



Opportunities for a Circular Textile Economy in South Australia

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Executive summary

This report highlights that the circular textile economy for South Australia (SA) needs to change from a linear model to a closed loop model. To achieve this, factors to tackle include sustainable design and manufacturing (such as phasing out raw material inputs of concern), sustainable supply chain management, and reducing the immense carbon footprint of the industry. This is achievable through improved logistics, improved packaging, water use, shifting to renewable energy sources and encouraging greater textiles recovery.

The work will require shared responsibilities along the supply chain will support increased circularity and keep textiles and fibres at their highest utility and value, thus contributing to South Australia's net-zero ambition.

The State's transition to a circular economy should not only focus on waste but also on design and manufacture. These are integral parts to the transition, with citizens and the environment the ultimate benefactors.

Section 3 highlights that the volumes, types and fibre blends of textiles imported into South Australia mirror national trends. This can be leveraged by the South Australian Government advocating and supporting national responses and/or cross-jurisdictional actions and policy development, including approaches to National Product Stewardship¹.

Notwithstanding, this report recommends that greenhouse gas (GHG) emissions can be reduced by the following pathways: embodied impact reductions, use impact reductions and end of life impact reductions. Use stage reductions, clothing reuse, increasing recycled content, and supporting supply chain improvement are all key 'hotspots' in the textile lifecycle. Economic and social impacts of the proposed actions are beyond the scope of this study but provide reason to support textile reuse and recycling. Discussions with stakeholders have highlighted that uniforms, excess clothing and linen are the major sources of textile waste needing solutions in SA. 94% and 77% of council and industry respondents, respectively, indicated a willingness to contribute in further discussion regarding this issue.

The interventions identified focus on solutions which could support short to medium term shifts towards circularity in SA. With this context, the opportunities and interventions identified focus on identified opportunities for clothing and uniforms as a priority for industry, clothing and linen for charitable organisations, and linen for the health and tourism sectors.

Designing, manufacturing, using and recovery of textile waste in alignment with the waste hierarchy will allow for textile circularity that is both sustainable and effective in reducing greenhouse emissions and South Australia's aims for net-zero carbon. Intervention measures will provide local government and industry (including the charitable and not-for-profit sectors) with the means to advance the shift towards textile circularity in the short term. Medium and long term measures are identified as opportunities in this report.

¹ Noting that clothing textiles was listed for the first time in 2021-22 on the Minister's Priority List - DAWE of products and materials considered to be most in need of a product stewardship approach. This included four priority actions for a product stewardship approach to be undertaken 2022-2025.

TABLE OF CONTENTS

1.	Introduction	7
2.	Project approach	8
2.1	Objectives	8
2.2	Project methodology	8
2.3	Stakeholder consultation	9
2.3.1	Industry perspective	10
2.4	Limitations to the study	16
3.	Textiles in Australia	17
3.1	Textiles imported into Australia	17
3.2	Textile waste management in Australia	19
3.3	Textiles imported to South Australia	21
3.4	Textile waste management in South Australia	23
3.4.1	Textile recovery	25
4.	Greenhouse gas emissions associated with textiles	26
4.1	Lifecycle emission estimations	26
4.2	Embodied impacts and clothing	28
4.3	Use impact of clothing	29
4.3.1	Fibre types	29
4.3.2	Electricity emissions related to clothing use	29
4.3.3	Reuse of clothing	30
4.4	End-of-life impact of textiles	30
4.4.1	Disposal to landfill	31
4.4.2	Energy recovery	31
4.4.3	Emissions benefit of the charity sector	32
4.4.4	Mechanical and chemical recycling	32
5.	Textile management	34
5.1	Product stewardship	34
5.2	Textile waste management options in Australia	34
6.	Options assessment	35
6.1	Textile waste and the waste management hierarchy	36
6.2	GHG impact reduction	37
6.2.1	Embodied impact reductions	38
6.2.2	Use impact reductions	38

6.2.3 End of life impact reduction	39
6.3 Interventions	39
6.3.1 Data analytics	40
6.3.2 Design and manufacture	41
6.3.3 Cleaner production	41
6.3.4 Collection, separation and sorting	41
6.3.5 Reuse and repair	42
6.3.6 Education and awareness	43
6.3.7 Government waste management practices	44
6.3.8 Procurement	45
6.3.9 Emerging industries	45
6.3.10 Redistribution	46
6.4 Opportunities	47
6.4.1 Industrial symbiosis	47
6.4.2 Lifecycle stage interventions	48
6.4.3 Organisational opportunities	48
6.4.4 Textile waste management improvements	49
7. A case study	51
8. Conclusion	52
References	53
Appendix I	56
Examples of available textile waste management solutions	56
Appendix II	60
Stakeholder Survey – Local Government	60
Stakeholder Survey – Industry	61
Stakeholder Workshop Presentation	62
Stakeholder Register	63

LIST OF TABLES

Table 1: Summary of stakeholder interviews	10
Table 2: Comparison of national waste data 2016/17 vs 2018/19	20
Table 3: Contributing emission sources	27
Table 4: Passive and active textile types	27
Table 5: Emissions benefits from recycling clothing (Moazzem, 2021b)	32

LIST OF FIGURES

Figure 1: Climate change impact from a pair of Levi's Jeans (Levi Strauss, 2015).....	7
Figure 2: Project methodology	9
Figure 3: National textile imports by product type 2015-2019	18
Figure 4: National textile imports by fibre composition 2015-2019	18
Figure 5: National import trends 2015-2019	19
Figure 6: Export trends per waste derived product (Blue Environment, 2020)	20
Figure 7: National generation and management of textiles (Blue Environment, 2020) ...	21
Figure 8: National recovery and recycling rates (Blue Environment, 2020).....	21
Figure 9: Import trends for South Australia 2015-2019	22
Figure 10: South Australia textile imports by product type 2015-2019.....	22
Figure 11: South Australia textile imports by fibre composition 2015-2019.....	23
Figure 12: Typical waste categories collected by councils	24
Figure 13: Council respondents using EfW.....	25
Figure 14: Carbon footprint of clothing in the UK (Wrap UK, 2012)	26
Figure 15: Heatmap of textiles imported into SA by origin country (ABS)	29
Figure 16: Carbon impact of fibre waste treatments (Payet, 2021).....	31
Figure 17: Circular economy principles.....	35
Figure 18: A textile waste hierarchy	36
Figure 19: Single score LCA results for impact reduction options (Moazzem, 2020)	38
Figure 20: Points of intervention	39
Figure 21: Opportunities to advance textile circularity in SA	47

Glossary

Apparel	All clothing, consumer fashion, uniforms and workwear.
Blended fibre	Textiles consisting of (two or more) mixed fibres. (i.e. 50% cotton/50% polyester)
Clean textiles	Staple fibres not yet manufactured into a final product . (i.e. offcuts, by the roll, consistent fibres)
Complex textiles	Items such as clothing with zippers, carpet with rubber backing, and curtains with metal eyelets; where the major component is textiles.
Composite textiles	Products where textiles are a non-majority component. (i.e. furniture, mattresses, motor vehicle seats, textiles are a smaller component).
Contaminated textiles	Textile products presented at end of life contaminated by foreign matter from its use. (i.e. rags, nappies, medical waste)
Fast fashion	Clothing and apparel that are discarded after minimal use.
Natural fibres	Any natural or organic fibre. (i.e. wool, cotton, hemp, linen, etc.)
Non-apparel textiles	Textiles in all products exclusive of apparel products.
Post-consumer waste	Waste disposed of by consumers (individuals or households) typically tracked via kerbside or bulky waste collections, charitable donations or illegal dumping.
Post-industrial waste	Waste disposed of by businesses or organisations tracked through commercial and industrial waste disposal records. (i.e. manufacturing/production waste, off-cuts, faulty products, contaminated waste, etc.)
Single fibre fabric	Products containing textiles from a single fibre type only. (i.e. 100% cotton, 100% polyester)
Synthetic fibres	Any polymer or petrochemical derived fibre. (i.e. polyester, nylon, polypropylene, spandex, etc.)
Textiles	All woven and of non-woven materials synthetic or natural fibres.

1. Introduction

The Ellen MacArthur Foundation defines the circular economy as an economy that ‘eliminates waste, circulates products and materials and regenerates nature’. Furthermore, the Foundation estimates that clothing underutilisation and the lack of textile recycling results in excess of \$500 billion USDs of value loss per annum. Clothing underutilisation includes the disposal of nearly 50% of fast fashion produced each year.

Significant textiles value losses have been measured globally and in other jurisdictions. For example, it is estimated that approximately \$100 billion USD is lost annually because only 1 per cent of textiles globally are recovered to produce new clothing and disposal costs for textiles in the United Kingdom alone is estimated at \$108 USD (Ellen MacArthur Foundation, 2017).

In addition to the added waste disposal load, the carbon impact of the textile industry is a large contributor to climate change. The Ellen MacArthur Foundation estimates total greenhouse gas (GHG) emissions from textile production at 1.2 billion tonnes per annum². To further illustrate this point, it is worth considering the environmental impact of a pair of jeans. Levi Strauss undertook a study of a pair of Levi’s jeans in order to determine the associated carbon impact through its lifecycle. The study found that consumer care is the biggest source of carbon emissions in the jean lifecycle, with production being the second largest contributor (as illustrated in Figure 1).

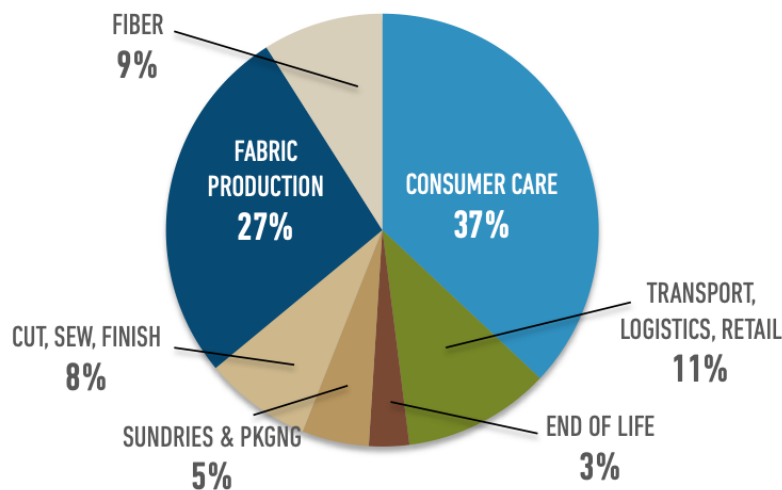


Figure 1: Climate change impact from a pair of Levi’s Jeans (Levi Strauss, 2015)

Local innovation, the increased use of secondary raw materials, a reduction in greenhouse gas (GHG) emissions, and zero avoidable waste to landfill by 2030 are all objectives of SA’s Waste Strategy 2020-2025. The objective of this report (and in particular the options assessment) is to provide a pathway to achieving these objectives for textiles.

² The Monash Sustainable Development Institute estimates the impact at 8% of carbon emissions & 20% of waste water

2. Project approach

2.1 Objectives

This study had four objectives:

- Undertake a literature review to understand the textile recycling market in SA, as well as nationally.
- Undertake a literature review to understand the potential contribution to GHG emissions realised by the textile industry.
- Engage with, and inform, stakeholders.
- Provide an options assessment for action to be taken to include textiles in GISA's proposed Circular Economy Roadmap.

2.2 Project methodology

The project methodology was undertaken in three phases, as detailed below, and summarise in Figure 2:

- Reporting (this document)
 - Understanding the status quo regarding textile management in South Australia, as well as nationally (Sections 3 and 5).
 - A literature review of greenhouse gas emissions associated with textiles (Section 4).
- Stakeholder consultation – articulating the interests and insights of key stakeholders to understand barriers and opportunities and to inform interventions, including:
 - A survey was circulated to councils via the Local Government Association in order to gauge the level of involvement the waste management officers (and others) have at a council level with textile waste. The main aim of the survey was to understand how textile waste is currently managed in South Australia (SA), gain insight into circular economy (CE) projects that encompass textiles, local government procurement regarding textiles, and what the expectations are of local councils wrt textile waste management going forward. A copy of this survey can be found in Appendix I.
 - A survey was distributed to targeted industry stakeholders in order to understand the development of the textile circular economy in SA at present time by investigating industry's current capacity to recover textiles, opportunities for expansion, current challenges and barriers to market, and opportunities and points of intervention needed. A copy of this survey can be found in Appendix I
 - Individual interviews were held with representatives from several industries. This allowed the opportunity for open form responses detailed in Section **Error! Reference source not found.** Copies of both surveys, as well as the stakeholder register are attached in Appendix I.
- Development of an options assessment for the proposed circular textiles market

- o Identification of points of intervention that will further existing progress, detailed in Section 6.3.
- o Identification of opportunities that will advance the circularity of the textile market, detailed in Section 6.4.

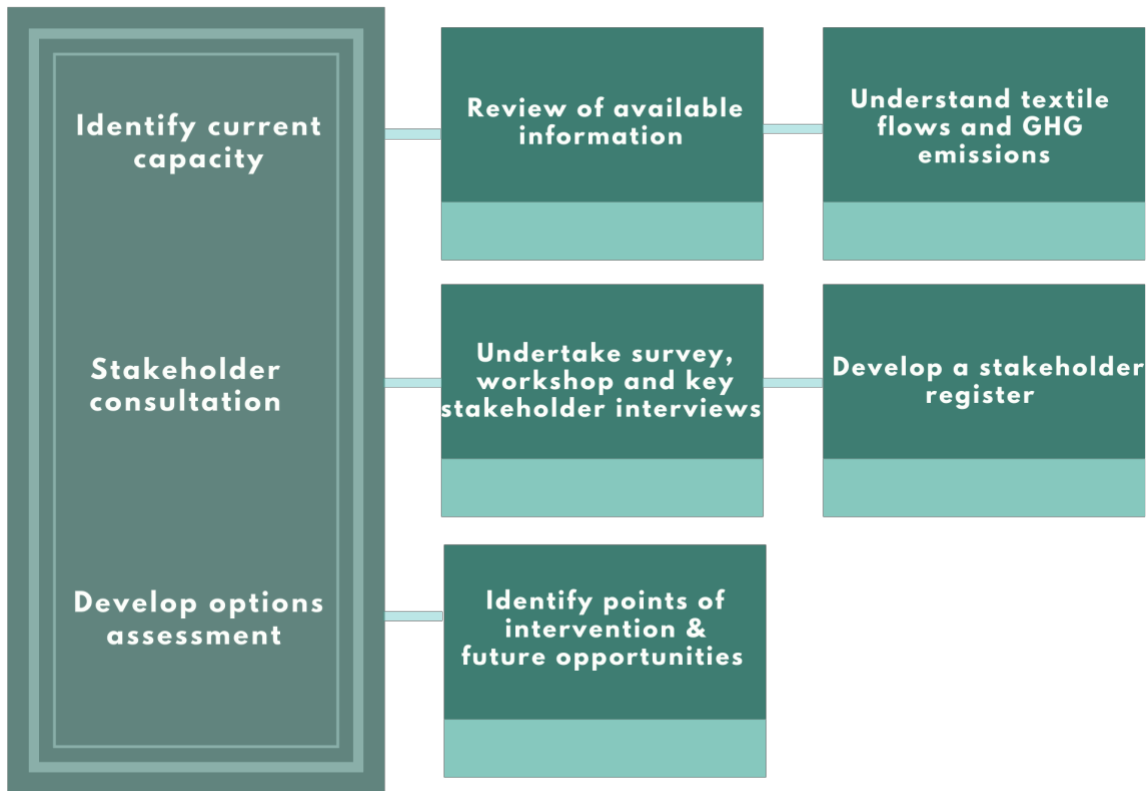


Figure 2: Project methodology

2.3 Stakeholder consultation

Stakeholder consultation for this project was undertaken in two phases: an interactive workshop with local government; and interviews with selected local government and industry stakeholders to gauge an industry perspective on the expansion of circular textile opportunities within the state.

Local government representatives were invited to register for the workshop via an invitation on the LGA website. Following this, a workshop was held with local government representatives on 21 July 2021. The aim of this workshop was twofold: to gain an understanding of the textile waste management challenges and opportunities in the local government space, and to provide detail regarding waste management opportunities in SA and nationally. A presentation was also made to the Waste Management and Resource Recovery (WMMR) Waste Educators Forum.

Copies of the surveys and the workshop are contained in Appendix II.

2.3.1 Industry perspective

94% and 77% of council and industry respondents, respectively, indicated a willingness to contribute in further discussion regarding this issue.

Discussions with stakeholders highlighted that uniforms, excess clothing and linen are the major sources of textile waste needing priority solutions in SA. However, it is cautioned that, while uniforms are a major component of the textile stream, not all uniforms are currently able to be recycled due to function (e.g. high visibility) and use (e.g. personal protective equipment and uniforms with potential for toxic contaminants such as PFAS and asbestos). Most industry respondents to the survey (73%) indicated that secure disposal of uniforms was a requirement – further highlighting that uniform processing should be addressed. A summary of these discussions can be found in Table 1.

The stakeholder register is appended in Appendix II.

Table 1: Summary of stakeholder interviews

Industry	Organisation	Interview Outcome
Utilities	SA Power Networks (SAPN)	<p>SAPN is working towards 90% recovery rate, textiles to now be included.</p> <p>Consultants have been engaged by SAPN to undertake a CE plan and waste composition analysis.</p> <p>Uniforms are to become a focus for textile waste: this has included investigating analysing and investigating fibre composition of uniforms and consideration of future suppliers.</p> <p>Supply chain management and engagement needed.</p> <p>No other materials, such as bunting, considered.</p>
Ship building	BAE Shipbuilding	<p>Currently undertaking waste composition analysis, undertaken by engaged consultants.</p> <p>It has committed to an aspirational organisational zero waste goal to be achieved by 2030.</p> <p>Supply chain management and engagement needed</p> <p>Bin composition analysis confirms the presence of PPE, gloves, reusable knee pads, rope, rags, and other on-site textiles including: scaffold sheeting, containment sheeting, plain weave fire retardant PVC, barrier tape, strapping, rags (recycled cotton), lifting slings.</p> <p>Recovery channels include: Cleanaway (Rags/hazardous waste). ResourceCo (general waste) and sheeting sent to landfill. General waste sent to ResourceCo.</p> <p>'Two' solutions on site - bins on the ground but 1 craneable bin on a ship. This means different ways of collecting recyclables.</p> <p>Industrial textiles on site: scaffold sheeting, containment sheeting, plain weave fire retardant PVC, barrier tape, strapping, rags (recycled cotton), lifting slings. Rags are sent to hazardous waste via Cleanaway. Sheeting is disposed at landfill.</p>

Industry	Organisation	Interview Outcome
		<p>Use of PPE includes also masks (composition fabric and organic) and disposable welding.</p> <p>The site holds space for uniform collection on site, collected via Upparel bins.</p>
Manufacturing	Imageworks Consultants	<p>No local solution for processing/recycling.</p> <p>Health sector produces large amount of textile waste, focus on uniforms, linen, surgeon and nursing clothing, patient clothing.</p> <p>Uniform shirts: trim, threads and labels are different composition to polycotton.</p> <p>Debranding of uniforms important, needs to be before export.</p> <p>Casino uniforms: RFID tags to be implemented</p>
Not-for-profit	Salvos Stores	<p>Expansion of education campaigns needed, with uniformity in messaging between local and state government.</p> <p>Local knowledge needs to be improved; state supported programs needed.</p> <p>Federal and state support improving.</p> <p>Reuse targets need to be set and capture rate needs to be increased.</p> <p>EfW still seen as a viable option for the next 10 years.</p> <p>CRA charities collaborate and pass donations on (prior to receiving and after receiving).</p>
Not-for-profit	Red Nose	<p>Presence in South Australia and Victoria only.</p> <p>Community campaigns needed - quality and to increase donations</p> <p>All donations accepted by Savers - paid by kg, Savers provides stats re sales, recycling and disposal. All proceeds passed on to the charity.</p> <p>Plastic bags from donations recycled through Red Cycle - being phased out. Plastic bags will be replaced by pamphlets dropped into letter boxes, donations accepted in plastic bags and boxes.</p> <p>Terracycle recycling station to be set up in the warehouse for plastic bags donations will be received in, cardboard boxes will be recycled.</p> <p>Barossa also serviced.</p> <p>2.5 month collection is optimal frequency, collection within seven days of drop-off.</p> <p>No council fees for collections from premises.</p> <p>Collaborations to receive goods from other charities, but must not be sorted.</p>

Industry	Organisation	Interview Outcome
		Multi unit dwellings, universities and childcare centres can be serviced through collection bins.
Resource recovery	Fleurieu Regional Waste Authority (FRWA)	<p>No textile recovery at any sites.</p> <p>Rawtec currently undertaking a composition analysis of waste received to facility.</p> <p>Kangaroo Island waste accepted at facility - no separation.</p> <p>Mattresses not processed.</p> <p>MOBO operate tip shop at Goolwa facility - Salvage and Save.</p> <p>Space at facility for textile sorting.</p>
Resource recovery	ResourceCo	<p>Uniforms and fabrics currently only accepted from Qantas and ShredX.</p> <p>No mattresses, carpets accepted.</p> <p>Fibre blends important: guarantee to customers about composition of product.</p> <p>Calorific value important for feedstock.</p> <p>Carbon credits only received for processing of natural fabrics.</p> <p>No acceptance of waste with hazardous rating.</p>
Resource recovery	East Waste	<p>62% household place textile waste in kerbside bins - 54% into residual waste bins and 13% into recycling bins (both yellow and green). This equates to 1.2% textile contamination in recycling bins.</p> <p>Material Recovery Facility (MRF) - textiles removed by hand sorters, then sent to landfill. Mobo Group operates the Salvage and Save op shop at Northern Areas Waste Management Authority (NAWMA).</p> <p>Hard waste sent to ResourceCo for use as alternative fuel.</p> <p>Targeted education: information provided on website, Why Waste It education campaign, bus shelters posters, flyers, weekly tips delivered via My Services App, social media, radio broadcast.</p> <p>Mattresses and bases received at Distribution 360 (D360) for recycling. D360 also provides a pick-up service. D360 typically breaks the mattresses down into several components: timber,</p>

Industry	Organisation	Interview Outcome
		<p>wood waste, textiles, springs, ensemble bases, metal components and variable components (dependent on type of mattress). These variable components include foam and latex. The timber is recovered and recycled as chipping and compost. The steel is recovered and recycled as spring steel. Some of the textiles are reused as alternative fuel in waste to energy, some sent to landfill. Recycling rate of mattresses is ~75%. Trials currently underway to increase recyclability to 90%.</p> <p>Carpet soon to be separated from the waste stream and sent to D360 where both carpet and underlay are processed. It is anticipated that the polyester and other synthetics will be sent to EfW.</p>
Not-for-profit	Makerspace (specific textiles) to	<p>Policy of total inclusion, activities must not be too targeted to one specific audience, and no exclusionary activities.</p> <p>Repair Cafè uptake not strong.</p> <p>Community awareness created through visiting school groups, as well as volunteers providing demonstrations at schools.</p> <p>Shredded textiles will be accepted by the Makerspace - numerous enquiries regarding supply.</p> <p>Makerspace currently accepts upholstery fabric donations.</p>
Education	KESAB (general and APYLands)	<p>Textile composition data submitted to GISA.</p> <p>Illegal dumping reported to GISA but no compositional analysis, only numbers and volumes.</p> <p>No facilities in APYLands for textile recovery, currently incinerated at landfill, large travel distances to Adelaide and Alice Springs. Collection of textiles may prove to be difficult.</p>
Retail	Savers	<p>Donation bags accepted from Red Nose and Diabetes Victoria sight unseen with pricing modes.</p> <p>In store donations also accepted - quality can be regulated due to donors having a point of contact and therefore better quality received.</p> <p>Two recycling streams: donations that are not fit for shop floor, and items on the shop floor that do not sell (~50% of both streams). Unused product sold to Savers Recycling Inc (SRI). SRI deal directly in the market (and not through brokers) and sell to graders and end users. Savers is provided with information by SRI regarding these sales, so Savers is aware of where unused goods land in the market.</p> <p>Clothing and soft items comprise ~50% of the total donation stream received.</p> <p>Some goods and clothing sent to landfill.</p>

Industry	Organisation	Interview Outcome
		Employees and not volunteers are responsible for sorting: training provided and continuous improvement implemented because constant workforce.
State government	Department for Education	<p>No textile data available.</p> <p>Currently 12% overall resource recovery</p> <p>New waste contract in 2022, opportunities will then be identified.</p> <p>No procurement guidelines in place.</p> <p>Uniform management is undertaken on a school-by-school basis. It is understood that many recirculation efforts are undertaken at the discretion of each school (for example, repurchasing second-hand) and that families are encouraged to manage their own uniforms (care; reuse/recirculation; and end of life disposal) once purchased.</p> <p>No textile requirements for new builds and upgrades currently underway.</p>
State government	Department of Health	<p>Medical waste collected and incinerated by Veolia.</p> <p>Single use towel project: NDIS contract to launder and not disposed of.</p> <p>New linen contract covers regional areas. Carbon footprint a focus, esp. concerning logistics.</p> <p>RAH operates independently. Aged care falls under federal jurisdiction, and not state.</p> <p>RFID trial underway - current indications are 5% loss in system.</p>
Local government	City of Holdfast Bay	<p>Interviewed in capacity of textile research undertaken on behalf of GISA.</p> <p>Overseas models explored during textile analysis.</p> <p>Polyester and cotton were found to be easiest to be reused and/or processed.</p>
Waste management industry	WMMR Waste Educators	Workshop presentation
Resource recovery	Upparel	B2C, B2B (overstock and customer returns), corporate. Manage recycling data on behalf of certain customers.

