TRADE & INDUSTRIAL POLICY STRATEGIES

DESIGNING CLIMATE-COMPATIBLE INDUSTRIAL STRATEGIES FOR SOUTH AFRICA: THE TEXTILES VALUE CHAIN

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October 2022

TIPS supports policy development through research and dialogue. Its areas of focus are industrial policy, trade and regional integration, sustainable growth, and a just transition to a sustainable inclusive economy

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ABBREVIATIONS

BBBEE	Broad-Based Black Economic Empowerment
BCI	Better Cotton Initiative
CO_2	Carbon dioxide emissions
CSIR	Council for Scientific and Industrial Research
CTFL	Clothing, textiles, footwear and leather
DFFE	Department of Forestry, Fisheries and Environment (previously Environment, Forestry and Fisheries).
dtic (the)	Department of Trade, Industry and Competition
EC	European Commission
EU	European Union
EPR	Extended Producer Responsibility
GDP	Gross Domestic Product
GHG	Greenhouse gas
IDC	Industrial Development Corporation of South Africa
IPP	Independent Power Producers
NCPC-SA	National Cleaner Production Centre South Africa
NGO	Non-Governmental Organisation
PV	Photovoltaic
R-CTFL	Retail-Clothing, Textile, Footwear and Leather
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals (EU)
rPET	Recycled polyethylene terephthalate
SABS	South African Bureau of Standards
SAC	Sustainable Apparel Coalition
SACMHM	South African Coalition for Menstrual Health and Management
SACNU	South African Cloth Nappy Users
SACTWU	Southern African Clothing and Textile Workers' Union
SCAP	Sustainable Clothing Action Plan (UK)
SDG	Sustainable Development Goal
SME	Small and Medium Enterprises
SMME	Small, Medium and Micro Enterprises
SVHC	Substance of Very High Concern
TIPS	Trade & Industrial Policy Strategies
TFG	The Foschini Group
UK	United Kingdom
UN	United Nations
WTO	World Trade Organization

1. INTRODUCTION

The textile industry is one of the most complicated manufacturing industries. It is a fragmented and heterogeneous sector dominated by retailers and brands, and small and medium enterprises (SMEs) – Hasanbeigi, 2010.

The global textile market was estimated at US$655 billion in 2021, with a projected annual growth rate of 6% to 2025 (Research and Markets, 2021a). This growth is mainly due to recovery and restructuring post COVID-19 (Teodoro and Rodriguez, 2020). China, the European Union (EU) and India dominate textile exports (66% of total global exports), with clothing exports dominated by China, the EU, Vietnam and Bangladesh (72% of exports) (Lu, 2021). COVID-19 had an impact on the sector.

The South African retail, clothing, textile, footwear and leather (R-CTFL) value chain contributed R70 billion to South Africa's Gross Domestic Product (GDP) in 2016 (3% of total GDP) (Stats SA, 2018a). In the second quarter of 2022, the clothing manufacturing sector contributed an estimated R6.6 billion to the economy. During this same period, the clothing sector employed 216 000 people, down from 246 000 in the first quarter of 2020, but higher than the COVID-19 employment levels of 179 000 in the second quarter of 2020 (TIPS, 2022).

Within a global context, South Africa's role is predominately that of an importer of textiles, clothing and footwear (the dtic, 2020). However, it is also globally recognised as a producer of high-quality[1] wool, mohair and cotton, which is mainly exported for processing. The sector used to have a solid manufacturing base but, due in part to difficult manufacturing conditions and a huge influx of cheap clothing from Asia, the sector went into decline from the late 1990s (Statista, 2021; Stats SA, 2018a). While this decline characterises the manufacturing base, there are signs of upliftment, with South African retailers beginning to drive domestic sourcing to meet "just in time" availability, to mitigate global supply chain risks and exposure to currency fluctuations (Statista, 2021). Online sales of clothing are also on an upward trend, increased by COVID-19 (Githahu, 2020; UNCTAD, 2020). This is happening in conjunction with the sector being recognised for its ability to generate large-scale employment and therefore seen as a strategic priority for South Africa's industrial growth (Kionka, 2021; Statista, 2021). As such, the government launched the *South African Retail-Clothing, Textile, Footwear and Leather Value Chain Master Plan to 2030* in 2020, to transition the sector to one which is financially sustainable and dynamic, provides compelling products, and is invested in growing local procurement, capabilities and employment (the dtic, 2020a). While one of the Master Plan's objectives is to ensure the South African R-CTFL value chain is recognised as ethical and environmentally responsible, this is not elaborated on. In addition, none of the seven signatory commitments acknowledge climate change or environmental sustainability (the dtic 2020a; 2020b). See Appendix C for a full list of the Master Plan's commitments.

Globally, the current model of "fast fashion" or "just-in-time delivery" has steered the sector towards industrial and global mass production, enabling multinational companies to produce in one country and sell in another. This allows for the production and sale of very cheap clothes that

[1] It has been argued that while the quality is high, the method of production, particularly in the case of cotton is not as sustainable as it could be. For example, it is difficult for retailers to obtain or request South African grown Better Cotton Initiative (BCI) cotton (Key informant interview, 2022).

can also respond to quick changing trends, short life cycles and delivery times (Silvestri, 2021; Teodoro and Rodriguez, 2020). This model has resulted in the sector becoming one of the most polluting industries in the world (Ballikar, 2013; Silvestri, 2021), and is responsible for about 4%-10% (1.2 billion tonnes CO_2 per annum) of annual global greenhouse gas emissions (Fashion for Good, 2021; Remington, 2020; World Bank, 2019). It is also wasteful from numerous perspectives, including both during production, and end of life, with an estimated 21 billion tonnes of textiles landfilled annually (Silvestri, 2021), and 20% of global wastewater attributed to the sector (UNECE, 2018). In addition, many clothes are not worn for their full lifespan (under-wearing) and recycling rates for clothing are low – an estimated 13% globally (Ütebay, Çelik and Çay, 2020; Silvestri, 2021).

This perspective makes it clear that the business model of the textiles value chain is unsustainable and requires a significant shift to transition it to one that is low-carbon and less environmentally impactful.

There is general consensus that the South African textiles sector, as with its international counterparts, should focus on:

- Reducing pollution, as well as chemical, water and energy use;
- Adopting circular reuse and recycling economic models;
- Shifting towards more local production to create jobs and to build supply chain resilience; and
- Shifting towards the use of more natural fibres.
- Reducing the use of hazardous chemicals and improving water management;
- Optimising manufacturing energy efficiency and consumption;
- Fibre-to-fibre recycling;
- Reducing single-use sanitary wear;
- Adopting clothing and footwear leasing models, and
- Increasing the market for legal, domestically-traded, second-hand clothing.

The above should be done within the context of keeping and increasing decent jobs in the country.

While the dominant trend in the sector is to place products on the shelf quickly and/or cheaply, preference towards sustainable practices and products is increasing, with both retailers and manufacturers beginning to better understand the impact of their products both socially and environmentally, and to adopt low-carbon and sustainable practices and standards.

Internationally, an emphasis on sustainability within the clothing sector saw a shift around 2010, with the establishment of the Sustainable Apparel Coalition in 2009 and the release of the Higg Index[2] in 2011. In the same year, Greenpeace published its first *Dirty Laundry* report, which exposed toxic water pollution associated with the textile industry in China, and linkages to many recognised multinational clothing brands (Greenpeace, 2011). These initiatives raised the concern, and need, to mitigate the sector's environmental impact, carbon emissions and poor labour conditions. Subsequent to this, there have been numerous regional and brand initiatives to mitigate socio-environmental impact. This initially focused on child labour and toxicity (water

[2] The Higg Index is a suite of tools which together are used to assess the social and environmental performance of textile value chains and the environmental impact of products (Sustainable Apparel Coalition, 2022).

pollution) and has shifted towards traceability and circularity in the value chain, and more recently carbon emission with, for example, the launch of the *Fashion Industry Charter for Climate Action* in 2018 (UNCC, 2021).

Within South Africa, the textile and clothing manufacturing industry has tended to focus its efforts on remaining cost competitive, albeit also taking into consideration technological improvements, identification of new markets and, in the main, compliance with employment and environmental standards. Major local retailers have begun to place an emphasis on transitioning towards sourcing from local manufacturers; switching to organic and Better Initiative Cotton (BCI); increasing recycled content; and adopting measures to reduce hazardous chemical use in textiles. Within manufacturing, there have been some efforts to reduce hazardous chemicals in dye houses, and to optimise water and energy use. More recently, the government has begun to investigate how best the sector can improve its sustainability with projects, for example, initiated by the National Cleaner Production Centre South Africa (NCPC-SA), through the United Nation (UN)-funded InTex project, the Council for Scientific and Industrial Research (CSIR), and GreenCape/City of Cape Town.

This report delves into the environmental sustainability of South Africa's textile value chain, with a focus on the manufacturing components of the value chain. The aim of the report is to inform the sector's path towards climate compatibility. Sections 2 and 3 provide a description of and introduction to South Africa's textiles value chain, with an emphasis on manufacturing activities in the country. This also provides a brief introduction to the main environmental impacts associated with South Africa's textiles manufacturing sector. Section 4 provides a set of proposed interventions to set South Africa's textiles value chain on a climate-compatible and sustainable pathway. These mitigation options focus on the manufacturing component of the value chain, or interventions that will directly impact and enhance manufacturing practices in the country.

These include:

- Reducing the use of hazardous chemicals and improving water management;
- Optimising manufacturing energy efficiency and consumption;
- Fibre-to-fibre recycling;
- Reducing single-use sanitary wear;
- Adopting clothing and footwear leasing models; and
- Increasing the market for legal, domestically-traded, second-hand clothing.

This is followed by Section 5, which presents a proposed action plan for how these interventions can be packaged and rolled out to decarbonise the South African textiles value chain. This is set within the context of and considering the implementation of the R-CTFL Master Plan.

2. TEXTILES VALUE CHAIN IN SOUTH AFRICA

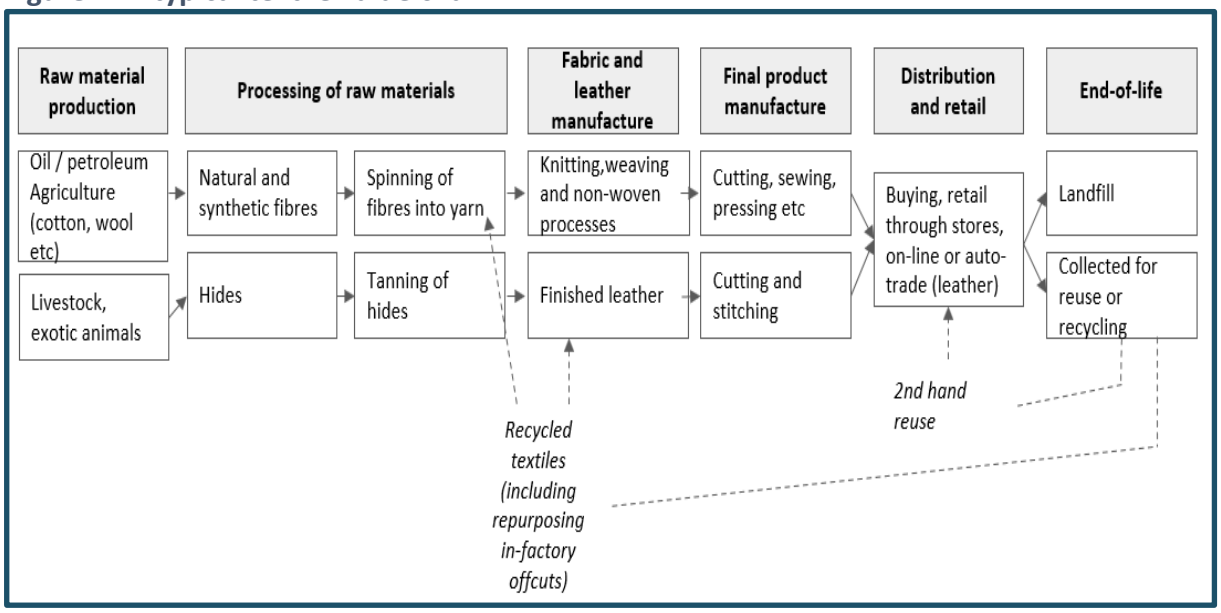
This section provides an overview of South Africa's textiles value chain, industry dynamics and market structure. Prior to delving into these, it is worthwhile providing a description of textiles and what this covers, as it is complex, and not a singular product or activity.

Textiles in the broadest sense can include clothing, textiles, footwear and leather (CTFL), all of which are recognised in South Africa's R-CTFL Master Plan (the dtic, 2020a). For the purposes of this report, the focus is mainly on textiles and clothing (often referred to as apparel). Textiles are a flexible material produced from natural or synthetic fibres. They are produced by weaving or knitting yarn into fabric or are non-woven and bonded by chemical or mechanical treatment. Textiles can be categorised into four main types, based on processing stage: raw materials, fibres, yarns, fabrics and finished products (e.g. clothing). The latter is classified into a number of broad categories: industrial technical (e.g. medical, outdoor, construction), clothing (e.g. formal and casual wear, uniforms), accessories (e.g. bags, gloves, zips), home and office (e.g. bedding, carpets and soft furnishings) and other (e.g. stuffing, toys) (GOTS and Textile Exchange, 2020; Notten, 2020) (See Appendix A for a detailed list of textile product categories). It should be noted that while paper-based products can fall within textiles, it is not within the scope of this work.

2.1. Textiles value chain and process

A textiles value chain contains numerous stages, including raw material production and processing, fibre and yarn production, tanning (in the case of leather), textile production and final product (clothing, footwear and accessory manufacturing). See Figure 1 for a typical textile value chain.

Figure 1: A typical textile value chain



Source: Authors, adapted from the dtic (2020a), Duke University (2022), Morris and Fessehaie (2012) and Notten (2020).

In the case of a fabric-based value chain, the first stage begins with fibre production (e.g. wool, cotton and leather), or crude oil extraction and chemical production for synthetic fibres. Once harvested or manufactured, fibres are spun into yarn. These yarns are processed into fabrics using a number of processes, most notably through weaving, knitting or non-woven.

Depending on the process, chemicals and lubricants are added to strengthen the yarn and to reduce friction. Prior to dyeing and printing fabric, pre-treatment may take place to prepare the fabric to accept dyes and functional chemicals. This can include washing, desizing, scouring or bleaching fabrics with detergents, solvents or bleaches. The fabric is then ready for dyeing and printing. Dyes can be applied at the yarn, fabric or clothing stages of production. Following the dyeing and printing stages, the fabrics may be treated to enhance the technical or aesthetic properties of the finished fabric, e.g. to make it flame retardant, water resistant or anti-bacterial. Once the fabric has been treated (if required), it is manufactured into finished products, such as clothing, industrial and technical, toys or accessories. Finished products are distributed for retail, from where consumers purchase products for use. Once used by the consumer, finished products are often landfilled and incinerated, or dumped on the markets of African countries. This either undermines domestic production capacity (including South Africa) or ends up in landfills in countries with less onerous environmental requirements (Goldberg, 2016; Hakeenah, 2021; Ugochukwu, 2020). In the case of leather-based products, hides are semi-processed and treated at tanneries. The hides are often exported for finishing into leather goods (e.g. bags and belts), footwear, or for the automotive industry and then distributed for sale (Memedovic and Mattila, 2008); Morris and Fessehaie, 2012).

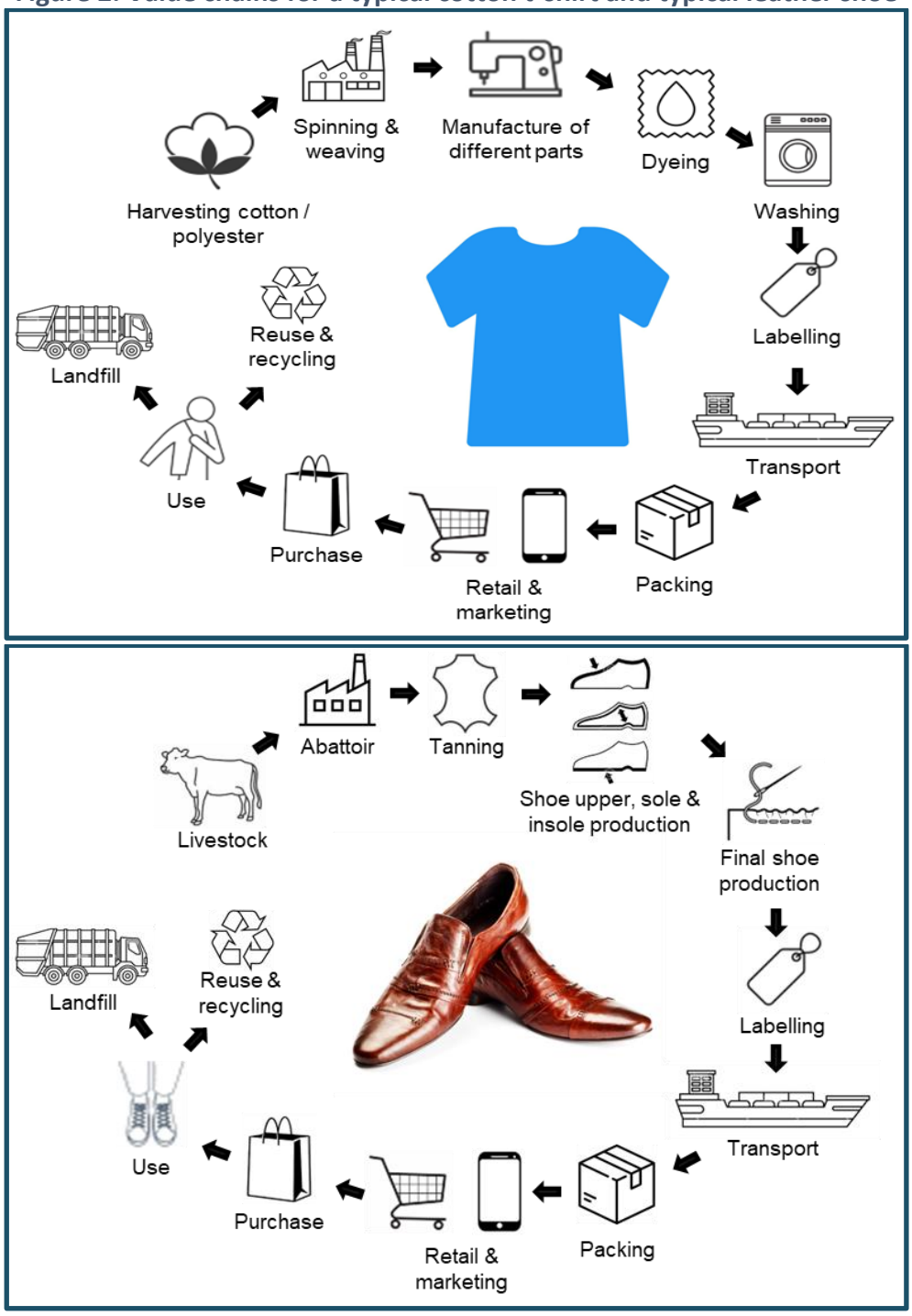
VARIANCE BETWEEN THE PRODUCTION OF A T-SHIRT AND LEATHER FOOTWEAR

By way of example, and to illustrate the variance in fabric and leather-derived products, the production process for a cotton shirt and leather shoe are presented in Figure 2.

