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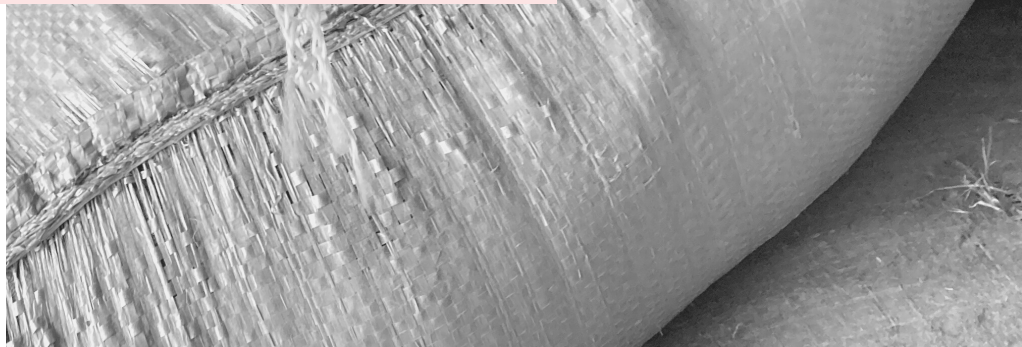
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REPORT - CAMBODIA

WASTE STREAMS MAPPING

Pathways from Key Suppliers to Landfill



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Fostering and Advancing Sustainable Business and Responsible Industrial Practices in the Clothing Industry in Asia (FABRIC)

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Phnom Penh, Cambodia

<https://www.giz.de/en/html/index.html>

FABRIC

The project “Fostering and Advancing Sustainable Business and Responsible Industrial Practices in the Clothing Industry in Asia” (FABRIC) is implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, which works on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ). FABRIC is addressing sustainability in the textile and garment industry in its social, economic, and environmental dimension. The project is working in Bangladesh, Cambodia, Myanmar, Pakistan, Vietnam and cooperates with actors in China, supporting the efforts of business representatives, government institutions, civil society and trade unions to build an industry that offers quality jobs, protects the environment and contributes to economic growth.



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REPORT OBJECTIVES

The Cambodian Garment Industry generates a vast volume of fabric waste, predominantly scraps remaining after cutting and also including large cut piece lengths and fabric end rolls. There is a thriving unregistered industry for end of roll remnants and cutting waste is also procured then moves through a well established supply chain until it is eventually buried or burned within Cambodia. This project was designed to map this waste stream from factory through to landfill (or burning) while providing visibility into stakeholders, and consumption and purpose of usage across the various waste pathway streams. Gained insights will contribute to a broader feasibility study determining if there is demand for domestic industrial textile recycling.

The research investigation carried out during February and March 2021 covers formal and informal stakeholders present in the sector, estimates quantities of wastage across the chain where possible and has been conducted with focus on financial data. When consolidated, these segments will influence and contribute to a business model viability review, hence the research and report design must focus on presenting concise, pragmatic findings as a business case study.

A total of twenty five interviews were conducted.

METHODOLOGY

The report contents and conclusions are based on an initial literature review, followed by analysis of data collected. Data collection methods included:

- Formal interviews with various stakeholders. Predominantly onsite and including online where needed due to COVID-19 restrictions. Standardised question sets used can be found in the appendices at the end of this report.
- Less formal, conversational interviews with some buy and sell stakeholders such as cutting waste and end-roll collectors and small at-home garment manufacturers. Interviewees were encouraged to identify as many stakeholders in their personal waste supply chain as possible using diagrams and maps if preferred.
- An online, bilingual (English and Khmer) survey of stakeholders.

Anonymity of participants was agreed. When permission to record interviews was granted it was agreed that the contents would only be used as a supplement to note-taking and not be published.

Note:

- Sections of the report detailing the country and garment industry have been developed with data drawn from the literature review and referenced accordingly.
- All other data, observations and findings presented in this report are based solely on engagement with stakeholders during the study.
- Many stakeholders, particularly in factories, expressed knowledge that the current process of textile waste is complicated and controversial, especially regarding sale of waste.



Image - Small fabric scraps remaining after cutting, stored to be sold.

SUMMARY OF FINDINGS

Textile waste resulting from manufacturing in the Cambodian Garment Industry is formally disposed of on landfill sites belonging to licensed waste disposal companies, however there is a thriving unregistered industry selling waste. In addition to being disposed of on landfills, cutting scraps are being burned, both at factories and brick making sites, exported, and in very few cases, recycled. Including interviews with all mapped stakeholders, the study presents profiles of parties involved noting volumes moving through each step of the waste stream and, where possible, average pricing for purchase and sale.

The circular economy is not only key to the global achievement of climate and environmental targets, the transition across various industries is already proving that circular principles increase revenues and profits, mitigate risk and reduce costs for stakeholders. Evolution of the Cambodian Garment Industry will need to occur to ensure it remains competitive. Detailing challenges, the report also presents opportunities and current economic, government and administrative influences and conventional practices.

Positive opportunities such as large volumes of waste available in-country and the development of national waste management strategies suggest the viability of establishing an industrial textile waste recycling facility, a first step in the application of circular practices for the Cambodian Garment Industry. However, shifting from the current deeply embedded practices will require a balance of education, brand influence, government policy development and implementation, and financial incentive.

INTRODUCTION

Cambodia has a population of 16.4 million of which 64% are of working age. As of 2019 per capita GDP was \$1643. Between the period 1998-2018 Cambodia achieved an average growth rate of 8% which led to it achieving low middle income status in 2015 and being cited by the World Bank as “one of the fastest growing economies in the world”.¹

Cambodia’s growth has relied predominantly on four sectors:

- Construction
- Tourism
- Garment & footwear manufacturing & export
- Agriculture

The Cambodian Garment Manufacturing Industry and Waste

Cambodia is the 9th largest garment producer in the world. As of 2018, there were a total of 625 garment exporting factories in the country employing 86% of the industrial labourforce. Compared to other countries in South East Asia, the labour pool available to the garment sector in Cambodia is generally younger and cheaper than other countries.

The garment industry in Cambodia is heavily CMT focused, relying on textile imports - predominantly from China, Taiwan, Vietnam, South Korea and Japan - to meet production needs.

In 2017 \$7 billion in garments (approx 80% of total exports) were exported contributing around 40% to national GDP. 43% of garment exports in 2018 were to EU countries.