Industry	Organisation	Interview Outcome
		<p>Reuse solutions sought prior to recycling - support charities and not-for-profits.</p> <p>New facility in NSW to be commissioned, in partnership with Disability Australia.</p> <p>Impact statement and secure destruction certificate issued to client.</p> <p>Collaboration with ShredX and BlockTexx.</p>
Retail	National Retail Association	<p>Policy is opt-in for members.</p> <p>Association has diversion programs.</p> <p>Uniforms are a strong focus in terms of textile waste.</p>
Not-for-profit	Thread Together	<p>Thread Together partners with 1000 retailers to accept stock for redistribution.</p> <p>Redistribution via one hub in NSW.</p> <p>Distribution of clothing via charities registered with the organisation.</p> <p>Partnership with ~1000 charities.</p> <p>Pathways to manage excess stock, always open to new pathways/solutions.</p> <p>Stock that is not fit for redistribution is sent back to the retailers and further handling/recycling/disposal for the retailers' responsibility. This stock <1% of donations.</p> <p>All onshore - nothing sent offshore.</p> <p>Carbon footprint known (approximate).</p> <p>Zero cost to retailers.</p> <p>4 means for redistribution: online, retail, vehicles (2 in Adelaide), centres to access clothing.</p>
Industry	Linen Services Australia	<p>Linen rented to the Department of Health.</p> <p>Linen also supplied to aged care facilities.</p> <p>Trials at Women and Children to curb losses: alternate uses for single use towels, and RFID tags for linen that should have been returned.</p> <p>Measures put in to place to curb losses in ambulances: change in linen size and increased branding.</p> <p>Obsolete linen sent to charities in the DRC, as well as Australian-based charities (specifically Fred Hollows Foundation).</p> <p>Future waste management includes sending used linens to a recycling facility.</p>

Industry	Organisation	Interview Outcome
Resource recovery	BlockTexx	<p>Plant operational early May: initial volume = 4000t, 1t/hr.</p> <p>Accepts a minimum volume: 3t/month.</p> <p>Compositions accepted: polyester cotton blends, polyester, cotton, man-made cellulose.</p> <p>B2B only, and only directly with clients.</p> <p>Safety disposal certificate provided to client.</p>
Industry	Veolia	<p>Veolia transports medically contaminated waste to site in Dry Creek.</p> <p>No sight of contents in bins - bins placed in theatres.</p>

2.4 Limitations to the study

The following limitations are identified for future research or interrogation:

1. Local government information referred to in the report has been obtained through an interactive workshop and online survey.
2. A limited number of interviews were able to be conducted within the project scope, and the following sectors or services were unable to be included:
 - o Fisheries,
 - o Construction,
 - o Mining, and
 - o Ports authorities.
3. The GHG emission analysis was undertaken by a desktop study, and calculations are based on published literature only.
4. Plastics were not considered as part of this study.

3. Textiles in Australia

3.1 Textiles imported into Australia

The Australian Circular Textile Association conducted research (unpublished) (based on data from the Australian Bureau of Statistics (ABS)) and found annual textile imports to Australia have exceeded 1,000,000 tonnes per annum annually since 2015. Nationally, this consumption is approximately 40kg of textiles per person per year of textiles. Figure 3 provides a simple breakdown of all textiles imported by product category (2015-2019 aggregated). Apparel comprises the single largest component of imported textiles (36.9%), followed by soft furnishings (16.9%), and carpets (10.2%).

There is substantial variation in fabric and fibre types and composition across product categories demonstrated by Figure 4 (2015-2019 aggregated). This variation generally reflects trends, detailed by the Textile Network, in international fibre products, which have trended toward a majority production of synthetic fibres in the past decade.

It is noted here that import classifications use '85% or greater' as a common description for items. These were considered 'synthetic' or 'natural' in each case and is a limitation in the data. As a result, the quantity of blended textiles may have been underestimated.

It is acknowledged that textiles might also make up a component part of the following importation categories - these were omitted from the analysis on the basis of data unavailability, and, that they might contain textiles in only fractional quantities:

- Section VIII – Raw hides and skins, leather, fur skins and articles thereof; saddlery and harness, travel goods, handbags and similar containers; articles of animal gut (other than silk-worm gut).
- Section XII - Footwear, headgear, umbrellas, sun umbrellas, walking-sticks, seat-sticks, whips, riding-crops, and parts thereof; prepared feathers and articles made therewith; artificial flowers; articles of human hair.
- Section XVII - Vehicles, aircraft, vessels and associated transport equipment.
- Section XX - Miscellaneous manufactured articles.
- Chapter 94 - Other furniture and parts thereof.
- Chapter 95 - Toys, games and sports requisites; parts and accessories thereof.
- Chapter 96 - Miscellaneous manufactured articles.

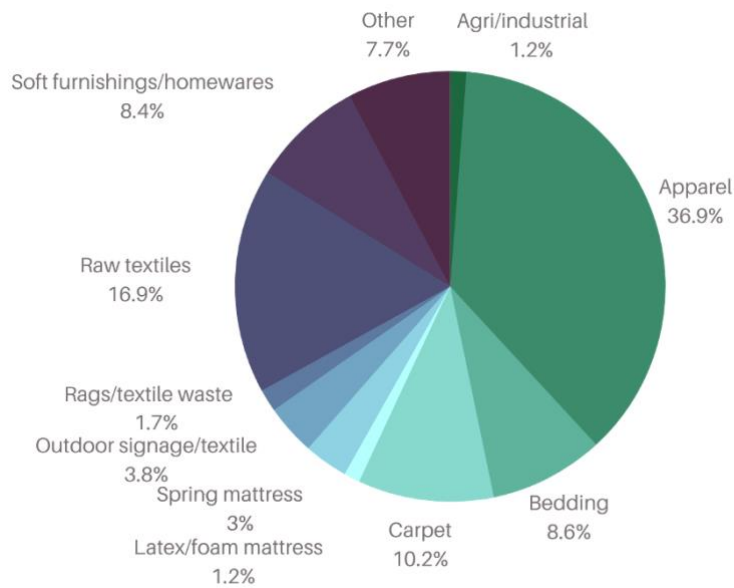


Figure 3: National textile imports by product type 2015-2019

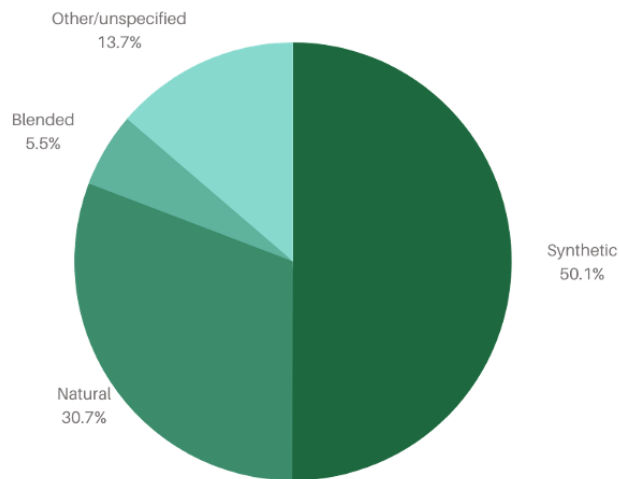


Figure 4: National textile imports by fibre composition 2015-2019

It is apparent from Figure 5 that there was been a decrease in the volume of apparel imported over the period 2015-2019. Whilst this textile group is the biggest component of textile imports into Australia, the number of textiles imported has decreased (396.5kt in 2015 vs 364kt in 2019). Overall, the import amounts for the other textile categories have remained fairly constant.

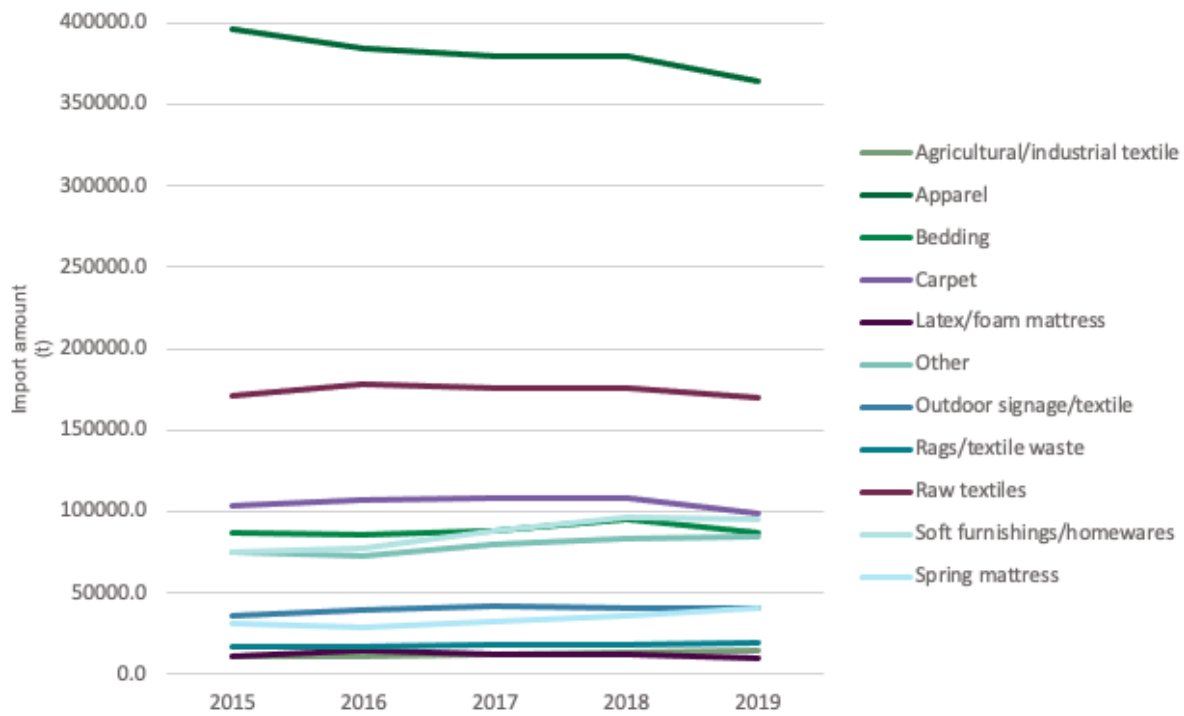


Figure 5: National import trends 2015-2019

3.2 Textile waste management in Australia

The National Waste Report 2020 regards textiles as coming from textiles, leather, and rubber (excluding tyres). The following categories of textiles are listed:

- Clothing,
- Carpets,
- Floor coverings,
- Rags,
- Bags,
- Tarpaulins, and
- Similar products.

Using annualised data, the National Waste Report estimates only 7% of textiles are recovered – and of this recovered component, 92% is exported.

Table 2 provides a comparison of national waste data between the periods 2016-17 and 2018-19 (emphasis author’s own) for each state. It is clear from this table that there has been a decrease in textile waste generation in SA, with an accompanying decrease in recycling and energy recovery rates.

Table 2: Comparison of national waste data 2016/17 vs 2018/19³

Jurisdiction	Generation (kt)			Recycling (kt)			Energy recovery (kt)			Disposal (kt)		
	'17	'19	Change	'17	'19	Change	'17	'19	Change	'17	'19	Change
ACT	14	13	-5%	0	0	-51%	3	3	18%	11	10	-11%
NSW	254	206	-19%	2	1	-12%	55	31	-43%	198	174	-12%
NT	7	9	29%	0	2	880%	1	1	9%	6	6	4%
Qld	154	164	6%	1	0	-100%	17	25	44%	136	139	2%
SA	57	45	-22%	24	21	-11%	12	5	-62%	21	19	-11%
Tas	22	20	-9%	2	0	-88%	2	3	27%	18	7	-5%
Vic	183	240	31%	7	25	254%	34	43	27%	142	173	21%
WA	87	83	-5%	2	3	38%	9	7	-25%	6	73	-4%
Total	778	780		38	53		132	117		609	610	

Figure 6 (Blue Environment, 2020) provides a graphical representation of the trend in waste exports from Australia. It is clear from this figure that the export of textiles is on the decline.

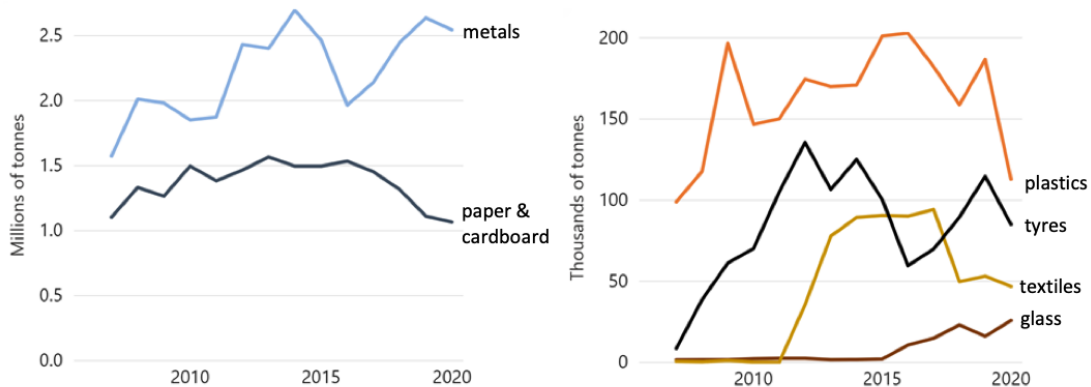


Figure 6: Export trends per waste derived product (Blue Environment, 2020)

Figure 7 and Figure 8 (both Blue Environment 2020) provide an overview of textile waste in Australia. Figure 7 provides information regarding the tonnages of textiles waste generated in Australia, as well as the management methods used for this waste.

³ National Waste Report 2020

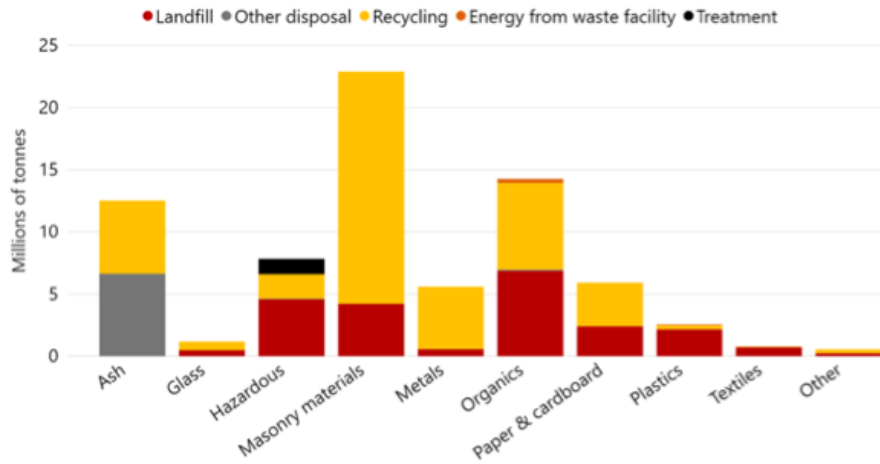


Figure 7: National generation and management of textiles (Blue Environment, 2020)

Figure 8 provides information regarding the recovery and recycling rates of textiles in Australia. It is clear from this diagram that the recovery rate is low (and includes energy recovery), and that textiles have the lowest recycling rate of all core waste materials at 7%.

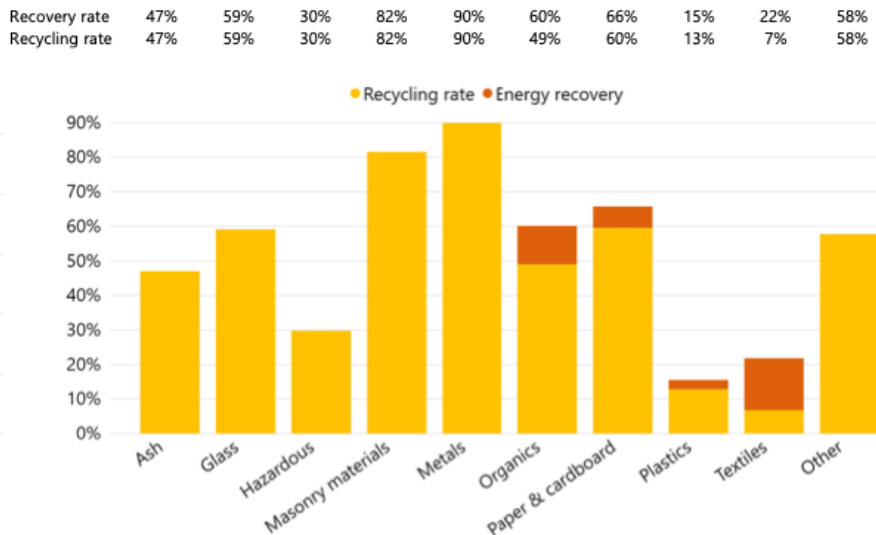


Figure 8: National recovery and recycling rates (Blue Environment, 2020)

3.3 Textiles imported to South Australia

Textile imports into SA have been relatively steady, with a high of 33.6 kt in 2017 (refer Figure 9), and a total of 152.6kt over the period 2015-2019. As detailed in Figure 9, there has been an increase in the amount of apparel imported over the period 2015-2019 (7.21 kt in 2015 to 7.81 kt in 2019). Whilst this textile group is the biggest component of textile imports into Australia, the volume of textiles imported has decreased (396.5kt in 2015 vs

364kt in 2019). Overall, the import amounts for the other textile categories have remained fairly constant.

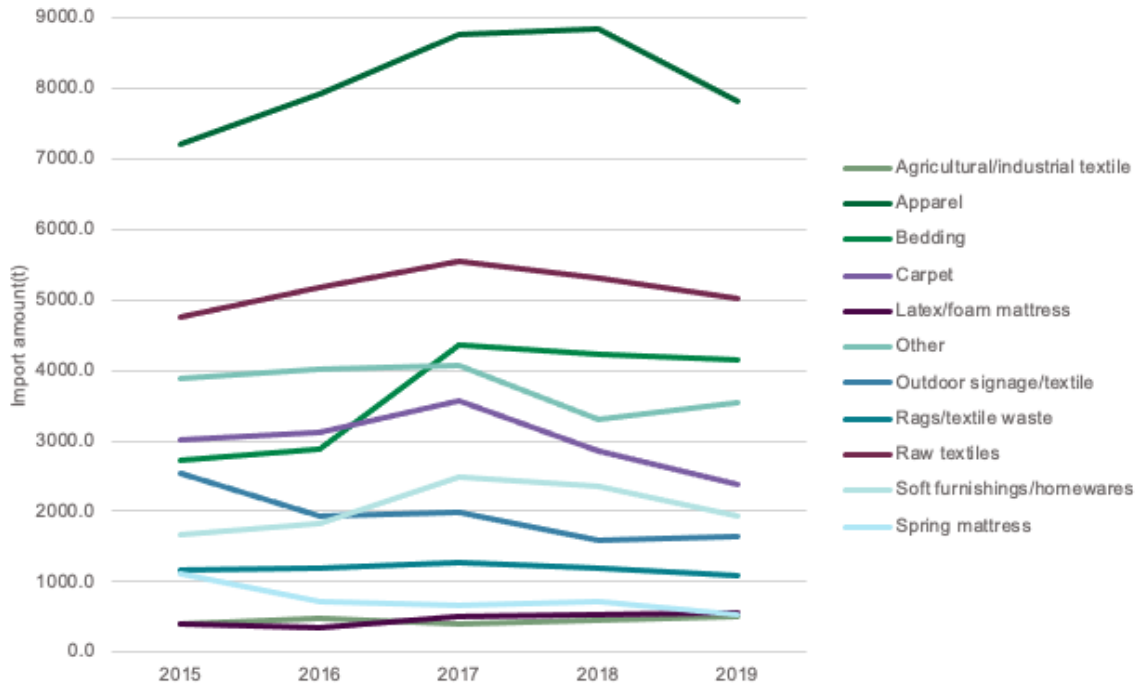


Figure 9: Import trends for South Australia 2015-2019

It is apparent from Figure 10 that apparel is the highest import into SA (26.6%), followed by soft furnishings (16.9%). Bedding is the third highest import at 12.0%. This somewhat reflects that national textile product type import trend, with the exception of bedding (carpets are the third highest import nationally).