The first process of t-shirt production is the cultivation, ginning (sorting, cleaning and baling) and spinning of cotton into yarn. Cotton is sourced from a number of countries, with China, India, United States and Pakistan accounting for nearly 70% of the world's cotton production (Khan et al., 2018; Turner, n.d.). South Africa does grow cotton, but much of this is exported (Key informant interviews, 2022; Van der Walt, 2020). The yarn is then woven into fabric, which is most likely exported to the place of t-shirt manufacture. The manufacturing process is either manual or automated, and involves pre-treatment, cutting, assembling, bleaching or dyeing, washing, softening, drying and application of finishing touches. Final products are exported or distributed locally to the retailer for sale to the consumer. Following use by the consumer, the t-shirt is most likely to be thrown away, or donated (Bhuiyan, 2016; Khan et al., 2018; Turner, n.d.).

In the case of producing a leather shoe, the first phase includes the farming of the animal from which the hide is obtained. Hides go through a tanning process, which includes curing, rewetting, dehairing and defleshing, (pre-)tanning and drying to transform it into leather (Cowley, 2019). The process for transforming the leather into a shoe includes die cutting shoe pieces, stitching and gluing the pieces together (which may include other non-leather components, such as soles), and finishing (SUGA, 2016). As with the cotton t-shirt, finished shoes are exported or distributed locally to a retailer for sale to the consumer. Following use by the consumer, the shoes are likely to be thrown away, mended or donated.

Figure 2: Value chains for a typical cotton t-shirt and typical leather shoe



Source: Authors, adapted from Bhuiyan (2016) and Germani, Mandolini, Marconi and Marilungo (2015).

The variances in value chains illustrates that no clothing or footwear process can be assumed to be the same, and that core factors of raw materials and the processes for cleaning, dyeing and washing will use, to varying degrees, chemicals, water and energy to produce the products. This also illustrates that the textile industry is one of the most complicated manufacturing industries. It is also a fragmented and heterogeneous sector dominated by retailers and brands, and SMEs that are often secondary and tertiary producers (Hasanbeigi, 2010; OECD, 2021).

2.2. The textiles industry in South Africa

Prior to South Africa's introduction to the world trading stage post-apartheid, the sector was focused on protecting domestic production, and mitigating competition from international trade and imports, primarily through high, product specific tariffs (Morris et al., 2021; Vlok, 2006). It is argued that this led to the sector becoming inefficient, with a focus on low value-add products and therefore uncompetitive when it entered the international market post-apartheid (Morris et al., 2021; Vlok, 2006). This coincided with a period when the South African Rand was strong, largely due to a global commodity boom until the late 2000s (Petousis, 2022; SARB, 2007). Since reintroduction into the international market, the sector has become more modernised with a focus on technology upgrades. Yet, the sector has witnessed significant fluctuations since 1994 with, for instance, the leather industry fluctuating substantially. A large part of this is because leather is inextricably linked to the automotive industry, and therefore shifts in relation to vehicle demand (Venter, 2015). Other reasons[3] given for industry decline are lack of demand; underutilisation of capacity; elimination of import quotas; termination of bilateral quotas negotiated under the Multifibre Arrangement; China flooding the market with cheap clothing when it joined the World Trade Organization (WTO) in 1995; and more recently the effects of the COVID-19 pandemic, which saw a 20% decline in sales and 30% in production volumes (Crotty, 2022; Cotton SA, 2017; the dtic, 2020a; Morris et al., 2021; South African Market Insights, 2021). While these difficulties have been faced by the sector, it should be noted that the South African government has invested in the textile industry through various programmes to help it upgrade and modernise, to ensure it remains globally competitive (Research and Markets, 2021; SA Government, 2021a).

As indicated, and given the decline in manufacturing capacity, South Africa is a net importer of textiles and finished products (TIPS, 2021). See Table 1 for the top imported and exported products (by trade value) associated with the broader textile sector in 2020. In the main, raw products, such as wool, cotton and hides are exported, and clothing and footwear as finished products are imported. In 2019, R35.9 billion worth of clothing was imported (compared to R5 billion in 2000), of which about 58% was from China (South African Market Insights, 2019). In comparison, locally manufactured clothing is an estimated R25 billion.

Of the total imported, about three-quarters is declared (GreenCape, 2019; Smith, 2021). This points to a high degree of illegal importation of clothing and footwear into the country. This high rate of illegal trade (mainly counterfeit or brand copies) and cheap imports from Asia continue to put pressure on an already constrained manufacturing sector (Key informant interviews, 2022; Research and Markets, 2022). While illegal trade is considered a concern, it has been acknowledged that South African customs and border police are becoming more effective at detecting and detaining containers and small consignments of counterfeit goods. However, goods do filter through (Budeli, 2021; Key informant insights).

[3] Key informants refer to interviews undertaken with individuals operating within South Africa's textiles sector, including government, industry and industry associations, union and civil society e.g. non-governmental organisations (NGOs).

Table 1: Imports and exports associated with the broader South African textiles sector in 2020, by trade value

PRODUCT	US$ (MILLION)
Top 10 imports	
Other cloth articles	505
Non-knit men's suits	286
Rubber footwear	271
Non-knit women's suits	254
Textile footwear	246
Leather footwear	223
Trunks and cases (leather)	188
Knit t-shirts	178
Light rubberised knitted fabric	144
Models and stuffed animals	123
Top 10 exports	
Wool	264
Tanned equine and bovine hides	120
Other cloth articles	71.5
Prepared wool and animal hair	50.8
Mattresses	40.8
Non-knit men's suits	44.5
Unprocessed synthetic staple fibres	35.4
Awning, tents and sails	35.3
Leather footwear	33.2
Non-knit women's suits	33.1

Source: Authors, derived from OEC (2021).

The South African textiles manufacturing sector is characterised by about 20 large firms, a high number of small- and micro-enterprises, and informal operations (Research and Markets, 2018). In 2018, it was estimated that 800 clothing manufacturers operated in the country, and generated revenue of R19 billion, with a retail sales value of clothing, footwear and textiles of more than R175 billion (Veitch, 2019). While it is difficult to ascertain clear figures on market share, some of the main players in the sector are identifiable (see Appendix B). Most manufacturing activities are located in Kwa-Zulu Natal, Gauteng and the Western Cape, with fabric production and finishing (e.g. dyeing) predominantly undertaken in the former, and all stages of manufacture in the Western Cape (CCTC, 2022; GreenCape, 2019; KZN CTC, n.d.; TIPS, 2021). The prominent manufacturing activity is general knitted clothing and sportswear, with less fibre milling (due to

closures) and leather processing and manufacture (Berman-Jacob, 2020; Key informant interviews, 2022). A few, albeit it large, manufacturers specialise in protective and technical clothing, and outdoor products and accessories.

It is suggested that most clothing and shoe manufacturers employ on average fewer than 500 workers, with around 20 manufacturers between 500 and 3 000 employees (TIPS, 2021). It is also worth noting that the sector employs a high number of women – more than 26% of all women manufacturing workers (Research and Markets, 2018; TIPS, 2021).

An important characteristic of the South African textile sector, relevant to employment, is the role of the Southern African Clothing and Textile Workers' Union (SACTWU) and the Bargaining Council. According to Morris et al., (2021, p11), which noted the following: "The industry was also caught in an industrial relations bargaining trap based on a process of rigidifying labour markets and the introduction of a nationally centralised bargaining council system. This drove a strategy of raising wages and closing the gap between the metro and non-metro wage levels, resisting management attempts to dilute historically inherited operational systems, and pursuing firms deemed to be non-compliant in terms of wage and other benefits requirements. The latter included government rendering firms deemed to be non-compliant and ineligible for various industry support and training schemes."

One of the contradictions of the South African textiles sector is the low use of locally produced natural fibres, with some fibres, such as BCI cotton, being imported from Zimbabwe (for instance). This is contradictory to South Africa having a reputation for producing world-leading cotton lint and mohair (50% of global production) (Better Cotton, 2022; Cotton SA, 2017; Louw, n.d.; Mohair South Africa, n.d.). However, most of this is exported, and is very likely to find its way back into South Africa as imported fabric or clothing (Cotton SA, 2017; Key informant interviews, 2022).

The South African retail sector may be the key to leveraging a shift in the use of locally produced fibres, especially given its commitment through the launch in 2019 of the South African R-CTFL Master Plan, which includes ambitions to reignite local production and manufacturing to 65% of total retail sales by 2030 (an additional 85 million units of clothing, leather goods and footwear) (the dtic, 2020a). The intention is to thereby stimulate an increase in employment to almost 320 000 (Crotty, 2022; the dtic, 2020a; PMG, 2020; Research and Markets, 2021b). Examples of signatory entities to the R-CTFL Master Plan include The Foschini Group (TFG), Pepkor, Edcon (no longer in existence), Mr Price and Woolworths. Additional objectives include enhancing the value chain's cost, process and product competitiveness, embracing new technologies, improving financial returns to improve local investment, and to advance management, technical and operator skills to achieve economic growth and local capability (the dtic, 2020a). See Appendix C for a detailed list of the Master Plan commitments. This reference to retail indicates the significance of the South African retail clothing and footwear sector as the key driver of demand in the sector. It is recognised that the textiles value chain is retailer and established brand owner led, which set their final product specifications and needs, which in turn drive the demand and sourcing of fabrics and finished products (Duke University, 2022; Key informant interviews, 2022). It is estimated that 21% of South African retail revenue is attributed to textiles (including clothing and footwear) (Gaille, 2018). This equates to approximately 0.5 million tonnes of fabric, and 1.2 billion items of clothing (GreenCape, 2019). However, a decline of 20% in sales was witnessed during the COVID-19 pandemic (Research and Markets, 2022).

3. MANUFACTURING TEXTILES, CLIMATE CHANGE AND ENVIRONMENTAL IMPACT

The textiles industry is a major contributor to climate change and creates significant environmental impacts through resource depletion, air and water pollutants, energy and hazardous chemical use. At 1.2 billion tonnes of CO_2 per annum (about 10% of total global emissions), the industry is considered to be one of the largest greenhouse gas (GHG) emitters in the world – greater than international flights and maritime shipping combined (Anon., 2018; Huitema, 2020; Rana et al., 2015; World Bank, 2019). Of these emissions, one-third are suggested to arise in China (Carbon Trust, 2011). The industry's contribution to global GHGs is set to increase, especially if the projections of a 63% to 81% increase in clothing consumption between 2018 and 2030 are realised (Lehmann et al., 2019; Munasinghe et al., 2021; Remington, 2020).

Given the variations in different textile and leather-based products, CO_2 emissions therefore also vary along the value chain stages, as illustrated in Table 2. The washing of clothing in-home by the consumer, the textiles dyeing and finishing, and the leather tanning process in comparison to other fibres and production stages, generate the most GHG emissions per kg of product (Carbon Trust, 2011). It should be noted that, while these climate change and environmental impacts are indicated, they mainly occur outside South Africa – unless processing and manufacturing takes place locally. As such, it is important to acknowledge that the trade of textiles and associated products has a major impact on the net import or export of emissions embedded in clothing.

Table 2: Examples of greenhouse gas emissions and environmental impacts associated with different stages of textiles production

VALUE CHAIN STAGE	ITEM	GHG EMISSIONS (KG CO2EQ/KG)	ENERGY USE (MJ/KG)	WATER USE (L/KG)
Raw material	Cotton production (Africa)	0.87		3 400
	Merino Wool (Australia)	19.46–25.04	7.18–22.39	204–394
	Wool (general)	2.2	63	125
	Polyester (China)	3.1	53.64	130*
Yarn spinning	Cotton	3.84–4.05	0-52.28	0
	Wool	4.5	-	-
	Polyester	2.8–4.56	40.2-58.46	-
Yarn dyeing	Cotton	-	7.2	180
	Wool (Open winch-traditional acid dyeing)	2.9	15.3	90
	Polyester (Modal–spin dyeing)	-	21.6	43
Leather tanning	1.2 mm Chromium tanned leather (Spain)	27.31	327.69	1 485.52
Fabric knitting	Cotton (general)	0.64–0.97	1.28–10.24	0
	Wool	1.76	-	-
	Polyester	0.882–7.08	-	-

Fabric weaving	Cotton	-	19.76	-
Fabric dyeing	Cotton	2.52–17.3	6.34–26.98	23-185
	Wool (conventional dyeing)	7-10	108	40
	Polyester	8.8		
Clothing manufacture	Cotton blouse	6.37	2.34	6.02
	Polyester jacket	0.22	2.92	-
Consumer washing****	Cotton at 40C	28.26	**51.84	**621
	Wool at 30C	3.195	***37.26	***805.5
	Polyester	34.65	634.95	

Source: Authors, derived from Parsons (2022) and Sumner (2020).

*Western Europe; **Cotton at 49.7C; ***Wool at 25C; ****emissions associated with 45 wash cycles.

Most GHG emissions are associated with energy use (Carbon Trust, 2011), which is mainly attributed to the washing of textiles, and 15%-20% attributed to the production process, notably machine use, cooling, temperature control, lighting and office equipment (Munasinghe et al., 2021; Rana et al., 2015). As per Table 2, the production and spinning of polyester, tanning of leather, and washing of cotton and polyester are associated with the highest levels of energy use (Munasinghe et al., 2021).

The textiles industry is also water intensive, consuming about 79-93 billion cubic metres of water per annum (Anon, 2020; Helps, 2021; Hudd, 2022). During the textiles manufacturing process, for example, most dyes and chemicals are applied in water baths, and processes for designing, scouring, bleaching and mercerising often require water-reliant systems (Kumar and Pavithra, 2018; Johnson, 2020). The use of water, as illustrated in Table 2, can vary greatly depending on the raw material source, production process, especially dyeing and finishing, and in-home washing practices (Fibre2Fashion, n.d.). For example, the production of cotton, tanning of leather, and clothes washing consume the largest volumes of water within the sector's value chain activities. In comparison to other textiles, the processing of leather is particularly water intensive. The pre-tanning and tanning operations consume about 57% of water during the leather process, and washing about 35% (Rao et al., 2003).

Directly linked to water use is the chemicals used during the textiles production process, and associated water pollution. More than five trillion litres of water are used globally for the dyeing of textiles per annum (Hasanbeigi, 2017). Chemicals are commonly used during the manufacturing of textiles, clothing and leather production, with many of these being hazardous to both humans and animals (Hudd, 2022; Tounsadi et al., 2020; Tsai, 2019). An estimated 8 000 chemicals are used during various stages of the textile manufacturing process (Nimkar, 2018). These chemicals are used to clean fibres, whiten fabrics, for ease of care (e.g. no wrinkles, odour control), and to colour fabrics (Pure Chemicals, 2015; Tsai, 2019). If not managed correctly, chemicals can enter liquid effluent which in turn can be released into rivers and oceans, as well as pollute soil (Hudd, 2022; Uddin, 2018). It is suggested the textile dyeing industry contributes 20% of global water pollution (Hasanbeigi, 2017; Hudd, 2022; Johnson, 2020). The hazardous nature of this pollution, which is well acknowledged, can have a catastrophic effect on river and ocean biodiversity (Bagayas, 2021; Greenpeace, 2011; Hasanbeigi, 2017; Hudd, 2022; Nimkar, 2018; Tony, 2021). If not managed properly, the leather tanning process can be equally polluting. Pollutants include

chromium and nitrogen, which can contaminate groundwater up to seven to eight kilometres from a tannery (Hutton and Shafahi, 2019; Mondal, Saxena and Singh, 2005).

Another key impact associated with textile production is waste, with an estimated 92 million tonnes of textiles waste generated globally per annum and is expected to increase to 134 million tonnes per annum by 2030 (Beall, 2020). In association with clothing wastage, is its longevity of use, with estimates suggesting that purchased clothing is only worn for 40% of its lifespan, and only 12% of clothes in a wardrobe are worn, before being thrown away (Beall, 2020; Souchet, 2019). Of these unused items of clothing, globally about 73% are landfilled or incinerated end of life (Souchet, 2019), and only 13% of textiles are recycled, with less and 1% recycled back into clothing (GreenCape, 2019; Raij, 2019).