Data obtained from the Ministry of Environment indicates that 60% of all industrial waste in landfill comes from the garment industry, equating to around 90,000 tonnes in 2019. According to the UN Comtrade database, exports of garment waste between 2016-2019 totalled over 49 million kgs

Since this data was produced a number of factors have changed, the impact of which are not yet fully known.

1. [World Bank 2020](#)

2. [ILO 2019](#)

3. [AFD/GERES](#)

4. [B2B Cambodia](#)

5. [AFD/GERES](#)

6. [ILO 2019](#)

7. [UN Comtrade](#)

Within the garment industry generally:

- Introduction of the changes to the EU Everything But Arms (EBA) agreement in 2019, reducing the access to duty and quota free exports to the EU from Cambodia.
- Changes in labour laws to provide for annual increases in salary for garment workers along with adjustments to benefits such as seniority payments negatively impacting the costs of production for garment manufacturers in Cambodia compared to other major manufacturing countries such as Bangladesh, Myanmar & Vietnam.
- The Covid-19 global pandemic has impacted economies across the world. Cambodia's tourism industry has seen significant negative impact and the reducing export requirements have impacted the garment sector.

Specifically pertaining to garment waste:

- China has implemented a series of waste management reforms over recent years which included the ban on importation of textile waste in 2017. By the end of 2020, import of all waste to the country had been banned
- Following in the footsteps of China, both Malaysia and Vietnam have slashed scrap import quotas over recent years
- Countries such as Bangladesh have successfully launched advanced textile recycling schemes to create a circular economy within the garment industry and reduce waste to landfill.

8. [Xinhua News Agency](#)

9. [Waste 360.com](#)

10. [Global Fashion Agenda](#)

WASTE MANAGEMENT SECTOR

Waste Management in Cambodia falls under the jurisdiction of the Ministry of Environment. Rapid population growth and industrialisation have led to significant challenges within the waste management sector. The World Bank reports that in 2016, municipal solid waste disposal at dump sites country-wide reached 1.3 million tonnes.¹¹ Meanwhile, industrial waste, which the Royal Government of Cambodia define as “solid waste remaining or generated from production activities of factories or enterprises, which do not contain toxic substances or hazardous waste”,¹² for the same period was reported by the Ministry of Environment as approximately 151,000 cubic metres/tonnes going to landfill.

There are a number of policies in place to regulate waste management throughout the country. Those most relevant to the garment industry and this report include:

- Sub-Decree on Solid Waste Management, No. 36 (1999)
- Declaration on the permission for Sarom Trading to collect and transport industrial wastes from Phnom Penh and Kandal province, No. 156 (2001)
- Declaration on Industrial Solid Waste Collection and Transport in Phnom Penh and Kandal, No. 148 (2002)
- Inter-Ministerial Declaration of Ministry of Interior-Ministry of Environment on Waste and Solid Waste Management in Province/ Municipalities of Cambodia, No. 80 (2003)
- Guideline on Solid Waste Management at factories, enterprises and companies, No. 11 (2003)

Amongst other things, these policies mandate the subcontracting of waste disposal to private sector contractors.

In 1999, Sarom Trading Company was awarded an exclusive permit to collect and transport industrial waste and to create and manage a landfill site specifically for this purpose. This site is located in Kandal Province.¹³ Fees for collection of industrial waste were set at \$10 per cubic metre. Monthly fees for a 5 cubic metre collection 4-6 times per month were set at \$60.¹⁴

In 2002 CINTRI was awarded an exclusive contract for providing waste management services to the Phnom Penh municipality.¹⁵

Most recently, in July 2020 a contract was signed for Chip Mong Group to build an industrial waste recycling plant within the Sihanoukville Special Economic Zone (SSEZ), specifically for recycling of waste produced within the SSEZ.¹⁶

11. [World Bank](#)

12. [IGES/UNEP](#)

13. [IGES](#)

14. [Royal Cambodian Government](#)

15. [ODC](#)

16. [Khmer Times](#)

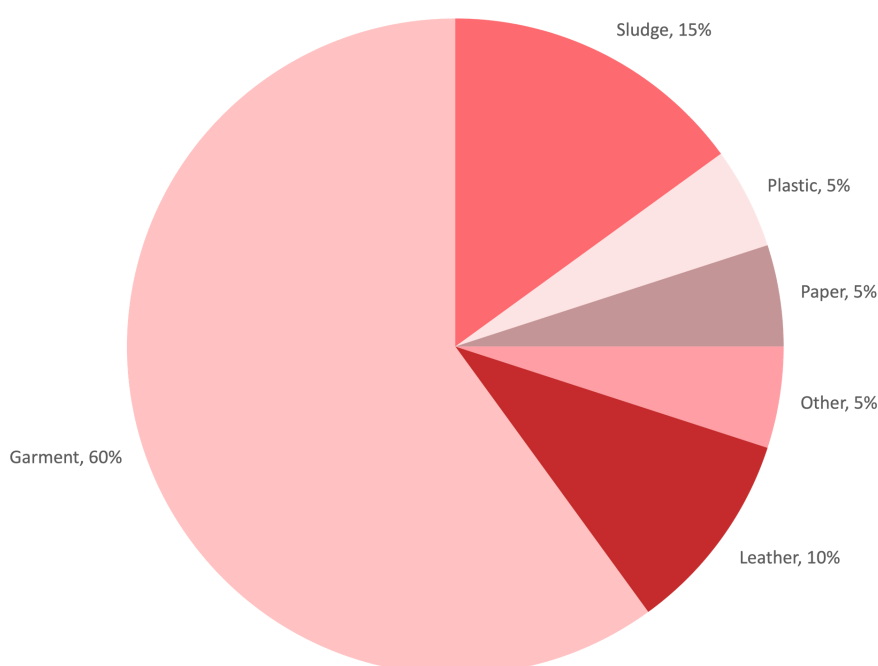
Quality of waste collection & management collection over the years since contracts were awarded has been regularly challenged, leading eventually to CINTRI losing their exclusive contract at the beginning of 2020.¹⁷ Whilst industrial waste management hasn't proved equally as contentious, challenges have been made regarding the quality of Sarom's provision by members of the GMAC.¹⁸

CURRENT WASTE MEASUREMENT

Cambodia's industrial waste comprises approximately 60% of textile & garment waste generated by the garment manufacturing sector.¹⁹ Reported predominantly by Sarom Trading Co., Ltd, The Ministry of Environment refers to this percentage as a reflection of Cambodia's current industrial waste composition and did not provide extensive historical data when interviewed. Additional textile waste export data was sourced using UN Comtrade Database.