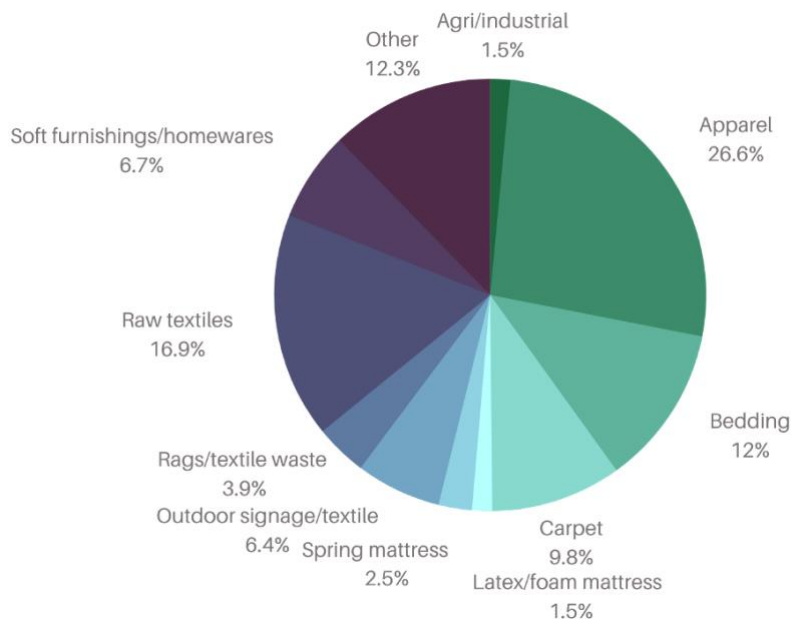


Figure 10: South Australia textile imports by product type 2015-2019

The fibre composition of imports into SA, refer Figure 11, mirrors the national trend. Synthetic fibres are the biggest components of imports, followed by natural fibres and blended fibres being the smallest component. Figure 11 indicates that synthetic fibres comprise the majority of textile imports (48.2%), whilst natural fibres comprise 29.4% of the imported fibre types.

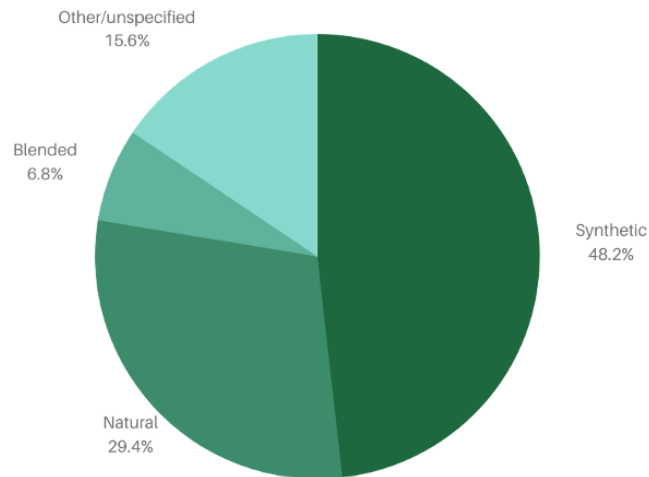


Figure 11: South Australia textile imports by fibre composition 2015-2019

3.4 Textile waste management in South Australia

Seventeen of the State's 68 councils responded to the survey invite and the data discussed in this section is based on these survey responses⁴.

Textiles are discarded via several means:

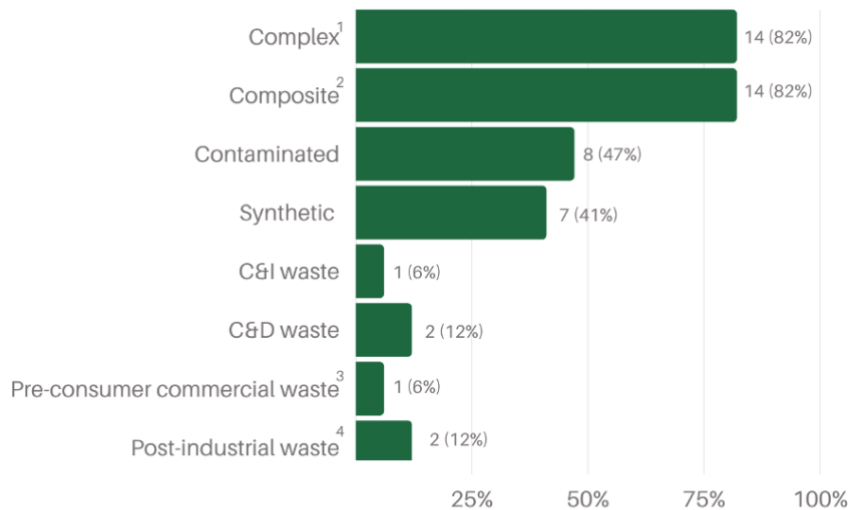
- Kerbside collections (general waste, and as contamination in co-mingled streams);
- Bulky waste collections;
- Self-haul;
- Illegal dumping;
- Commercial and industrial waste;
- Construction and demolition; and
- Charity and not-for-profit networks.

Most of the councils received complex⁵ and composite⁶ waste, whilst most councils do not accept commercial and industrial (C&I) and construction and demolition (C&D) waste (refer Figure 12).

⁴ The waste figures provided are for material before allocating any tonnage to energy recovery

⁵ Products with textiles as the major component, clothing, manchester, leather goods, uniforms, carpets, curtains

⁶ Composite (i.e. furniture, mattresses, motor vehicle seats, prams, car seats, shade cloth)



- ¹Products with textiles as the major component, such as clothing, manchester, leather goods, uniforms, carpets and curtains
- ²Products with textiles as one of the components, such as furniture, mattresses, motor vehicle seats, prams, car seats and shade cloth
- ³Waste generated from manufacturing, such as yarn and fabric manufacture and fishing nets manufacture
- ⁴Waste generated from other industries, such a scrap textiles

Figure 12: Typical waste categories collected by councils

Councils⁷ were not able to provide compositional data analysis.

While energy from waste (EfW) is considered a way to recover energy and can reduce the volume of materials needing landfill disposal, consistent with *South Australia’s Waste Strategy 2020-2025*, SA encourages high-order beneficial uses when considering opportunities for resource recovery, including for textiles.

Survey results indicated that 35.3% of respondents send textile to EfW as a management option (refer Figure 13). Overall, respondents indicated that hard waste and mattresses were the items commonly sent either for incineration or as a feed for alternative fuels.

⁷ With the exception of councils serviced by East Waste

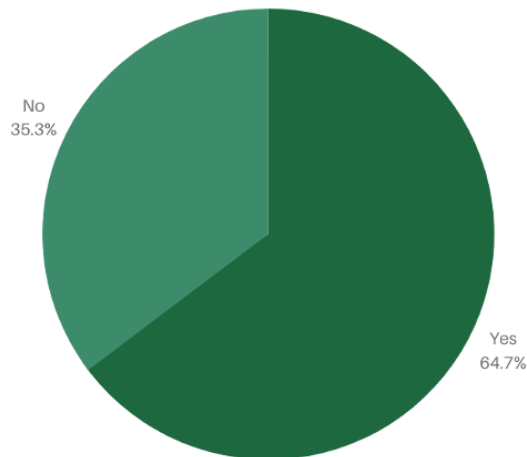


Figure 13: Council respondents using EfW

The Wave 81 litter report undertaken by M^cGregor Tan (on behalf of KESAB, 2021) found that illegal dumping still makes up the biggest volume of miscellaneous waste in the litter stream. Clothing, materials and rubber items were amongst the most frequently items found in the miscellaneous litter stream.

3.4.1 Textile recovery

SA's Recycling Activity Survey 2019-20 Report states that there was a decline in textile resource recovery from the previous year⁸, with a net recovery of 900 tonnes (including leather).

The estimated on-sale price for 'other' materials, of which textiles is included, was \$191/t but there is no single estimated value for textiles. This was decrease from the previous reporting period of \$312/t.

The 2019-20 report found that the majority of textile recovery is from textiles recovered in the municipal solid waste (MSW) stream. The only end products determined in this report were cleaning cloths, and this is congruent with the previous reporting period.

Analyses of the two most recent recycling reports indicate that there is a limited market in SA for the processing of end products, with the only end product being cleaning cloths (themselves not a circular product).

⁸ 2,600 tonnes 2018-19 (GISA, 2020)

4. Greenhouse gas emissions associated with textiles

Textile emissions occur throughout the lifecycle of a garment, and in the context of SA’s net-zero ambition, a circular economy roadmap should address emissions reduction opportunities across the lifecycle.

The Ellen MacArthur Foundation estimates that the global textiles industry (across production, manufacture, use and disposal) generates around 1.2 billion tonnes of CO₂e emissions every year. Moazzem (2021a) has estimated that the contribution of the textile industry is 6.7% of the global total; and that textile consumption, use and disposal accounts for 16,608,028t CO₂e, or 0.698t CO₂e per person per year in Australia.

4.1 Lifecycle emission estimations

Figure 1 provides a description of the lifecycle of an item of clothing. The study of a pair of jeans determined that most impact is embodied in the production and care of products. For the purpose of this study, we consider this to be representative of clothing more broadly.

A study of the carbon footprint of clothing, undertaken in the UK, produced the similar findings (refer Figure 14) highlighting the importance of usage stage impacts.

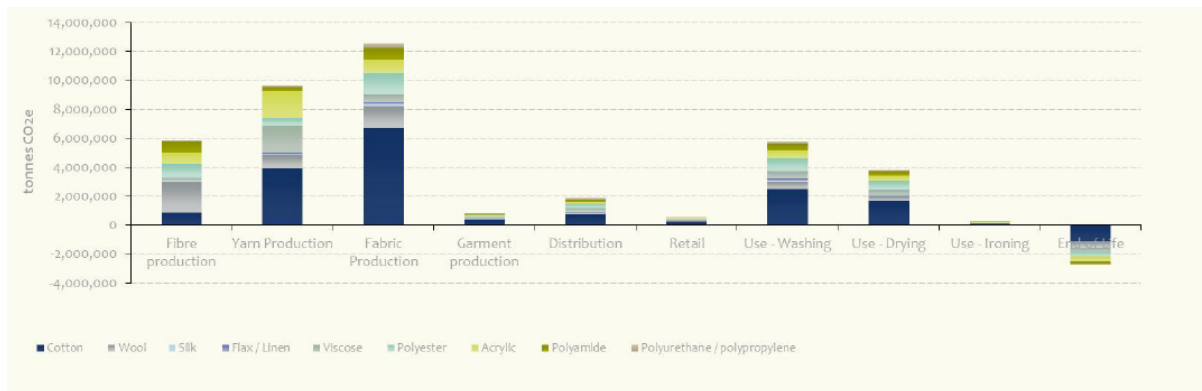


Figure 14: Carbon footprint of clothing in the UK (Wrap UK, 2012)

An Australian study Moazzem (2021a) investigating lifecycle emissions of individual clothing types found may vary (in kgCO₂e):

- For a cotton t-shirt – 37% is generated in pre-consumer production and 56% of impact comes from consumer use.
- For a polyester jacket – 65% is generated in pre-consumer production, and 31% is generated in consumer use.

This highlights the variability between garments (where for example, t-shirts might be washed more frequently than jeans) and gives an indication of how lifecycle impacts are likely to vary across other textile products. Building on Figure 1 and Figure 14, the contributing emission sources are summarised in Table 3.

Table 3: Contributing emission sources

Lifecycle Stage	Emissions
Embodied impact, including fibre production (agriculture and fossil fuel extraction), manufacturing, and packaging represent the ‘embodied energy’ of a product	60-70%%
Use impact, including washing and drying and maintaining the product	>35%
End of life impacts, primarily the decomposition of natural fibres (organic material) in landfill. Synthetic products disposed to landfill are generally considered to have negligible carbon emissions (as they do not readily decompose).	<10%

From the analysis above, embodied impact represents the largest component of clothing, followed by usage impacts. To apply this to textiles more broadly (where data is lacking on many other products), two categorisations can provide general guidance: ‘active’ and ‘passive’ products. These are described, with examples, in Table 4.

Passive textile products have little usage stage emissions (i.e. furnishings, banners, carpets), therefore the focus for emissions reductions should be on material substitution to reduce embodied impact, designing for reuse and supporting lifecycle extension.

Active products have usage stage emissions and thus an ongoing focus on embodied emissions is encouraged (but the impact of consumer behavior with these products is acknowledged).

Table 4: Passive and active textile types

Product type	Description	Examples
Passive	Products such as shade cloth, fencing mesh, geotextiles, netting and the like	Carpets, outdoor textiles, signage, furniture and most industrial netting textiles
Active	Products that either through their operation, or maintenance, have a proportionally significant impact over their useable lifetime	Manchester, soft furnishings, bedding, towelling

Data adjustment is beyond the scope of this study, but it is expected that embodied and end-of-life impacts constitute relatively higher proportion of total impact than is outlined by the literature (as a result of lower ‘use’ phase impact). To summarise what is little studied but a pertinent concern (Levanen, 2021):

- Business models or platforms that allow consumption reduction by extending product lifetimes or reselling garments generally offer greatest emissions reduction potential (as they address the embodied impacts of clothing through avoided consumption)⁹.
- Share economy projects, should they reach mass adoption, may increase emissions from the base landfill case based on substantial increases to use phase emissions.

⁹ It is noted that some studies have cautioned that induced customer transport in clothing reuse may cause environmental impact that exceeds the benefit of avoided production where the use phase is not sufficiently extended (Sandin, G., Peters, G. (2018))

- Recycling offers limited emissions reduction potential without fibre-to-fibre recovery and relatively high emissions impact.

Figure 15 (wherein recycling is not addressed) provides an Australian context for guidance for prioritising actions for impact reduction in clothing textiles, suggesting that many usage stage changes could equal significant impacts to supply chain substitution (assumes textile origin is China). These actions have been determined using BEES¹⁰ and BPIC¹¹ weighting methods.

Further, it is pointed out that as garments are reused more, or their lifetime extended, these use phase impacts will proportionally increase their footprint in the overall garment life cycle emissions. This highlights the importance of consumer education in textile emissions reduction.

4.2 Embodied impacts and clothing

The embodied impact of textile will vary by two major variables:

- Country of origin – due to variations in farming practices, and electricity grid mixes (emissions factor of each MWh of electricity used) the embodied emissions for identical products can vary.
- Fibre type – as synthetic (oil-based) fibres, and natural (grown) fibres have very different emissions profiles and impacts during manufacturing.

Textiles have a high embodied impact: production and manufacturing emissions are typically greater than both use and disposal.

Shipping and packaging and retail sale impacts are unlikely to vary significantly by product/product types and in any case are relatively small components of overall emissions.

The following nations are SA's major trading partners: China (47%), India (10%), Bangladesh (9%), South Korea (7%), Pakistan (6%) (as per Australian textile import data provided by the Australian Bureau of Statistics (ABS) (refer Figure 15). This is consistent with American and European studies (including the WRAP study) where the majority of clothing consumed originates from similar countries.

¹⁰ Building for Environmental and Economic Sustainability

¹¹ Building Productions Innovation Council

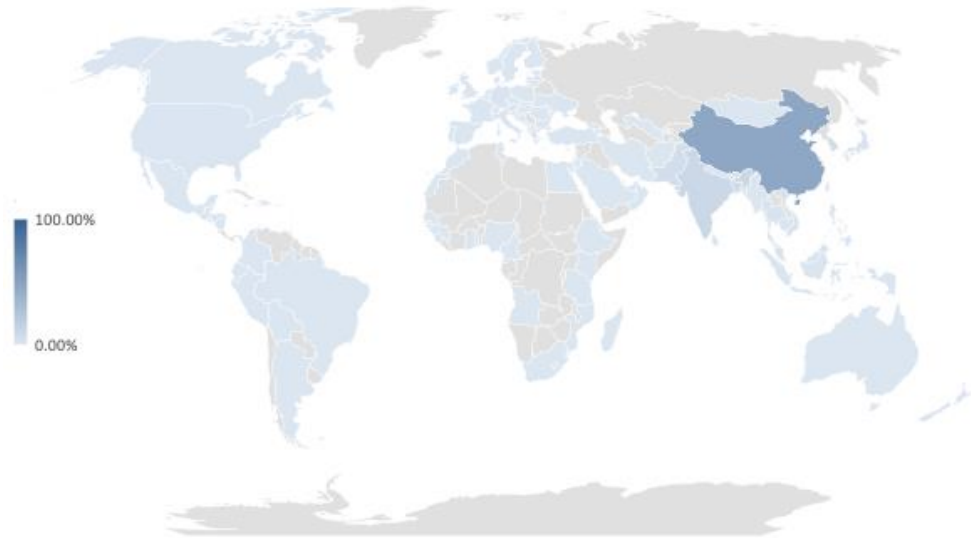


Figure 15: Heatmap of textiles imported into SA by origin country (ABS)

The Textile Network¹² has found that the share of natural fibres in total fibre production has fallen from 41% in 2008 to less than 30% by 2018, following an increasing use of synthetic fibres. Similarly, Charitable Recycling Australia also established a fibre mix of 73% synthetic and 27% natural fibres for clothing by different means in a recent Australian study undertaken by MRA Consulting:

Fibre type accounts for the primary differences in the embodied impacts of textiles, natural fibres being grown and harvested from plants, and synthetic fibres being extracted from crude oil. Synthetic textiles are now produced in such volume that it now accounts for 14.5% of all polymers produced, the third largest use category behind packaging and building/construction product (Beckman, 2018).

Consensus in literature (Stockholm Environment Institute, 2005 and Rana, 2015) shows that overall embodied emissions in fibre production from polyester is higher than cotton and might range between 7-9 kg CO_{2e} / tonne of spun fibre.

4.3 Use impact of clothing

4.3.1 Fibre types

Laitala, K *et. al.* (2018) found the use-phase impacts of synthetic and natural fibre clothing do not differ substantially with cotton/cotton-blends and synthetic fibres both seeing 'machine washing' comprising 71% and 81% of washing method respectively. On this basis, we conclude that fibre-type does not have significant bearing on use stage emissions for clothing.

4.3.2 Electricity emissions related to clothing use

Emissions are affected substantially by the emissions factors of grid electricity. The OpenNEM Project indicates 62.8% of electricity generated in SA was from renewable sources between February 2021-2022: By comparison, the eastern states range from

¹² In turn ,sourced from the Bremen Cotton Report No. 05/06 – February 7th, 2019.

around 10-25% renewable energy over the same period. *As a result, usage stage impacts (i.e. washing and drying) for clothing as described in Australian literature, are likely overstated in relation to the South Australian situation.*

4.3.3 Reuse of clothing

International studies (Woolridge, 2006) indicate that the re-use of one tonne of polyester clothing and one tonne of cotton clothing uses only 1.8% and 2.6% of the energy required to produce virgin polyester and cotton material, respectively.

There is growing adoption of rental and subscription models for clothing. However, new studies are cautioning around increase washing and transport effects that occur as a result.

In summary, what is little studied but of pertinent concern (Levänen *et. al.*, 2021):

- Business models or platforms that allow consumption reduction by extending product lifetimes or reselling garments are generally offer greatest emissions reduction potential (as they address the embodied impacts of clothing through avoided consumption).
- Recycling offers limited emissions reduction potential without fibre-to-fibre recovery and relatively high emissions impact.
- Share economy projects, should they reach mass adoption, may increase emissions from the base landfill case based on substantial increases to use phase emissions.

Whilst these models continue to gain momentum, and where they genuinely decrease overall clothing consumption, burden shifting can occur through transportation emissions.

The methods used for treating and cleaning clothing items through this rental system, such as dry cleaning, can also have long-term adverse effects to the environment.

4.4 End-of-life impact of textiles

The likely fates of textiles must be identified before the end-of-life emissions can be investigated. The following fates are the expected outcomes for textiles:

- a) Textiles sent to landfill,
- b) Textiles consumed in energy recovery,
- c) Clothing reuse and recycling by the charity sector, and
- d) Mechanical and chemical recycling systems (and opportunity of recycled content).

EfW has been included here for the sake of completeness and fair comparison for the end-of-life impact of textiles.

Emissions related research into textile recycling remains limited in the Australian context. In overview, the following analysis made for the French textile sector provides an indicative overview of the relative impact of different end-of-life scenarios for both natural and synthetic fibres (positive values representing an emissions burden, whilst negative values are an emissions credit). Reuse provides the greatest improvement (where possible), followed by various means of mechanical recycling, incineration and finally landfill. This is summarised in Figure 16.

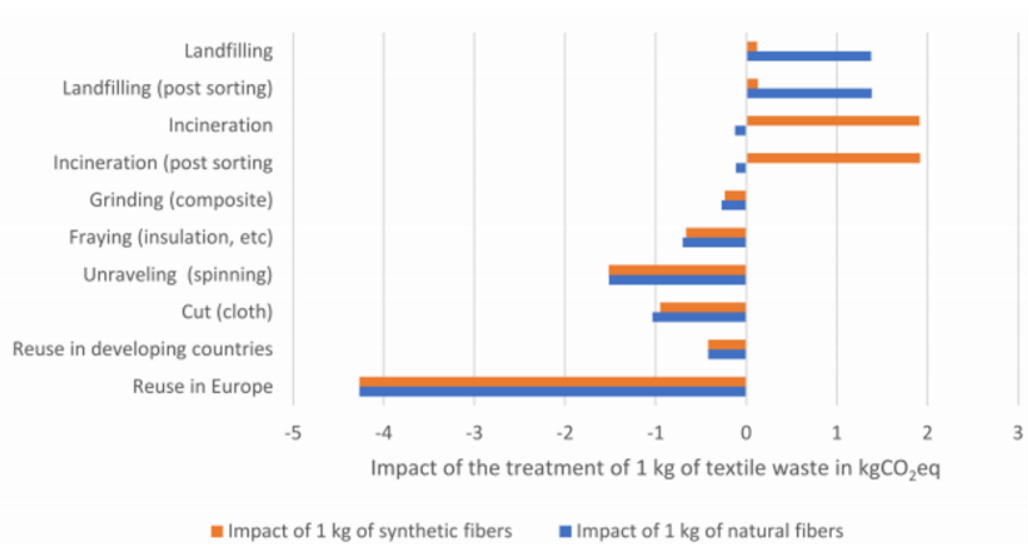


Figure 16: Carbon impact of fibre waste treatments (Payet, 2021)

4.4.1 Disposal to landfill

Natural fibre products generate emissions as they breakdown, whilst synthetic garments are generally assumed not to decompose and therefore do not incur emissions directly from landfilling. However, there is a missed opportunity cost of recycling. This is validated by the data in Figure 16 where the emissions impact of natural fibres sent to landfill is significantly higher (than synthetics). The installation of landfill gas capture technologies at landfills handling textile waste can generate an emissions reduction credit by offsetting electricity generation. Australian studies assuming 70% capture rate of landfill gas have shown an emissions reduction for the landfill of natural fibres (Moazzem, 2021)

For textiles in aggregate, the National Greenhouse Accounts Factors assume emissions 2 tonnes of CO₂e emissions per tonne of textiles disposed to landfill, which is roughly consistent with French data (refer Figure 16).