4. PROPOSED INTERVENTIONS TO DECARBONISE SOUTH AFRICA'S TEXTILES VALUE CHAIN

4.1. Numerous solutions and interventions

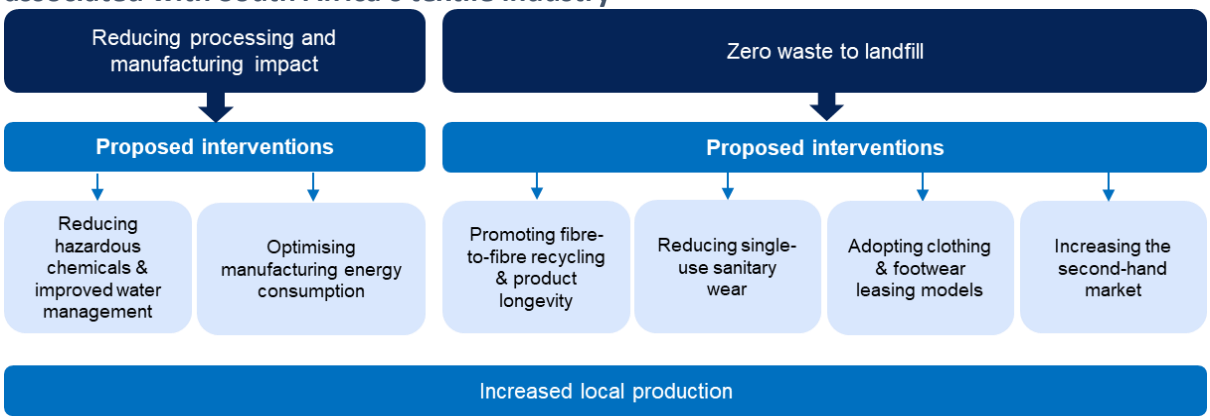
To facilitate change in the South African textiles sector, looking to international policy and initiatives as a guide proves useful. The recently published EU's strategy for sustainable and circular textiles sets a target to achieve carbon neutrality by 2050, and a 50% reduction in GHG emissions by 2030 (European Commission, 2022b), which aligns with the United Nations Climate Change Fashion Industry Charter for Climate Action's ambition for net zero emissions by 2050 (UNCC, 2021). Other notable initiatives focus on interventions and tools to support intervention implementation, such as the Sustainable Apparel Coalition (SAC), and the Ellen MacArthur Foundation, which support a circularity agenda, and advocate for policy or standards to leverage the textiles industry to transform. Numerous interventions are proposed within these initiatives, covering, for example, clothing labels to identify textile composition, social and environmental measurement tools and indicators, a shift to renewable energy, reduced use of hazardous substances, clothing reuse, water reduction (growing and manufacturing) and wastewater reuse solutions, waste reduction and increased recycling (Ellen MacArthur Foundation, 2017, European Union, 2021, SAC, 2022).

Drawing on the literature and key informant interviews, two main themes of mitigation and adaptation for the South African textiles manufacturing sector emerge. These are the reduction of processing and manufacturing impact, and zero waste to landfill. Within these two strands of activity are the following proposed "industrially" scalable textile (1-3) and clothing (4-6) interventions (see Figure 3):

1. Reducing the use of hazardous chemicals and improving water management;
2. Optimising manufacturing energy efficiency and consumption;
3. Fibre-to-fibre recycling;
4. Reducing single-use sanitary wear;
5. Adopting clothing and footwear leasing models; and
6. Increasing the market for legal, domestically-traded second-hand clothing.

While these proposed interventions are the core focus of this study, the significance of local sourcing and keeping and increasing local employment cannot be ignored, given that the R-CTFL Master Plan has set a target to source 65% of goods from local manufacturers by 2030 (the dtic, 2020a; Kew, 2020). Therefore, local sourcing is also acknowledged as an overarching intervention and/or context.

Figure 3: Proposed interventions to mitigate climate change and environmental impact associated with South Africa's textile industry



Source: Authors.

The focus for each of these proposed interventions is on the local South African textiles manufacturing and retail sectors within the textiles value chain: the latter due to the significant influence the retailers have in determining CTFL and therefore manufacturing activities within the value chain. This local focus aligns with the R-CTFL Master Plan localisation emphasis and the dtic's focus on the manufacturing component of the South African economy. As such, while it is recognised that manufacturing impacts associated with imported CTFL also exist, it is not the core focus of this study.

4.2. Proposed interventions to reduce processing and manufacturing impact

Globally, it is recognised that the process of manufacturing textiles contributes significantly to the textiles value chain GHG emissions and environmental impact (water use and pollution, energy and chemical use, and waste) (see e.g. European Parliament, 2022; Notten, 2020; UNCC, 2021; UNEP, 2020). This also applies to South Africa (see e.g. AfDB, 2019; GreenCape, 2019; Hoskins, 2015; NCPC, 2021). Within the theme of reducing processing and manufacturing impact, two scalable and viable interventions are proposed as areas of focus:

- Reducing the use of hazardous chemical and improving water management; and
- Optimising manufacturing energy consumption.

4.2.1. Reducing the use of hazardous chemicals and improving water management

The textile industry uses about 8 000 different chemicals, including heavy metal-based dyes and fixing agents, bleaches, solvents and detergents. Most are used during the pre-treatment process, which includes dyeing, printing and finishing (Nijkamp et al., 2014; Notten, 2020; Scott, 2015). The fibre type determines both the processing steps and substances used. For instance, natural fibres require more chemical treatment – for softening and shrink-proofing – than synthetic fibres (Nijkamp et al., 2014). When managed well, 70%-95% of dyeing agents should adhere to the fibres. The dyeing process uses soluble dyes and insoluble pigments to colour textiles. Binding agents are used during the printing process to adhere pigments to fabrics. The finishing process involves application of chemicals to treat textiles to improve comfort (e.g. softening), functionality (e.g. water and fire resistance) and aesthetics (e.g. bleaching) (Nijkamp et al., 2014).

If not managed properly, discharge of hazardous chemicals during these processes can be detrimental to aquatic systems, and worker health (Bagayas, 2021; Greenpeace, 2011; Nijkamp et al., 2014; Ranasinghe and Jayasooriya, 2021; Tony, 2021). Discharge into water sources from dyeing textiles is significant, with the sector contributing 20% of global water pollution (Hasanbeigi, 2017; Hudd, 2022; Johnson, 2020). Given the scale, and pressure from NGOs, such

as Greenpeace (2011), major brands, retailers and clothing and footwear manufacturers are either stipulating, adopting or adhering to non-hazardous chemical standards and regulations. In turn, chemical companies are responding to this demand by developing less hazardous textile processing chemicals or concentrated versions (Key informant interviews, 2022; Scott, 2015).

A key intervention to reduce the use of hazardous chemicals in textiles manufacturing, and therefore mitigate water pollution and human health concerns, is the adoption of hazardous substance regulations and standards. While some South African retailers have begun to adopt hazardous chemical restriction lists, the proposed intervention is to scale the adoption of hazardous regulations and standards on both imported and domestically-produced CTFL. It is proposed that emphasis is initially placed on high-volume clothing items, such as clothing for infants, school and work uniforms (e.g. public and private branded firmware, healthcare, correctional services, police and military ware). This focus would provide a market pull to influence South African buyers, through procurement of CTFL (both imports and locally produced goods), to specify the use of non-hazardous chemicals.

To aid in the specification of reduced hazardous chemical use, three mechanisms for intervention can be considered for adoption:

- Regulations and restricted substances lists;
- Procurement guidelines; and
- Use of eco-labels.

The most prominent set of regulations is the *European REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) Regulation (EU) No. 1907/2006.* It aims to improve the protection of human health and the environment through the early detection of chemicals in products, registration, evaluation, authorisation and restriction of chemicals produced. Article 33 of REACH requires suppliers to respond to requests confirming whether their product contains any substance of very high concern (SVHC). In 2018, this regulation was amended to restrict the use of certain chemicals in products, notably those that have carcinogenic, mutagenic or toxic reproduction qualities. The responsibility to manage risks from chemicals and provide safety information is placed on the industry, which requires manufacturers and importers to gather information on the chemical substances they deal with (Anthesis, 2018; European Commission, 2018; Nijkamp et al., 2014; Notten, 2020). Given that many of the clothes imported into South Africa are sourced from China, it is important to acknowledge China's "MEE Order 12", which is similar to REACH. Chemical manufacturers and importers are required to submit notifications and obtain approvals before producing or importing chemicals (Tsai, 2021). While neither of these regulations target the textiles industry specifically, many textiles companies develop or adopt restricted substances lists to provide their suppliers with guidance on chemicals they wish to restrict during the manufacturing process (Tsai, 2019).

As the textile industry is predominantly buyer driven, procurement guidelines can also provide the pull through to drive demand for textiles using reduced hazardous chemicals. An example of good practice is the European Commission's Green Public Procurement criteria for textiles, which aims to direct public purchasing towards environmentally friendly textile products and services such as uniforms, workwear and personal protective equipment (European Commission, 2011). Procurement guidelines can also be adopted for particular sectors, such as the healthcare sector. An example includes the UN's One Planet green procurement guide for the healthcare sector, which encourages green criteria, including for chemicals, in contracts (Watson and Fisher-Bogason, 2017).

To respond to these regulations and guidelines, dye houses and textile manufacturers have begun to adopt technologies and solutions to:

- Replace, reuse or reduce dye use (e.g. using lasers to finish jeans, digital printing and dyeing, bio-based dyes);
- Use new materials that reduce chemical use (e.g. leather alternatives); and
- Reuse wastewater and effluent (e.g. treat water for in-factory reuse, or to produce added value products, such as building materials) (Adams, 2022; Safer Made, 2018; Tsai, 2021).

The consumer angle is labelling textiles-based products to indicate environmental credentials and therefore inform purchasing decisions. With more than 100 ecolabels of relevance to the textiles industry, this can be a complicated intervention to adopt. In addition, ecolabels – while having laudable intentions to change consumer behaviour – can be problematic. Well-regulated ecolabels often carry a cost; there use carries the potential for "greenwashing"[4]; and a proliferation of ecolabels can result in poor consumer recognition or confusion, and therefore inaction (Blakkarly, 2021; Brécard, 2014; Ranasinghe and Jayasooriya, 2021).

SOUTH AFRICAN ACTIONS TO MITIGATE THE USE OF HAZARDOUS CHEMICALS AND WATER POLLUTION IN THE TEXTILE MANUFACTURING PROCESS

A number of South African CTFL retailers and manufacturers have started to shift towards adopting approaches and technologies to reduce chemical use and improve water management during textiles manufacture, for example:

- **Dyefin Textiles**, a leading South African commission dyeing, printing and finishing plant, has introduced technologies to reduce water use, and to improve the purification of water released into the environment. In addition, it uses new formula dyes, which require less dye to achieve the same colour as previous dyes (Dyefin Textiles, 2022).
- **The Foschini Group** has been working with one of its denim suppliers to use less water and fewer chemicals in its Redbat brand. The suppliers recycle water, reusing it in the manufacturing process; and in the case of chemicals, the spraying of potassium permanganate has been replaced by laser finishes (TFG, 2021).
- **Woolworths** has implemented a chemical detox strategy, which focuses on eliminating 11 priority chemicals. As part of this "detox" all forms of sandblasting denim have been banned (Woolworths, 2016; n.d.).

While these efforts are acknowledged, additional evidence-based scaled effort is required by retailers and manufacturers to better understand the levels of hazardous chemicals used in the textile- and leather-based products they sell. With water reduction, this includes working with suppliers to adopt water reduction and purification measures to reduce use and improve the quality of water released back into the environment. Given the complexity of the supplier base, it is recognised that this will take much effort. A potential strategy to support retailers and manufacturers is to include the reduction of hazardous chemicals, water usage and pollution in the implementation of the R-CTFL Master Plan, particularly in Commitment 5 which aims to increase investment and upgrading of the CTFL value chain to drive competitiveness and productivity (the dtic, 2020a).

Table 3: provides an overview of the potential social impact assessment and cost considerations associated with key actor groups for this intervention.

[4] 'Greenwashing' refers to the use of false or exaggerated environmental claims (Edwards, 2022).

Table 3: Socio-economic implications associated with the adoption of a reduction in use of hazardous chemicals and improving water management in the South African textile value chain.

STAKEHOLDERS	IMPLEMENTATION REQUIREMENTS	EXPECTED BENEFITS	EXPECTED COSTS
Manufacturers (clothing)	- Adopt EcoIndex standards / REACH (or similar) - Request / understand chemical usage and management (e.g. pollution) in textiles procured - Work with suppliers to phase out textiles that do not meet standards - Chemical audits of textiles manufacturers	- Reduction in usage of hazardous chemicals in clothing manufactured - Reduced water pollution - Local manufacturers gain access to more locally suitable, sustainable textiles - Possible increased market (in South Africa and international)	Standards licence Audit costs / lab testing Possible reduced clients (those not interested in reducing use of hazardous chemicals) Reduced textiles options, therefore higher cost textiles purchased
Manufacturers (textiles)	- Adopt EcoIndex standards / REACH (or similar) - Reduce hazardous chemical usage in and improve management of dyeing textiles with dye houses - Lab testing of textiles to assess levels of hazardous chemical use - Chemical audits of facilities used for dyeing	- Reduction in usage of hazardous chemicals in textiles manufactured - Reduced water pollution and improved water quality - Reduced worker exposure to hazardous chemicals - Possible increased customer market, especially with sustainably conscious designers, and retailers with environmental targets	- Standards licence - Audit costs / lab testing - Cost to switch to dye house adopting chemical reduction and new dye technology, and water pollution reduction interventions - Installation of water treatment plants / technologies
Dye houses	- Adopt EcoIndex standards / REACH (or similar) - Reduce hazardous chemical usage / transition to less toxic dyes / more concentrated dyes that require less dye volume	- Improved worker, local community and biodiversity health (handling of hazardous chemicals, water pollution) - Cleaner water for in-production usage	Standards licence Lab testing Upgrading/installing new technologies to reduce water usage and pollution outputs Switch to new chemicals / dyes (may be more costly)

	- Lab testing of dyes/textiles for customers - Reduce / mitigate water pollution from dye houses - Adopt water purification and reticulation technologies for in-house use of recycled water and release of clean water into the environment	- Possible increased market from retailers and clothing manufacturers	
Retailers	- Adopt EcoIndex standards / REACH (or similar) - Adopt chemical 'detox' lists which prioritise Top 10 chemicals to reduce in textile-based products - Request / understand chemical and water usage and management (e.g. pollution) in textiles procured (traceability) - Phase out clothing that does not meet chemical standards - Audits of facilities used for dyeing	- Benefit of understanding what is in clothing (enhanced traceability) - Enhanced corporate social investment, and potential middle- to high-income market share - Meet internal targets	Lab testing and audits Possible increased cost in sourcing clothing and footwear from a smaller manufacturing base Market segment and scale dependent, possible increase in retail prices leading to reduced sales
Middle to high income consumers	- Better understand the importance of purchasing clothing with reduced hazardous chemicals to make informed decisions	- Enhanced understanding and knowledge of what is in clothing - Possible improved long-term health (carcinogens etc.)	Possible increase in clothing and footwear price
Low-income consumers	- Responsibility of the retailers to ensure clothing sold in volume meets required standards	- Conscious parents having more options for their children - Possible improved long-term health (such as carcinogens)	Possible increase in clothing and footwear price
Government	- The dtic to ensure hazardous	- Significant potential to lever a	Cost to update / develop guidelines and

	chemical reduction and traceability are included in the R-CTFL Masterplan - Government to consider developing hazardous chemical guidelines for the sector - Government procurement of corporate wear, school uniforms, etc. seen as priority for garments with reduce chemical use - DFFE (Department of Forestry, Fisheries and Environment) to improve monitoring and enforcement of water pollution legislation	reduction in usage of hazardous chemicals in large volume of work wear / school uniforms - Through R-CTFL Masterplan ability to shift signatories (collective) - Reduced water pollution, enhanced aquatic and soil biodiversity	policy Cost to adopt and improve hazardous chemical reduction enforcement Cost to improve water pollution enforcement

4.2.2. Optimising manufacturing energy consumption

Energy use is the main contributor to GHG emissions in the textile value chain (Carbon Trust, 2011), of which an estimated 80% occurs during manufacturing, in particular the wet processing stages of dyeing and finishing (Chrobot et al., 2018; Munasinghe et al., 2021; Notten, 2020; Rana et al., 2015).

For clothing manufacturing, about 34% of energy is consumed during the spinning process, 23% weaving, 38% chemical processing, and 15% for sewing activities (Godiawala et al., 2014; Industrial Energy Accelerator, 2020; Hasanbeigi, 2010; Prince, 2008). For the production of leather footwear, tanning contributes 5%-35% of GHG emissions (a proxy for energy use) (Chrobot et al., 2018). This energy consumption is attributed to driving machinery, cooling, temperature control, lighting and running of equipment (Hasanbeigi, 2010; Rana et al., 2015; The Conscious Challenge, 2019). In a country such as South Africa, such large energy usage is compounded by high and ever-increasing energy costs (up to 30% of total operating costs), instability and inconsistency of supply due to loadshedding and power failures, and dependence on coal as the main source of fuel (Bezuidenhout and Ramutumbu, 2021; Cock, 2019; ESI Africa, 2020; Nkhonjera, 2022).

Two key interventions regularly cited to mitigate energy consumption and reduce carbon emissions within the industry are 1) the adoption of in-factory energy efficiency measures; and 2) switching to renewable energy.

Lehmann et al. (2019) estimate that energy management improvement in the global textiles sector could realise a net potential value of R993 billion, and 90 million tonnes of GHG emissions by 2030 (Berg et al., 2020).[5] Berg et al. (2020) suggest that about 45% of GHG emissions savings can be derived from energy efficiency improvement in raw material production, preparation and processing. Most in-factory energy efficiency solutions are considered to be cost-effective and, in the case of South African manufacturers, are often already implemented as a business cost-saving strategy (Key informant interviews, 2022). However, it is recognised that little information is available on energy used by the South African textiles sector, whether it is adequately monitored, and the nature of the machinery used (which could be old). Therefore, opportunities to adopt latest practices or technological solutions may not always be implemented – due to lack of information and/or cost (Hasanbeigi, 2010; Key informant interviews, 2022).

Proposed energy efficiency improvement opportunities can include the implementation of:

- In-house energy management programmes – these are considered to be one of the most successful and cost-effective ways to reduce energy use through the identification and implementation of energy efficiency improvements. A plan or programme can set a baseline from which a basis of continuous improvement can be implemented and monitored (Hasanbeigi, 2010);
- Electrical demand control (Hasanbeigi, 2010);

[5] This assumes a 30% energy efficiency improvement across heating, ventilation and air conditioning-related equipment and an around 20% efficiency improvement in sewing machines through new technologies and equipment upgrades (Berg et al., 2020).