The reported data is considered 'generalised' due to multiple factors including: Sarom Trading Co., Ltd being the sole provider of data while other licensed collectors are operating; limitations of systems of measurement available; broad spread underreporting data by factories to avoid complicated tax implications regarding import of raw materials and export of goods, and to allow for sale of waste within the unregistered segments of the supply chain.

A broader estimation of 20% of all textile raw materials imports into Cambodia annually was made to generate an assumed average of wastage allowance during cutting and manufacturing processes (following page).



17. [The Diplomat](#)

18. [Khmer Times](#)

19. [Phnom Penh Waste Management Strategy and Action Plan 2018 - 2035](#)

Industrial Waste Landfill

Exported

Year	Total waste Tonnes	Textile waste (60%) tonnes	Waste Scrap clothes & textiles tonnes (MoE)	Waste Scrap clothes & textiles tonnes (Comtrade)
2004	172,511	103,507		5889
2005	180,921	108,553	9862	6456
2006	201,078	120,647	13786	10385
2007	194,011	116,407	10688	19398
2008	178,075	106,845	20079	23488
2009	181,602	108,961	24939	25831
2010	74,978	44,987		32705
2011	65,865	39,519		43283
2012	108,980	65,388		36799
2013	160,741	96,445		29291
2014	206,690	12,4014		28032
2015	160,191	96,115		24045
2016	150,695	90,417		24263
2017	145,114	87,068		5183
2018	165,302	99,181		10936
2019	154,593	92,756		9396

Fabric Imports & Waste Assumption 2016 - 2019 (Tonnes)

Type	2016	2017	2018	2019
Woven	155422	141050	155663	248471
Knitted	645694	419036	431898	826941
Other	13717	13667	12497	18229
Total Waste	162967	114751	120012	218728

Full data can be reviewed in Appendix B

FACTORIES SUMMARY

Cutting waste forms the largest portion of total waste for CMT garment factories in Cambodia. Domestic waste, sometimes referred to as organic waste, is generally disposed of via CINTRI and buried at their licensed landfill site. Although practices differ slightly between factories, overall waste management involves sorting during the manufacturing process and prioritising any waste that can be sold to recyclers: cardboard; plastics; metal scraps.

There is a well-established market for the cutting waste produced by Cambodian factories. Waste disposal practices differ between factories and include paid disposal via waste management service providers, "cost recovery" through burning in boilers and sale to collectors or dealers. Regardless of whether they actively sell cutting waste or not, all factories surveyed described a cutting waste sale process involving sales agreements made by top-level management or owners that involve the payment of an annual lump sum fee. The average estimated price is \$7,000-10,000/year for large factories. The details of these arrangements were later confirmed during interviews with cutting waste dealers and collectors.

Demand for cutting waste decreased in 2019 due to waste import regulatory changes in China, broader awareness of the impacts of brick kiln fabric burning and increased difficulty of licensing for export to Vietnam. This suggests an increase in the volume of cutting waste remaining in Cambodia destined for landfill. Projecting accurate total in-country waste volumes is impossible under current facility practices and reporting conditions. Factories can determine estimates, but the broad diversity of data occurs due to the varying common percentage (2-20%) of waste allowance per design, also influenced by the volume of items being cut, fabric type, and machinery and technique applied.

Factory-level waste pricing cannot be accurately determined due to the extreme variance in the volume per factory and lack of transparency on financial agreements. From data collated, average costs of processing were deemed to be in the region of \$0.001-0.12/kg.

Examples of sample data provided during factory interviews

Staff	Monthly production capacity	Cutting waste / month (tonne)	Cutting waste / 100,000 pieces (tonne)	Disposal
1749	50,000	28.00	672.00	Sarom, Sale
3,000	176,000	26.20	178.66	Sarom, Sale
1,100	300,000	1.50	6.00	Sale
900	600,000	2.00	4.00	Sarom
1,134	600,000	2.00	4.00	Sarom
1,333	666,667	41.67	75.00	Sale
1,333	666,667	41.67	75.00	Sale
1,333	666,667	41.67	75.00	Sale
1000	1,000,000	5.00	6.00	Sarom, Sale
2900	1,000,000	26.20	31.44	Sarom, Burning
6,000	1,000,000	67.40	80.88	Cintri
6,000	1,000,000	43.10	51.72	Cintri
2,280	1,200,000	12.80	12.80	Sarom
3,350	1,416,667	15.00	12.71	Burning
3,000	2,000,000	50.69	30.41	Burning

Waste measurement and management practices

Most factories interviewed were not accurately measuring their cutting waste due to:

- Difficulty allocating a waste allowance, as designs and quantities differ across POs
- Labour costs of sorting and recording
- Business practices and tax expectations of 0% waste financial reporting

When asked, many factories also suggested that underreporting volume data allows for easier sale of waste to recyclers. Comparing onsite estimations performed during interviews with recorded data provided showed a discrepancy of approximately 50%.

Cutting waste is bagged during manufacturing, bags are then moved to separate storage locations. Estimating the weight of bags and quantity of bags per day appeared to be the most common method of measurement. Given the waste is then collected by truck or incinerated, interviewees expressed a lack of need to measure an accurate amount of waste generated per day or production order, explaining that estimations are realistic and provide enough information for their business purposes.

Factories who are measuring accurately generally weigh and record bags per day.



Image - Remaining scraps after cutting, mixed fibres, paper and cardboard

Significant tax implications prevent the majority of factories from formalising their cutting waste sales and reporting in accordance with national tax requirements. Many factories describe an expectation from government departments for factories to report on raw material usage being exactly equal to garment exports, thus requiring an unrealistic zero waste figure, directly preventing legitimate reporting of waste sales. This misinterpretation of law could be a result of hearsay or experience resulting from previous engagement with customs authorities or the General Department of Taxation (GDT).