4.4.2 Energy recovery

Data specific to energy recovery in Australia was not found in this literature review. However, leaning again on the data presented in Figure 15, the following can be assumed:

- a) Synthetic textiles used in energy recovery can generate much greater emissions than landfill, as per the WRAP study.
- b) Natural textiles see a small reduction credit when used in energy recovery.

A blended fibre stream (70:30) can produce approximately 1-1.5t CO₂e emissions per tonne of textiles.

Australian studies (Moazzem, 2021b), assuming a 70% capture rate of landfill gas, have shown an emissions reduction for the landfill of natural fibres.

4.4.3 Emissions benefit of the charity sector

The aforementioned MRA report identified that 310,316t of clothing is donated to charities across Australia – an average of 12.1kg per person. Of this material, 17% is resold at charity shops in Australia, 26% is recycled domestically, 33% is exported and 14% is sent to landfill. The report references that this data in this study is representative of registered charity organisations only and may not be representative of other commercial operations who also actively accept clothing donations.

The aggregate impact of clothing reuse and recycling of clothing (including landfill of the residual fraction) is a 66% reduction in emissions (assumes reused clothing offsets garments that would otherwise be purchased new). In absolute terms, each tonne of clothing:

- a) Sent to landfill will have an emissions impact of 4.4t CO₂e.
- b) Reused or recycled (into rags) by the charity sector will have an emissions impact of 1.5t CO₂e (66% reduction).

4.4.4 Mechanical and chemical recycling

Moazzem *et al.* (2021b) provides detail regarding end-of-life emissions impact of recycling textiles. The emissions benefits identified in this study for different recycling outcomes are presented in Table 5.

Table 5: Emissions benefits from recycling clothing (Moazzem, 2021b)

Description		Assumptions	Emissions (tCO ₂ e)
Recycling to fibre (natural fibres only)	Discarded cotton waste is passed through a machine to produce small pieces, and then shredded, blended and combed, and finally turned into recycled cotton fibre as raw material.	The quality of recycled cotton is comparatively lower than virgin cotton and requires mixing with virgin fibre.	-1.375
Recycling to insulation (natural and synthetic fibres)	Production of insulation material from waste cotton apparel through a mechanical process involving shredding and carding.	This is considered to substitute the production of virgin flax fibres.	-0.254
Recycling to PET raw material (synthetic fibres)	Depolymerisation of synthetic textiles to create a recycled polymer Includes energy in the cutting, washing, dissolution and purification of waste textiles.	Recycled PET considered to be of equal quality to virgin polymers.	-0.141
Recycling to cotton wipes (natural and synthetic fibres)	Recycled cleaning wipes produced through a mechanical process. These are assumed to be disposed of after one use.	Recycled wipes would otherwise made from virgin fibres.	-4.178

In interpreting these results, there are two areas of contention:

- a) Assumed 'substitute' for the product created through recycling.
- b) Energy and other 'inputs' used to do the recycling.

Generally, mechanical recycling processes were seen to have lower energy 'inputs' to recycle and where they might directly substitute virgin textiles (and their embodied impacts), provided the greatest emissions benefit. More complicated chemical recycling processes saw greater 'inputs' in recovery which despite offsetting virgin PET polymer, had greater emissions impact than virgin PET production. In any case, it is an improvement on landfill emissions. A reasonable case could also be made to suggest the emissions benefit of ragging is overstated. It assumes that ragged product avoids the production of rags made from virgin fibres, which seems unlikely as there will certainly always be more clothing available, than rags needed.

To summarise, the authors state '...recycling to cleaning wipes is a most preferable option in terms of environmental savings, followed by other mechanical recycling options, insulation material and cotton fibre. Chemical recycling to make PET raw material is the least preferred option due to the highest energy amount and resources used, which cause increased environmental impact'.

5. Textile management

5.1 Product stewardship

Clothing textiles was added as a priority product under the Minister's Priority List 2021-22 that identifies the priority products and materials determined in most need of product stewardship under the *Recycling and Waste Reduction Act 2020*.

The Australian Government further committed to list textiles as a priority product for stewardship and committed a further \$1 million to support industry-led stewardship for clothing nationally (this following the Clothing Textiles Waste Roundtable held in May 2021).

The National Product Stewardship Innovation Fund has already funded the following programs related to:

- Texback -led by the Vinyl Council of Australia to establish PVC coated polyester used in shade cloth, fencing mesh and banners.
- National Mattress and Bedding Stewardship - led by Australian Bedding Stewardship Council, to establish a national collection and processing program for mattresses and bedding.
- National Commercial Furniture Product Stewardship Scheme - led by Edge Environment, to establish recovery systems and design guidelines for all office furniture and fittings.
- National Product Stewardship Scheme for clothing textiles – led by the Australian Fashion Council, to establish a roadmap to 2030 for clothing circularity in Australia corresponding with the National Waste Policy Action Plan targets.

5.2 Textile waste management options in Australia

Australian-based businesses and organisations are currently equipped to collect and process textiles. Retail and charitable models also provide excellent avenues for the sale of second hand clothing (both online and in store) and the upcycling of textiles. This demonstrates the viable alternatives to textile waste disposal to landfill¹³, and while not all of them are situated in SA, would be worthwhile for SA to consider interstate options until sufficient textile waste management options become locally available.

Appendix I provides details for these options¹⁴.

¹³ Primarily clothing, uniforms, and manchester

¹⁴ This list is not exhaustive

6. Options assessment

A circular textile economy for SA will need a change from a linear model to a closed loop model.

This will need investments in areas including:

- Sustainable design and manufacturing such as phasing out raw material inputs of concern.
- Sustainable supply chain management.
- Reducing the immense carbon footprint of the industry through improved logistics, improved packaging, water use, shifting to renewable energy sources.
- Encouraging greater textiles recovery.

The circular economy is underpinned by design (including zero waste) resource efficiency (including materials and products at their highest value for as long as possible – not only in terms of the waste hierarchy but also market value) and renewable energy that supports regeneration of natural ecosystems (refer Figure 17). The options identified within this section align with this framework.

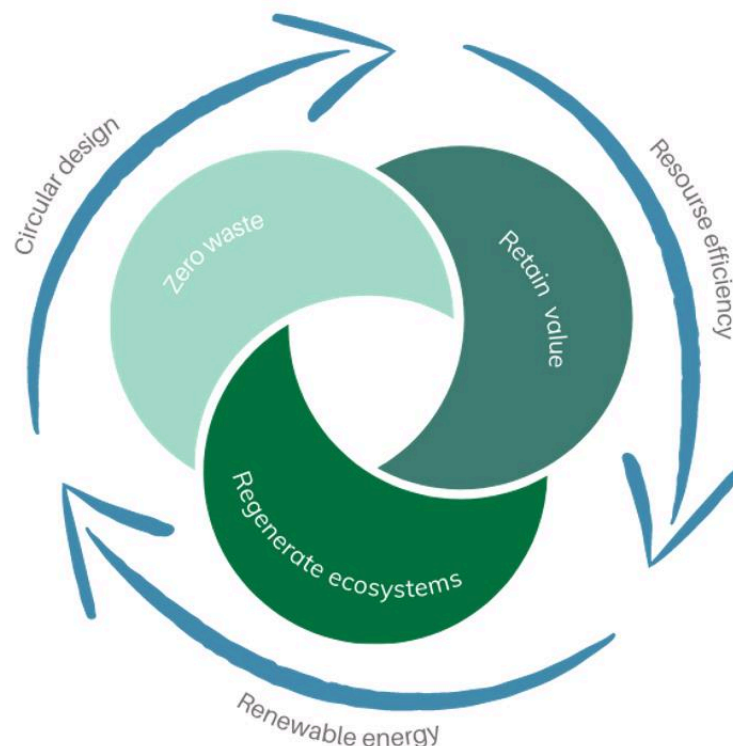


Figure 17: Circular economy principles

The supply chain needs to be considered holistically, from conception and design through to recovery. This shared responsibility along the supply chain will prove successful in increasing the circularity of textiles in the State.

Based on the data discussed in Sections 3.1 and 3.3, it is anticipated that apparel will be the largest volume of textile waste to be managed. Most interventions discussed in this section will address clothing.

Given the wide assortment of textiles in the market, it would be prudent to focus initially on those where solutions are available. The implementation of solutions to deal with the largest volume and most homogenous textiles will have the largest and most efficient impact in reducing the volume of textile waste currently disposed of at landfill.

6.1 Textile waste and the waste management hierarchy

The implementation of the waste hierarchy in the textile waste space will ensure that textiles are kept at their highest value (refer Figure 18).

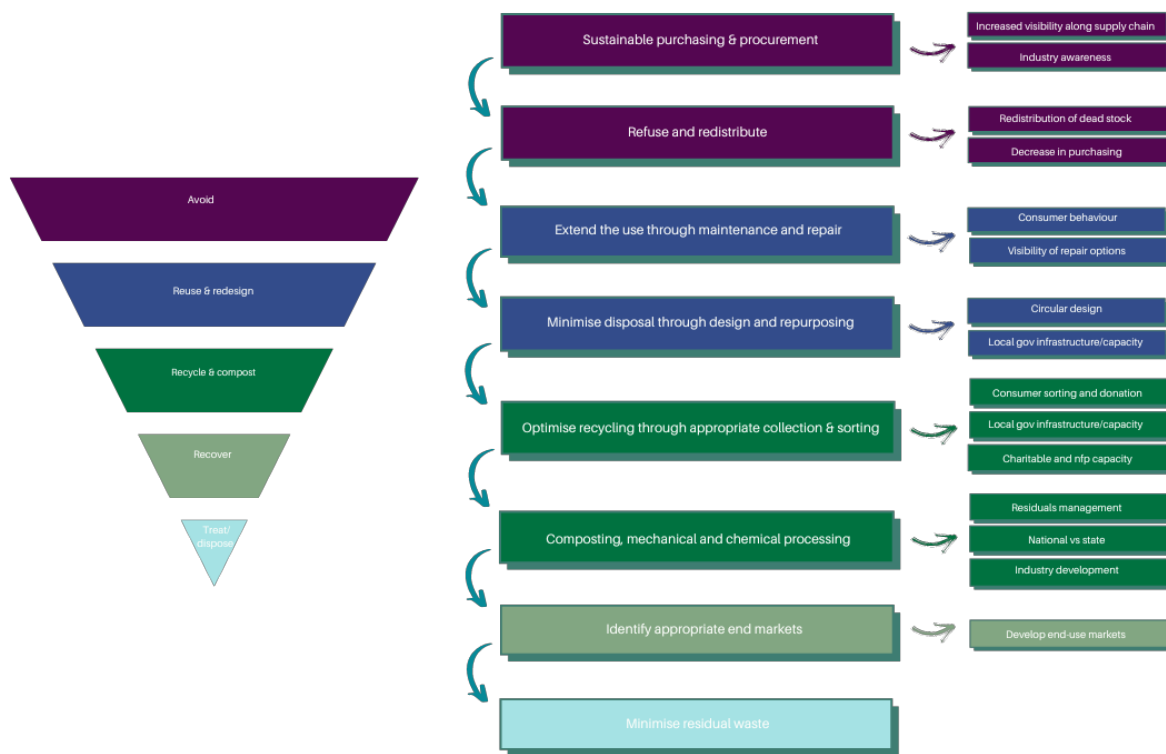


Figure 18: A textile waste hierarchy

Textile waste avoidance through sustainable purchasing, including procurement, will allow for a decrease in volumes disposed through discretionary purchasing. The procurement of textiles with a (or wholly) recycled content will further contribute to the generation of textile waste. The redistribution of textiles such as end stock (retail) or over purchasing will decrease the volume of textile waste to landfill. Whilst the immediate assumption of end stock is to fashion retailers, this can include over-ordering in, for example, tourism linens and agricultural feed bags. The shift from products to services, such as industries renting linen, will decrease the volume of textile waste generated and encourage reuse and repurposing.

Extending the use of garments, and other textiles, through mending and repair and improved consumer behaviour will not only lead to a decrease in textile waste disposal to landfill but also present opportunities in the market place for employment and innovation. Equally, repurposing textiles will have similar outcomes. Design is an integral part of the circular economy and manufacturing textile products whose components can be re-used will not only decrease waste to landfill but also encourage innovation and collaboration between industries.

Appropriate collection and sorting are an important pre-cursor to repurposing and recycling. This should be applicable at all spheres of textile handling from consumer to waste collection; and, where applicable, in the charitable and not-for-profit spaces.

Composting, mechanical and chemical processing will aid in the re-use of textile containing waste. However, the residual waste streams from these processes will need to be critically analysed to ensure that no harmful waste is created through these processes.

End markets need to be identified in order for solutions to be successful.

6.2 GHG impact reduction

GHG emissions can be reduced by the following pathways: embodied impact reductions, use impact reductions and end of life impact reductions.

Economic and social impacts of the proposed actions are beyond the scope of this study but provide reason to support textile reuse and recycling.

Figure 19 (wherein recycling is not addressed) provides an Australian context for guidance for prioritising actions for impact reduction in clothing textiles, suggesting that many usage stage changes could equal significant impacts to supply chain substitution (assumes textile origin is China). These actions have been determined using BEES and BPIC weighting systems.

Further, as garments are reused more, or their lifetime extended, these use phase impacts will proportionally increase their footprint in the overall garment life cycle emissions. This highlights the importance of consumer education in textile emissions reduction.

The following key 'hotspots' in the textile lifecycle can be surmised from Figure 19:

- 1) Use stage reductions - education to wash with cold water, line dry and ensure only full loads are washed have been demonstrated in several studies to a significant area for emissions improvement over the clothing lifecycle.
- 2) Clothing reuse - Moazzem, 2021b have found reusing one tonne of clothing uses only 1.8% and 2.6% of the energy required to produce a tonne of virgin polyester and cotton clothing respectively.
- 3) Increasing recycled content – the United Nations Convention on Climate Change indicates that the use of PET textiles reduces emissions by 66% and build high value markets for kerbside recycling.
- 4) Supporting supply chain improvement – the Levi Strauss study found that textiles have a high embodied impact in that production and manufacturing emissions are typically greater than both use and disposal.

The incorporation of textiles in energy from waste feedstocks provide little, if any, emissions benefit: this should be reserved for otherwise non-reusable or non-recyclable textile products.

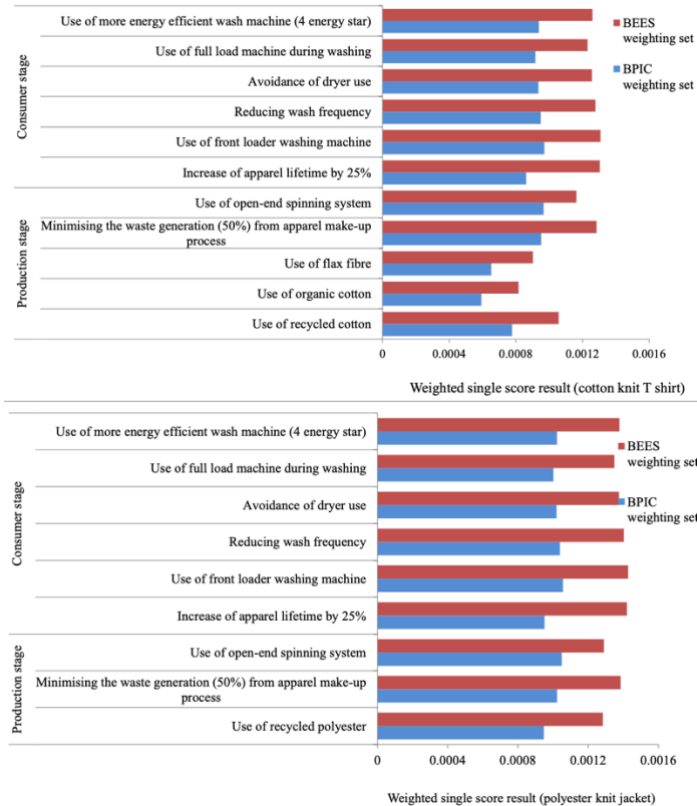


Figure 19: Single score LCA results for impact reduction options (Moazzem, 2020)

6.2.1 Embodied impact reductions

Business model adaptation through supply chain improvement is crucial when considering emissions reduction. Improved design and logistics changes will aid in the decrease in embodied energy. Manufacturing through material substitution and the use of recycled content, coupled with design for reuse will realise a decrease in GHG emissions through the supply chain. the use of recycled PET textiles reduces emissions by 66% and builds high-value markets for kerbside recycling.

Product packaging improvements, local/onshore manufacture and supply chain improvements are further ways in which to reduce the embodied energy associated with textile products.

6.2.2 Use impact reductions

Use impact reductions can be achieved by implementing change on a societal level.

Consumer awareness regarding hot water washing, detergent and dryer use will result in a more efficient usage stage, and therefore a reduction in emissions. Education to wash with cold water, line dry and ensure only full loads are washed has been demonstrated in several studies to a significant area for emissions improvement over the clothing lifecycle.

The reuse and repair of textiles will result in a decrease in consumption, with an associated decrease in emissions through the substitution of embodied impacts of new garment consumption. Reusing one tonne of clothing uses only 1.8% and 2.6% of the energy required to produce a tonne of virgin polyester and cotton clothing respectively.

6.2.3 End of life impact reduction

Establishing a general emissions reduction potential for recycling textiles is a significant piece of work, given the scope of textile all products and the breadth of options that recycled materials might substitute. Reuse is widely acknowledged to be a superior environmental outcome to any recycling method.

The recycling of textiles will directly avoid landfill emissions (not captured by landfill-gas recovery), but more impactfully can offset the embodied energy of virgin material it substitutes.

The installation of landfill gas capture technologies at landfills handling textile waste can generate an emissions reduction credit by offsetting electricity generation.

The incorporation of textiles in energy from waste feedstocks provide little, if any, emissions benefit: this should be reserved for otherwise non-reusable or non-recyclable textile products.

6.3 Interventions

The interventions identified in this section are short-term solutions that will help in the shift towards circularity in the State. The purpose of these interventions is to focus on programs and activities that are implementable in the current market; and in the case of local government the socio-economic environments in which they operate (refer Figure 20).



Figure 20: Points of intervention

The aims of these interventions are to advance innovation, strengthen existing projects, and minimise textile waste disposed of to landfill in SA. GISA funding (through various grants) will aid in the establishment of viable and sustainable businesses and improved infrastructure and logistics.

6.3.1 Data analytics

Data analytics is crucial to the implementation of successful circularity projects – both in determining the scale of the problem, identifying viable solutions and analysing the success of interventions. In addition to which, life cycle assessments cannot be undertaken effectively without reliable data. Reliable data gathering is therefore integral to understanding the data.

Data should be placed centre stage, and used as the powerful tool that it is for projects going forward. Eventually, establishing material flows for textiles will provide mass balance reporting and the inclusion of textiles in compositional analyses will contribute to closing the gap of this missing knowledge.

Councils and industry should both be encouraged to quantify textile quantities – not only in disposal but also use and procurement. Improved and increased data collection will inform the material flow, and this in turn will establish the flows of textiles through SA. In addition to providing information regarding the flow of textiles, data analyses of textile composition will afford GISA and local government the opportunity to analyse the effectiveness of the implementation of community and organisation education and awareness programs.

In addition to textile waste data, it will be prudent to measure the shift towards goals and standards. This can be achieved by measuring the value of the secondary raw materials generated through the circular economy, as well as the profitability and uptake of the end markets in this system.

The tracking of products and resources through the circular economy is important. Systems and tools will need to be set up to track the movement of products and resources, as well as quantify environmental gain from circularity.

Data analytics can be used to monitor the regeneration of ecosystems achieved through the implementation of CE principle in the textile industry. Monitoring of emissions, water and energy consumption, and the tracking of residual waste will provide input data for such models.

6.3.1.1 Intervention measures for improved data analytics

The SA Environment Protection Authority (EPA) should be encouraged to establish waste compositional analyses to use as auditing guidelines. New national standards for kerbside auditing are to be mandated. It is suggested that the EPA is encouraged to review these new standards and include them in the waste compositional analyses.

GISA should provide assistance, e.g. funding etc., to councils with the implementation of data bases, and encouraging industry to implement metrics to monitor performance through the provision of grants for data collection and analyses.

GISA should consider establishing an industry-wide circularity tool that measures the flow of textile resources and allows for the appraisal of the market in the circular economy.

In considering the reduction in emissions, GISA should further explore carbon reduction through life cycle assessment, focussing on both fossil carbon and biogenic carbon dioxide emissions. Calculations and analysis in this report are based on published literature and a complete life cycle assessment will further strengthen carbon reduction programs.

6.3.2 Design and manufacture

Industry, should be encouraged to design products with longevity, appropriate recovery, appropriate dismantling for conversion to a secondary raw material and with a focus on recycled and not virgin materials (where applicable).

Local manufacturing of fabric, uniforms and textile products should be encouraged.

6.3.2.1 Intervention measures for improved design and manufacture practices

The funding of projects or infrastructure that will encourage innovation, improved design practices and the establishment of a textile manufacturing industry in SA.

6.3.3 Cleaner production

Industries should be supported when adopting new technologies/manufacturing methods to decrease the waste and pollution that is generated through textile manufacturing or processing.

Products that are manufactured, or waste that is processed, should be done so with circularity at the forefront, so that keeping textiles in the loop is encouraged.

6.3.3.1 Intervention measures for adopting cleaner production

Funding infrastructure upgrades, infrastructure modernisation, new infrastructure builds and product development based on cleaner production will support the shift towards cleaner production in SA.

6.3.4 Collection, separation and sorting

Ease of collection will encourage people to return textiles that they no longer wear or have a use for. Ideally, this collection process should rely on existing infrastructure and logistics in the State. Collection networks have proven highly efficient in European countries for the capture of textiles with a high value. In addition to collection networks within the community, similar collection points should be considered for industry in order to encourage the collection of uniforms, industrial textiles and rubber, and other such products that can be used to generate secondary raw materials.

It should be cautioned that collection services should *complement* charitable donations and not replace them. The use of a single collection service may conflict with charitable donations in that members of the public may dispose of all clothing through a residential collection service and this will decrease the numbers of donations that charities receive.

77% of the local government respondents were not aware of the final destination of the waste collected by a recycler. Increased transparency will enable product and end market traceability, which in turn will build a more robust textile circularity economy in SA.

In addition to NDIS employment, collection, sorting and separating services provide ideal opportunities for training, as well as employment opportunities.

6.3.4.1 Intervention measures to improve collection, sorting and separating practices

Interventions include investigating a targeted system of collection, both in urban and regional SA. This targeted system should be able to capture textiles that can be reused, as well as the diversion of textile waste from landfill.

Collaborative partnerships should be formed between charities and local government for the collection of textiles so that the charitable sector is not affected by councils implementing improved textile collection practices. Even though a large portion of the charity sector is represented by Charitable Recyclers Australia that is the voice of the industry, the smaller charities that do not have a membership should not be overlooked.

Other considerations to improve household textile waste recovery could be to explore strategies implemented in other jurisdictions for example, using the existing recycling bin. An example includes mimicking the trials undertaken in Coffs Harbour and Bathurst Regional Council.

Industry should be encouraged to implement uniform collection within their organisations; and to find appropriate solutions for the uniforms collected.