- Machinery maintenance and repair to prevent leaks and maintain optimal functioning (Parvez, 2018);
- The upgrading, modification and installation of efficient electric motors; lighting; and compressed air, pumping, fan, lighting and steam systems (Berg et al., 2020; Hasanbeigi, 2010; Key informant interviews, 2022; Lehmann et al., 2019; Parvez, 2018). Studies suggest that old, inefficient machinery contributes to 20%-32% of energy wastage in a textile plant (Hasan & Leonas, 2018);
- Adoption of technologies or technical solutions in high-energy intensity stages to reduce energy consumption, including for example thermal insulation of pipes, tanks, fittings and machines; installation of online combustion gas analysers to reduce boiler efficiency and automatic control systems to tailor boiler blowdown rates (each of these realising a saving of about 16t CO_2 per annum); and day-light harvesting (potential to reduce factory lighting load by 20%) (Godiawala et al., 2014; Industrial Energy Accelerator, 2020; Hasanbeigi, 2010); and
- Collection and recycling of heat energy generated through production processes (Lehmann et al., 2019).

Shifting to renewable energy is also identified as an imperative for the global textiles sector to transition to one which is low-carbon and sustainable (Berg et al., 2020; European Commission, 2022a; UNCC, 2021). Berg et al. (2020) suggest that 39% of GHG emissions in the sector can be mitigated by transitioning to renewable energy. Notable retailers and brands, such as Asics, H&M, Burberry, Chanel, Kering and Nike have made in-house or global initiative renewable energy commitments e.g. through the RE100 initiative[6], which commits signatories to using 100% renewable energy across their global operations (RE100, 2022).

With renewable energy now on the South African government's agenda (Akinbami et al., 2021; DMRE, 2019), the textile industry has the opportunity to consider renewable energy as a viable electricity source. With rising demand, renewable energy technologies have become more viable financially, and technologies have improved over the years (Evans, 2021). In particular, the South African textile industry has the potential to tap into the vast potential of solar power to provide efficient and cost-effective energy (Evans, 2021).

By way of example, the textile industry in India is considered to be one of the most advanced in using solar technologies, and as a result has contributed significantly to the growth of clean energy in the country (Saur News Bureau, 2017). South African textile and clothing manufacturing operations, if using under 100MW of electricity, could procure renewable energy from Independent Power Producers (IPP) (Montmasson-Clair, 2022). GreenCape suggests that such a switch, to solar photovoltaic (PV), could "help South African businesses save ~15% in electricity costs, with systems paying for themselves within three to 12 years of installation, providing free energy for nearly 15 years thereafter" (Strydom, 2019, p1).

With the South African textile industry heavily weighted towards imports, the sector should also consider either encouraging its suppliers in Asia (which is still heavily reliant on fossil fuels [Fabbrocino, 2021]) to switch to more renewable energy (as in India) or to shift towards sourcing textiles and clothing manufactured in plants using renewable energy.

[6] RE100 is a global corporate renewable energy initiative that brings together large and ambitious businesses to commit to 100% renewable electricity (RE100, 2022).

SOUTH AFRICAN ACTIONS TO REDUCE ENERGY CONSUMPTION IMPACTS DURING THE TEXTILE MANUFACTURING PROCESS

To illustrate types of energy reduction activities undertaken in the country, some examples are highlighted below.

Energy efficiency

- In partnership with the NCPC-SA), **Narrowtex** (a company that produces narrow woven textiles) began its energy reduction journey by undertaking an energy assessment, which resulted in the identification and implementation of eight energy efficiency improvements. This included the reduction of standing losses on machinery through improved insulation, installing geyser timers and motion sensors in locker rooms, and adopting an LED lighting retrofit programme (Narrowtex and NCPC-SA, 2021).
- **The Foschini Group** has implemented "world-class" automation and energy efficient lighting and manufacturing equipment to increase resource efficiency in its operations. In addition, energy efficiency is one of the key measures it tracks and reports (TFG, 2021).

Installation of solar PV

- As early as 2012, **Impahla Clothing** in Maitland, Cape Town, was one of the first textile factories in the country to install a solar energy system. The installation of the system was funded by the Industrial Development Corporation (IDC) to enable the company to become more energy secure and self-sufficient (Western Cape Government, 2012).
- In 2017, **K-Way** Manufacturers installed an 83kWp solar PV system at its factory in Cape Town. The system produces 125 000 kWh per annum, saving 136 tonnes of CO_2 emissions per annum. In addition, to improve energy efficiency in the plant, K-Way only purchases machinery following detailed examination of its energy use (Hartzenberg, 2017).

While the South African government acknowledges energy efficiency as a mechanism for reducing energy consumption in its framework for sectoral emission targets (DFFE, 2021), it does not explicitly recognise the textiles sector as a priority for implementing such measures. However, this said, the government does provide a tax incentive for investment in energy efficiency technologies, multiple incentives for upgrading manufacturing operations, a tax incentive for renewable energy investment, and carbon tax exemptions. It is therefore recommended that some form of streamlining of regulation bottlenecks and communication about these incentives to the sector is required. This could be done through a forum connected to the R-CTFL Master Plan (the dtic, 2020a). Having said that, the Master Plan does not recognise energy efficiency as a mechanism for increasing investment and upgrading of the CTFL value chain to drive competitiveness and productivity (see Commitment 5) (the dtic, 2020a). It is recommended that this is considered during the implementation phase of the Master Plan, along with encouraging the adoption of renewable energy technologies to improve energy security. One mechanism through which this could be achieved is through the UN and NCPC-SA's InTex project, launched in December 2021, which aims to work with the South African textiles value chain to improve resource efficiency and sustainability (NCPC, 2021).

Table 4 provides an overview of the potential social impact assessment and cost considerations associated with key actor groups for this intervention.

Table 4: Socio-economic implications associated with the adoption of energy efficient textiles manufacturing practices, and a switch to solar renewable energy technologies

STAKEHOLDERS	IMPLEMENTATION REQUIREMENTS	EXPECTED BENEFITS	EXPECTED COSTS
Manufacturers (textiles and clothing)	- Identify energy hotspots within the factory - Develop an energy management plan - Adopt technologies to reduce energy efficiency in hotspot areas - Measure and monitor energy use - Implement a programme of maintenance - Investigate feasibility of installing solar technologies to switch to renewable energy	- Reduced energy costs and utility bills - Shift to RE from municipal grids financially attractive - Increased energy stability and consistency - Improved understanding of energy hotspots and how to manage them - Employers better skilled in maintenance and repair - Less reliance on national grid for electricity	- Cost of purchasing new technologies - Upgrade of system costs - Upfront solar technology capital and installation costs
Retailers	- Identify energy hotspots in downstream manufacturing activities	- Improved understanding of supplier energy hotspots - Potential to negotiate reduced textile product cost if manufacturing costs are reduced through energy savings	- Costs may be incurred if retailers have vertical operations (see manufacturers implications)
Middle to high-income consumers	- None	- Possible reduced cost of textile products through energy savings - Better understanding of the energy impacts associated with textile product manufacture	- None
Low-income consumers	- None	- As above	- None
Government	- Identify key energy hotspots in South African textile processing and manufacturing operations to inform reduction priorities - Through the R-CTFL, acknowledge and	- Ability to facilitate and provide support to the sector to collectively identify interventions and opportunities. e.g. through the NCPC InTex programme - Communicate to the already cash-strapped	- Human and financial resources to review and/or enhance and/or develop policy, expand the R-CTFL Master Plan - Potential additional costs to scale financial support to the sector

	incorporate energy reduction and renewable energy interventions - Communicate and streamline government incentives to adopt energy efficiency practices and/or switch to renewable technologies - Government department policy and legislation alignment to encourage and enable energy efficiency practices and installation of renewable technologies	sector the incentive opportunities to upgrade facilities to reduce energy costs; and to install solar technologies - Enhanced relationship between public and private textile sector	

4.3. Zero-waste to landfill

South Africa faces significant waste management challenges, and the textiles industry is a major contributor (Key informant interviews, 2022; Stats SA, 2018b). The evidence is clear that South Africa needs a shift to increasing textiles recycling, using recycled textiles content, and encouraging reuse. There is a need to incorporate the circular economy[7] into the textiles industry and provide a call to action for decision-makers to acknowledge circularity during the implementation of the R-CTFL Master Plan, including the identification of how the sector can move to circularity and make sustainable consumption and production the norm.

While several additional interventions exist to mitigate textiles waste, the following are highlighted as critical for decarbonising the sector:

- Promoting fibre-to-fibre recycling and product longevity;
- Reducing single-use sanitary wear;
- Adopting clothing and footwear leasing models; and
- Increasing the second-hand clothing market.

4.3.1. Promoting fibre-to-fibre recycling and product longevity

Textile waste, both during the manufacturing process and post-consumer, are substantial contributors to the environmental impact associated with the textile value chain (Akter et al., 2022; Aishwariya and Jaisri, 2020). In 2017, it was estimated that globally about 92 million tonnes of textiles waste is generated per annum, with an expected increase to 134 million tonnes per annum by 2030 – if current practices remain unabated (Akter et al., 2022; Beall, 2020). Post-consumer, most clothing globally is landfilled or incinerated (Souchet, 2019), with very little (about 13%) recycled, and less than 1% recycled back into clothing (Akter et al., 2022; GreenCape, 2019; Raij, 2019).

Textile waste is produced in every stage of the manufacturing process, from spinning through to dyeing and garment manufacturing. This is commonly referred to as pre-consumer waste, and includes scraps, damaged or defective material samples, fabric selvages and fabric off-cuts from the cutting process (Aishwariya and Jaisri, 2020). It is suggested that about 15% of textiles used in clothing production is wasted (Aishwariya and Jaisri, 2020). While biodegradable fabrics made from natural fibres, such as cotton and wool, can be composted, synthetic fabric requires an alternative solution. Berg et al. (2020) suggest that the minimisation of production and manufacturing waste could realise globally 24 million tonnes of GHG emission savings.[8]

Post-consumer waste is on the rise, and is exacerbated by the fast fashion, throw away culture; and the mending and repair of items becoming not only a lost art, but not considered by the contemporary consumer (Akter et al, 2022; Aishwariya and Jaisri, 2020). Post-consumer textile products that are not landfilled or incinerated are either collected for recycling or donation. The

[7] A circular economy is defined by DFFE (2020) as a means of a regenerative system in which resource input and waste, emissions, and energy leakage are minimised by slowing, closing, and narrowing energy and material loops which can be achieved through long-lasting design, maintenance, reuse, remanufacturing, refurbishing, recycling.

[8] This assumes a one to two percentage point improvement in the waste generated in the transition from fibre to textiles and in cutting waste in the garment manufacturing stage through better design and modern cutting techniques (Berg et al, 2020).

latter is a common practice in developed countries. However, the reality of the latter is that a portion of the clothing is not recycled or sold domestically and is sent to, in the main, less developed countries. As a result, and indicated previously, this donated clothing is either not used as it is not fit for purpose, or is dumped or sold cheaply on the second-hand market. In addition, the resale of second-hand clothing can impact the viability of the local CTFL manufacturing sector (De Sousa, 2021; Freeman, 2020; Key informant interviews, 2022; LeBlanc, 2020; S&V Publications, 2018). It should be noted that it is illegal to import bales of second-hand clothing into South Africa, with the exception of second-hand coats (Department of Police, 2012; ExpertHub, 2009; Pilane, 2016).

To mitigate this issue, more pre- and post-consumer textiles need to be diverted from landfill in South Africa and recycled back into textile-based products – referred to as fibre-to-fibre (or closed loop) recycling. To inform South Africa's ambitions for this, it is useful to identify textile recycling targets set internationally. Not many countries have textile recycling targets. Examples that do exist include China which has a target of recycling 25% of its textile waste by 2025, and the United Kingdom (UK) Sustainable Clothing Action Plan (SCAP) which set a target to reduce clothing to landfill or incineration by 15% by 2020 – from a 2012 baseline (Glover, 2022; White, 2021). In South Africa, most fibre-to-fibre practices are textiles down-cycled into other products, with little back into fibre. However, some South African retailers aim to increase the recycled content of polyester-based products with recycled textiles, and support entities, such as Rewoven, a start-up that recycles used textiles into new fabrics (Key informant interviews, 2022; Magoum, 2021). This lack of activity and targets, and difficulty in achieving them (SCAP failed to achieve its target), illustrates the challenge in recycling textiles (Key informant interviews, 2022; LeBlanc, 2020). Reasons given for this challenge include not knowing the fibre-type used, level of hazardous chemicals used, quality of the clothing collected for recycling not being of adequate quality, and clothing made from a complex blend of fibres, fixtures and accessories (Beall, 2020; Key informant interviews, 2022).

Therefore, two key interventions to mitigate GHG emissions associated with textiles waste in the country are to:

- Adopt fibre-to-fibre recycling; and
- Improvement of product durability, repairability and recyclability. In the case of improving durability, repairability and recycling rates, the following are proposed:
    - Careful selection of materials to increase longevity, durability and repairability (Botta and Cabral, 2021; Cooper and Hill, 2013).
    - Enhancing colour and fabric resistance for longevity and durability (Cooper and Hill, 2013; European Environment Agency, 2022).
    - Reduce use of difficult-to-recycle fibres and materials (Beall, 2020; Celep, Tetik and Yilmaz, 2022).
    - Practical requirements, e.g. ensuring clothes are multifunctional and fit for purpose (Ibharim and Tajuddin, 2021).
    - Repairability, e.g. supplying repair kits or accessories, such as buttons (Gardiner, 2022; Theodosi, 2021).
    - Design for disassembly to reuse and recycled component parts of clothing and footwear (Bharadwaj, 2022, Plank, 2019).

These interventions should be supported by government through the recognition of textiles in the current Extended Producer Responsibility (EPR) Scheme (South African Government, 2021). According to Fixing Fashion, a levy of £0.01 on each clothing item sold in the UK through its EPR programme raised £35 million per annum for the textiles industry (BIR, 2019). In addition, implementing and scaling a design for recyclability (fibre-to-fibre) strategy requires technical, social and business model innovation, as well as enablers from policy, consumption and education. It also relies on consumer behaviour to return clothing and footwear for collection (see interventions for adopting leasing models and increasing the second-hand clothing market further in this report), and policy to realise this potential and enable implementation (European Environment Agency, 2022).

While it is recognised that this will require retailers and manufactures to make changes to their manufacturing and purchasing practices, the benefits to the South African textiles value chain could be multiple, including access to locally sourced recycled textile content, the ability to stipulate recycled material quality and a collection system, job and skills creation through textile collection and repair – in particular supporting SMEs) (Key informant interviews, 2022; Larney and Aardt, 2004).

SOUTH AFRICAN ACTIONS TO INCREASE THE RECYCLING AND LONGEVITY OF TEXTILES

One of the most commonly practised recycling activities within the South African textiles sector was (and still is) the use of recycled polyethylene terephthalate (rPET) in clothing. However, with the negative impact of micro-plastics associated with clothing seeping into the environment, this practice is on the decline (Islander, 2021; Van Elven, 2018). As such, textile and clothing manufacturers are switching to and increasing the volume of clothes containing recycled textiles. Some examples of this are:

- **Woolworths** has committed to ensuring all its private-label fashion and home products are designed to be reused, repaired, repurposed and recycled (Child, 2021).
- **Pick n Pay** have set commitments to work towards sourcing and producing clothing that uses recycled materials, with more than 1.5 million clothing items sold by September 2021 containing recycled content (3SMedia, 2021; Pick n Pay Clothing, 2020).
- In 2021, **@home** (part of the Foschini Group [TFG]) launched Jacquard Bedding which is made from 50% recycled yarn and 50% virgin yarn (TFG, 2021).
- **Ackermans** have partnered with Wastecrete to identify a solution for its textiles manufacturing waste. Textile waste is shredded and mixed into concrete and baked. The resultant brick or concrete object contains 70% textiles waste (Karim, 2022).

Aside from the proposed inclusion of textiles as a product within the government's EPR scheme, the implementation of the R-CTFL Master Plan should also recognise and encourage the development and adoption of CTFL design guidelines for longevity, recyclability and reuse, as well as setting a CTFL recycling target for the sector.

Table 5 provides an overview of the potential social impact assessment and cost considerations associated with key actor groups for this option.

Table 5: Socio-economic implications associated with the promotion of fibre-to-fibre recycling and product

STAKEHOLDERS	IMPLEMENTATION REQUIREMENTS	EXPECTED BENEFITS	EXPECTED COSTS
Non-South African manufacturers (textiles and clothing)	- To adopt recyclability and longevity guidelines stipulated by South African clothing manufacturers and retailers - Adapt current manufacturing technologies and design machinery to handle new designs - Workforce educated to adopt and implement guidelines - Switch to different materials and accessories to enable recycling - Increase recycled textile content in textiles/clothing	- Better use of materials and recycled textiles. - Solution to recycle in-factory off-cuts. - Increased or new customers. - Reduced material complexity which could improve operational efficiency and reduce wastage. - Could adapt manufacturer only model to repair and maintenance. - Reduced energy and water use (pollution) from using recycled textiles.	- Potential costs to adapt or install new technologies. - Cost to shift to new fibres or textiles could cost more. - Potential reduction in output if longevity of products is increased, and consumers purchase less.
South African manufacturers (textiles and clothing)	- Access to locally source recycled textile feedstock. - Adopt EPR requirements - Change practices to adopt design for recyclability and longevity guidelines - Switch to different materials and accessories to enable recycling - Adapt current manufacturing technologies and design machinery to handle new designs - Workforce educated to adopt and implement guidelines - Increase recycled textile content in textiles/clothing	As above, plus: - Access to locally source recycled textile feedstock. - Potential reduced costs (transport) for sourcing textiles. - Potential to scale SME activity and create jobs around textiles collection for recycling, and recycling of textiles.	- As above. - Potential cost to join EPR scheme.
Retailers	- Adopt EPR requirements - Stipulate/specify design for recyclability and longevity guidelines - Make collection facilities and points available in-store for recycling	- Improved customer brand loyalty. - More consumers bringing end of life clothing and footwear back to store for recycling and/or reuse. - Diversion route for rejects, damaged products	- Potential cost to join EPR scheme. - Costs to set up and maintain collection points for recycling. - Potential reduced sales due to consumers purchasing less.

	collection - Provide (where feasible) accessories, tools and/or mechanisms (e.g. returns) to enable consumers repair or get clothing and footwear repaired - Awareness campaign to encourage consumers to repair and recycle clothing and footwear.	or returns.	- Use of more recyclable materials could be more expensive than cheaper difficult to recycle materials.
Middle to high income consumers **Low-income consumers**	- Incentivisation to encourage consumers to repair clothing and footwear. - Incentivisation to bring back clothing and footwear no longer required	- Higher quality products that last longer - Cost saving through not having to purchase clothes and footwear as often - Improved feel-good factor in knowing clothing and footwear is being recycled	- Use of more recyclable materials could result in clothing and footwear being more expensive than those made from cheaper difficult to recycle materials.
Government	- Include textiles in the EPR scheme for manufacturers, brands and retailers. - Ensure policy and legislation enables textile recycling and repair. - Provide incentivisation for textile and clothing manufacturers, brands and retailers to 1) increase recycled content in textiles and textile-based products, 2) provide facilities / systems for collection for repair and recycling, and 3) reduce use of unwanted materials.	- Increased employment opportunities through recycling and repair activities. - Support the R-CTFL's local manufacturing agenda. - Alignment with / expansion of the R-CTFL. - Levy from retailers, brands and manufacturers to implement textile recycling and repair interventions.	- Cost to include and implement textiles in the government's EPR scheme. - Cost to develop and implement incentivisation schemes.