Legally sale of waste is permitted, providing submission of documentation under The General Department of Customs and Excise (Prakas 105) confirms that textiles imported under duty tax exemptions transition to becoming a taxable product remaining in Cambodia.²⁰ Annual inventory reporting submitted to customs must align with annual

20. General Department of Customs and Excise

tax submissions to the GDT, where sales reporting and income tax payments must be compliant with the general income tax policy (Prakas 098).²¹

Although a clear directive to support the establishment of industrial recycling facilities for both environmental and economic benefit has been expressed by multiple private and public stakeholders and the Cambodian Government, as a priority for improving Cambodia's overall waste management, factories see tax implications as the primary barrier to formally selling their waste to recycling facilities. Loss of unregistered income is also assumed to be a significant influence.²²

Waste management and disposal options informally include: serviced disposal via licensed contractors; sale; incineration in boilers (considered as cost recovery); unregistered landfill.

In limited cases, factories are instructed to manage fabric waste according to strict brand requirements including: returning to the supplier; transporting to another partner factory and burning branded fabric, both cutting and end roll waste.

ENVIRONMENTAL AWARENESS AND SUSTAINABILITY PRACTICES

There is a marked difference between those factories implementing extensive environmental sustainability practices, mainly influenced by expectations and agreements of brand clients, and others who are not. However, all factory representatives interviewed openly discussed the negative impact and environmental damage caused across their supply chains. There is an understanding that the acquisition and retention of clients can be enhanced by lifting environmental standards and it is clear that the primary driving factor for waste measurement and management currently is cost recovery, along with external income generation for ownership and management.



Image - Cutting waste prepared for incineration as steam production.

21. General Department of Taxation

22. Phnom Penh Waste Management Strategy and Action Plan 2018 - 2035

HR Manager - Factory, Takeo

Monthly production capacity: 300,000 pieces

Monthly cutting waste volume reported: 1.5 tonnes (estimate)

Waste disposal: Sarom Trading Co Ltd, recyclers, sale

After disposing of domestic and general waste and recyclables, cutting waste, fabric pieces and rolls are sold. Accurate cutting waste measurement is not happening and multiple fabric types are mixed in bags, any sorting of waste is done after it has left the factory.

Cutting waste is being sold to Stage 2 Collectors due to volume and the HR Manager explained that the collectors are travelling directly to the hammock and mat makers in Takeo. Leftover fabric rolls and large pieces are sold once per year onsite. Collectors are charged \$500-800/tonne based on fabric type.

When discussing environmental practices, the HR manager expressed willingness to work with a recycling facility allowing the factory to meet the needs of their customers for enhanced environmental practices. He also explained that price and licencing [of a textile waste recycling facility] would be the primary influence on decision-making by ownership.

Compliance Team - Factory, Sen Sok

Employees: 1300

Monthly production capacity: 600,000 pieces

Monthly cutting waste volume reported: 2 tonnes (estimate)

Collection: Sarom Trading Co Ltd, collected 8 times/month

Processes are in place for waste allocation when raw materials are ordered, an additional 3% of fabric is ordered to prepare for mistakes in production, late Production Order quantity increases, and defective fabric issues. During manufacturing, the cutting waste is not measured or weighed, fluctuations occur based on the design being produced, and waste data is not used or required to manage compliance. Most cutting waste is collected by Sarom and the compliance team does not know what happens after the waste has been removed from the factory site.

The factory management allows small amounts of textile waste to be used to start boilers that then rely on wood. Large lengths of cut fabric and remaining rolls are recorded in a fabric log, and stored for future use. When discussing discrepancies in data and asked if cutting scraps are being sold, the compliance team explained that the factory owners manage any sale of waste and no information is available to employees.

Client engagement - Factory, Bati

Employees:

Monthly production capacity:

Monthly cutting waste volume reported:

Waste disposal: Sarom Trading Co Ltd, recyclers, sale, incineration

Detailing both organic and recycled fabrics when asked about materials used during clothing manufacturing, the Client Engagement Officer explained that cutting scraps are not separated by fibre even though the factory owners know that selling waste by fabric type would be more lucrative. Described as labour intensive and a heavy impact on production time, the factory management prioritise the work at hand rather than waste management.

After contracting Sarom Trading Co Ltd to remove domestic waste, remaining industrial waste is sold to unregistered collectors of recyclables. Currently collected once per month, both textile scraps and end roll fabrics are sold. As with many other factories, the sale agreement was described as an area managed by high level factory representatives and company ownership.

Burning fabric is not prioritised due to boiler model and capacity. Although sometimes used, boilers require inspection if textile waste is being burned, contributing to the same overall concern of decrease in manufacturing efficiency and time pressure.

CoC Responsible - Factory, Por Senchey

Employees: 3000

Monthly production capacity: 2,000,000 pieces

Monthly cutting waste volume reported: 51 tonnes

Waste disposal: Sarom Trading Co Ltd, recyclers, incineration

Practicing more robust waste measurement processes than many other parties interviewed, the factory measures cutting waste generated by weighing bags prior to storage. The average wastage across a full production order is 15-18% for most garments, drastically dropping to 2% when producing low-waste items eg; t-shirts.

Initially explaining that waste disposal is predominantly via Sarom Trading Co Ltd, the representative explained that the measurement of cutting waste is being performed by the boiler operator on a daily basis, with bags averaging at 25-30kg each. When questioned about the storage and measurement of cutting waste being managed by boiler operators and potential consumption of textile waste as fuel for boilers, it was explained that boilers need to produce steam across multiple shifts each day and that small scraps could be being used to start boilers.

Describing environmental sustainability as a 'top priority' from management, the representative explained that selling waste to a licensed recycling facility would be possible, as would sorting the waste prior to sale, which would influence price.