Industry reforms regarding transparency of disposed materials should be strongly encouraged. GISA should work with industry to establish minimum reporting requirements for exported textiles.

Synergy with the theme of 'learning and employment in the state's Disability Access and Inclusion Plan will provide NDIS employment and skills creation. This will enable the textile industry to contribute to disability employment.

Sorting at source will not only decrease the contamination rates of recycling but will also provide employment and expansion opportunities in regional areas.

6.3.5 Reuse and repair

The replication of the repair café and Makerspace models, particularly in regional and remote areas, will encourage consumer care prior to disposal, keeping textiles at their highest value. The financial and technical support shown by GISA for these initiatives is proof of replicability.

The implementation of reuse and repair schemes will keep textiles in circulation at their highest value prior to processing and recycling. This will also ultimately increase textile recovery as there will be a reduction of textile waste to landfill.

In addition to NDIS employment, reuse and repair services provide ideal opportunities for training, as well as employment opportunities.

6.3.5.1 Intervention measures to encourage reuse and repair models

The models of the Makerspace and repair cafés should be replicated to ensure increased community access to these services. Feasibility studies should be undertaken to assess the viability of makerspaces and repair cafés in the regional areas.

Feasibility studies should consider what makes a successful operating model for usable material as well as 'offcuts' and mixed items and consider which platforms have worked and how can these attract ongoing users. Research may need to consider other jurisdictions but carefully determine their applicability in the SA market (for example, explore sharing and redistribution models that have worked in jurisdictions like Canada and Scotland, among others, but determine how these could apply to SA). It would be

prudent to also consider models that were not as successful and undertake further research into why. It is understood, for example, that many models need to be hyper-localised and require ongoing maintenance. The research could consider broader examples and methods utilising software and online platforms and directories to match supply and demand for usable material.

Communities should be encouraged to resell, swap and donate clothing as means to keep clothing in use and as alternatives to landfill disposal.

Charitable and not-for-profit partnerships should be strengthened to improve the redistribution of goods between these entities.

In relation to large retail chains, it is understood that a persistent problem exists in relation to oversupply and 'dead stock', with huge volumes still being sent to landfill. Include examples. The solutions to this stock are currently limited, with charitable donation and recycling currently offering the preferred solutions. Increasingly, there are privately owned retailers who offer buy-back solutions in their stores with the donated clothing sold as second hand clothing.

Partnerships should be identified, especially in the industrial space, where industrial and agricultural textiles can be reused or recycled into other products prior to landfill disposal. Innovation for the processing of industrial and agricultural textiles should be encouraged through funding and collaborations.

6.3.6 Education and awareness

Behaviour change will be the pivotal point on the journey towards circularity. A centralised message, that is resonant across all spheres of society, will be an effective way to encourage the shift towards circularity. This behavioural change should not only be focused on donations and recycling, and emphasis should also be given to post-consumer use and maintenance.

Council respondents indicated that the three main requests from the community were around end-of-life disposal, the location of donation centres, and the recycling options available for textiles. This indicates that there is a (growing) consumer awareness regarding the responsible use of textiles.

It has become clear through industry consultation in SA, as well as in other states, that industry does not appreciate the volumes of textiles currently being generated. There is also a lack of knowledge as to what the definition of 'textiles' covers, and this can lead to under recovery of these resources. Sixty percent of the respondents were unsure of the fibre types in textile waste, and only 53% of respondents were aware of textile waste generated in their organisation.

Messaging through social media platforms and in strategic locations (such as bus and tram stops) are proven means of communication in circular textile programmes globally. Indeed, East Waste advertises at bus stops and has stated this type of consumer engagement has proven to be effective. Although 77% of council respondents indicated that there are education programs in place for raising community awareness, the issue of community awareness and education has been raised in numerous interviews. Community programs were also highlighted as programs that councils intend to explore in future.

There is a need for a more nuanced message regarding textiles, and perhaps even more generally to avoid recycling stream contamination. Respondents who operated a Materials

Recycling Facility (MRF) highlighted challenges presented by textiles in the MSW. Community awareness regarding the correct disposal of textiles, including dog beds, car seat covers and manchester, is obviously still lacking and should be improved upon.

As evidence suggests, consumer behaviour is a significant contributor to the environmental impact of the use of textiles and can be further explored through a consistent national approach to policy development, consumer education and investment in product stewardship.

6.3.6.1 Intervention measures to improve education and awareness

A broader local government and industry consultation is recommended to gain a better understanding of expectations, especially one that will strengthen regional capacity in the waste sector. An industry-wide consultation process should be implemented to achieve this. Local government should also investigate the feasibility of training programs for industry whereby knowledge regarding the design, use and disposal of textiles is further enhanced.

Community education programs undertaken by certain councils should be expanded to all councils, as well as boosting the education programs in the schools.

Consumer awareness regarding garment care and appropriate donations should be investigated. Garment care is a vital component of reducing the impact of clothing and consumers should be encouraged to modify their behaviours to not only extend the life of their garments (and therefore ultimately keep clothing and manchester at a higher value for donation or reuse) but minimise their carbon footprint and impact(s) to the environment.

Increased visibility regarding programs (such as the Tread Lightly and Australia Remade campaigns) initiative will improve awareness around textile waste management within the community. The replication of programs such as the Why Waste It¹⁵ program in LGAs where there is no education campaign addressing textile waste issues will further increase the message to local communities.

6.3.7 Government waste management practices

94% of local government respondents did not have a waste management plan that incorporated textile wastes. Waste management plans should be updated to include the management of textile wastes, with achievable objectives that will integrate with the GISA Circular Economy Roadmap and strategy.

82% of the council respondents indicating that there are circular economy projects in action within their council. However, no textile waste specific projects were highlighted. Councils should be encouraged to implement textile circularity in local government.

Support from GISA can ensure that practicable and implementable waste targets can be met.

6.3.7.1 Intervention measures to improve government waste management practices

Interventions include the implementation of a kerbside audit guideline that is congruent with the newly released national textile categories.

¹⁵ East Waste's education campaign

Regional waste management strategies should be implemented in order to encourage regional collaboration in the CE. This includes revising waste management policies to include textile waste.

Waste management practices, not only limited to textile waste, should be assessed in all levels of government in SA. Management measures, such as the reduction in textile use, the reduction in the volume(s) of waste generated, and improved textile recycling measures (such as uniform collection) can then be instituted to decrease textiles waste generated and increase recoveries.

6.3.8 Procurement

The procurement of sustainable textiles, and those with a high recycled content, will be a powerful tool in shifting the textile market towards circularity. Due to the increasing demand on organisations to implement sustainable solutions, and a willingness to follow a circular route, many organisations are reviewing and revising procurement standards to include improved design with a focus, inter alia, on recycled content and modern slavery.

The implementation of sustainable design and manufacturing will assist with the shift towards sustainable procurement, as the supply chain will have achieved (and in progress) its own sustainability and CE goals.

Forward thinking when procuring textiles or textile-containing items will allow for the sustainable management of textiles. Examples include understanding the reuse/repurposing/recycling pathways for textile garments containing recyclable contents; the use of textiles within and between government departments¹⁶, and the recyclability of mattresses purchased in the tourism industry.

It is anticipated that most organisations will need to collaborate with their supply chains in order to realise enhanced procurements standards. However, this may prove to be both expensive and time consuming for organisations to carry these negotiations themselves.

Discussions with certain stakeholders has made it apparent that there is no governmental focus regarding procurement. A shift towards sustainable procurement will demonstrate a commitment from government to moving towards circular solutions.

Collectively, councils can jointly effect change in the market by leveraging their combined purchasing power. This includes changing behaviours to avoid textile consumption entirely (i.e. transitioning to projected or digital signage for events (rather than banners), as well as procuring recycled content, products subject to stewardship schemes, or those suitable for repair or reuse. Awareness for procurement and behavioural change should be a priority for employee education in both state and local governments.

Given that uniforms is a focus area of stakeholders, it is suggested that uniform procurement is given priority.

6.3.8.1 Intervention measures to improve procurement models and practices

Procurement policies that address purchasing from manufacturers who have adopted clean production, waste minimisation, water minimisation and clean energy should be encouraged.

¹⁶ For example, during the Brisbane Commonwealth Games, the linen for the athletes villages was rented from the Department of Health Queensland.

GISA should work with, and providing funding to, organisations to engage with the supply chains. The forward procurement pipeline should be incentivised to implement changes that will advance textile circularity.

These improved procurement policies should be introduced across the government sector, both state and local.

6.3.9 Emerging industries

Charitable Recycling Australia's operational data, as analysed by MRA, has shown that offshore reuse and processing of clothing is a major end-market for donated clothing. It is important to note, that if offshore markets falter (and clothing donation services are reduced/withheld) the kerbside stream will potentially see substantial increases textile volumes and its associated cost of waste processing. This, in turn, will exacerbate the impacts of waste processors.

Innovation should be encouraged, particularly in regional centres if regional capacity is to be increased, to facilitate the establishment of emerging industries to ensure that textile reuse and processing can become a viable solution onshore, protecting not only the waste management industry but also perhaps providing a stable offtake market for the charity sector.

A high proportion of Council respondents (82%) did not have a relationship with a not-for-profit/social enterprise. Sorting and resale are ideal opportunities for job creation in the social enterprise space, whilst also taking cognisance of Disability Access and Inclusion Plans. 35% of respondents indication that there are opportunities for supported employment, whilst 41% were unsure – perhaps signalling a greater opportunity space. 47% of council respondents indicated that these relationships are to be investigated in future.

6.3.9.1 Intervention measures to support emerging industries

Interventions include working in conjunction with Inclusion SA. Synergy with the theme of 'learning and employment in the state's Disability Access and Inclusion Plan will provide NDIS employment and skills creation.

Feasibility studies should be undertaken to determine which regional centres will be able to accommodate emergency industries in the textile space.

6.3.10 Redistribution

Whilst the focus falls typically on clothing donation to charities, there are large volumes of clothing that are disposed of in the retail sector (such as dead stock). The disposal of such clothing to landfill should be prevented, and programs. In addition to dead stock from the retail sector, op shops dispose of items that do not sell.

Charities with membership to Charitable Recyclers Australia are currently granted a discount to the waste levy. It is recognised that this levy discount allows charities to save on operational costs, not all charities currently have access to this program. Therefore, not only are some charities disadvantaged financially, but there is no incentive to reduce waste going to landfill.

GISA has provided the Salvation Army with funding for the purchase of a modified waste collection vehicle to transport unusable materials to ResourceCo. This vehicle is used to transport the materials from the Salvos (and other charities) to the ResourceCo depot. Although this is outside of GISA's policy regarding EfW, it is considered to be an intervention for the diversion of waste disposed of at landfill.

6.3.10.1 Intervention measures to redirect textiles from landfill

Interventions include investigating and implementing programs for the re-distribution of end stock, and incentives for all charitable organisations to reduce waste going to landfill.

GISA should support the recycling and processing industry with funding and mentorship to investigate options for waste that the charitable sector currently sends to landfill.

The current programs regarding laundering and tagging that are being implemented by the Department of Health should be further supported for expansion into the Health Sector as a whole.

The feasibility of these programs across the Aged Care sector should be investigated.

6.4 Opportunities

The opportunities discussed in this section have been identified on a qualitative basis, with no data analysis nor investigation of business cases. These opportunities have been identified as a result of the stakeholder engagement process, as well as knowledge of the textile market in Australia. It is anticipated that the implementation of the opportunities identified in this section will help build a flexible yet robust way forward for the development of circularity within textiles in SA (refer Figure 21).



Figure 21: Opportunities to advance textile circularity in SA

6.4.1 Industrial symbiosis

Industry respondents indicated an interest in grants, funding, improved centralized data capturing, assistance identifying circular opportunities, and events and knowledge sharing; whilst 77% of respondents indicated a willingness to contribute in future discussions regarding textile circularity. There is thus an opportunity to engage with industry more broadly with the potential of forming collaborative partnerships.

Industrial symbiosis may prove to be beneficial in finding uses for textiles that no longer have a high value associated with them.

This model could also be rolled out in regional areas where access to multiple resources at large volumes may prove to be problematic, forcing consideration of solutions that combine various material streams.

If, as the University of South Australia suggests, circular economy hubs are established GISA should ensure that the reuse and recycling of textiles are included. The establishment of these hubs, using this model of symbiosis, will not only allow for the exchange of underused resources (as secondary raw materials) but also allow for knowledge sharing, increased collaboration in the CE industry, and cost sharing. Similar hubs are being established in regional Queensland and the research behind their being places for successful collaboration is positive.

The challenges faced with waste management in regional areas that are sparsely populated with dispersed communities will be met by progressive improvement in these areas. Recalling the GISA Strategic Plan 2021-2015, textile circularity in the regional areas of SA can be encouraged by meeting four of the priorities:

- Priority 2: 'Reducing wasteful consumption by sustaining products through repair and reuse, avoiding waste, and improving recycling and recovery' – the establishment of repair cafes, encouraging the expansion of the charitable section to remote areas will create the opportunities necessary to advance this priority.
- Priority 5: Capacity building through investment in training, education, innovation and research and development to nurture the next generation.' – encouraging industry collaboration, multiple waste regeneration into a single product, and improving community awareness will enhance capacity to meet CE objectives.

6.4.2 Lifecycle stage interventions

Providing organisations with improved/increased resources to fully investigate the lifecycles of the processes/projects will aid in identifying challenges and opportunities in the shift towards circular textile management.

Local and state government can serve as funding agents as well as encourage the collaboration between industries for the identification of synergies and opportunities for shared resources.

Understanding lifecycles along the supply chain will provide an improved understanding of the GHG emissions associated with the design, manufacture, use and disposal of textiles.

6.4.3 Organisational opportunities

6.4.3.1 Charitable sector

Charities and councils have common vision, such as the reduction in waste to landfill, job creation, the creation of circular economy and the reduction in illegal dumping. Local government is in the position to provide industry-industry connections to enable the use of secondary raw materials; has the ability to introduce community initiatives, thus encouraging interaction between the charitable sector and community.

Charities should continue to make use of the discounted waste levy but only in cases where the waste cannot be reused, recycled or sold; or sent for recovery. Whilst the

charities are able to discard of unusable donations at an exemption rate, it should be noted that there may still be some opportunity for discarded items to be broken down into components that can form secondary raw materials.

Local government should form collaborative relationships with the charitable organisations within their jurisdiction to ensure that the organisations are given every opportunity for their items to stay in the closed loop, and investigate ways in which collaboration can further reduce waste sent to landfill. There are replicable projects, such as mattress processing through 360, that can be duplicated in other LGAs. This will allow for an increased mattress processing capability in the State.

The links between textile (including waste) management options and industry (including charities and not-for-profits) should be further investigated to develop a way forward for increased redistribution, donations and textile recovery. This includes assessing the new federal Remade initiative.

6.4.3.2 Health sector

There is an opportunity to further expand projects in the health sector. Projects such as the single-use hand towel projects should be further investigated. The outcome(s) of the current RFID trial in the hospitals should be considered for further implementation in other industries, such as aged care.

6.4.3.3 Sustainable business practices

The emergence of the textile CE provides an ideal opportunity for organisation to evaluate their sustainable business models and implement the necessary improvements to further advance their CE agenda. Targeted government investment will assist in providing organisations with the resources to further their sustainable business agendas.

Forty percent of the industry respondents indicated that there were procurement guidelines in place. This provides an indication that there is an appetite for change in industry to move towards sustainability in textiles and business practice. To further emphasise this commitment, 47% of industry respondents indicated that textiles were reused in the organisation.

6.4.3.4 Education sector

Given the size and coverage of this sector, the Department for Education should be afforded the opportunity to investigate textile solutions as the new waste contract matures.

Opportunities in the tertiary education sectors should be investigated.

6.4.4 Textile waste management improvements

6.4.4.1 Collection and sorting

All council respondents who sent waste to a MRF indicated that textiles are viewed as a contaminant and disposed of at landfill. There is an opportunity to capture this textile waste from the sorting stream and process this in order to divert the textiles from landfill. There are various methodologies that can be explored to achieve this, such as collection bins at transfer stations and intervention prior to disposal at landfills, to achieve sort separated clothing collection and promote the diversification of recovery markets.

The donation of unusable textile items contributes to the volume of materials disposed of at landfill by charities.

6.4.4.2 Regional capacity

Textile waste management is in its infancy in regional areas and presents first addressing improved waste management and recovery opportunities by incorporating textiles as a stream within waste management plans to support strategies for improving community awareness, and the investigation of technologies and collaborative efforts that will be best placed in the regional areas.

6.4.4.3 Other waste streams

Whilst there is a focus on municipal solid waste and the associated recycling streams, there is a large volume of textile waste that can be reclaimed from C&I waste. Better sorting and separation of waste streams will enable improved recovery of textile waste, and also reduce the contamination of said stream.

6.4.4.4 Recycling and processing opportunities

Sustainable recycling and processing options should be investigated for introduction into the SA economy. Targeted government investment in research and development will increase encourage innovative solutions to the recovery and processing of textiles, as well as establishing collaborative partnerships in the textile industry. New industries should be encouraged to establish operations in SA in order to realise recycling and processing capacity in the State.

These opportunities should be focused on wholly onshore solutions that are expandable so that current offshore solutions can be replaced.

There is currently an unrecovered fraction of textiles that are currently sent to EfW by Councils (refer Figure 13). This fraction should, ideally, be diverted from EfW to recycling and processing.

7. A case study

The Department of Health is a major procurer of textiles in the SA economy, and these textiles are used within various divisions within the health sector. The consultation undertaken for this report looked exclusively at linens, and discounted scrubs, masks and other textiles that the health sector uses.

Linens are hired from an appointed linen provider, Linen Services Australia. Veolia provides incineration services for medically contaminated materials (including linen).

Veolia transports medically contaminated waste to site in Dry Creek where it is incinerated. Due to the nature of collection, there is no sight of contents in the bins situated in the operating theatre (and other such places). Therefore, it is unclear if linens that are not medically contaminated are being disposed of in the bins for medically contaminated items.

Linen Services Australia has implemented various measures (as per Table 1) to curb losses and find suitable uses/recycling measures for linen that is past its use-by state for the health sector. These include trials at the Women's and Children's Hospital to monitor the losses of certain items to disposal, as well as adjustments to linen sizes and branding in the ambulances to curb losses in this sector.

Whilst it can be assumed that there is adequate separation between medically contaminated and contaminated linen, it is worth investigating this further. Losses to incineration can be avoided where disposal has been careless or health care workers are uninformed. Training and appropriate signage are useful solutions to implement in order to prevent these losses to incineration.

As per comms with both Linen Services Australia and Veolia, transport logistics are adequately addressed and optimised.

The Department's procurement office should be abreast of trials and recycling disposal avenues in order to ensure adequate cognisance has been taken for the potential of reducing textiles to landfill. It is worthwhile addressing other textiles in order to appreciate the true extent of textile use and disposal within the health sector.

8. Conclusion

Whilst textile waste management is in its infancy in SA, there is interest from community, local government, state government and industry to progress textile circularity. National programs and industry solutions are progressing and this provides an opportunity for SA to progress textile waste management towards circularity. It is apparent from Section 3 that the amounts, types and fibre blends of textiles imported into SA mirror the national trends. This can be leveraged by GISA to join nationwide programs that support the same sorts of reuse and recovery.

It should be noted that the shift to a circular economy should take place from the design phase right through to the identification of end markets and the use of recovered resources as secondary raw materials. Emphasis should be placed on recycling not being a complete circular shift. Nor should the use of products as a secondary raw material into another product that then requires disposal at landfill be considered a circular solution. Indeed, with textile circularity being in its infancy, and added to this the lack of design and infrastructure available, there are not wholistic circular solutions currently available for all textiles.

Whilst the reuse of textiles as secondary raw materials into products that ultimately result in disposal are not ideal in terms of the waste hierarchy, they are also (mostly) the only solutions currently available. For this reason, they should not be completely discounted.

In terms of energy from waste, while it sits higher in the hierarchy than landfill disposal as 'recovery' on the internationally accepted waste management hierarchy, to achieve a fully circular economy, further investment to reduce this need can be explored for textiles, including in the design of systems to reduce waste generation and in extending the value of textiles through other opportunities such as reuse and upcycling, followed by recovery through recycling solutions.

The interventions identified are short-term solutions that will help in the shift towards circularity in the State. The purpose of these interventions is to focus on programs and activities that are implementable in the current market. The aims of these interventions are to advance innovation, strengthen existing projects, and minimise textile waste disposed of to landfill in SA. GISA funding (through various grants) will aid in the establishment of viable and sustainable businesses and improved infrastructure and logistics.

The opportunities identified are medium and long term measures that will enable a shift towards a circular textile economy in SA. GISA funding and industry collaboration will aid in this shift.