4.3.2. Reducing single-use sanitary wear

Sanitary waste, such as female hygiene and adult incontinence products, and also baby nappies, contributes large volumes of landfill waste. A large component of these products are non-woven fabrics made from polymers and natural and synthetic resins (Ajmeri and Ajmeri, 2016). According to South African Cloth Nappy Users (SACNU) association, the average child will use more than 4 000 disposable nappies between birth and potty training, with estimates of about 2 400 tonnes of disposable nappy waste generated per day in South Africa – all of which ends up in South Africa's landfills (SACNU, 2022a Smout, 2021).

Research suggests that "single-use nappies are one of the biggest contributors to plastic waste globally" and because they are made from multiple materials, they have huge environmental impacts across their life cycle (UNEP, 2021). In the case of female sanitary products, it is estimated between 5 000 to 15 000 pads and tampons will be used by one individual over their lifetime. Most of the used products will land up in landfill sites, where – aside from the health hazard – sanitary towels can take 500 to 800 years to decompose (Borunda, 2019; Sambyal, Henam and Tariang, 2019).

From this evidence, it is clear that single-use sanitary wear needs to be eliminated over time and the sector needs to shift to washable multi-use sanitary wear that will have a longer lifespan, lessen the burden on landfills, and reduce environmental pollution and health hazards associated with these products.

Companies that produce disposal nappies and menstrual pads bear limited responsibility once the consumer buys the product, and the disposal of the waste item once used becomes a consumer and then a municipal problem. South Africa's EPR scheme does not apply to absorbent healthcare products — nappies (for infants and adults) and sanitary towels. At some point, however, it is proposed, as with textiles in general, that they are included in the scheme.

The intention of the South African textiles sector to shift to the manufacture and sale of reusable sanitary wear is to ensure that waste produced during the manufacturing process, and end of consumer use, is minimised and not sent to landfill. In addition, for the consumer the cost savings for switching are also deemed beneficial, for example SACNU (2022a) estimated that savings of R11 000 can be achieved for a single child, and R26 000 plus for two children when switching to cloth nappies. Another benefit of multi-use sanitary wear is a drive toward the use of natural fibres that can support the agricultural sector in South Africa to produce these fibres (for example cotton and hemp) (SACNU, 2022b).

There are several reusable sanitary towel and nappy manufacturers in South Africa. These businesses are often driven by local entrepreneurs that are pushing new boundaries in the sector. However, they experience several challenges, as illustrated in the case study in the following box, which illustrates the need to create more capacity building programmes and manufacturing support for new SMEs entering the reusable sanitary market.

REUSABLE SANITARY WEAR MANUFACTURE: CAPACITATING AND INVESTING IN SMES

The South African Bureau of Standards (SABS) passed the first reusable sanitary standard for the manufacturing of washable, reusable sanitary towels (SANS 1812) in May 2020 (South African Government, 2020). The publication of this standard is one of the first standards for washable sanitary towels in Southern Africa and is leading the way for other African countries to follow. This opens up the market for SME manufacturers of reusable menstrual towels. However, they require greater support to design and manufacture products that meet market needs. The South African Coalition for Menstrual Health and Management (SACMHM) Products, Standards and Supply Chain Task Committee also has a role to play to assist newcomers that require capacity building to better understand the specification to adhere to the quality control standards.

General barriers identified by some of the reusable sanitary SME manufacturers (Key informant interviews, 2022) include:

- **Testing cost:** The high cost related to product testing to adhere to the SABS product certification requirements is a challenge (estimated at around R200 000).
- **New industry standard:** A female-owned manufacturer, who has been in operation since 2017 and manufactured over 400 000 sanitary towels to date (June 2022) indicated her product does not meet the new reusable sanitary towel standard (SANS 1812). The introduction of the standard therefore requires reengineering of the product, at additional cost and time, to meet the standard.
- **Product design support:** There is a need to increase technical capabilities to design reusable sanitary towels according to SANS 1812. For example, a female-owned SME received feedback from SABS on why the product did not meet SANS 1812, but it has the expertise in-house to find a solution to alter the design to comply. The recommendation is to engage other established manufacturers to undertake in-house testing and to share knowledge. This should open up the market and make reusable washable sanitary wear more the norm.
- **Lack of procurement opportunities:** It is difficult for SMEs to apply for government tenders to supply reusable sanitary towels to schoolgirls. There is no specification in government procurement frameworks to make room for a percentage of washable, reusable sanitary towels. Therefore, most SME orders come through the private sector's corporate social responsibility projects. These orders are often for small batches and are inconsistent. This limits cash flow and stifles production, which impacts growth potential. Acknowledgement and the improved understanding of reusable sanitary towels by government could stimulate this growth. This will require adjustment to procurement guidelines.

SMEs involved in the manufacture of reusable sanitary towels can create jobs and their activities respond to several Sustainable Development Goals (SDGs), namely:

- SDG 3 Good Health: Reusable nappies and sanitary towels can be reused by washing thus providing dignity and pride for up to five years.
- SDG 6 Clean Water and Sanitation: reusable sanitary wear does require access to water for washing but is far better than throwing a single-use sanitary product into a landfill or a river or into a toilet.
- SDG 4, Quality Education: Provide education and use entertainment to change the face of menstrual cycles.

- SDG 5 Gender Equality: The reusable sanitary towels provide longer-term access to the use of a product and empowers girls and women to control their lives and be plugged into circularity.
- SDG 8 Good Jobs and Economic Growth: Multi-use sanitary products provide affordable, sustainable, eco-friendly solutions to women. Many of the designers and producers are female-owned businesses and they are hand made in South Africa by previously disadvantaged men and women through in-house training programmes.

There is sufficient capability, competence, skill, and knowledge to implement and sustain the production of reusable sanitary wear in South Africa. In addition, a wide range of highly absorbent reusable sanitary wear products are available in the country, including reusable cloth nappy products, sanitary towels and menstrual cups. The reusable products are predominantly locally manufactured by SMEs. As indicated, increased consumer demand is needed, coupled with government interventions to provide SMEs and other larger manufactures to expand their manufacturing capacity, or enter into the reusable sanitary wear market.

To create the conditions for market readiness for reusable sanitary wear, notably nappies and sanitary towels, retailers, wholesalers and consumer acceptability and awareness needs to be strengthened, for example. through consumer campaigns, to ensure increased market uptake over the coming years.

Examples of such campaigns include Somalia's menstrual hygiene campaign, initiated in 2021, to educate and empower schoolgirls to use reusable sanitary towels, thereby enabling them to attend school during the menstrual cycle (UNFPA, 2021), and India's Sustainable Menstruation for underprivileged women and young girls (The Hindu, 2018). The latter focuses on reducing the environmental, health and costs impacts associated with single use sanitary towels by advocating the use of cloth sanitary towels and menstrual cups.

Table 6 provides an overview of the potential social impact assessment and cost considerations associated with key actor groups for this intervention.

Table 6: Socio-economic implications associated with the increased manufacture and use of reusable sanitary wear

STAKEHOLDERS	IMPLEMENTATION REQUIREMENTS	EXPECTED BENEFITS	EXPECTED COSTS
Manufacturers (mainstream sanitary products)	- Existing single use manufacturers to be incentivised to include a new washable reusable sanitary product range	- Market reach expansion to environmentally conscious consumers - Enhanced corporate responsibility and brand loyalty - Reduced environmental and health impacts associated with reusable sanitary wear	- Additional costs likely to design and manufacture new reusable sanitary wear products - Additional costs to market the product.
Manufacturers (textiles)	- Textile manufacturers will need to procure more natural fibres for the use of multi-use sanitary wear - Textile manufacturers will need to take greater responsibility for their product being recyclable or reusable	- Potential expansion of natural fibre industry - Increased use of locally manufactured textiles in locally manufactured reusable sanitary wear - Access to a growing reusable market and customer	- Lab testing and R&D costs to shift to natural fibres - Potential increased fibre cost compared to synthetic alternatives - Additional costs to upgrade / purchase new machinery
SMEs: Producers of reusable products	- SME manufacturers designing, manufacturing, selling and distributing reusable products will need to increase their capacity to meet growing market demand by acquiring new equipment and additional skilled labour. - SMEs will need to adhere to SABS quality standards	- SMEs can grow their business by increasing sales - Increased and more consistent sales cycles - Contribute to greater job creation by employing skilled staff	- SMEs will carry expansion costs unless they can be supported by the government with access to inclusive finance for manufacturing upgrades - Testing to meet SABS standard
Retailers	- All retailers that stock single-use sanitary products need to procure and make available more reusable sanitary wear for their customers - Create awareness and provide consumer education campaigns on reusable sanitary wear	- Greater product selection to offer environmentally conscious and budget sensitive consumers - Enhanced corporate responsibility	- Marketing and promotion costs
Middle to high income consumers	- Greater awareness is required to reach middle to high income consumers to	- Increased access to a wider variety of reusable sanitary wear products	- Initial upfront cost to purchase reusable sanitary wear

	switch from single use sanitary wear to reusable washable sanitary wear - Infrastructure may be required to encourage collection for washing	- Reduced in-home waste - Longer-term savings through reuse	- Potential additional costs to wash reusable, e.g. machinery maintenance, detergents, water and time - Potential subscription fees to join reusable sanitary wear washing schemes
Low-income consumers	- Low-income consumers will benefit from buying reusable durable sanitary products that can last for two to five years.	- Longer term savings through reuse - For schoolgirls in the lower Living Standards Measures (LSMs), increased ability to attend school during menstruation	- Initial upfront cost to purchase reusable sanitary wear. As such, access to free reusable sanitary towels through government hygiene programmes for schoolgirls is encouraged - Cost and time to access clean, running water; electricity costs to run automated washing machines
Government	- Government should encourage local manufacturing of reusable washable sanitary wear made from natural high absorbent fibres - Government procurement needs acknowledge and to include or accept reusable sanitary products in the roll-out of free sanitary towels to schoolgirls - Government needs to provide product testing and manufacturing support to SMEs with the innovation of new reusable sanitary wear products	- Reduced environmental pollution and waste volumes and costs - Reduced sanitation related infrastructure maintenance and repairs costs - More local job creation - Greater support for SMEs manufacturing and selling reusable sanitary wear	- Government can expect an increased cost to provide financial support for SMEs that are designing new products that require testing - Increased investment to support reusable sanitary wear SME manufacturers - Costs to run and implement free access to sanitary wear for schoolgirls
Other (eco-system builders)	- SACNU to expand awareness campaigns around the use of cloth nappies as alternatives to single use	- Increased reusable nappy users/SACNU membership - Increased awareness of the benefits and how to use reusable cloth nappies - More parents / guardians aware of the benefits ore reusable cloth nappies	- Potential increased costs to scale awareness campaigns and to engage with disposable sanitary wear manufacturers and retailers

4.3.3. Adoption of clothing and footwear leasing models

Overconsumption and the inevitable disposal of unwanted clothing has become a worrying global problem – and in many cases, this clothing is unnecessarily thrown away, landfilled and incinerated. Instead, it could be repaired or recycled. A staggering 100 billion items of clothing are being produced annually, and 50% of fast fashion pieces are disposed of within a year (Braithwaite, 2018). A solution to mitigate this trend and the waste associated with it is needed. One intervention to orientate business models towards circularity to contribute to decarbonisation efforts in the textiles value chain is the leasing of clothing, accessory and footwear. This intervention is in line with the emerging "sharing economy" that is disrupting fashion, clothing and retail by offering rental (leasing) options to consumers (MacGlip, 2021). This can help to mitigate the fast fashion trend by offering consumers more sustainable and low-carbon ways to wear clothing and footwear. Renting fashionable clothes and footwear (as opposed to theatre costumes or "fancy" dress) is still a novel concept in South Africa. It could, however, offer promising growth for retail, particularly through the leasing of fashionable or more expensive clothing, accessories, for example bags and footwear for singular formal events, such as weddings (see CGS, 2019a; Glamour South Africa, 2021; Del Monte, 2022).

As the leasing economy continues to grow, numerous brands and retailers are following the lead by offering rental subscription services. Currently, adoption levels for clothing and footwear rentals are still low. Findings from a global 2019 Future of Fashion & Retail Consumer Survey showed that out of 17 000+ consumers, only 5% had considered using a subscription service to rent clothes, and 3% had used a clothing rental service (CGS, 2019b). The study also revealed that 39% of respondents had never heard of clothing rental services or did not understand the model. Given this is a relatively new trend for clothing and footwear, it is therefore not a surprise that adoption levels are low. This does not mean that South African retailers or businesses should ignore it, as there is a need to increase leasing options to ensure that the sector moves towards circularity and to meet a growing demand, especially by the youth. In the UK, for example, it has been suggested that the leasing of clothes has a potential value of R18 100 million, with 25% of those surveyed in London indicating they would rent clothing. The concept is most popular among 25 to 34-year-olds (Pinnock, 2019).

While the leasing of clothing may be a relatively new concept in South Africa, there is evidence of retailers pioneering clothing and accessories rental services (Del Monte, 2022). It is important to unpack how South African retailers and SMEs could benefit from increasing the adoption of clothing and footwear leasing models. As such, this proposed intervention includes engaging with retailers and SMEs to offer leasing options and to provide greater consumer awareness of leasing options and availability in the country. Capacity building programmes would be required to equip retailers and SMEs with the knowledge to develop, implement (e.g. using tracking and subscription technologies) and manage leasing models as leasing would disrupt operations drastically and new operational systems would need to be put in place to manage how clothing and footwear items are distributed, returned and dealt with when they reach end of life (see Marketing Essentials Lab, n.d.; Matyunina, 2020)).

There are many advantages for retailers as renting becomes more mainstream, and proven evidence that the apparel rental market can provide an opportunity to drive brand growth and loyalty (CGS, 2019a). This can have significant payoffs for early adopters of the rental model to find the right product and pricing mix. As leasing becomes more mainstream and companies find

the right pricing mix, brands can convert more customers. Monthly paying customers are also proven to be more loyal, and more profitable when it comes to leasing items (CGS, 2019a). There is evidence from research conducted by CGS (2019a) that Generation Z are more familiar with and used to using rental services across a variety of sectors, e.g. for entertainment Netflix, Uber for transport, and Airbnb for accommodation. In addition, school uniforms are another viable leasing option, as the consumer profile that requires a school uniform uses the item for a limited period of time before it becomes too small, and they require a larger size. Therefore, leasing options – as a concept – are a viable intervention for retailers and SMEs to respond to for these two consumer groups. For these consumers, the benefits include the ability to try new brands, save money, wear premium or luxury brands, save closet space and reduce environmental impact (Amed, et al., 2019; CGS, 2019b).

LEASING MODELS FOR ECO-FRIENDLY REUSABLE BABY ITEMS: A CASE STUDY

Anew Leasing Services, established in 2020 in Cape Town, is a South African business that leases a range of eco-friendly second-hand baby furniture. The need for the service was to meet growing customer demand for the short-term rental of basic baby equipment, such as eating chairs, safety car seats, and prams. Their customers are mainly new parents in their 20s and 30s from Cape Town. However, the business has grown to include the more high-end market, and for tourists, seeking short-term rental options for convenient, safe and eco-friendly equipment when they arrive at airports and also for the use in hotels.

One of their biggest challenges has been to ensure the right type of business system to manage online orders, and to put logistic systems in place for collection, cleaning and delivery of the items.

In addition to baby equipment, the company has also explored the need for leasing reusable eco-friendly washable cloth nappies for babies (see previous intervention on reusable sanitary wear). A customer survey with over 1 000 respondents indicated there is a demand from parents to lease reusable nappies. Most of these parents were environmentally conscious (looking for ways to reduce their environmental footprint), but also included parents looking to test different brands prior to purchase. Of particular interest within the South African context, was respondents' comments that cloth non-South African nappy designs do not cater for all demographic baby and toddler body types in South Africa. Most of these products do not fit larger-sized babies. As such, Anew Leasing Services is exploring opportunities to collaborate with local brands to develop a reusable nappy design that is more compatible with the South African population.

Table 7 provides an overview of the potential social impact assessment and cost considerations associated with key actor groups for this option.