CoC Responsible - Factory, Ang Snoul

Employees: 3350

Monthly production capacity: 1.4 million

Monthly cutting waste volume reported: Ang Snoul

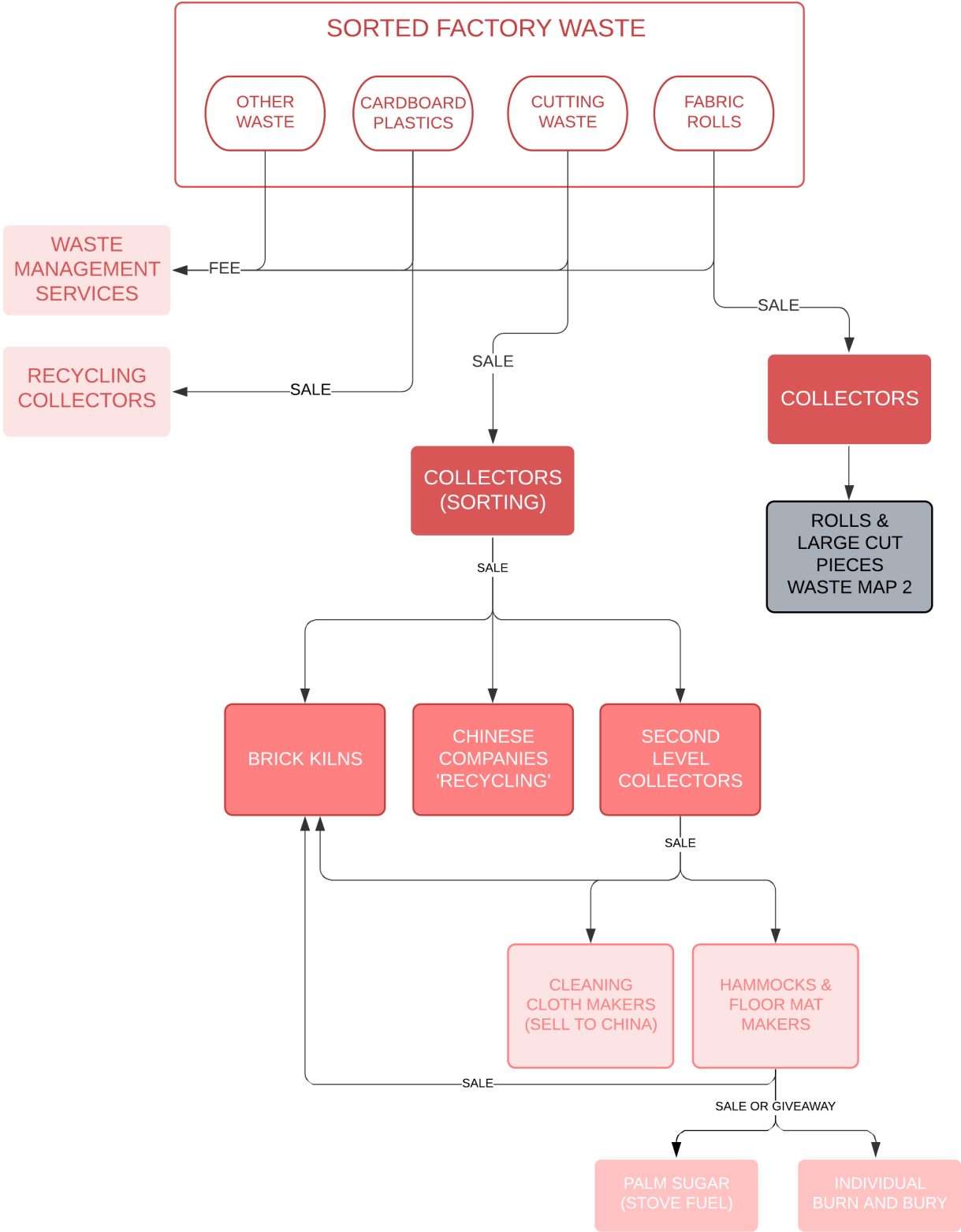
Waste disposal:

The factory is not accurately measuring their waste for reporting as it is mostly being incinerated for steam generation, general estimates are being recorded by warehousing and boiler management teams. Incineration is considered as 'cost recovery' by ownership, alleviating the impact of rising wood costs while simultaneously preventing waste disposal fees.

Cutting waste is rarely sold. Sarom is contracted to remove other domestic and industrial waste, including ash, and end rolls are stored and sold to recyclers every 2-3 months paid by tonne.

Factory ownership and board directors have a significant interest in recycling and supporting sustainable practices and would sell cutting scraps to a recycling facility after assessing price and comparing costs of replacement fuel (wood). Sorting onsite was described as a challenge and would impact cutting scraps available for sale.

FACTORY WASTE STREAMS MAP 1 CUTTING FABRIC SCRAPS



INFORMAL SECTOR PROFILES

Cutting waste scrap collectors generally fit into two business types; people negotiating directly with factories to purchase all recyclable waste (cardboard, plastics, end rolls and cutting scraps) and those who purchase cutting scraps only. In the former case, the waste is separated with plastics, and cardboards rapidly being sold off. In both cases the textile scraps, generated during cutting, move through a supply chain of businesses until finally ending up in landfill or being burned.

A significant drop in demand for cutting scraps is generally thought to be influenced by the tightening of international import regulations and restrictions, lowering the amount of waste exported to China, Vietnam and other ASEAN nations. Demand from the brick kiln industry has also decreased.

However, while interviewing factories for this study it was confirmed that thousands of tonnes per annum are still being sold out into this informal sector, later confirmed by the waste collectors interviewed.

Challenges in quantifying the actual scale of this supply chain come from the lack of consistency in use of standard units of measure, and standardised pricing.



Image - Approximately 20% of total waste being held at the collector's facility who described it as "basically empty."

Stage 1 (large-scale) Scrap Collector - Sen Sok

Waste type:

Cutting scraps, large cut pieces, occasionally fabric rolls

Procurement:

Currently working directly with two factories.

Pays an annual lump sum contract fee to access all cutting waste. The contract price depends on the size of the factory and the volume being collected.

Sale/disposal:

- Industrial recycling clients
- Hammock, floor mat and cleaning rag makers
- Fabric buyers to sell for manufacturing of t-shirts, sweaters, pants etc.
- Manufacturers of pillows, mattresses and other stuffed products
- Truck drivers selling to fabric kilns

Relevant figures:

Currently buys 1.5-2 tonnes per factory, per week

Sale price:

Man-made fibres	\$0.04-0.15	kg
Cotton mixed colour	\$0.23-0.25	kg
Cotton white	\$0.50-0.55	kg
Polyester plastic*	\$1.00	kg
Remaining to brick kilns	\$0.03	kg

*The collector described a white polyester fabric that is rare to find in Cambodia and recognisable by the intense smoke emitted when burning. He rarely sources this product, estimating 300kg/year. This product is sold to specific Chinese customers exporting to Vietnam to make plastics.

This scrap collector has been dealing directly with factories for approximately eight years. Previously, he worked with 10-14 factories each year, collecting at least five tonnes per day, and 70-80% of the scraps purchased were sold to burn in the brick kilns.