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Appendix I

Examples of available textile waste management solutions

Option	Organisation	Description	Location
Collection household -	Rednose South Australia	Distributes red coloured bags freely or by order to letterboxes ahead of dedicated collection times Donations can include second hand household items This service is a charity run program operating with the permission of councils, but without their direct funding	SA and VIC
	Reluv (via Upparel)	Shipped at resident's cost and resident packages textiles	National
	Upparel	Shipped at resident's cost and resident packages textiles	National
	Waverley Council Canterbury-Bankstown Council Coffs Harbour City Bathurst	Council provides pick-up as part of waste collection service provided to residents	NSW council-based
	King Cotton (Clothing Cleanup)	Collected from residence	NSW
Collection drop-off points -	Savers	In-store drop-off points	SA and VIC
	Charitable sector	Op shops and charities	National
	SCRgroup	Hubs located in cities	National
	H&M	Provides a take-back model for consumers	National
	Save Our Soles (Tread Lightly)	Provides a take-back model for consumers, using stores as hubs	National
Collection schools -	SCRgroup	Schools have a dedicated space for uniform collection	National

Option	Organisation	Description	Location
Collection - workplace	Upparel	Bins placed in the workplace	National
	Shred-X	Collection on a needs-be basis	Qld and NSW
	Thread Together	Collection on a needs-be basis	National
	Textile Recyclers Australia	Collection on a needs-be basis	NSW and VIC
Sorting	Charitable sector	Typically hand sorting	National
	Selected MRFs	Typically hand sorting	National
Redistribution	Thread Together (working with Anglicare in SA)	New clothes only Donated by retail and wholesale industries	National
	Charitable sector	Donation of textiles received that cannot be used redistributed to other charitable organisations and various not-for-profits	National and online
	Good360	New items only Donated by retail and wholesale industries	National
Retail models	Savers	Donations from Red Nose and bought sight unseen Hand sort donations Unused product sold to SRI (Savers Recycling Inc), who in turn sells to graders and end users Savers is for-profit enterprise and pays its charity partners for good received	SA and VIC
	Charitable sector	Second hand sales	National
	Tip shops	Resaleable textile goods recovered from waste management centres, or through donation of goods	National
	Consignment stores	Second hand clothing sales	National and online
	Reluv	Second hand clothing sales	Online
Rental and subscription models	Glam Corner	Subscription	Online
	Designrex	Rental	Online
Upcycling and repairs	Makerspace	Open to the public who can create products using donated fabrics and yarn	SA

Option	Organisation	Description	Location
	Remakery	Repurposing model - textiles are upcycled into clothing, accessories	SA
	Boomerang Bags	Bags made from donated fabrics and textile	National
	Repair Cafè	Hosted by local councils	National
	Lifeline Downs Darling	Alternate uses for unusable donations are sought prior to landfill: pillows baled for use in archery, stockings and old curtains have an offtake for fruit tree coverings, cables are removed from electric blankets and then used as dog blankets NDIS employment opportunities	Qld
	Brisbane City Council	Local annual events to encourage reuse, such as the Greenheart Fair	Qld
	A Fitting Connection (The ReFashioned Label)	Repurposing model - textiles are upcycled into clothing, accessories, furniture, outdoor textiles	Online
	Second Stitch	Home products, face masks and accessories made from donated fabrics; and repairs and alterations offered Subsidised training for migrant, refugee and asylum seekers	Online sales On site repairs
Processing	Distribution 360	Provides a collection service for mattresses and bases These items are processed, and some components are recycled Trials are underway to increase processing capability; as well as for the processing of carpet and underlay	SA
	Peats Soil and Garden Supplies	Provides organic recycling, and accepts textiles for on-site processing	SA
	ResourceCo	Receives some uniforms and shredded fabric Bulk of textile receipt is through hard waste Textile feed is generally not accepted at the gate Waste received is processed as an alternative fuel source.	SA and Qld
	Atlas Soils	Textiles are processed and produce HumiSoil® using organic waste for the urban environment	Qld

Option	Organisation	Description	Location
		This process has the ability to accept textile waste, in any condition (including contamination)	
	QUT	Researchers have developed robotics that can sort and disassemble discarded clothing using a pilot disassembly system	Qld
	BlockTexx	Poly cotton processing Initial feedstock will be commercial linens, uniforms and C&I wastes	Qld
	Endeavour Foundation	Mattresses processed on behalf of local councils Offtake markets include mattress foam sold for use as carpet underlay NDIS employment opportunities	Qld
	Goondiwindi Circular Cotton Project Trial	Investigating the outcome of returning shredded cotton products to cotton fields.	Qld
	Shred-X	Uniform destruction service	Qld and NSW
	Circular Centre	Sorting and dismantling of uniforms and workwear Distribution to secondary markets NDIS employment opportunities	NSW
	Worm Tech	Compost and fertilisers produced through organics recycling using vermiculture and a thermophilic composting process	NSW
Recycling	Worn Up	Uniform recycling, including source separation and processing Garments are shredded and remanufactured into a range of products	National
	Endeavour Foundation	Excess clothing processed into cleaning cloths and rags NDIS employment opportunities	Qld
	Textile Recyclers Australia	Rag manufacture	Offshore
	Brummers	Rag manufacture	Offshore



Appendix II

Stakeholder Survey – Local Government

GISA Local Government Survey - Textile Opportunities in Circularity

This survey has been developed by the Australasian Circular Textiles Association (ACTA) on behalf of Green Industries South Australia to identify sustainability trends, data, interests and priorities in the textile supply chain in South Australia.

GISA has appointed ACTA to identify and describe opportunities for textile circularity in South Australia.

The object of this survey is to understand the current capacity for textile waste, as well as current textile waste management practices, current challenges and barriers, and lastly opportunities. This work will inform the creation of GISA's circular economy roadmap for South Australia.

This information will inform potential opportunities in or towards circularity for textiles. To support this work, we are seeking data on textile acquisition, importation, consumption and disposal - if you can assist, please email <hello@acta.global>

As a local government representative, your participation is critical to ensuring that future solutions are fit for purpose and support a holistic transition to circularity for textiles whilst at the same time will be implementable and practicable at a local level.

Textile waste referred to in this survey refers to all types of textiles, and not only clothing, present in material disposal. This includes synthetic fibres and leather. Kerbside waste, recycling streams, hard waste collection, self haul, commercial and industrial waste, and construction and demolition waste are all known to contain textile waste.

Survey will responses will be published in aggregate only, and all information collected will be treated as confidential. We estimate it will take around 20 minutes, with the survey closing on 23 July 2021.

*** Required**

1. Email *

2. Council represented *

Textile Waste Management

3. Which of the following best describes your Council's textile waste? Please tick any that apply ^{*}

Check all that apply.

- Complex (i.e. products with textiles as the major component, clothing, manchester, leather goods, uniforms, carpets, curtains)
- Composite (i.e. furniture, mattresses, motor vehicle seats, prams, car seats, shade cloth)
- Contaminated (i.e. rags, nappies, medical waste)
- Synthetic textiles
- C&I waste
- C&D waste
- Pre-consumer commercial waste (yarn and fabric manufacture, fishing nets manufacture)
- Post-industrial waste (scrap textiles from other industries)

Other: _____

4. If you have selected 'other' as the waste type, please provide detail

5. Does your Council include textile waste data in waste audits and characterisations? ^{*}

Mark only one oval.

Yes

No

6. Does your Council have a strategy in place to manage textile waste? *

Mark only one oval.

- Yes
- No
- Don't know

7. If yes, please provide detail

8. Does your organisation operate a Material Recovery Facility (MRF) subsidiary, or a direct contract with a MRF ? *

Mark only one oval.

- Yes
- No
- Not yet operational

9. If yes, please provide detail regarding textile management through the facility, including an challenges textile waste poses to operations.

10. Does your Council send textile waste to Energy from Waste (EfW)? For example, is any waste sent to a third for processing and/or incineration? *

Mark only one oval.

Yes

No

11. If yes, please provide detail

12. Does your Council recycle mattresses? *

Mark only one oval.

Yes

No

13. If yes, please provide detail

14. Are waste management sites and/or infrastructure managed by a not-for-profit/social enterprise? For example, is the waste transfer station managed on behalf of Council or is the tip shop managed by a 3rd party? *

Mark only one oval.

Yes

No

15. If so, please provide detail

16. Do opportunities exist for supported employment through Council's waste management practices (such as receiving, sorting and/or resource recovery) that align with Council's Disability and Inclusion Plan? *

Mark only one oval.

Yes

No

Don't know

17. If yes, please provide detail

18. Do you rely on grant funding for any textile recovery/recycling/processing projects? *

Mark only one oval.

Yes

No

19. If so, please provide detail

20. Do you have any circular economy projects that Council is implementing? *

Mark only one oval.

Yes

No

21. If yes, are any of these projects addressing circular waste? Please provide detail

Procurement

22. What textile wastes are generated by your Council's internal operations (e.g. uniforms, event banners, shade cloth in parks etc.)? *

23. Does your Council have procurement and disposal guidelines in place for textiles? *

Mark only one oval.

Yes

No

Don't know

24. If yes, please provide detail

Check all that apply.

Business model or procurement transition to support circular models

Procure textiles with a percentage recycled content

Reuse initiatives

Recycling initiatives

Other

25. If yes, do you know if your textile waste is exported by the waste collector/recycler? *

Mark only one oval.

Yes

No

Don't know

26. If other, please provide detail

27. If no, how does your Council dispose of the textile waste it generates?

28. If you do not have procurement information: please provide contact details for the responsible person here.

Circularity and Sustainability

29. Has your organisation implemented any programs/projects listed below? Please tick any that apply. *

Check all that apply.

- Industry consultation with parties who generate/process textile waste
- Partnerships with not-for-profit and NDIS organisations to divert the disposal of textiles to landfill
- Education programs/material for community members regarding reuse and correct disposal for e of life
- Repair cafes

30. If yes, please provide detail on these programs/projects

31. Which of the following does your organisation intent to explore in future? Please tick any that apply. *

Check all that apply.

- Industry consultation with parties who generate/process textile waste
- Partnerships with not-for-profit and NDIS organisations to divert the disposal of textiles to landfill
- Education programs/material for community members regarding reuse and correct disposal for e of life
- Repair cafes

32. Do you receive requests from the community regarding the following in relation to textile *

Check all that apply.

- Donation centres
- Recycling options
- Collection
- End of life disposal
- How to care for textiles and lower the associated environmental impact

Other: _____

Contact information

33. Full name *

34. Position *

35. Contact number *

36. Would you like to contribute in future discussion regarding circularity in textiles? *

Mark only one oval.

Yes

No

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Stakeholder Survey – Industry

GISA Stakeholder Survey - Textile Opportunities in Circularity

Green Industries South Australia (GISA) has appointed Australasian Circular Textiles Association (ACTA) to identify and describe opportunities for textile circularity in South Australia by:

1. Investigating South Australia's current capacity to recover textiles, and how/where it can be expanded.
2. Consider current challenges and barriers for textile circularity.
3. Identify further opportunities and interventions to the current system.

Your participation in this survey will aid in the creation of a sustainable, solutions-driven textile circular economy roadmap for South Australia, supporting innovation, future growth and employment opportunities.

Textiles referred to in this survey include not only clothing and manchester, but also includes synthetic fibres, leather, soft furnishings, carpets, mattresses, donated goods, kerbside waste, recycling streams, hard waste collection, self haul, commercial and industrial waste, and construction and demolition waste. These can be both virgin and recycled fibres.

Survey results will be published in aggregate only, and all information collected will be treated as confidential.

Time: 10-15 minutes

Closing date: 25 August 2021.

* Required

1. Company name *

2. Industry represented by respondent. Please select all that are applicable. *

Mark only one oval.

- Import
- Export
- Manufacturing
- Waste management - government
- Waste management - private
- Recycling
- Not-for-profit
- Social enterprise
- Health
- Hospitality and event
- Construction
- Agriculture
- Mining
- Telecommunications
- Fisheries
- Port authority
- Consulting
- Waste processing
- Aged care
- Regulatory
- Defence and police force
- Fire fighting
- Education
- Apparel and retail
- First responder
- Furniture and interior
- Other

3. If you answered 'other' above, please specify which industry you represent.

4. Select any of the following that describes your organisation. *

Mark only one oval.

- We import/supply/distribute or retail textiles (to business)
- We manufacturing using textile (i.e. furniture, automotive, clothing)
- We retail textiles (to consumer)
- We procure/use textiles in our operations
- We recover/reuse/recycle textiles (inc. charities)

5. Regarding issues of textile sustainability, how does your organisation identify? *

Mark only one oval.

- Innovator
- Early adopter
- Majority
- Follower

1. Textile Imports

Industry that imports textiles into Australi

6. Does your organisation import textiles? *

Mark only one oval.

- Yes
- No (please proceed to '2. Textile Manufacture') *Skip to question 8*

7. If yes, please specify what textiles are imported.

2. Textile Manufacture

Industries that manufacture yarn, textiles from raw and/or secondary raw material

8. Does your organisation manufacture textiles? *

Mark only one oval.

Yes

No (please proceed to '3. Manufacturing Industry') Skip to question 10

9. If yes, which of the following textiles do you produce?

Check all that apply.

	Virgin fibre	Recycled content
Synthetic textile	<input type="checkbox"/>	<input type="checkbox"/>
Natural textile	<input type="checkbox"/>	<input type="checkbox"/>
Blended fibre textile	<input type="checkbox"/>	<input type="checkbox"/>

3. Manufacturing Industry

Manufacturing industries that produce goods containing textile

10. Does your organisation manufacture goods using textiles as a raw material? *

Mark only one oval.

Yes

No (please proceed to '4. Textile Use') Skip to question 14

11. If yes, which of the following textiles do you produce?

Check all that apply.

	Virgin fibre	Recycled content
Synthetic textile	<input type="checkbox"/>	<input type="checkbox"/>
Natural textile	<input type="checkbox"/>	<input type="checkbox"/>
Blended fibre textile	<input type="checkbox"/>	<input type="checkbox"/>

12. What kinds of products do you manufacture? Please select all that are applicable.

Check all that apply.

- Complex (i.e. products with textiles as the major component including; clothing, manchester, leat goods, uniforms, carpets, curtains)
- Composite (i.e. furniture, mattresses, motor vehicle seats, prams, car seats, shade cloth)
- Synthetic textiles such as fishing/agricultural netting

13. If you are a designer, what is your preference for textiles?

Mark only one oval per row.

	Virgin fibre	Recycled content
Synthetic textile	<input type="radio"/>	<input type="radio"/>
Natural textile	<input type="radio"/>	<input type="radio"/>
Blended fibre textile	<input type="radio"/>	<input type="radio"/>

4. Textile Use

Industries that use/distribute goods containing textile

14. Does your organisation use goods that contain textiles? *

Mark only one oval.

Yes

No (please proceed to '5. Textile Waste') *Skip to question 18*

15. When purchasing textiles, are any of the below taken into consideration? Please select all that are applicable.

Check all that apply.

- Recyclability
- Sustainability of the supply chain
- Potential for reuse
- End of life use
- Ethical sourcing
- Modern slavery
- None of the above

16. Does your organisation have procurement and disposal guidelines in place for textiles?

Mark only one oval.

Yes

No

Don't know

17. Which of the following is true of your organisation?

Check all that apply.

- We use/procure recycled content in our textiles wherever possible
- We are unable to locate and procure recycled content for textiles in many instances
- We do not actively seek recycled content in the textiles we consume
- We do not procure textiles

18. Does your organisation generate waste containing textiles? *

Mark only one oval.

Yes

No (please proceed to '6. Textile Reuse") *Skip to question 27*

19. Which of the following best describes your organisation's textile waste? Please select any that apply.

Check all that apply.

Complex (i.e. products with textiles as the major component, clothing, manchester, leather goods uniforms, carpets, curtains)

Composite (i.e. furniture, mattresses, motor vehicle seats, prams, car seats, shade cloth)

Contaminated (i.e. rags, nappies, medical waste)

Synthetic textiles

C&I waste

C&D waste

Pre-consumer commercial waste (yarn and fabric manufacture, fishing nets manufacture)

Post-industrial waste (scrap textiles from other industries)

My organisation does not generate textile waste

Clean/pre-consumer (i.e. offcuts, by the roll, consistent fibres)

My organisation is responsible for recovering textile waste (e.g. charities)

Other: _____

20. If you answered 'other' above, please specify your textile waste

21. If you have selected 'other' as the waste type, please provide detail

22. Are you aware of the fibre types in the textile waste generated by your organisation?

Mark only one oval.

Yes

No

Not sure

23. If yes, please provide further detail. Our textile waste is predominantly...

Check all that apply.

Natural fibres

Synthetic fibres

Blended fibres

24. What kinds of preprocessing would be required to recycled your textile waste? Please select all that are applicable.

Check all that apply.

Cleaning

Contamination removal (i.e. grommets, zips, staples, buttons)

Sorting (into fibre types)

25. To the best of your knowledge, how are your organisations main textiles waste(s) processed?

Check all that apply.

- We don't dispose of textiles in our operations
- I don't know
- Landfilled
- Secure disposal before landfill
- Mechanically recycled (e.g ragging, flocking, felting, stuffing)
- Chemically recycled (into constituent parts)
- Reused (onshore)
- Reused (offshore)
- Repaired & reused
- Donation to charity/community

26. Does your textile waste require secure disposal?

Mark only one oval.

- Yes
- No

6. Textile Reuse

Organisations that reuse textiles as a part of the operation

27. Does your organisation reuse textiles? *

Mark only one oval.

- Yes
- No (please proceed to '7. Waste Management') *Skip to question 34*

28. If you answered yes above, please indicate the source of the textiles. Please select all that are applicable.

Check all that apply.

- Generated within the organisation
- Bought from a third party
- Donated by a third party
- Obtained from a waste management site

29. Is the reuse of textiles for commercial gain?

Mark only one oval.

- Yes
- No

30. Please provide detail regarding the reuse of textiles within your organisation

31. Do the processes you employ for reuse result in waste generation/residual waste?

Mark only one oval.

- Yes
- No

32. If waste is generated, please specify the type(s)

Check all that apply.

- Textile
- Recyclables
- General
- Hazardous

33. If waste is generated, please specify the means of disposal. Please select all that are applicable.

Check all that apply.

- Recycling
- Processing
- Landfill
- Energy from Waste

7. Waste Management

Organisations that process textile waste

34. Does your organisation process textile waste? *

Mark only one oval.

- Yes
- No (please proceed to '8. Circularity & Sustainability') *Skip to question 43*

35. Does your organisation process waste containing textiles? *

Mark only one oval.

- Yes
- No

36. If you answered yes above, please indicate the source of the textiles. Please select all that are applicable.

Check all that apply.

- Generated within the organisation
- Bought from a third party
- Donated by a third party
- Obtained from a waste management site

37. Is the processing of textiles for commercial gain?

Mark only one oval.

- Yes
- No

38. What type(s) of process(es) do you use to separate textile waste?

Check all that apply.

- Mechanical
- Chemical

39. Please provide detail on the resultant 'product'

40. Do the processes you employ for processing result in waste generation/residual waste?

Mark only one oval.

Yes

No

41. If waste is generated from processing, please specify the type(s)

Check all that apply.

Recyclables

General

Hazardous

42. If waste is generated from processing, please specify the means of disposal. Please select all that are applicable.

Check all that apply.

Recycling

Processing

Landfill

Energy from Waste

8. Circularity and Sustainability

43. Are you able to contribute textile data (and be contacted after this survey)? *

Check all that apply.

Primary data (i.e textile acquisitions/imports, consumption, or disposal)

Anecdotal information (i.e inferred amounts, industry averages or other)

No

44. Has your organisation implemented any programs/projects listed below? Please tick any that apply. *

Check all that apply.

- Partnerships with not-for-profit and NDIS organisations to divert the disposal of textiles to landfill
- Partnerships with textiles recycling services
- Textile life cycle assessment
- Business model or procurement transition to support circular models (e.g. leasing rental, take-back improved warranty/repair)
- Procure textiles with a recycled content
- Design out textile waste and pollution (.e.g. design for disassembly/debranding, single material, dematerialisation)
- Keeping textiles in circulation (e.g. supporting peer-to-peer resale, extended warranty and repair, providing customers a recycling service)
- Education for customers on correct disposal at the end of life and/or care of garments
- Participation in industry stewardship
- Other
- None

45. If yes, please provide detail on these programs/projects

46. Do you receive requests from customers (or, make requests to your suppliers) for the following in relation to textiles: *

Check all that apply.

- Use of recycled content
- How to reduce environmental impacts during use of textiles
- How to dispose at end-of-life (recycling options, take-back, donation)
- Established standards & labels (i.e. organic / BCI cotton / Fairtrade)
- No

47. Is your organisation involved in any trial projects regarding textiles?

Mark only one oval.

Yes

No

48. If yes, please provide detail

49. Please provide detail on assistance and/or knowledge creation your organisation can benefit from. Please select all that are applicable. *

Check all that apply.

- Events and knowledge sharing
- Improved centralised data capture and reporting
- Grants
- Funding
- Research assistance
- Regulatory approval
- Mentoring
- Assistance identifying circular economy solutions within my organisation
- Assistance with identifying markets

50. Should your organisation have extra information to contribute, please provide detail regarding projects and programs that have not been covered above.

9. Contact information

51. Full name and title *

52. Would you like to contribute in future discussion regarding circularity in textiles? *

Mark only one oval.

Yes

No

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Stakeholder Workshop Presentation

Textile Opportunities in South Australia

21 July 2021

FACILITATED BY



Government of South Australia

Green Industries SA

HOSTED BY



**Local Government Association
of South Australia**

*Welcome **to the** Textiles Workshop*

- > Housekeeping
- > Why Are We Here?

What you will be able to describe by the end of the session:

- What are textiles, where do they occur?
- Why aren't textiles recycled and why is it an issue?
- How big is the textile issue in Australia/SA/my area?
- In what way do councils contribute to textile waste?
- What kinds of circular opportunities are there in SA?

What we'll cover

- > An overview of textiles
- > Textile flows in SA & nationally
- > Textile recycling innovation & technology
- > Opportunities for textile circularity in SA
- > Completing the LGA survey
- > Discussion



Who is *ACTA*?



OUR VISION >

***Accelerating the transition to a circular textile economy* by 2030**

OUR AIM > Offer stakeholders access to strategic innovation, by introducing new tools and resources, and creating economically viable future business models, a necessity in building practical solutions to improve systemic change.

OUR MISSION > We formulate game-changing partnerships with National and International experts to enact change. ACTA will successfully implement a circular textile economy over the next 5-10 years, in every aspect of the textiles.

A teal-colored shield-shaped icon containing the number "1" and a hash symbol "#".

#1

ADVOCACY

Forge pathways for collaborative actions supported by the Commonwealth Government and Private Industry.

A yellow-colored shield-shaped icon containing the number "2" and a hash symbol "#".

#2

RESEARCH & INNOVATION

Quantifying measurable actions and identifying gaps within current textiles challenges to formulate pathways for intervention.

A blue-colored shield-shaped icon containing the number "3" and a hash symbol "#".

#3

ACTION

Providing a platform to industry delivering education, tools and resources; via **The Australian Circular Fashion Conference and The Australian Textiles Network.**

ACTA's work remains accessible in the public domain.

Collective **impact**

ACTA enables the broad cross-sector of Members to come under one umbrella.

Each Member, independently represented, but collectively we speak the same message.



Vision to **action**

ACTA 2030 Strategy sets out to achieve:

- 01** *Create Market Demand* > Generate demand for recovered synthetic materials and support regenerative agriculture.
- 02** *Close-the-Loop* > Operate circular business models and influence consumer behaviours to maximise products lifespans.
- 03** *Measuring Action* > Meet National Textile Waste Policy Targets, 80% of textiles are kept out of landfill at end of life.

ACTA's Current Projects.

> Thread Count Report | NSW EPA

*Textiles are more than clothing. This research provides the robust data basis for future initiatives and clues for quantifying textiles at a National level. **ACTA identified data gaps as a critical barrier to a circular textile economy.***

> Circular Textiles | SYDNEY COUNCILS

*Investments in local programs present significant opportunities for jobs and economic growth. **This project focuses on understanding where Sydney Councils' efforts are best placed to improve textile waste data collection and to determine the priority areas for councils to focus on textile waste reduction.***

> Textiles Action Plan | QLD DES

Developing a consolidated plan in QLD with strong emphasis on waste hierarchy, reuse and avoidance, mapping textiles stocks and flows and increasing capacity within the charity network.