Table 7: Socio-economic implications associated with the adoption of clothing and footwear leasing models

STAKEHOLDERS	IMPLEMENTATION REQUIREMENTS	EXPECTED BENEFITS	EXPECTED COSTS
Manufacturers (clothing)	- Manufacture more durable garments that can meet leasing requirements - Increase local manufacturing - Increase capacity to meet leased clothing demand (design) that appeals to a younger group of consumers - Decrease in the manufacture of "fast fashion" items - Identify suitable product and pricing mix	- Repeat orders from retailers and SMEs once brand loyal customers are established - There could be benefits form repairing items that provides a new revenue stream - Enhanced corporate responsibility - Reduce waste and raw material/textile costs	- Manufacturers might receive less orders if "fast fashion" high season items are re-used by multiple consumers. - Decrease in manufacturing demand - Marketing to inform customers of items are applicable for leasing - Increased R&D and market research costs - Potential increased materials costs to those which are more robust
SMEs	- SMEs to be capacitated on opportunities within leasing model supply chains - SMEs that want to switch to leasing models will need operating systems to manage logistics and customer relations - Traceability and trust with customers - Ability to adapt and be flexible due to growth - How to manage leasing to non-address customers	- Increased opportunities for SMEs to participate in the value chain through maintenance (cleaning of items) and delivery and collections and even repairs of items - SMEs that are leasing clothing items locally can gain customer loyalty if they deliver good services.	- Set up costs to purchase clothing, accessories and footwear - Technical and logistical set up costs (e.g. online platforms, postal and collections services) - Risk of theft and item loss / damage - Cleaning and repair costs
Retailers	- Business model innovation and adaptation - Identify suitable technology and operational systems to manage leasing options - Hiring of staff that have knowledge of how best to operate leasing models - Increase knowledge of customer needs - Increase marketing efforts to appeal to consumers, notably youth seeking leasing options	- Retailers and brands can convert more customers - Enhance corporate responsibility - Reduce waste and purchasing costs related to demands of supplying 'fast fashion'	- Increased R&D and market research costs - Technical and logistical set up costs (e.g. online platforms, postal and collections services) - Risk of theft and item loss / damage - Cleaning and repair costs - Increased expansion costs

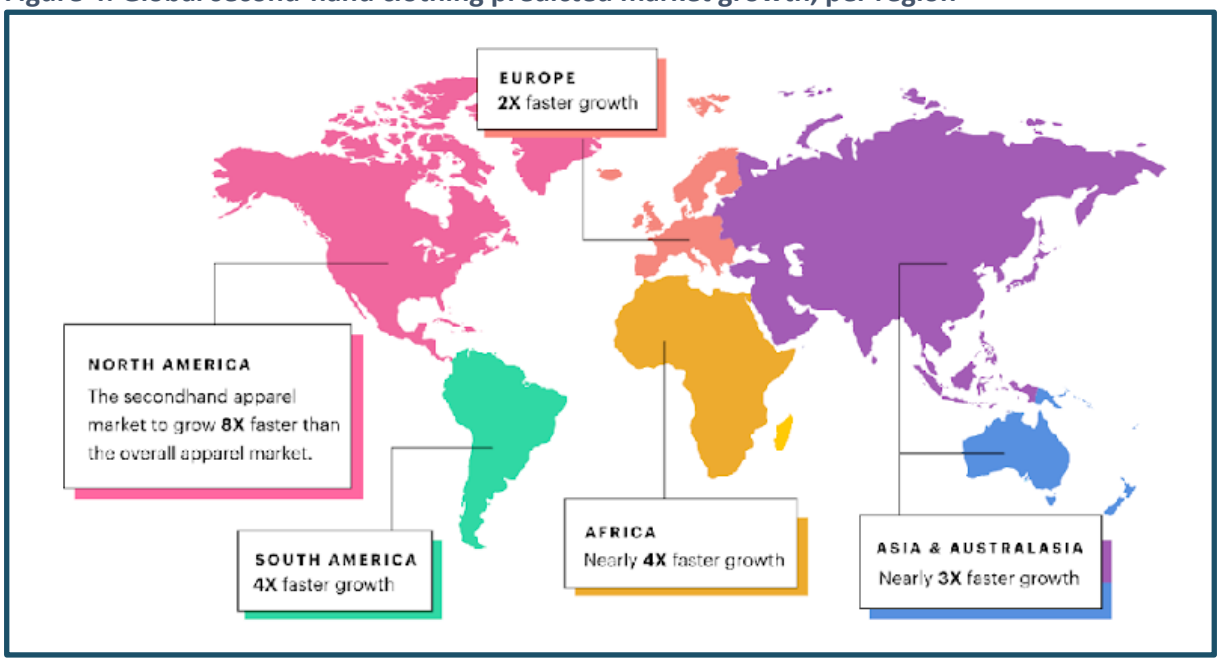
	- Identify the right product and pricing mix - How to manage leasing to non-address customers		
Middle to high income consumers	- Increase knowledge and awareness around leasing of clothing items - Increase ability to plan ahead to hire items - Will need to become more familiar with clothing leasing models and how they operate - Recognise and understand implications of delayed, damaged and lost returns	- Spending less on more expensive items of clothing - Reduced clothing storage needs - Ability to address body height and shape changes - Stay on trend with fashion by leasing the latest items at a lower cost - Ability to meet environmentally conscious aspirations - Become more empowered to make informed decisions to support retailers that are offering circularity	- Possible subscription and postal costs - Penalties for delayed, damaged or lost items
Low-income consumers	- Increase knowledge and awareness around benefits leasing of clothing items - Consider if and how leasing can lower monthly expenses - Consumer information on subscription options and policies (fair practices)	As above	- As above - Potential limited access/blacklisting
Government	To increase awareness campaigns and lobby retailers to adopt leasing models To increase knowledge about the benefits of leasing models and how it can support circularity and to meet net-zero targets by 2050 To identify champions in the industry to lead the transition to decarbonize the textiles value chain	To benefit from carbon emission reductions Benefit from lowering cost to expand landfills if there is less textiles waste going to landfill Benefit from more job creation and creator inclusion of SMEs in the value chains that require suppliers in leasing models	There is a cost to influence and capacitate retailers to adopt leasing models Increased capabilities to better understand leasing models and the positive impact on the economy will require investing in capacity building

4.3.4. Increasing the market for legal domestically traded second-hand clothing markets

The expansion and recognition of viable and reputable second-hand clothing and footwear markets can significantly reduce textiles waste and reduce the carbon impact of the textiles value chain. This intervention, as with the leasing model, aligns with the concept of circularity, in which garments are circulated for as long as their maximum value and quality is retained – by which time appropriate end of life solutions e.g. recycling can be put into effect (D'Adamo, et al., 2022; Ellen Macarthur Foundation, 2020).

Globally, the second-hand clothing (resale) market is a growing, emerging trend. The global market saw record growth of 32% in 2021 (D'Adamo, et al, 2022; Erdly, 2020; Forrest, 2022; Smith, 2022; ThreadUp, 2022), and is estimated to be worth more than double that of fast fashion, with a projected value of US$84 billion by 2030 (compared to fast fashion which has a projection of US$40 billion) (Erdly, 2021). Figure 4 illustrates the predicted global market growth in second-hand clothing per region.

Figure 4: Global second-hand clothing predicted market growth, per region



Source: ThreadUp, 2022.

An increase in second-hand clothing could reduce the global GHG emissions impact of the sector by 340 million tonnes of CO_2, and can indirectly reduce water and fertiliser use (Kaldor, 2022; Hirschlag, 2019; Roberts-Islam, 2019).

Much of the growth in second-hand clothing can be attributed to younger consumers (Generation Z and millennials) who are adopting a thrifting culture (Statista, 2022). It is seen as a cheaper and more environmentally friendly way to buy clothes, and a way to share and pass items around quickly (Buso, 2019; Keihn, 2018). The reduced prices of second-hand apparel also make luxury and "vintage" clothes and goods more accessible (Keihn, 2018; Sicurella, 2021). Popular mechanisms for purchase are smartphone applications and online markets (e.g. Gumtree and Facebook in South Africa), which give shoppers greater choice and convenience, although many people still buy second-hand clothes from thrift shops (Statista, 2022).

International retail giants at all ends of the market have been strengthening their positions in resale. For example, Gucci has recently launched a luxury consignment online store, ASOS has invested in luxury resale, as well as allowing second-hand clothing on its marketplace, and Levi's has launched its own resale site, too, Levi's SecondHand (Erdly, 2021). Big business is getting into the trend of second-hand sales and there is room for SMEs and consumers to participate directly in second-hand clothing marketplaces.

In addition, the COVID-19 pandemic changed how people behave in many ways: one key change is the way people purchase clothing. More people are decluttering closets and finding marketplaces to either sell online or at physical second-hand markets to earn additional income (Introducing!SA, 2022). This has stimulated growth in the resale of clothing and other textiles products in South Africa. While the sale of second-hand clothing has always existed, usually informally, in the country, it is growing into a more formal activity (Buso, 2019). As such, the fast fashion industry expects to see a 20% increase over the next 10 years, while the pre-loved market has a projected growth of about 185% (Introducing!SA, 2022). However, as indicated previously, it should be noted that it is illegal to import bales of second-hand clothing into South Africa, with the exception of second-hand coats (Department of Police, 2012; ExpertHub, 2009; Pilane, 2016).

An enabler of second-hand purchases is increased technology that makes it more accessible to trade online (Bae, et al., 2021). However, this does open up the potential to trade illegal new and second-hand clothing and footwear in South Africa, which is to be avoided. If undertaken legally, the activity of resale is seen as more accessible and inclusive than sustainable fashion items – inclusive cost prices suiting all budgets, body shapes and sizes (ThreadUp, 2022). For example, in a ThreadUp (2022) survey, nearly 20% of first-time thrifters said finding items in their size encouraged them to continue the practice of purchasing second-hand.

Therefore, the intervention proposed for the South African textile sector to transition to one which is more low carbon, is to enhance the formal, legal domestic second-hand clothing and footwear markets (both online and physical). This provides an opportunity for local job creation, particularly for SMEs and start-ups, in sorting and cleaning, repair and restyling, transporting and sale of second-hand clothing and footwear (Baden and Barber, 2005; Erdley, 2021). Online channels are increasingly providing more e-commerce trading opportunities for SMEs as e-commerce technology enables online payments and the tracking of deliveries. Examples of local SME-owned online second-hand stores gaining popularity are Yaga and Wisi-Oi Marketplace (Introducing!SA, 2022; Luckhoff, 2021).

However, as indicated, it is crucial that the dealing with and sale of second-hand clothing is done legally. If clothing is to be imported, permission is required from the International Trade Administration Commission (ITAC), and South African Police Service regulations for dealers and recyclers have to be adhered to (Department of Police, 2012; ExpertHub, 2009; and Pilane, 2016). In addition, second-hand clothing interventions need to be cognisant of the impact this may have on CTFL manufacturing jobs in South Africa. In some instances, the growth in second-hand clothing imports and trade has been regarded as a contributing factor to the substantial job losses in formal clothing manufacturing (Bhanushali, 2021; Key Informants, 2022; and SACTWU, 2022). SACTWU (2022), for example, argues that the importing of second-hand clothes has been responsible for the loss of jobs of some of the poorest paid workers in the manufacturing industry.

Expansion of the legal sale of second-hand clothing and footwear would require:

- A concerted campaign to increase importers, dealers and traders' knowledge of the legislation and processes required to deal with and/or sell second-hand clothing in South Africa.
- Jobs created in the local second-hand market are legal, just and decent.
- Clothing and footwear is designed to last, be repaired and restyled, beyond its initial purchase.
- Investment in local infrastructure and technology to enable the collection, processing and sale of locally derived second-hand clothing (Erdly, 2021).
- To ensure that once second-hand clothing reaches its end of life, it enters the fibre-to-fibre recycling stream (see proposed intervention above).

CASE STUDY: SMALL MEDIUM ENTERPRISES AND THRIFTING OPPORTUNITIES

A female-owned SME was interviewed to better understand her business challenges and opportunities in the thrifting space. This innovator set up an eco-friendly online store selling vintage, retro and eclectic used or newly discarded clothing, accessories and decor, and has been trading for the past 10 years. A key add-on to the online store is a blog that is used to educate consumers on reasons why it is important to support second-hand purchases – to be more responsible eco-conscious consumers who can lower their carbon footprint.

She also runs a local community project working with unemployed youth to retrofit used office chairs with an associated website used as a platform for market access. The intention is to expand this element of the business through business corporate responsibility projects to refurbish office equipment.

There are sufficient skills and capabilities within the enterprise, and with the help of unemployed youth in her community she is fixing old office chairs using fabric from damaged clothing, bedding or furniture that is no longer fit for purpose.

This case illustrates how SMEs can effectively participate in the second-hand market to offer new products and extend lifespans, and in doing so create jobs and build in-country capability.

Table 8 provides an overview of the potential social impact assessment and cost considerations associated with key actor groups for this option.

Table 8: Socio-economic implications associated with increasing second-hand clothing and footwear market activities

Stakeholders	Implementation requirements	Expected benefits	Expected costs
Manufacturers (clothing and footwear)	- Manufacturers of new clothing items need to be prepared for concerns that the second-hand market trade will undermine local textile and garment industries - Clothing to be manufactured for longevity and repair (to enable reuse)	- Few benefits for manufacturers of new clothing items unless they open their doors for repairs	- Manufacturers could lose market share due to the increase of second-hand clothing and footwear markets - Potential job losses
SMEs	- Require support to adopt new technology to enable second-hand sales - Require support to undertake market research to better understand their second-hand value creation and how to navigate this environment - Invest in business model innovation time and resources to acquire new skills and technologies to be effective players in the second-hand sales markets	- Increased participation and revenue associate with the growing trade of second-hand clothing and footwear - Increased job creation - Being a key role player to bring affordable second-hand clothing to consumers with budget constraints - Playing a role to extend the life cycle of clothing and footwear items and avoid waste to landfill	- Set up and maintenance costs (especially if on-online) - Investment in new technology - Cleaning and repair costs - Cost to train staff – logistics, customer service and experience, product handling and returns - Increased investment in logistics to collect second-hand items (stock) and customer delivery
Retailers	- To expand knowledge to adopt second-hand business models - Development of online mechanisms for supporting resale - Implement infrastructure for clothing and footwear returns for donation / sale for resale - Consumer marketing to increase awareness / mitigate concerns e.g. health	- Increased sustainability targets to lower their carbon footprint and orientate towards circularity - Increased sales that will result in increased profitability - Retailers can become more responsible for the product that they sell and ensure that the life expectancy of these items are prolonged and avoid waste to landfill - Retailers can provide more affordable clothing prices to consumers with budget constraints - Consumer loyalty	- As above
Middle to high income consumers	- Education on processes e.g., understanding measurements, trusting outlets (not purchasing counterfeit goods),	- Cost savings, especially for luxury items - Meeting environmentally conscious needs - Quick access to ‘new’ cloths and styles	- Shopping online requires data to browse second-hand items - Possible cleaning and repair

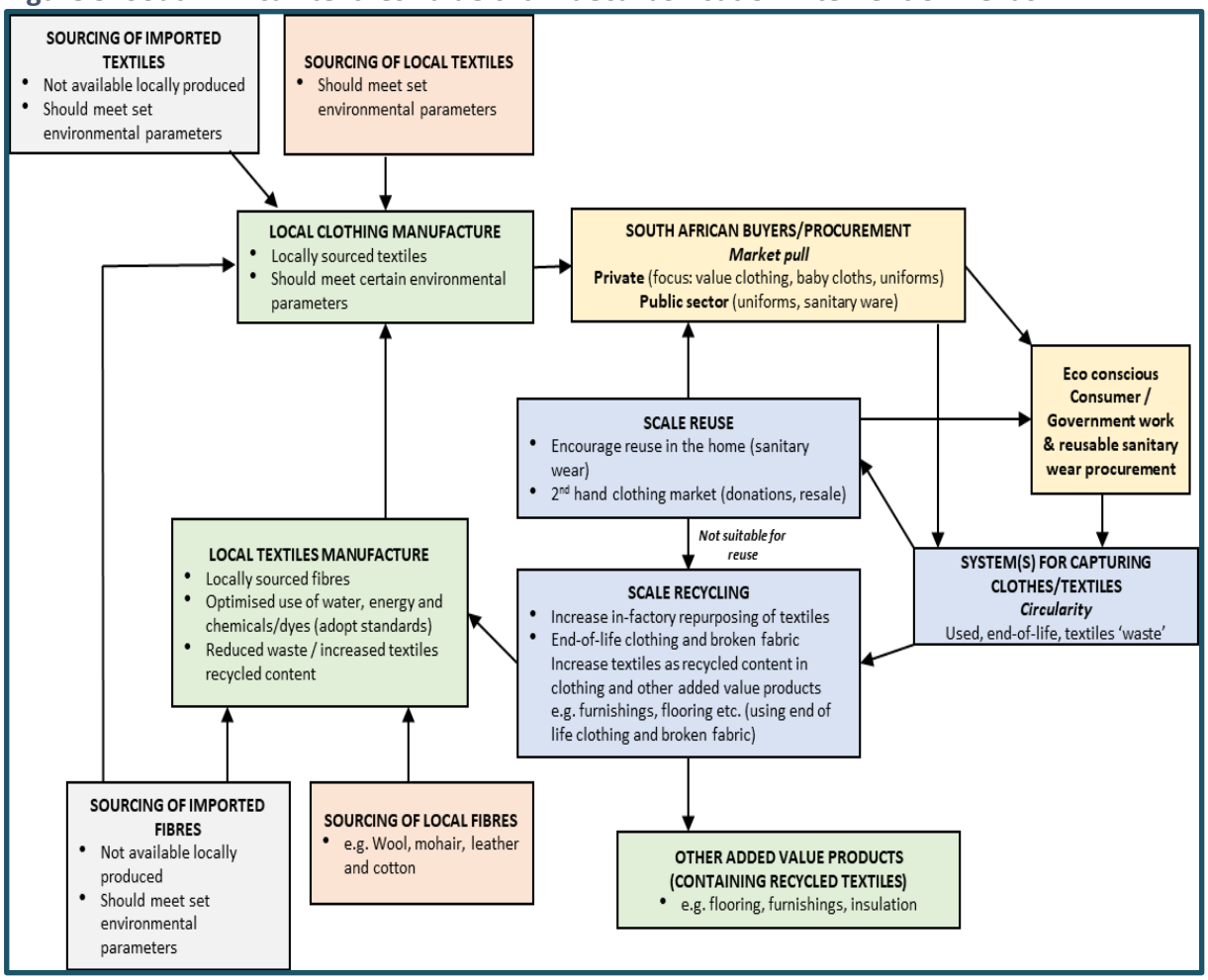
	setting budgets and understanding return policies. - Awareness of where to purchase second-hand (reputable) – both online and physical		- Postage or travel costs for collection - Longevity of clothing could not be sufficient (waste of money)
Low-income consumers	As above	- Ability to access high fashion, baby clothes and school uniforms at a fraction of the cost. - Often more convenient to purchase as in suitable locations e.g. taxi ranks, markets	- As above
Government	- Increase support for improved infrastructure for physical markets, notably in informal settlements, e.g. safe and secure, storage, and access to good sanitation, to improve safety and access to sanitation (toilets) - To encourage retailers to adopt second-hand clothing models, e.g. through the R-CTFL - To provide capacity building programmes for SMEs to access incubation services (business development support) to be equipped to set up second-hand clothing and footwear business models - May need to develop standards and guidelines for trade	- Assists with meeting job creation and SMEs targets - Less clothing and footwear waste going to landfill / reduce landfill costs - Assists with achieving climate change targets - Helps to support efficiency and some value chain R-CTFL commitments (but needs to be made more obvious)	- New infrastructure role out / physical and technology - Campaigns / engagement with retailers - Investment in SME capacity building - Cost to develop standards / adaptations and R-CTFL engagement

5. PROPOSED ACTION PLAN FOR INTERVENTION IMPLEMENTATION

The interventions proposed in this report are all interlinked and, combined as a nexus, could significantly decarbonise the South African textiles value chain. The market pull is the drive towards more sustainable fashion and to reduce waste to landfill. This comes in the form of more eco-conscious and considered consumers, and the commitment of retailers and brands to reduce their environmental impact, and through the R-CTFL market plan to increase local, more efficient manufacture. Consumers include private individuals, and government – the latter having the ability to shift the value chain significantly by adjusting its clothing and footwear procurement policies, in line with some of the interventions proposed.