He collects the factories’ scraps in bulk which are then sorted at his premises, in response to customer requests for particular fabric types. Once deemed unsuitable for sorting due to size, fibre composition, colour or financial reasons, the remaining waste is sold to the brick kilns.

Chinese clients currently purchase a considerable portion of sorted polyester fabric pieces to recycle. According to the collector, some of the clients’ recycling processes occur in Cambodia, where the fabric is broken down to a raw plastic material that is exported into the recycling industry in Vietnam, for use in making small plastic products and buttons.

Non-processed scrap exports to China and Vietnam are still occurring. Other buyers include hammock and mat makers, Cambodian clothing and other product manufacturers selling in local markets and export to Thailand also occurs via wholesalers located in Poipet.

The collector showed great interest in working with an established recycling facility, explaining his ability to build a community of existing scrap warehouses and use their established factory contacts networks. If demand allowed, he estimated availability of > 10 tonnes/day of cutting waste at an average price of \$30/tonne. He openly expressed his desire to prevent the final stage scraps from being used in the brick kilns.

Stage 2 Scrap Collector - Tonle Bati

Waste type:

Lengths of cutting scraps, medium and small-sized cutting scraps

Procurement:

Buys from Stage 1 Collectors in Chom Chao who are one or two steps removed from factories.

Sale/disposal:

- Hammock, floor mat and cleaning rag makers
- Truck drivers selling to fabric kilns
- Palm sugar farms

Relevant figures:

Purchases 500-600kg at a time, when it is available.

Sale price:

Cotton/poly cut lengths	\$0.25	kg
Fleece lengths	\$0.50	kg
Mixed cutting scraps	\$0.10	kg
Remaining to brick kilns	\$0.008	kg

The collector purchases lengths and small pieces of cutting scraps in bulk at Chom Chao and transports them to Tonle Bati. She sorts the waste into long strips for hammock and mat makers, small squares for making cleaning cloths, then sells remaining scraps to the brick kilns. Final pieces are given away to local palm sugar farms for stove fuel.



Image - Typical delivery size applying to both Stage 1 and Stage 2 collectors.

Micro-enterprise scale producers - Tonle Bati, Takeo

Unregistered roadside businesses, common throughout Cambodia, feature certain products depending on their location. Tonle Bati is well known for hammocks and mats made from fabric waste. Comprising weavers and knitters working roadside or in small workshops housed on their property, the small cottage industry started when factories were established in Takeo province. Although well developed, this industry is not lucrative for the makers involved. Most of the makers are women who previously worked in the garment industry and chose to set up small businesses in order to stay at home, most often to manage families.

Stage 2 scrap collector trucks drive through the region announcing types of fabric that have been purchased from wholesalers closer to large trade centres in Phnom Penh: Teuk Thla; Ta Khmao; Chom Chao and other key areas known for procurement of garment factory waste. Buying between 20-100kg at one time, makers meet in a centralized location, often the scrap collector's house or property, observe the sorting process, and purchase fabrics based on desired fibre type. After producing hammocks, mats and other small knitted products remaining waste is burned or buried at home, sold to collectors transporting to brick kilns for a very minimal fee (100r per 5-10kg) or given to local palm sugar processing farms to fuel stoves.

When describing their customers, the stage 2 scrap collectors also frequently described .

makers collecting small squares of various fibres to be sewn into cleaning cloths. The producers however explained that most people have stopped making these pieces as their customers, predominantly Chinese, are now unable to ship the products to China.



Image - Roadside hammock and mat makers, Tonle Bati.

FABRIC ROLLS

Summary

Many people across Cambodia are purchasing end roll fabric from garment factories. Wholesalers confirm an agreement whereby those who place a deposit with factory management have first access. Unlike cutting waste, where a single lump sum fee is paid annually, this deposit only allows access to the fabric, wholesalers then need to pay an additional fee to purchase what is available. Most factories expect all fabric available to be purchased at once. Individual 'first access' contracts are made annually, while fabric pickups occur according to availability, the frequency ranges from 2-3 times per year to multiple times per month. Factories don't consider excessive sorting or fabric identification as their responsibility however, due to the nature of their manufacturing, fabrics are grouped into broad composition categories. Wholesalers buy large amounts, 1.5-10 tonnes at once, then sort and store at their home or property in large makeshift warehouses.

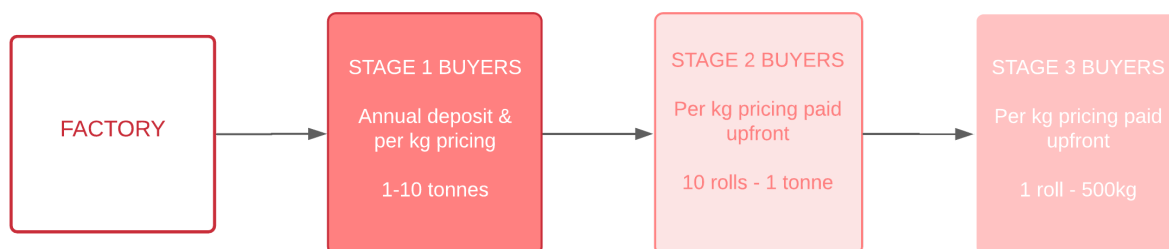
Key information is lost as the fabric leaves the factory. All rolls are labelled and categorised at the factory, but many rolls leave without labelling, or in a few cases are re-labelled to misrepresent fibre composition (usually presenting a higher proportion of cotton). If the fabric composition remained clear, the end roll waste could be sold on through the supply chain more effectively.

A small amount of end roll fabric waste is being sourced from textile mills in Cambodia, with the predominant portion being from CMT facilities. In addition, some wholesalers are sourcing from textile mills and CMT facilities in Southern Vietnam and Thailand if orders of specific volume or fibre can be placed. Combined, this allows the fabric roll wholesalers to deal with a variety of customers purchasing for in-country manufacturing and export. When dealing directly with factories in Cambodia, wholesalers are also required to pay fees of \$50-100 per truck to customs police.

Recently, end roll wholesalers have experienced a sharp rise in Indian and Chinese customers purchasing fabric for immediate export to their respective countries. It is assumed this is a result of interruptions in supply chains caused by COVID-19 however, there are also financial and tax incentives in comparison to buying directly from Vietnam.

