What is unclear, however, is whether all stakeholders have a common denominator that can act as clear baseline. Siderious and Poldner (2021), for example, further warn about potential re-bounce effects in that environmental

innovations of CE could be overshadowed by economic and behavioural mechanisms leading to increased consumption, while Liboiron (2021) has shown how even well-intentioned recycling initiatives risk reproducing structural violence with regards to land rights and colonial relations.

Similarly, we should ask ourselves what policies should be taken to ensure consistency. When it comes to responsibilities, should textile waste diversion and recycling practise be addressed at a local or municipal level or is it the national governments responsibility? This highlights a need to understand how different types of governance structures will impact local government's ability to enact CE approaches to waste. While there are certainly benefits of learning from different geographic contexts about what works and what does not work when it comes to addressing this complex issue, it remains essential to keep in mind a need to move beyond one-size-fits-all models and instead recognise local contexts, opportunities and challenges that will shape policy, and thus impact people, and planet.

5. Conclusion

This article was set out to address three key questions: first to explore responsibilities in tackling the textile waste issue; second, to provide an overview of current initiatives, and third, to highlight opportunities and challenges in conceptualizing CE practices through a stakeholder mapping approach. In addressing these key questions this article has made several contributions.

The first focuses on terminology in that recycling may be interpreted as a technological approach (chemical, mechanical, biological) or as re-cycling or re-looping garments and textiles to extend their useful life. Whilst these terms do exist, this paper demonstrates that they are often also used interchangeably, which can cause tension especially when seeking to address a common goal, namely 'recycling' of textiles. Although very different approaches are taken, the ultimate denominator in all reviewed policies and approaches was the diversion of textile waste out of landfill.

The second contribution lies within the mapping exercise itself, which not only highlights different stakeholders that play a key part within the 'recycling' process, but also demonstrates a power imbalance across, and within, geographic regions. While local, municipal, national, and supranational levels all play a key role, degrees of responsibility remain unclear.. Is it the local and municipal levels that should develop and maintain waste streams? This would imply that even if there are national guidelines, they may not have 'teeth': it depends on the 'lower' levels to uphold these. Without the necessary support, in, only some areas may be able to fully act.

Across the dominant take-make-use-dispose economy, fashion products are mostly produced at low cost to be sold at low prices. Under this model, there is a lack of incentives for certain stakeholders to invest in reducing post-consumer textile waste. While this issue has raised concerns across the board, from local to supranational levels, how it should be addressed remains a key question..

Whether considering textile consumer waste in pre- or post- consumer spaces, stakeholders must pay attention to ways in which environmental challenges are embedded within and across social issues. While we have identified four key stakeholder groupings within the literature (policymakers, fashion industry stakeholders, clothing textile recyclers, and actors from the non-for-profit sector), these broad groupings cannot fully capture the diverse, and divergent, nature of stakeholders working towards environmental stewardship, in varying degrees and capacities, across a multiplicity of spaces and temporalities.

Yet, this challenge brings opportunities for stakeholders working within decision making positions, whereby they must engage in critical reflections related to power dynamics within, across, and between, supranational, national, and local landscapes. We see challenges with different CE approaches and have highlighted these throughout. This implies that while a one-size-fits-all model may not be appropriate, tailored, approaches that meet different needs, at different times, may support meaningful change. To address the textile waste issue, we may need to look for solutions beyond the boundaries of the CE.

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