Figure 5 shows the South African textiles value chain decarbonisation intervention nexus with the proposed plans of action, setting out a staged process of implementation to be considered for committing to and implementing activities to meet CO_2 emissions reduction targets to reach net-zero by 2050. It should be noted that the interventions proposed focus predominantly on manufacturing-focused activities, and/or those that could have a significant impact or be a driver for a shift in manufacturing decarbonisation (with a focus on environmental) practices.

Figure 5: South African textiles value chain decarbonisation intervention nexus



Source: Author.

The green boxes in the figure point to the stimulation of both local clothing and textiles manufacturing. Local clothing manufacturing includes locally sourced textiles, and these should meet certain environmental, social and labour parameters. Local textiles manufacturing includes sourcing local fibres, optimising energy consumption, adopting standards for reducing hazardous chemicals, optimising water management, and reducing waste and increasing the use of recycled textiles content – with a focus on fibre-to-fibre.

The blue boxes cover interventions to scale reuse and recycling and systems for collection of reuse/recycling items. Scale of reuse includes both online marketplaces and physical second-hand clothing and footwear markets. Scale recycling includes increasing in-factory repurposing of textiles and end of life clothing and broken fabric, increasing textiles as recycled content in clothing and other added value products, e.g. furnishings and flooring (using end of life clothing and broken fabric). It also includes creating systems for capturing clothes for circularity for used items, end of life, and textiles "waste".

The peach-coloured box acknowledges the sourcing of local natural fibres, e.g. wool, mohair, leather and cotton, albeit not a focus of this study. In contrast, the grey box captures the importation of textiles and fibres. The import of textiles and fibres, however, should only be if they are not available from local producers and should meet set environmental parameters.

The yellow boxes highlight the decarbonisation market pull stakeholders – namely retail and brand buyers, individuals in their private capacity, and government – that can procure volume and influence scale. The retail and government stakeholders are driven by the R-CTFL Master Plan, and all interventions should be considered for inclusion in the implementation of the Master Plan. It is proposed that procurement activities informed by the interventions are focused on large volume products, such as value clothing, baby clothes, uniforms (workwear and school clothing).

The need to address climate change and to shift the South African textiles sector to a net-zero carbon emission pathway is urgent and requires the textiles sector to work together to act (Berg et al., 2020). This report provides a strategy of interventions for consideration to adopt a new system for South Africa's textiles economy to adopt principles of circularity and decarbonisation. In such a model, CTFL re-enter the economy after use and never end up as waste, processes of operation are optimised, and just and decent jobs are kept or increased. One of the first activities to undertake will be the setting of GHG emission targets suitable for the South African textiles value chain. It is proposed these align with international sectoral commitments, for example, the:

- UN Climate Change Fashion Industry Charter for Climate Action's ambition for net zero emissions by 2050 (UNCC, 2021); and
- EU strategy for sustainable and circular textiles target to achieve carbon neutrality by 2050, and 50% reduction in GHG emissions by 2030 (European Commission, 2022b).

To implement the proposed interventions to achieve the agreed targets and ambitions, short-term (2-5 years), medium-term (5-10 years) and long-term (10-15 years) phases of implementation are proposed for the sector to transition to one that is decarbonised.

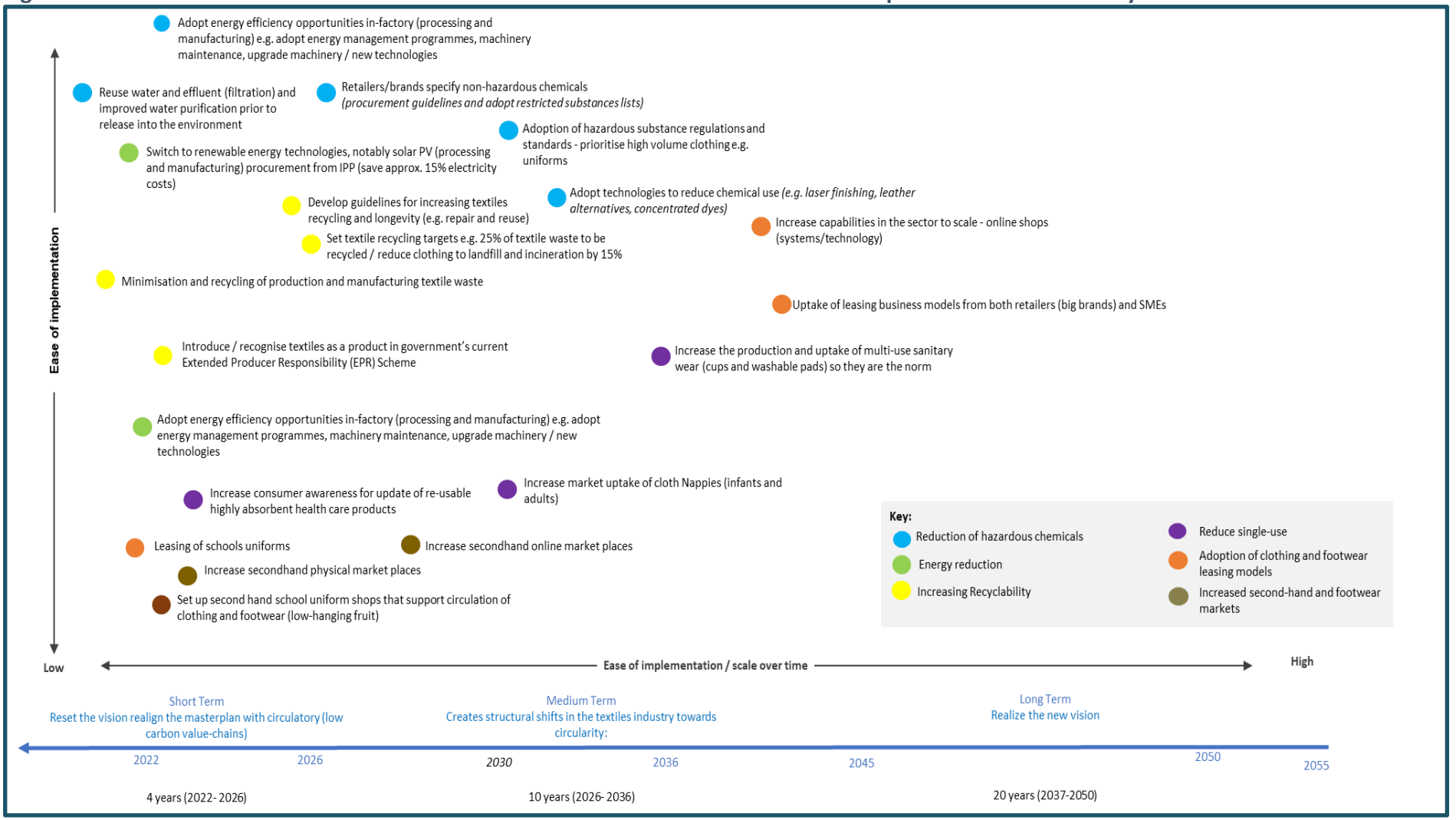
The following three phases are based on a temporal approach whereby net-zero emission targets can be incrementally reached over a 28-year period (up to 2050) (see also Figure 8 on page 52):

Decarbonisation phase 1 (4 years):	Continue with and scale current good practice. Develop a textiles decarbonisation community of practice or forum. Set relevant CO_2 emissions reduction targets.
Decarbonisation phase 2 (10 years):	Implement agreed zero-net CO_2 emission practices/ targets.
Decarbonisation phase 3 (20 years):	Achieve zero-net CO_2 emissions.

The phased approach needs to incorporate the interventions outlined as strategic shifts, namely reducing processing and manufacturing impact, and zero waste to landfill.

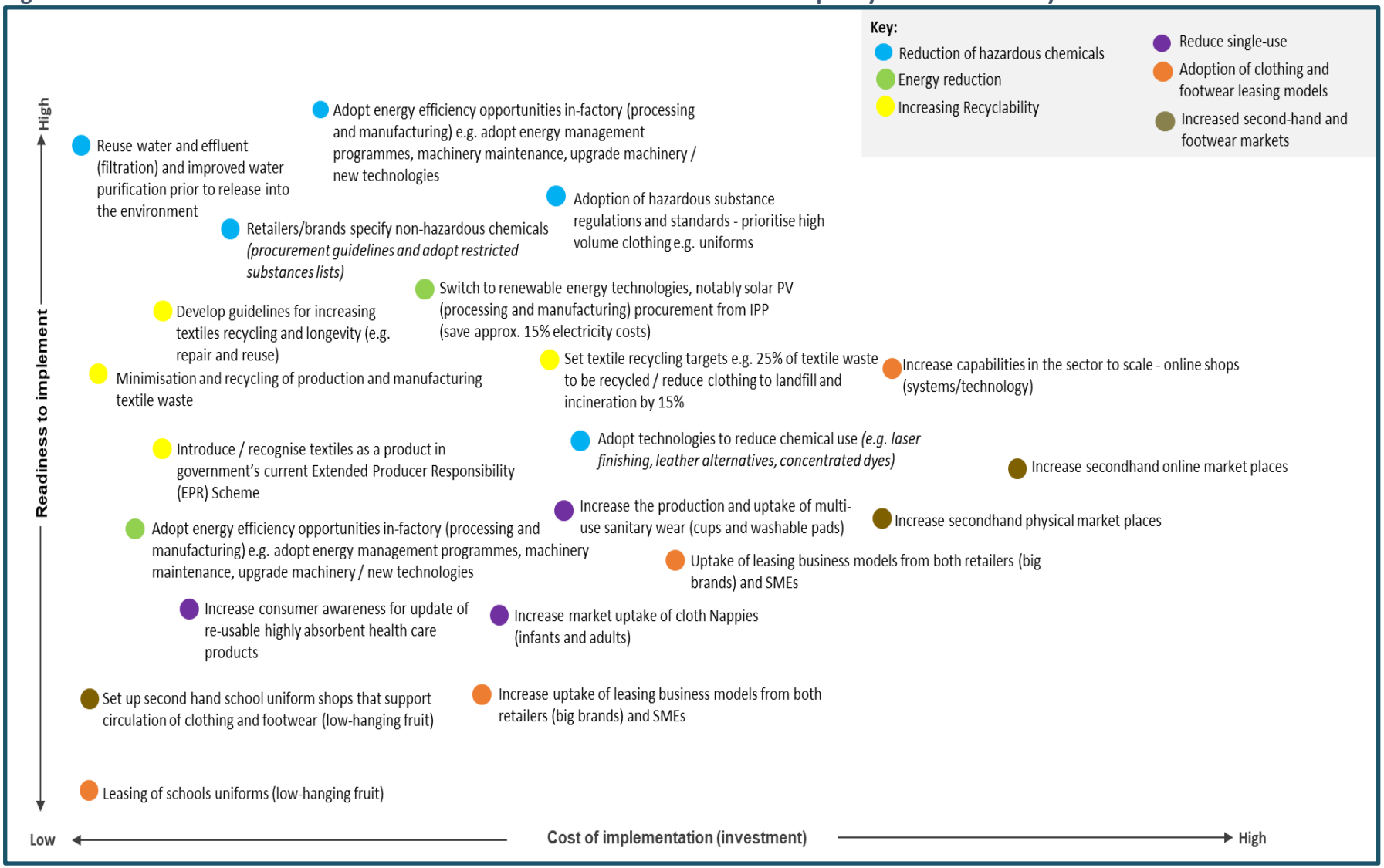
Figures 6 and Figure 7 illustrate the likely viability (ease) of the South African textiles value chain to implement the proposed interventions, including ease of implementation, potential to scale over time, readiness to implement, and cost of implementation (investment). The placing of the interventions on the matrices is subjective and open to discussion and refinement. What the matrices illustrate is that all interventions are viable and can be implemented and scaled from current action or implemented from new within the next 18 years. From about 2040 onwards, the focus would be on scaling the interventions to the point when they contribute significantly to reducing the carbon impact of the sector and are considered “common” practice or the “norm”.

Figure 6: Decarbonisation of South Africa's textiles value chain: Ease of intervention implementation and ability to scale over time



Source: Authors.

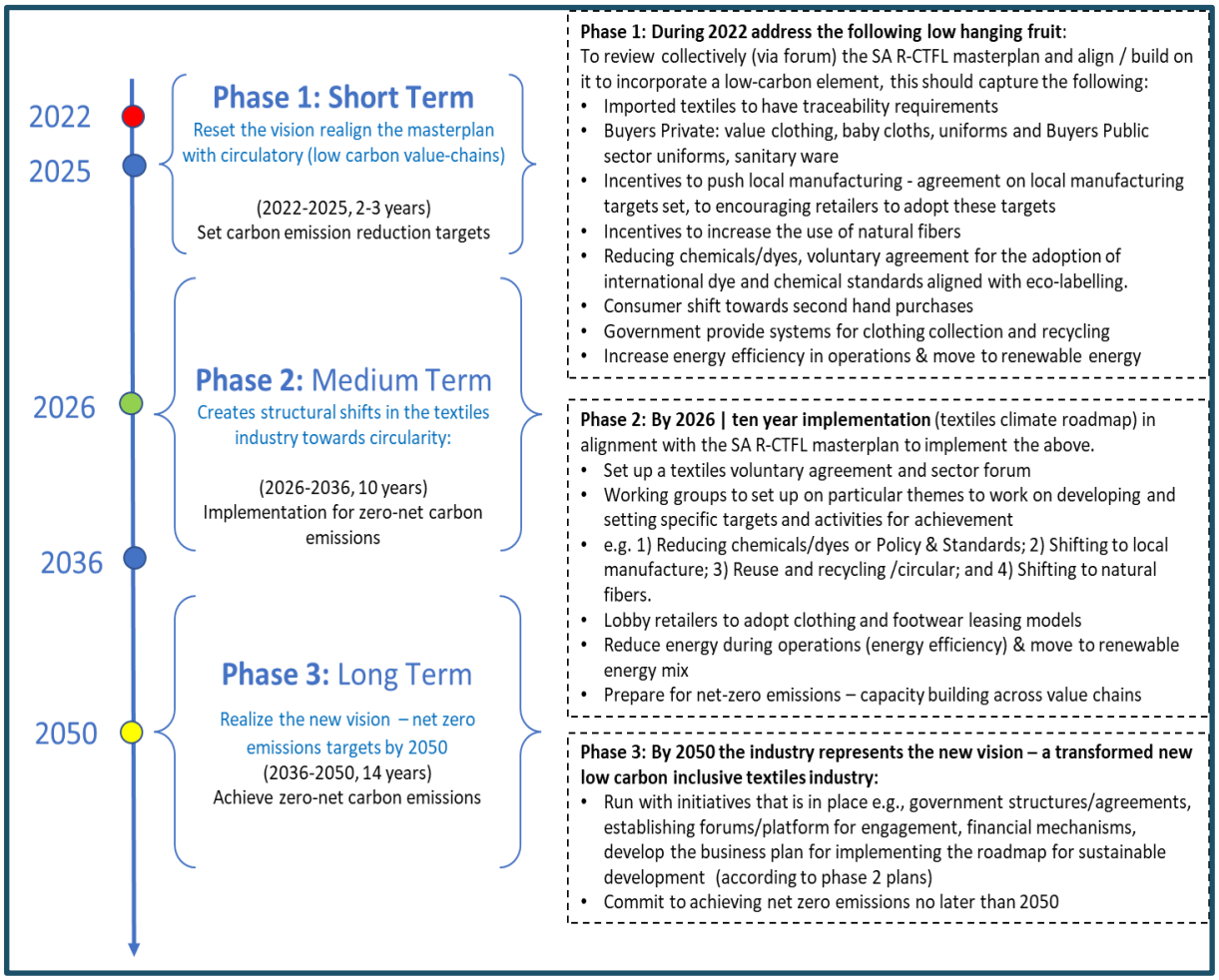
Figure 7: Decarbonisation of South Africa's textiles value chain: Intervention capacity and cost viability



Source: Authors.

Figure 8 provides an illustration of how these interventions can be packaged to roll out a proposed South African textiles value chain decarbonisation action plan.

Figure 8: Proposed pathway of actions for South Africa's textiles value chain to transition to one that is decarbonised



Source: Author.

These pathways illustrate the possibility of decarbonisation and meeting 2050 emission reduction targets. It is recommended that the dtic engages with stakeholders in the textiles value chain (including government, industry [including SMEs], trade unions, academia and research institutions, and civil society) to table these options and to get broad buy-in to ensure decarbonisation is implemented in an inclusive way that can benefit not only the environment, but also workers and increase profitability.