Wholesalers do not have fixed positions in this supply chain, proximity to buying direct from factories is instead determined by the capacity to purchase large volumes at one time. Referenced as Stage 1-3 buyers (following page), individuals will make purchases at any stage of the process dependent on their individual customer requirements and personal financial capacity.

FABRIC WASTE PURCHASE CHAIN ROLLS & LARGE CUT PIECES



Stage 1 Fabric Rolls Wholesaler - Pochentong and Toul Kork

Waste type:

End roll - mainly cotton jersey. Other fabrics include cotton/polyester blend, spandex, terry towelling and fleece.

Procurement:

Holds multiple agreements with factories secured through a 'first access' deposit. Pays between \$0.50-1.50/kg and purchases fabric in bulk when it is available, generally when the factory storage is full which can occur multiple times per week.

Sale/disposal:

- Stage 2 fabric rolls wholesalers
- Manufacturers selling at Orussey Market and in Poipet (for export)
- Local brands
- Exporters sending to India, Sri Lanka, Vietnam and China

Relevant figures:

Fixed deposit terms determined by factory management.

Sale price to Stage 2 Wholesalers:

100% Cotton - White	Up to \$2.50	kg
100% Cotton - Black	Up to \$2.00	kg
Cotton mixed colours	\$1.50-2.00	kg
Cotton / Poly blend	\$1.25	kg

Sale price to other customers:

100% Cotton - White	Up to \$3.80	kg
100% Cotton - Black	Up to \$3.50	kg
Cotton mixed colours	\$2.80	kg
Cotton / Poly blend	\$2.25	kg

Holding multiple agreements with factories, the wholesaler is collecting and storing fabric from factories daily. Separated between a large warehouse at Pochentong and then a small shop front at Toul Kork he prefers to sell larger amounts (multiple rolls) at once and, where fabric is available, can sell up to 2-3 tonnes to a single customer. His warehouse is broadly categorised into colour. Customers have to conduct their own to sample cutting and testing to assess fabric composition to determine if a large amount (eg; 500kg black) is a single fabric composition or is a combination of multiple batches of different compositions.

Attempting to meet his customer requests for certain volumes of specific fabric composition and colour, the wholesaler also works with both textile production and CMT factories in Southern Vietnam.

Historically, his Thai and Chinese customers were sourcing 5-10 tonnes/day of textile waste and cutting scrap specifically. He stopped trying to buy this from the factories due to inconsistency in availability and concluded that working with fabric rolls only is more expensive but more efficient and financially viable.

Stage 2 Fabric Rolls Wholesaler - Toul Kork

Waste type:

End roll - cotton jersey, 100% polyester, cotton/polyester blend and fleece.

Procurement:

Purchases from Stage 1 Fabric Rolls Wholesalers for between \$1.25-2.50/kg.

Sale/disposal:

- Manufacturers selling at Orussey Market and in Poipet (for export)
- Local brands
- Exporters sending to India, Sri Lanka, Vietnam and China
- Waste collectors selling to hammock and mat makers

Relevant figures:

Sale price:

100% Cotton - White	Up to \$3.80	kg
100% Cotton - Black	Up to \$3.50	kg
Cotton mixed colours	\$2.80	kg
Cotton / Poly blend	\$2.25	kg

Stage 1 Fabric Rolls wholesalers visit factories to ascertain the fabric available in terms of composition and colour and, wherever possible, work to organise sales with Stage 2 Wholesalers prior to purchasing. Bargaining occurs simultaneously between the factories and all wholesalers throughout the process with any remaining fabric rolls being sold at cheaper prices for making recycled fabric products; hammocks, mats, cleaning cloths etc.

The Stage 2 wholesaler prefers to buy from Stage 1 wholesalers rather than the factories directly to avoid working with factory management and police. Fabric availability greatly varies from one factory to another, some factories have 1-5 tonnes available annually with others over 100 tonnes total collected very frequently across the year.



Image - Wholesale warehouse containing rolls of fabric, cutting scraps, garment piece scraps and garments.

BRICK KILNS

Intro

Cambodia's consistent industrial growth and high demand for construction materials fuels the domestic brick industry, causing harsh environmental degradation and confronting social impact. Widely unregistered and notorious for breaking national laws and global human rights agreements, the industry is unregulated and consumes significant volumes of natural resources.²³ Fueling kilns with wood sourced from unsustainable and often illegal sources, the volatile market price and inconsistent availability generates demand for other fuel sources including rice husks, agricultural bi-products and textile waste.²⁴ The brick industry has changed significantly and continues to move toward more sustainable and energy efficient fuel sources, however this does not discount the kilns' significant positioning as a stakeholder in Cambodia's textile waste pathways map or the detrimental effect they have on the environment and communities involved in the sector.

Fabric scraps are sold to the kiln owners with small truck loads (1-2.5t) being sold for between \$0.01-\$0.03/kg. Fabric scraps are collected from a wide variety of manufacturers where collectors buy anywhere between a small 10kg bag from at-home manufacturing facilities, through to many tonnes from Stage One (large-scale) Scrap Collectors.

Workers onsite at brick kilns in Phnom Penh and Kandal provinces, and the people in the surrounding community confirmed that the deliveries and burning of textile waste has decreased, but has not stopped and is still causing health problems and damaging their crops and farmland.

Brick Kiln Owner - Preak Tamak, Kandal

Operating his brick kiln for almost eight years, the business owner discussed the history and present situation of garment waste being used as fuel for the kilns. Community concern over the health impacts of the region being constantly exposed to black smoke and harsh chemical smells resulted in kilns initially reducing the volume of garments in their total fuel consumption, switching to higher volumes of wood. He personally starts his kiln using fabric scraps and estimates 10% of his total fuel is small scraps of polyester and cotton fabrics. Textile waste is readily available, large trucks travel through the region offering between one bag to one truckload (1.5 tonnes). Costs of wood was repeatedly described as a challenge and a key influence in the proportion of fabric in relation to total fuel burned.

²³. [Geres](#)

²⁴. [Project Blood Bricks](#)

Brick Kiln Manager - Preak Tamak, Kandal

Fueling the brick kiln with rice husk and other agricultural bi-products and wood, the manager explained that many of the kilns in the region cannot use fabric as fuel. Many sites across Preak Tamak have reduced the burning of fabric due to community pressure over concerns for their health and the impact of ash and plastic residue on their farms. However, he confirmed that, inland from his site and away from the road on larger properties, kilns are still burning fabric with little concern for the people involved in, or impacted by the making of their bricks. He noted that there has been a significant drop in volume of fabric available and fabric sellers driving through the region,



Image - Rural brick kiln seconds sale site.