> Circular Threads | Product Stewardship

Uniforms will lead Australia's Circular Textile Economy through circular design education to maximise end-of-life, determine funding for apparel collection/take-back and access to emergent textile recycling innovation. **Circular Threads is the starting point which will guide the approach to circularity for all textiles.**



COMING 2021
IGNITING
FUTU'RE
FASHION

PRESENTING AN ALL NEW **LIVE EVENT**

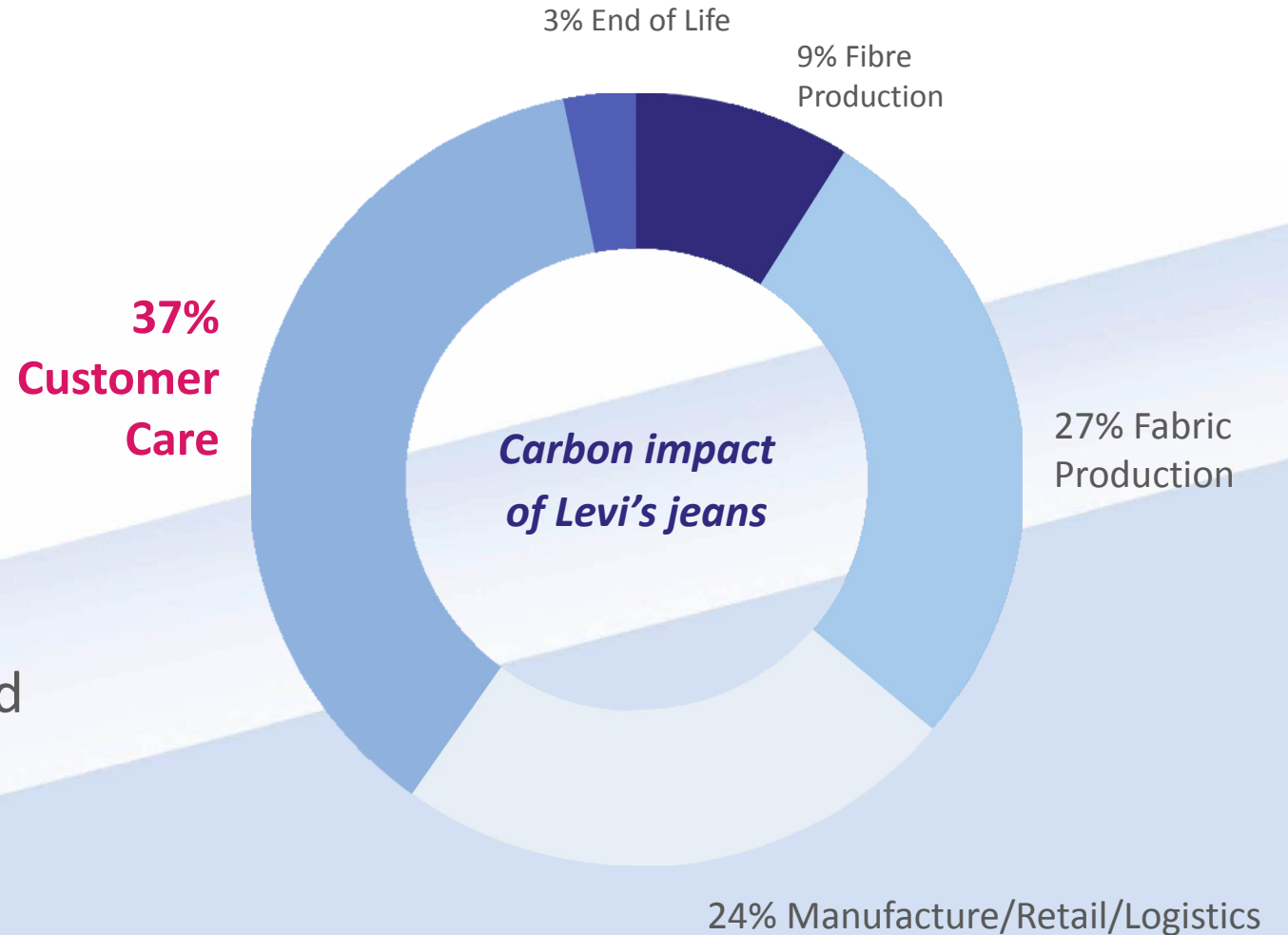
The Australian Circular Fashion Conference
NEXT EVENT 17-19th October 2021 | CANBERRA

The background of the slide is a close-up, monochromatic blue image of a person's hands and arms working with a piece of fabric. The lighting is dramatic, highlighting the texture of the fabric and the contours of the hands. The overall mood is professional and focused on craftsmanship.

Textile *knowledge*

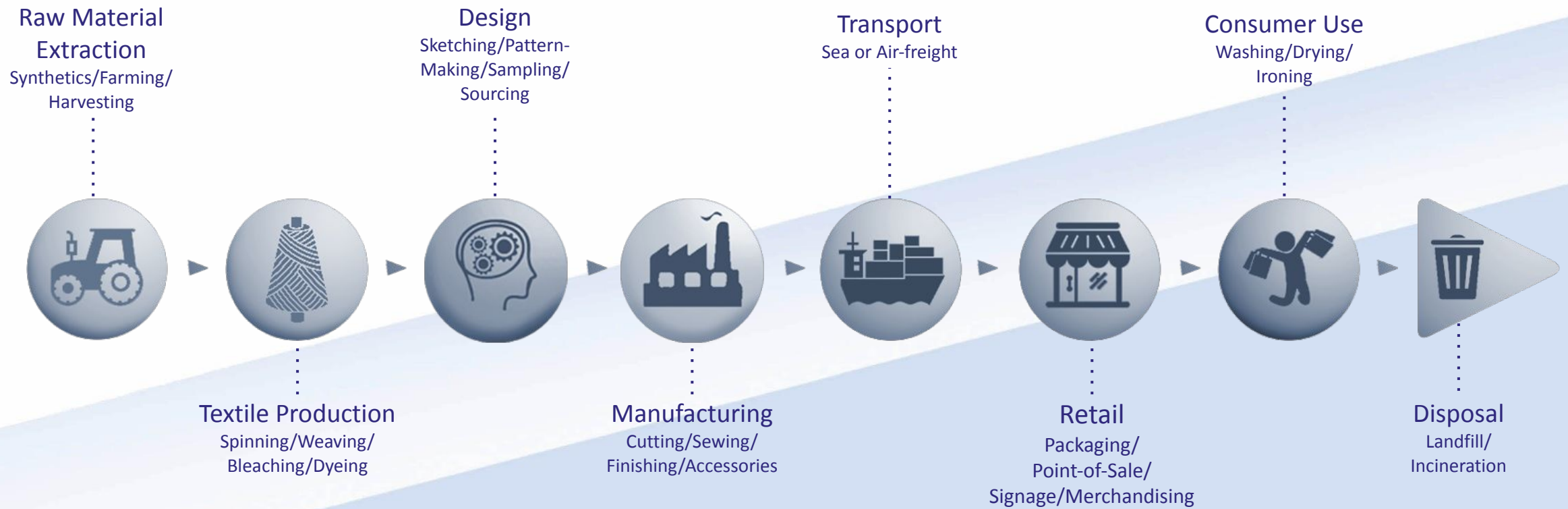
The bigger picture.

- > 8% of global emissions.
- > Clothing production 'units' has doubled since 2000.
- > Embodied energy from apparel accounts for 60% of the impact.
- > 100 Billion garments are produced annually.



A product's *current* lifecycle

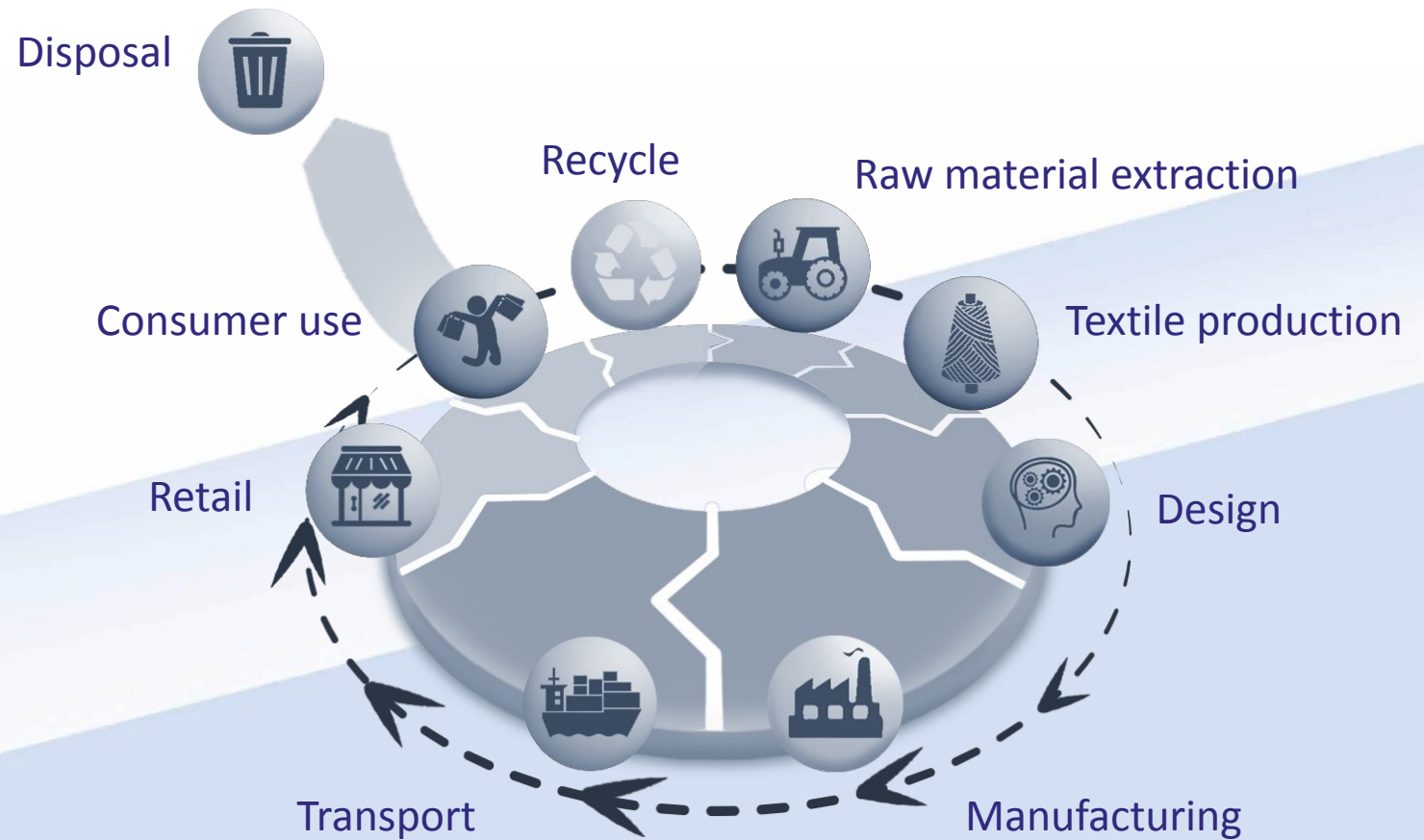
Typical Cradle to Grave. *Linear Model*.



A product's *new* lifecycle

Closed Loop. *Circular Model.*

- > Sustainable Fibres
- > Reduce Inventory
- > Carbon Footprint Reduction
- > Sustainable Factories
- > Renewable Energy
- > Packaging Waste



Climate *impact*

Recycled Polyester 5.2kg

Industry can **save 4.3kg** of CO2
per tonne p.a using **Recycled Poly**

Kgs of CO2 per tonne of spun fibre

Virgin Polyester 9.5kg

By 2024 ACTA
Recycles 158k tonne Poly
Saving **679,400kg** CO2 p.a

In 2015, Virgin Polyester
production contributed
706 billion kg of CO2

The apparel industry contributes
6.7% of global climate impact p.a

Fibre categories



NATURAL FIBRES

MAN MADE FIBRES

Fibre categories



REGENERATED CELLULOSE

Fibres made from wood & plants – they are processed with chemicals to soften:

- Viscose
- Lyocell
- Modal



SYNTHETIC

Fibres made from oil-based polymers:

- Polyester
- Nylon
- Acrylic
- Spandex



PLANT BASED

Also known as Cellulose. These fibres are harvested from plants:

- Cotton
- Linen
- Hemp



ANIMAL BASED

These fibres come from animals coats or produced by animals:

- Wool
- Silk
- Down

Outershell

84% Polyester

12% Viscose

4% Elastane

100% Polyester

Lining





CARPET



HOSPITALITY



HOME FURNISHINGS



MEDICAL



AUTOMOTIVE



WORKWEAR/UNIFORMS



MATTRESSES



FLAGS/BANNERS

The background of the slide is a close-up photograph of a person's hands holding and examining a piece of fabric. The lighting is dramatic, highlighting the texture and folds of the material. The overall color palette is dominated by deep blues and purples, with the text providing a sharp contrast.

*Unravelling textile
flows in Australia*

A national overview

What we *knew* vs *what we know now*



“Australians throw away 6,000kg of textiles every 10 minutes” –

ABC War on Waste

~ Extrapolates to **315,000t/yr**

“Australians dispose 23kg of textiles annually”

2010 ABS data identifying **501,000t** of “leather and textile waste”

~ per-capita rate

“Australians purchase 27kg of textiles annually”

Data ‘PCI Consulting Group’ ~ Extrapolates to **675,000t/yr**

ACTA’s research uncovered more than **1,000,000 tonnes of textiles consumed in Australia p/a**

A national overview

National Waste Report 2020

Textile definition: textiles, rubber and leather

Overall decreasing trend in textile exports

In 2018/19.....

22% total recovery, 7% recycling rate

4% non-hazardous scrap materials imported

3% sent to landfill

SA: 3.1%

> 3% MSW

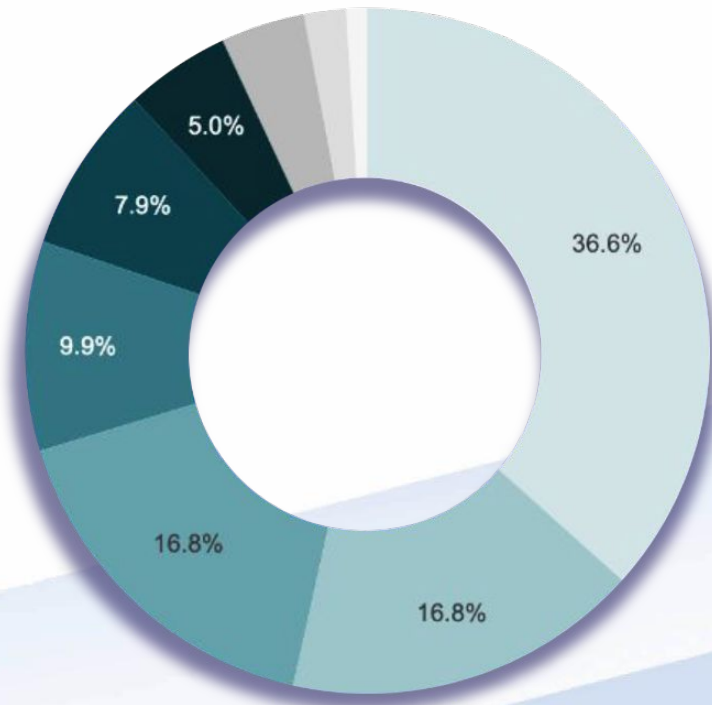
> 5% C&I

> 0.35% C&D

A national overview

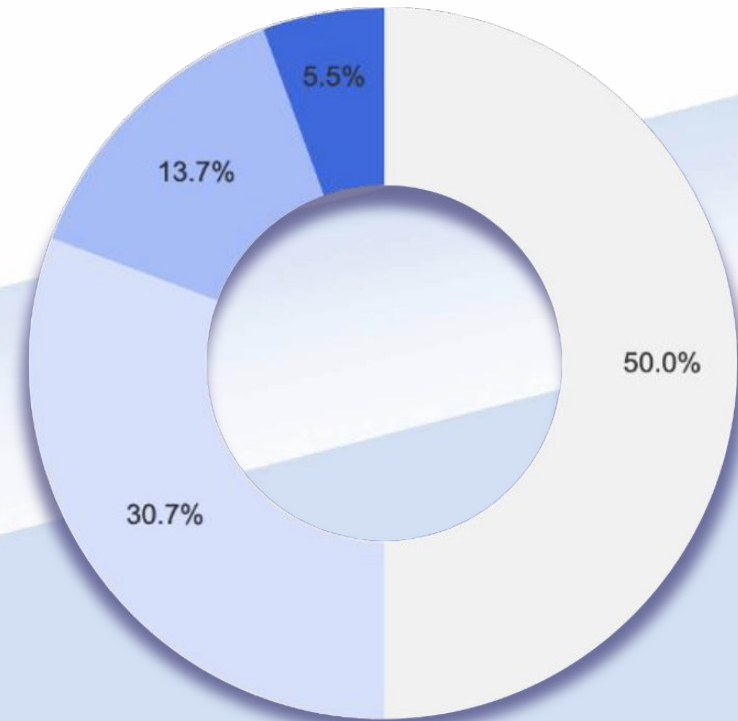
What makes up our *'Textiles?'*

Textile imports by product type (2015-2019)



● Apparel & uniforms
 ● Furnishings & Bedding
 ● Raw textiles
 ● Carpet
 ● Other
● Mattresses
 ● Outdoor textiles
 ● Rags/textile waste
 ● Agricultural/industrial textile

Fibre type across all product categories (2015-2019)