Achieving a new textiles decarbonised economy will demand unprecedented levels of alignment and collaboration (McKinsey, 2020). A system-level and multi-stakeholder change approach is required – one that will capture the opportunities missed by the current linear textiles system (Ellen MacArthur Foundation, 2017). Therefore, the proposed decarbonisation action plan is recommended to build on and align with the R-CTFL Master Plan (but including broader representation of manufacturers and producers) and needs to align and build on current activities – such as the CSIR textiles and circularity research, the UN and NCPC-SA InTex Programme, and the City of Cape Town (GreenCape). The action plan would need to be consulted on, using a collaborative forum to set the agenda, refine priority activities, and foster the journey towards

net-zero. Implementing the Textiles Value Chain Decarbonisation Action Plan would require the dtic to set up an industry forum to focus on developing and collaboratively implementing it. Nothing exists in this specific format and remit in South Africa. An initial set of stakeholders, albeit mainly retailers, was established during the development of the R-CTFL Master Plan. Could this "forum" of stakeholders be expanded and formalised into a community of practice that focuses on decarbonising the South African textiles value chain? Examples of similar activity and target-based initiatives already exist in this country, such as South Africa's food loss and waste initiative, and Plastics Pact. Such a model could be considered for textiles to drive collective change.

6. CONCLUSION

The research has shown that there are two key areas of proposed intervention, containing specific areas of action to decarbonise the South African textiles value chain, with a focus on local manufacturing. Reducing the use of hazardous chemicals and improving water management, and optimising manufacturing energy consumption are interventions aimed at reducing processing and manufacturing impact. These are often driven by the need to reduce cost, as witnessed in South Africa's already cost competitive textiles industry. The promotion of fibre-to-fibre recycling and product longevity, reducing single-use sanitary wear, adopting clothing and footwear leasing models, and increasing the market for legal, domestically-traded, second-hand clothing all aim to drive ambitions of zero waste to landfill.

While all these interventions would enable the South African textiles sector to transition to a decarbonised economy and meet UN targets for the clothing industry to be zero carbon by 2050, there is little collaborative activity in South Africa to develop, guide, implement and monitor these interventions. The risk is that the sector will continue on as business as usual or adopt siloed iterative activities to reduce environmental impact – either due to international environmental standards, or indirectly through the economically-focused R-CTFL Master Plan, which does not adequately recognise sustainability and decarbonisation.

With the respective proposed interventions and viability of implementation, those associated with cost benefit, such as energy and water optimisation and management, are considered the most viable. Interventions requiring investment in technologies, systems, increased manufacturing and infrastructure capacity, and human capability – such as decreasing the use of hazardous chemicals, setting up online markets for leasing and the legal, domestic sale of second-hand clothing and footwear, and increasing fibre-to-fibre recycle content – will require more considered planning, government support, awareness and training and collective action.

Case studies and interviews with key stakeholders in the sector indicate that there is the desire by some to shift to more sustainable practices, including the keeping of and/or increase in just and decent jobs. In addition, there has been recent national research and project activity to better understand sustainability within the sector, and to identify a full breadth of value chain interventions. These include projects being undertaken by the CSIR, UN-funded NCPC-SA InTex programme, and GreenCape's textiles action plans for the City of Cape Town. While these practices exist, South Africa does not have a centralised, formalised platform from which the sector can galvanise and act collectively to decarbonise the sector. It is proposed that the stakeholders consulted in the development of the R-CTFL (mainly retailers) are formalised into a collective community of practice and expanded to capture a broader set of stakeholders representing government, industry (large and small), trade unions, academia and research, and

civil society along the South African textiles value chain. It is recommended that South Africa's Food Loss and Waste Initiative, and Plastic's Pact, are seen as examples of such a structure. Furthermore, a recommendation, broadly supported by stakeholders in the value chain, is for DFFE to add textiles to the EPR scheme. This would be a strong mechanism to drive more circularity and low-carbon interventions in the industry.

While South Africa's textiles value chain is complex, its path towards decarbonisation yields much opportunity, especially for SME enterprise stimulation, job creation and supporting local production – a key commitment in the R-CTFL Master Plan. Given this complexity, and the need for collective formalised action, this research proposes a staged approach of three phases of activity to achieve net zero emissions by 2050.

The first is short term (2022-2025) and focuses on continuing industry good practice, improved understanding of the magnitude of the sector's impact such as waste, beginning to set targets, guidelines and standards for example reduction of hazardous chemicals and carbon emission targets.

The medium-term (2026-2036) includes establishing a forum and/or voluntary agreement to plan and implement activities in alignment with the R-CTFL Master Plan.

Long-term (2036-2050) activities should focus on achieving net zero emissions through value chain stakeholder measurement, targeting impacts, acting on these and reporting. While the focus of this research has predominantly been on the manufacturing component of the value chain, dimensions including textiles sourcing (raw material production such as growing of cotton), natural fibre selection, job creation, worker welfare and consumer interaction and use cannot be ignored.

APPENDIX A: TEXTILE PRODUCT CATEGORIES AND DETAILS

PRODUCT CATEGORY	PRODUCT DETAIL
Men's clothing	– Overcoats, jackets, vests – Suits, suit- pants – Pants, trousers – Sweaters, pullovers, cardigans – Shirts, blouses – Undergarment, sleepwear, robes – T-shirts, singlets – Activewear, sportswear – Socks, hosiery – Workwear, uniforms
Women's clothing	– Overcoats, jackets, vests – Suits, suit- pants – Pants, trousers – Dresses, skirts – Sweaters, pullovers, cardigans – Shirts, blouses – Undergarment, sleepwear, robes – Brassieres, suspenders, garters – T-shirts, singlets – Activewear, sportswear – Socks, hosiery – Workwear, uniforms
Children's clothing	See "Men's clothing" or "Women's clothing."
Unisex apparel clothing	
Home textiles	– Bed linen, bed sheets – Table linen, tablecloth, napkins – Towels, kitchen linen, toilet linen – Food contact textiles – Blankets, bedspreads, quilts – Curtains, blinds – Upholstery – Carpets, rugs, floor coverings – Pillows, cushions
Carried accessories	– Bags, handbags, totes, pouches – Luggage, suitcases
Worn accessories	– Gloves, mittens, hand coverings – Neckties, bow ties, cravats – Scarves, shawls, veils – Handkerchiefs – Hats, caps, head coverings
Personal care, hygiene	– Topical products – Invasive products
Medical	– Topical products

Bedding	− Mattresses − Pillows, cushions
Footwear	− Shoes
Functional accessories	− Buttons − Zippers − Labels, tags − Trimmings − Interlining − Sewing threads
Outdoor	− Tents, sails, camping goods − Tarpaulins, awnings − Mattresses − Luggage, suitcases − Bags, handbags, totes, pouches − Sleeping bags
Industrial / technical	− Tarpaulins, awnings − Automotive parts, upholstery − Building materials
Filling / stuffing	− Down, feather − Man-made fibre filling − Natural fibre filling
Toys	− Soft toys − Hard toys
Greige fabrics	− Knitted fabrics − Woven fabrics − Terry fabrics − Denim fabrics
Undyed fabrics	− as above
Dyed fabrics	− as above
Other fabrics	− Non-woven fabrics − Special fabrics − Leather − Bonded leather
Greige yarns	− Open-end yarns − Carded yarns − Combed yarns − Filament − Yarn for hand knitting − Core-spun yarns − Fancy yarns − Sewing threads
Undyed yarns	− as above
Dyed yarns	− as above

Undyed fibres	− Lint cotton − Raw fibres − Raw silk − Combed fibres − Soured fibres − Staple fibres − Mixed fibres − By-products − Comber noil − Cotton linter
Dyed fibres	− as above
Processed materials	− Down, feather − Tanned hide − Chips (pellets) − Flakes − Pulp − Popcorns
Unprocessed fibres / materials	− Seed cotton (raw cotton) − Greasy wool − Silk cocoons − Greasy animal hair − Pulp − Down, feather − Rawhide − Flakes − Popcorns
Reclaimed materials	− Reclaimed bottles − Reclaimed fishing nets − Reclaimed textiles − Reclaimed ocean waste − Reclaimed process waste

Source: Authors, adapted from GOTS and Textile Exchange (2020).

APPENDIX B: SOME OF THE MAIN PLAYERS IN SOUTH AFRICA'S TEXTILES SECTOR

PROCESSORS AND MANUFACTURERS	
ACA Threads	Manufacturer and supplier
ACM	Manufacturer of a comprehensive range of elastic and rigid narrow fabrics
AJ Charnaud & Co	Manufacturer of personal protective clothing and safety equipment
Alligator Manufacturing	Design, manufacturer and sourcing of promotional and retail products
Beaches Clothing	Design and manufacture of swimwear
Berzack Brothers	Industrial machinery and accessories, and distributors of fittings, accessories and other materials to the CTFL sector
C&R Brand Solutions	Design and manufacturer branded clothing
Canvas and Tent	Manufacturer and supplier of canvas-related products
Cotton Traders	Importer and processor of down and feathers, and inners
Denebe Investments Ltd	Distributor of branded products, notably toys, manufacturer of nonwoven, woven polypropylene, and household textile products
Durban Overall	Manufacturers of general and specialised workwear and uniforms
Dyefin Textiles	Dyeing, printing and finishing of knitted and woven fabrics
Eddels Shoes	Manufacturer and supplier of footwear
Falke	Knitting mills and manufacturer of knitted socks, stocking and tights
Farbe Designs	Manufacturer of branded clothing
Freudenberg Nonwovens	Manufacturer of performance materials, technical textiles and nonwovens
Gencon	Manufacturer and supplier of clothing, sports equipment and promotional products
Glodina Towelling	Manufacturer of towel products
Hammersdale Knitting Company	Manufacturer of knitted fabric
Headwear24	Manufacturer of headwear, including customisation
ITL	Manufacturer of labels
Kingspark Manufacturers	Manufacturer of textiles and clothing
K-Way Manufacturers	Manufacturer of outdoor clothing, footwear and accessories
Labora Shoes	Manufacturer of footwear

Luomo Atlantis Manufacturing	Manufacturer of clothing and workwear
Ninian & Lester Textiles	Manufacturers of textiles, clothing, knitted fabrics and yarn
Pall Mall Neckwear	Manufacturer of clothing, uniforms, ties and embroidery, and dyeing
Powerhouse Clothing	Clothing manufacturer
Prilla 2000	Cotton spinning mill
Reliance Clothing	Clothing design, manufacturer and supplier
Rotex Fabrics	Knitter, dyer and finisher of clothing and sports-wear fabrics
Sadler Belts	Leather belt manufacturer
Sentinel Workwear	Manufacturer and supplier of bulk workwear and overalls
Sheraton Textiles	Design and manufacture of bed linen and bedding accessories
MANUFACTURERS	
Ackermans	Clothing, footwear, and accessories retailer
Cape Union Mart	Camping, hiking and outdoor clothing, textile and accessory retailer
Mr Price Group	Clothing, footwear, accessories, sportswear and home textile retailer
PEP Stores	Clothing, footwear, accessories and homeware retailer
Pick n Pay Clothing	Clothing, footwear, and accessories retailer
The Foschini Group	Clothing, footwear and accessories retailer and manufacturer
Woolworths	Clothing, footwear, accessories and homeware retailer

Sources: Authors, derived from CCTC (2022) and KZN CTC (n.d.).

APPENDIX C: SOUTH AFRICAN R-CTFL VALUE CHAIN MASTER PLAN TO 2030 CORE ACTION COMMITMENTS

COMMITMENT	MAIN ACTIONS	STAKEHOLDER COMMITMENTS
Commitment 1: Grow the market for local CTFL producers	1. Develop and market local brands and labels 2. Upgrade local design and manufacturing competitiveness 3. Extend and scale "buy local" campaigns	**Retailer commitments:** 1. Each local retailer to develop "buy local" labels/brands 2. Minimum commitment to marketing of local labels/brands 3. Proudly SA **CTFL commitments:** 1. Invest to upgrade local design behind local design labels/brands 2. Proudly SA **Labour commitments:** 1. Lead and scale "buy local" campaigns 2. Proudly SA **Government commitments:** 1. Enforce designated category status for government procurement 2. Proudly SA
Commitment 2: Increase local CTFL procurement	1. Grow local CTFL procurement to R69 billion/65% share of retail sales 2. Commence retailer-led work to identify specific scale import substitution opportunities and define clear roadmap to development of local CTFL verticalization, capacity and capability 3. Develop an agreed common definition and methodology for determining "local" procurement	**Retailer commitments:** 1. Commit to local procurement targets with a clear roadmap over ten years and specific import-substitution opportunities 2. Define local content, determine how the 65% target will be measured & provide impact reports for increased localisation 3. Resource working groups 4. Lead value-chain verticalisation and work with domestic industry to identify new products, input requirements and develop new domestic productive capabilities **CTFL commitments:** 1. Invest in demand-led capacity, technology and skills upgrading 2. Work with retail to identify new products, input requirements and develop new domestic productive capabilities **Labour commitments:** 1. Negotiate appropriate adaptability arrangements

		Government commitments: 1. Extend targeted Clothing Instructional Programmes (CIP) and Production Incentive (PI) programmes for three years aligned to verticalization and transformation 2. Consider appropriate trade relief and rebates 3. Consider Competition Act exemptions where necessary and appropriate 4. Qualifications for training 5. Examine feasibility of a Special Economic Zone for clothing
Commitment 3: Stem the flow of illegal imports	1. Upgrade South African Revenue Service enforcement capacity and capabilities through: a. Development of comprehensive valuation database b. Deployment of expertise to support enforcement around Rules of Origin, misdeclaration and under invoicing c. Facilitation and commitment of resources to upgrade customs infrastructure, clearance procedures and logistics	**Retailer commitments:** 1. Deploy resources for valuation database development 2. Second experts to support customs enforcement 3. Funding for customs infrastructure upgrading 4. Registration on the Authorised Economic Operator and Preferred Trader programmes 5. Use Sector Education and Training Authorities (SETAs) to train buyers and manufacturers on legal importation processes and methods. **CTFL commitments:** 1. Deploy resources for valuation database development 2. Second experts to support customs enforcement 3. Funding for customs infrastructure upgrading **Labour commitments:** 1. Support development of valuation database 2. Secondment of experts to support customs enforcement **Government commitments:** 1. Implement customs enforcement upgrading plan 2. Develop valuation database 3. Review customs enforcement infrastructure, capability and capacity requirements

		4. Finalise Authorised Economic Operation (AEO) programme and roll out through the value chain 5. Accelerate City Deep pilot project
Commitment 4: Strategic use of Tariffs and rebates	1. Maintain applied tariff dispensation for CTFL imports, but 2. Develop appropriate mechanisms to provide transparency for tariff rebates 3. Review rebate provision on importation of second-hand clothing 4. Review rebate provisions on imported primary materials and components to support localisation of manufacturing, subject to: a. Demonstrated, measurable and enforceable employment and investment growth benefits b. Future rebates subject to strict conditionalities (e.g. bargaining council compliance, tax compliant) c. Effective enforcement to prevent abuse d. Taking account of employment and production across the value-chain, including textiles	**Retailer commitments:** 1. Off-take commitments to support scale opportunities to support and grow investment in local finished goods, primary material and component manufacturing **CTFL commitments:** 1. Invest to sustain and grow finished goods, primary material and component manufacturing 2. Targeted use of rebates to support employment growth 3. Eliminate rebate abuse **Labour commitments:** 1. Provide information on upstream and downstream industries **Government commitments:** 1. Deliver on rebate commitments 2. Support value-chain in developing scale demand for locally manufactured finished goods, primary materials and components 3. Develop mechanisms for tariff rebate transparency 4. Upgrade monitoring and enforcement of rebate regime
Commitment 5: Extend CIP and PI in an appropriate format for three years	1. Extend the CIP and PI programmes in an appropriate format for a further three years, with adjustments to focus investment support towards verticalization and transformation and on dynamic value chains and firms, with added support targeted at firms that are growing and adding jobs	**Retailer commitments:** 1. Identify and commit to specific procurement targets in specific lines and categories to support upstream scale investment **CTFL commitments:** 1. Specific investment and upgrading targets to deliver against retail procurement commitments

	2. Tailoring of programmes to the specific requirements of CTFL sub-sectors 3. Upgrade programme support to improve outcomes, efficiency, effectiveness and agility	**Labour commitments:** 1. Delivery of commitment #6 to align productive capacity to sales cycles **Government commitments:** 1. Extend CIP and PI commitments for three years 2. Upgrade programme support capabilities 3. Tailor programmes to CTFL sub-sector requirements
Commitment 6: Align production capacity to sales cycles	Implement appropriate adaptability arrangements to better align production capacity to selling cycles to be negotiated and agreed between labour and employers on a case-by-case basis for specific value-chains where clear job creation increases have been agreed, and where increased procurement, employment and investment commitments have been made by retailers and manufacturers and are authorised by a national bargaining council. Such adaptability agreements will be subject to: a. Workers' agreement thereto b. Workers total take- home pay and social benefits ideally being more than they would otherwise have been entitled to under current bargaining council agreements c. No downward variation in overall employment conditions d. Programmatic and effective monitoring and evaluation mechanisms to be put in place to periodically review that workers are not prejudiced financially and that	**Retailer commitments:** 1. Specific procurement commitments **CTFL commitments:** 1. Design and implement adaptability models that deliver job growth **Labour commitments:** 1. Negotiate and agree adaptability arrangements **Government commitments:** 1. Deploy targeted support

	expected productivity benefits are being realised e. Learnings from case- by-case agreements (current and future) to be systematically reviewed with a view to developing a framework for sector-wide flexibility arrangements in support of CTFL competitiveness and productivity upgrading without prejudice to worker earnings and benefits	
Commitment 7: Value chain transformation	1. Retail and CTFL manufacturing procurement to actively support Broad-Based Black Economic Empowerment (BBBEE) supply chains and the value-chain ecosystem 2. Commit and deliver on specific black and worker ownership targets through road-based and inclusive models that are genuinely empowering and compliant with the BBBEE Codes and labour legislation.	**Retailer commitments:** 1. Specific black and worker ownership targets 2. Procurement targets from black-owned and small, medium and micro enterprise (SMME) suppliers and 3. Dedicated supplier-development **CTFL commitments:** 1. Specific empowerment and worker ownership targets 2. Procurement targets from black-owned and SMME suppliers and 3. Dedicated supplier-development investment **Labour commitments:** 1. Develop worker skills around participation in ownership and management 2. Support partnership models at workplaces **Government commitments:** 1. Government procurement to follow retail and manufacturing commitments 2. Align Government incentives to support transformation objectives

Source: the dtic (2020a).

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