● Synthetic
 ● Natural
 ● Other/unspecified
 ● Blended

A national overview

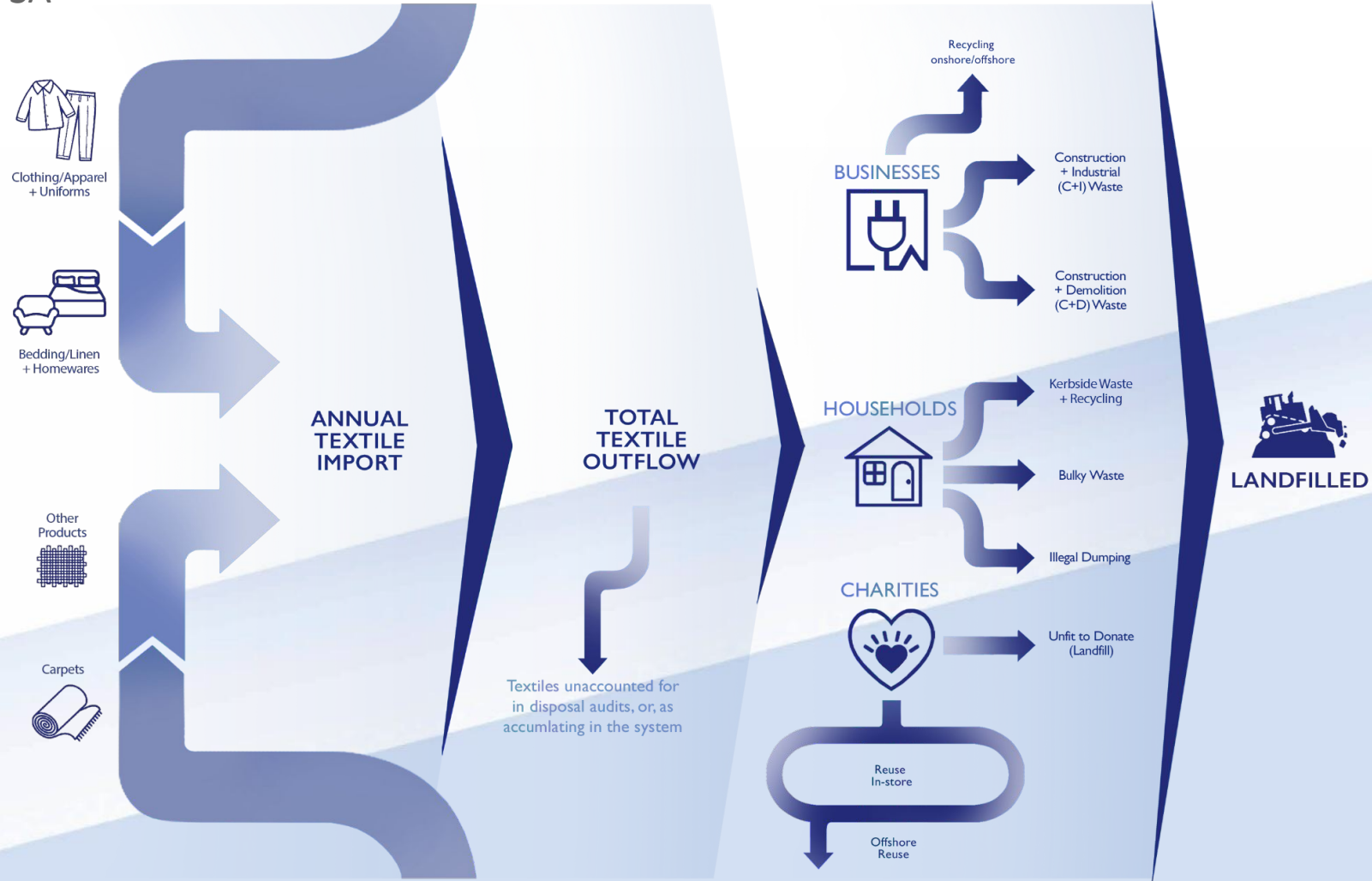
What we *knew* vs *what we know now*

It is estimated that each year

**Australians are
consuming 40kg of
textiles per capita**

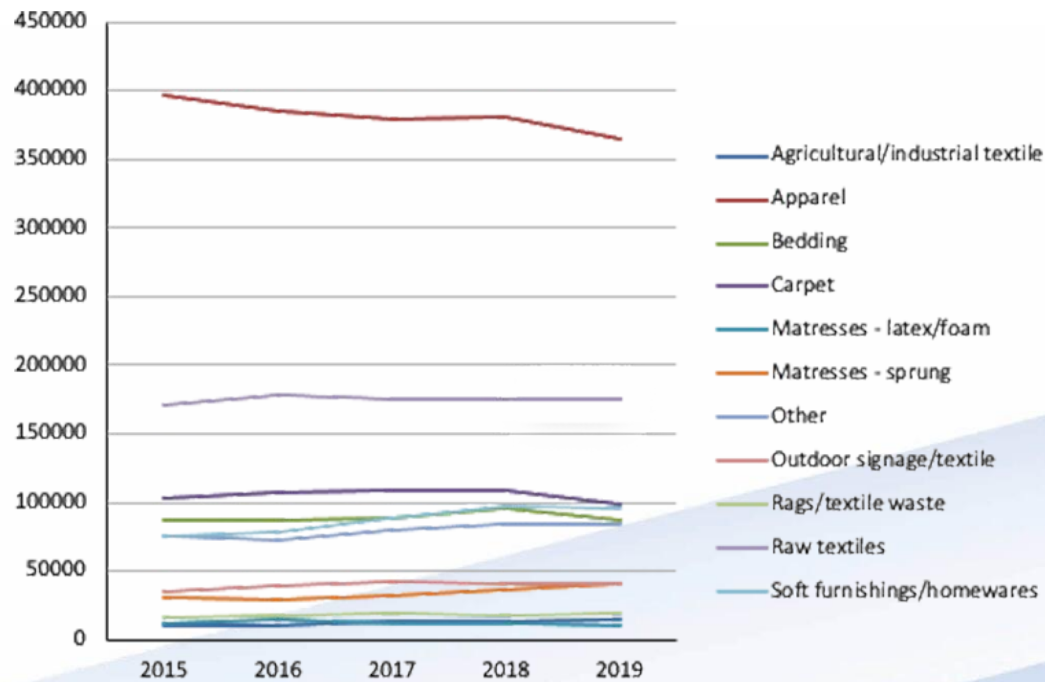
Understanding the detail

Material flow in SA

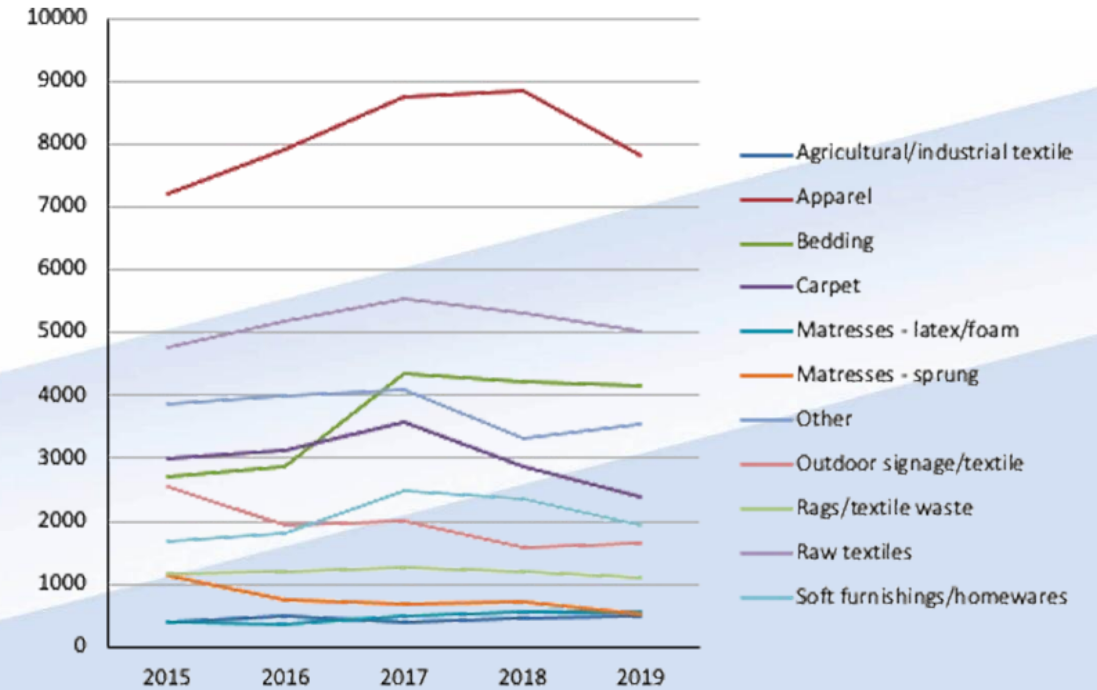


Understanding the detail

Imported textiles nationally vs SA



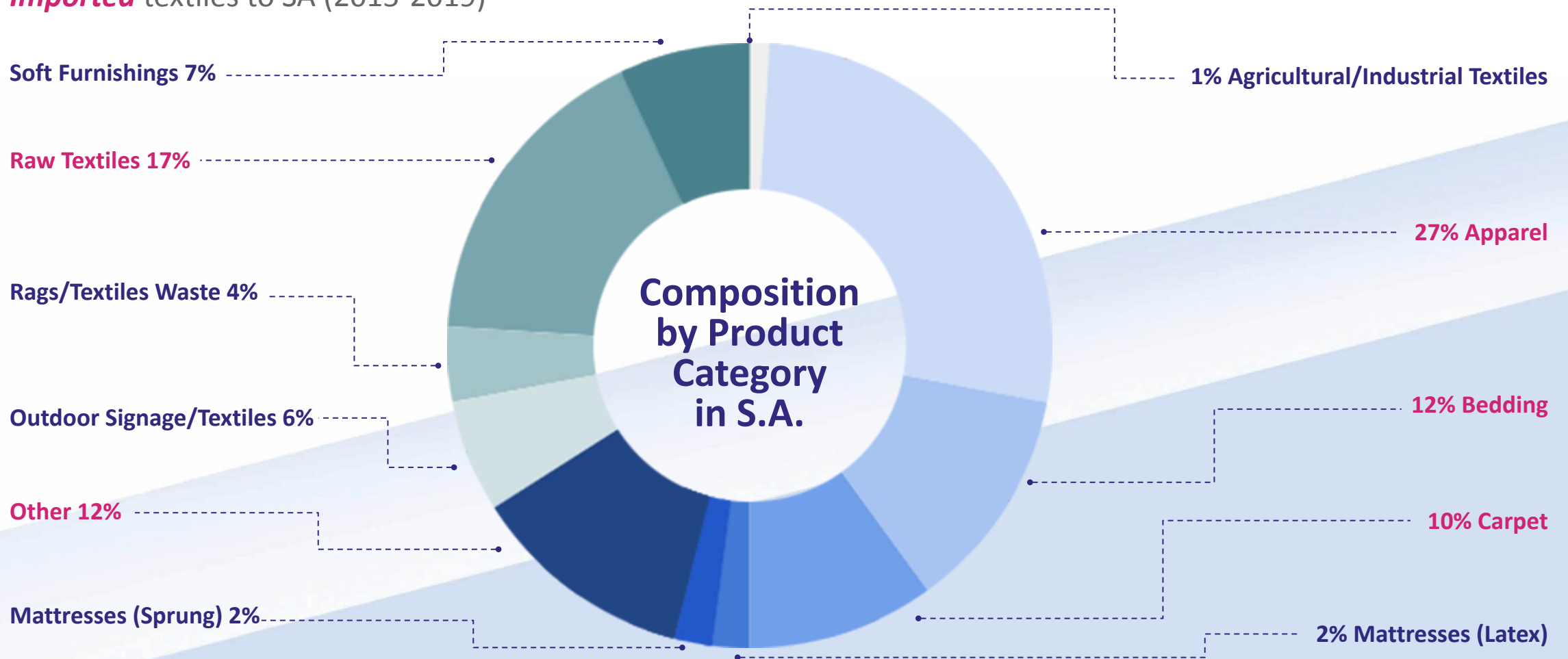
National imports



SA imports

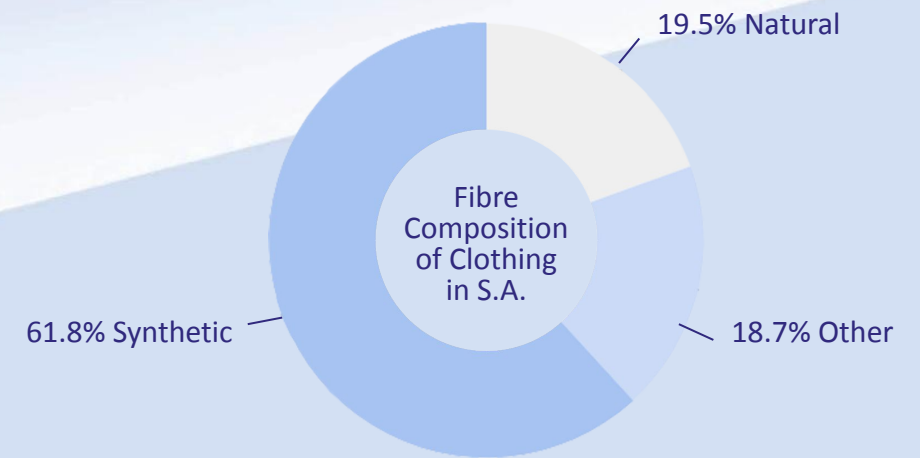
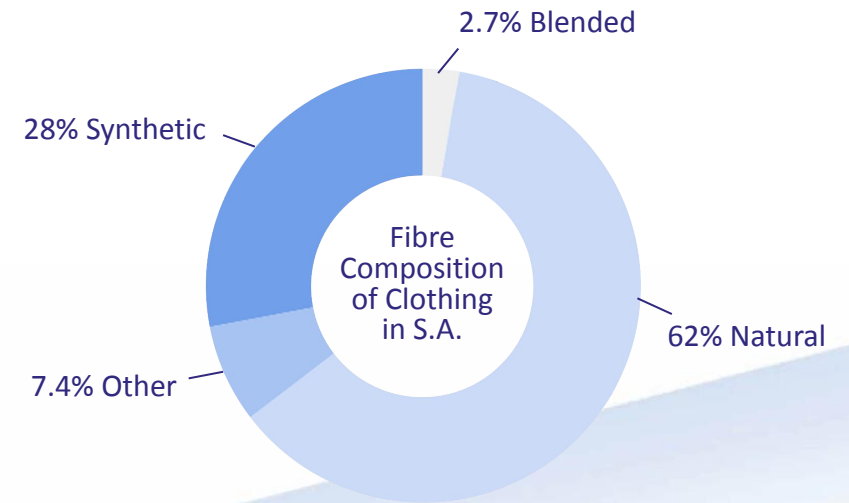
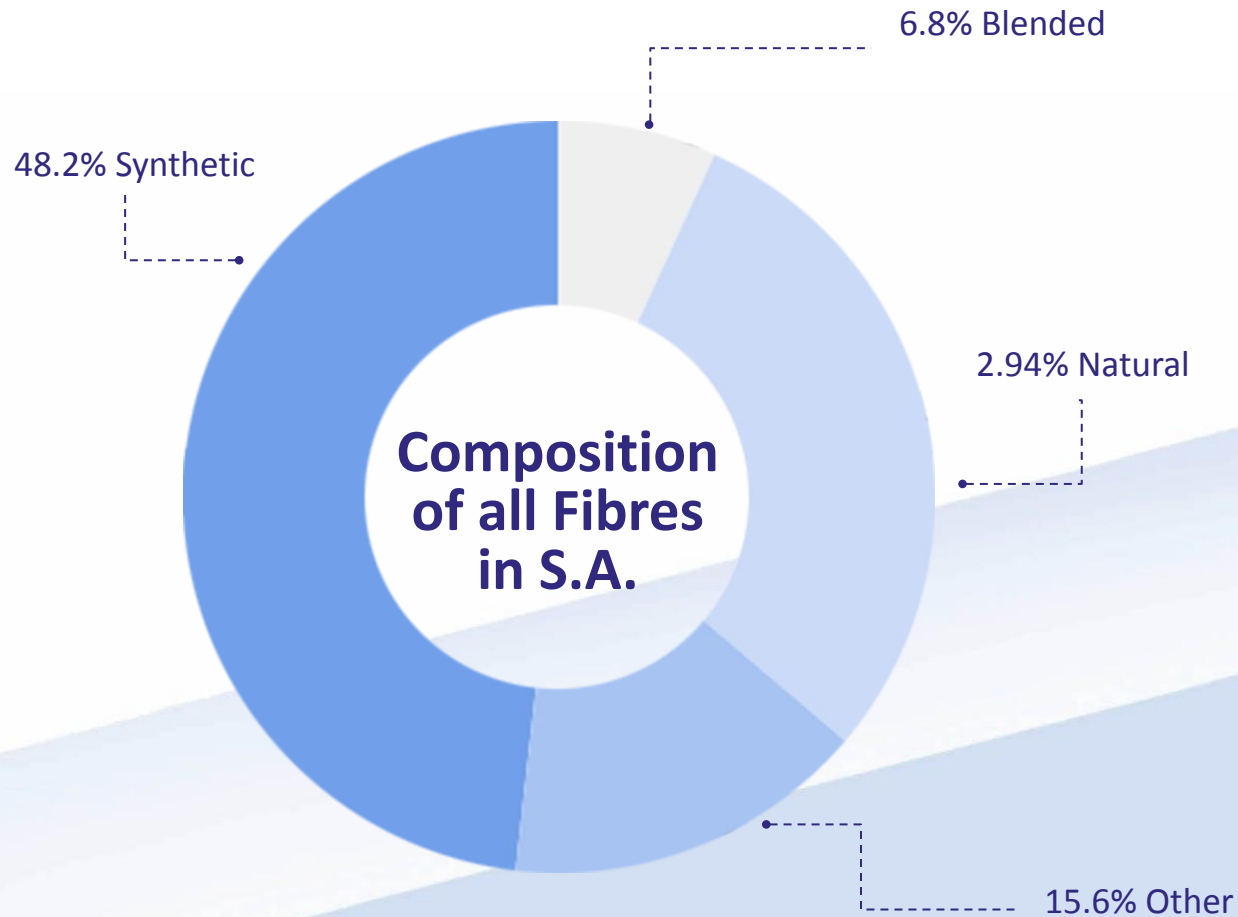
Understanding the detail

Imported textiles to SA (2015-2019)



Understanding the detail

Imported textiles to SA (2015-2019)



Learning from NSW

Discarded textiles in NSW

General waste categories referencing textiles in NSW kerbside audit guidelines

AWD	CATEGORY	MATERIAL TYPE	MATERIAL DESCRIPTION
A90	PAPER	Nappies & feminine hygiene	Used disposable nappies
CO2	OTHER ORGANIC	Textile/carpet	Wool, cotton and natural fibres
CO3	OTHER ORGANIC	Leather	Leather clothing, craft leather, some shoes, belts with a belt buckle
EO1	PLASTIC	PET (other)	Pillow and sleeping bag filler, laminated sheets, carpet fibres
E03	PLASTIC	PVC (other)	Electrical conduit, plumbing pipes and fittings, garden hose, shoe sole, tubing, rainwear
E05	PLASTIC	PP (other)	Appliance parts, crates and boxes, toys, houseware/kitchenware, furniture, plant pots, mouldings, irrigation fittings
E07	PLASTIC	Other Plastic	Tupperware, mixed unidentifiable plastics, low cost brittle toys, all other resins and multi-blend plastic materials, synthetic textiles, all other containers

The background of the slide is a dark blue, monochromatic image of a person's hands and arms, possibly working with fabric. The lighting is dramatic, highlighting the texture of the fabric and the contours of the hands. The overall mood is professional and focused on the textile industry.

*Textile **recycling** and
innovation horizon scan*

*The **technology barriers** that have previously hindered textile recycling **are being overcome***



TEXTILE WASTE



RAW FIBRES



RPET CHIPS



Textile recovery will be delivered by a suite of recycling technologies.

Providing clear data for business case development is critical.



SORTING

Differences in natural/synthetic/blended fibres



PRE-PROCESSING

Cleaning and removing contamination (shredding in some cases)



RECYCLING

Recycling process to deal with the fibre mix consumer in SA

Eastman's methanolysis technology in circular textile recycling





SOEX flagship sorting facility in Germany. Up to 400 categories of product are sorted. I:Collect (SOEX) operate H&M's worldwide take-back scheme.



Felted material finely shredded – commonly used for low-grade, down-cycled product i.e carpet underlay, insulation, stuffing, blankets.

Textile shredding is the next step post-sorting



TYTON
BioSciences
North America

**worn
again**
technologies
Netherlands

**UNIFIED
FIBER**
Finland

Interreg 
North-West Europe
Fibersort
European Regional Development Fund

Netherlands

RENEWCELL
North America


HKRITA
The Hong Kong Research Institute
of Textiles and Apparel

Hong Kong

loop
INDUSTRIES
Canada



JEPLAN
Japan Environment PLANning
Japan



Textile Recyclers
Australia



UPPAREL

BLOCK | TEXX

*Following the waste hierarchy –
Sharing > **Repairing** > **Reusing***

A *global* scan of alternative use for apparel

The most well established system and network globally/locally.

This sector is seeing digital disruption, aiming to increase the accessibility of reusability second-hand garments.



Charities, Collections & Sorting

Peer to Peer Platforms

Facebook, eBay, Gumtree provide simple marketplaces for household items. New platforms are emerging to allow clothing owner to lend, rent or swap clothing seamlessly in a safe online environment.



Delivered at the brand level, or community led, repair is essential to prolonging garment lifecycles.

Repair Models

Consignment & Certified Resale

To create trust and retain product value, online third parties are emerging that guarantee garment authenticity.



Charities, collections & sorting



> UK | TR Aid

- Collecting methods: Booking a free collection, in-store donation, donating in clothes recycling banks, retail stock donation.
- Launched a new education toolkit for educators exploring the impacts of clothes in people and planet; how we can take action.
- 1,500 clothes banks, plus Ebay and Depop online.

> UK | reGain

- Donate unwanted clothes to charity and access exclusive discounts/coupons.
- The first global platform connecting charities and retailers.

> AUS | Empower pack / good360

- NFP connecting people in need with brand new surplus goods donated by businesses.
- Distributing new goods to over 2,500 charities and disadvantaged schools Australia wide – also gifted to vulnerable people in communities.

> AUS | Thread Together

- Collect end-of-line brand new stock from apparel providers. With the support of volunteers, the clothes are sorted by age, gender, and purpose, and then re-distributed to people in need through charities across Australia.

Peer to peer platforms

It is estimated that the total resale market is expected to more than double in value to \$51 billion from \$24 billion by 2024



> UK | By Rotation

- **Lend, rent and rotate.**
People can send items via mail or meet in person. Customer have the option of rate and review to their fellow rotators and contribute to build the community.

> UK | HURR

- Customers can list items and rent them.
- Customers can rent items between 4 to 20 days. The option of consign is also available for designer items.

> UK | Depop

- One of the largest, most well established platforms.
- Has raised over US\$62m in capital.

> AUS | Designerex

- Built on trusted relationships between Renters and Lenders through the use of online ID Verification Technology ensuring authenticity, reviews after each transaction, a Private Messaging system and a Cashless Secure Payment Gateway.

> AUS | The Clothing Exchange

- Hosted in Melbourne, Sydney, Tasmania
- Customers bring clothes they wish to swap to the event, they are taken, sorted and each customer is given a button to swap/collect new (second-hand) items from other swappers.

Repair models

> Various | repair by brand

- i.e Patagonia - Since 2012, Patagonia's repair department has mended 65,000 items.

> Various | repair cafes

- Offering free meetings that revolve around repairing.
- Tools and materials are available to carry out all possible repairs.
- Expert volunteers on hand to offer repair knowledge and skills in all kinds of areas.

> UK | Clothes Doctor

- Online mending tutorials, private sewing sessions, mending starter kit.

> AUS | Bower

- An award-winning environmental charity
- Range of services and programs based on the ethos of reuse and repair.
- Suburbs in NSW and VIC have repair cafes via website or Facebook groups.

> AUS | Nudie Jeans

- As a provider of the jeans, they also take care of them when they're torn.
- Hand-over washed jeans to your closest Nudie Jeans Repair Shop, Repair partners or look out for:
 - Mobile repair stations
 - or grab a repair kit



Consignment & certified resale

> USA | The Real Real

- A large and important player in the online luxury resale business - publicly listed.
- The company is worth over \$1.7 billion.
- Buy and sell luxury items.

> USA | Wear Wardrobe

- To become a lender customers send their items for 120-day consignment cycle.
- Customers can decide if they want to continue or have any of the items back.
- They don't accept any fast fashion items, real fur or leather.
- Scalable for Australia's market. Valued over US\$1.5m.

> AUS | Modsie

- A combined value of listings worth over AU\$3m.
- Buy and sell preloved fashion including luxury certified items (peer to peer).

> AUS | Mio Tesoro Vintage

- In-store consignment luxury clothing and accessories.
- Consignors can negotiate rates on their items.
- Established in 2005.



Circular textile
opportunities for SA

The path to identifying opportunities

The way *forward*

Next steps

- 01 Completion of survey for local councils
- 02 Identification of opportunities to increase textile circularity
- 03 Understanding points of intervention

The path to identifying opportunities

Information gathering

Data gathering

towards a stock and flow analysis

Compositional
analyses

Volumes

Government
departments'
contribution to textile
waste

Textile management

Council-led textile
recovery

Infrastructure capacity
(MRF access, shredding,
sorting etc.)

Issues re handling (safety,
machinery)

Success stories

Where are the
successful projects?

Are there replicable
successes?

Financial environment

Grant reliance

Procurement practices

Employment
opportunities

The path to identifying opportunities

Working *towards* a stock and flow analysis

Textile disposal data collection allows for accurate data analysis:

- Data on textile quantity
- Data and textile composition
- Including private operators, C&I, and C&D

Accurate data analysis enables:

- Understanding of composition and variation
- Identification of hidden and lost flows

ACTA Textile Calculator

This tool provides a simple measure for NSW councils or regions to estimate total textile discarded in their jurisdiction, using available data. State level data, generated by population, GDP and other measures have been provided to account for textile waste in less frequently measured categories such as C&I textile waste, charitable disposal and illegal dumping.

To complete this report, Councils will need to provide or estimate:

- Simple demographic data as household and regional GDP,
- Kerbside waste collection (in tonnes), and,
- An estimate of total bulky waste collection (of household type).

USER NOTES - Input data to the GREY cells only & please pay attention to the units used! If data is unavailable, please leave blank.

DATA INPUTS

Council/Region	WSROC
Regional Group	WSROC
Population	2,893,228 n.e.
GDP	95,904,900,000 \$ n.e.
Single Unit Dualling (SUDr)	n.e.
Multi Unit Dualling (MUDr)	n.e.

NSW Totals (July 2020) as percentage of NSW

	2,164,000	74.7%
	593,275,000,000	6.2%

Kerbside MSW & recycling

Textiles occur in a range of products and materials disposed of as general waste, in general categories used in the NSW Guidelines on Kerbside Recycling (refer to 'Recycling 6'). This simple analysis allows operators to broaden their scope of what is traditionally reported as textile, to give a more accurate estimate to total textile disposed via kerbside service. This analysis is based on a general waste audit profile developed for the NSW EPA.

Total Kerbside (red-lid) collected	n.e.
Total Kerbside (yellow-lid) collected	n.e.

Composition detail of red-lid service

(E02) Textiles/Carpets	4.6%
(E04) Mattress and furniture hygiene	5.0%
(E05) Pillows and sleeping bags/filler, laminated sheets, carpet fibres	0.7%
(E03) Electrical cables, plumbing pipes and fittings, hoses, rain water	0.3%
(E05) Toys, hardware/furniture, raft/furniture	0.4%
(E07) Other Plastics (inc. E071, E072, E073)	12.0%

If this data is unavailable, state averages on the basis of population will be used

Business wastes (C&I + C&D)

Business waste estimates are generated by generating state-wide C&I and C&D textile data by GDP.

REVISED TEXTILE ESTIMATES

Textiles discarded (by pathway)

Total textile discarded (by pathway)

	Tonnes
Kerbside Waste	-
Bulky Waste	-
Illegal Dumping	21
Charity Disposal	25,424
C&I + C&D	13,645
Total Textile Waste (t)	39,110

The path to identifying opportunities

Shopping list

Local innovation

What does local innovation look like?

Who are the main players?

Who benefits?

Education & awareness

What textiles should be given priority

Who are the main players?

Who benefits?

The path to identifying opportunities

Points of intervention

Spending

Where is investment best spent?

What makes projects sustainable?

Can R&D be funded?

Infrastructure

Where can expansions & upgrades occur?

Where is new infrastructure best placed?

Increased capacity

are there regions/councils:

That require increased asset capacity?

That can benefit from additional funding?

That can benefit from additional expertise?

The path to identifying opportunities

The way *forward*

Next steps

- 01 Completion of survey for local councils - include additional detail (if any)
- 02 Identification of opportunities to increase textile circularity
- 03 Understanding points of intervention

Staying involved

Please contact Melisa directly to discuss the report and information in more detail <melisa@acta.global>

It's a wrap

> Discussion