OTHER PARTIES

The Ministry of Environment

The Ministry of Environment representatives describe the role of the department to include leading waste management operations and future improvement strategies with responsibilities including: policy and strategic plan development; organising ministries, institutions and other stakeholders; coordinating private and public sector counterparts; monitoring and evaluation of environmental and waste management work.

After providing Cambodia's national waste data, it was explained that access to export data specific to textile waste is more complex as a result of data being held by permitted exporters with licenses. Aligning with the Phnom Penh Waste Management Strategy And Action Plan²⁵ the representative communicated that it would be The Ministry of Environment's role to foster the establishment of an industrial textile recycling facility and that strategic support would need to be provided through facilitating a process for submission of tax agreements and exemptions. Similar finance reviews and exemptions would also need to be reviewed with the State-run electricity utility Electricite du Cambodge (EDC).

Alternative Manufacturers

The factories situated in Cambodia positioning themselves as alternative manufacturers expressed multiple approaches to managing waste ranging from the design and creation of new product lines to consume cutting waste through to giveaway to charities and social businesses creating upcycled products. Waste appears to be valued more amongst these alternative models with representatives identifying the financial loss incurred and environmental impact created when disposing of waste in conventional ways.

Chip Mong Insee Cement Corporation (CMIC)

CMIC's Ecocycle project, promoting a more environmentally sustainable approach to cement manufacturing, presents an at-scale opportunity for improvement in Cambodia's industrial waste management.²⁶ Experiencing slow uptake from factories, clients are accessing Ecocycle's services due to agreements with and instruction from brands seeking more sustainable waste management practices. For most factories, the gap from generating income through the sale of waste, to paying the highest service fees currently in the waste management sector, is too large to foster rapid adoption.

25. [Phnom Penh Waste Management Strategy and Action Plan 2018 - 2035](#)

26. [Chip Mong Insee](#)

Opportunities and Challenges

Industry development and circularity

The circular economy is not only key to the global achievement of climate and environmental targets, the transition across various industries is already proving that circular principles increase revenues and profits, mitigate risk and reduce costs for stakeholders.²⁷ The Cambodian Garment Industry has faced financial challenges impacting its effective competitiveness for well over a decade, where rising labour costs have not occurred simultaneously with a rise in productivity or efficiency. As other manufacturing regions invest in vertical systems, Cambodia is being left behind. Inserting circular principles into the current sector, whilst also establishing a facility that contributes to a pathway towards vertical practices will impact the sector as a whole, incentivising brands with an established presence in the country to stay and potentially drawing new investment.

Financial motivations

While it is technically the responsibility of the waste generating party to legally and safely dispose of industrial waste, in practice factories evade this legal responsibility opting to generate unregistered income through sale. The gap between this practice and paying for correct disposal has proven a significant challenge given the slow uptake from factories engaging with CMIC's Ecocycle project. However, most interviewees expressed licencing as the major preventative factor. A future recycling facility will require active support through ministries committing to their stated objectives to foster the establishment of industrial recycling models through licensing. In addition, incorporating the purchase of waste into the financial modelling of a facility would catalyse rapid uptake and guarantee access to the massive volumes of waste currently moving through the supply chain.

Transparency

Forming thorough conclusions and designing effective growth and sustainability strategies relies on accurate information and transparency from stakeholders in The Cambodian Garment Industry. Often factories present as adhering to legal requirements in Cambodia, but compliance to social and environmental regulations and agreements with brands is at times surface level, with most actual activity far removed from expectation. This was immediately apparent during onsite interviews, for example, one compliance department initially described 2 tonnes/day of cutting waste being stored, whilst later reporting 180 tonnes/year when providing data tracking.

27. [Ellen Macarthur Foundation](#)

Another factory detailed a recorded fluctuation between 70-100 tonnes/month during technical conversations about staff operating in Quality Control (QC) and warehousing, then provided a figure of 50 tonnes/month for the report. Furthermore, many interviewees contradicted themselves when discussing disposal practices, moving from disposal via Sarom Trading Ltd, to sale and back to disposal in the course of the conversation. As with all industries in Cambodia, the multiple levels of engagement with authorities, each with separate interpretations of policy, has established a 'common way' of practice contradictory to public policy. Inserting an industrial recycling segment into this established, albeit unregistered, deeply embedded practice will require a balance of education, brand influence, government policy development and implementation, and financial incentive.

Availability of valuable waste

Underreported, conflicting and mismanaged data led to generalised estimates of existing textile waste being generated in Cambodia, currently ending in landfill. Although approximate, the data clearly presents a high volume of waste available, and when combined with an additional high volume moving through the unregistered supply chain it is still safe to assume that realistic waste available is much greater than the data reported. As import restrictions in neighbouring ASEAN nations continue to increase, so too will the volume of the waste remaining in Cambodia.

Practice and sorting

Factories interviewed presented sorting waste as a major challenge where increased labour costs will impact already tight profit margins. Sorted waste leads to higher quality product output during industrial recycling²⁸ and will need to be included in the operations segment of a recycling facility business model. Price negotiations with factories, applying a higher purchase price according to both fabric fibre type and sorting practices presents as one pragmatic solution. While job creation could present as an additional opportunity and increase the efficiency of sorting, managing multiple factories' waste simultaneously.

Expenses - transport and utilities

High transport costs and notoriously unreliable and expensive electricity costs, Cambodia's tariff remains one of the highest in ASEAN,²⁹ are known challenges to industries across the nation, including the garment sector. Unless the brands who are pushing toward renewable energy³⁰ are successful, financial modelling for this project will need to account for these high costs as Cambodia's industrial sectors continue to grow rapidly.

28. [ResearchGate - Circular Economy — Challenges for the Textile and Clothing Industry](#)

29. [VOA - Global Brands Say Future Orders at Risk Given Cambodia's Increasing Coal Power](#)

30. [DW - Cambodia Electricity](#)

Annex A: Standardised Interview Questions

Factories

Introduce project and explain goals:

- To learn about the waste pathways in garment manufacturing:
- Volumes, collections costs / sale, current recycling, any other processes.
- To understand factory waste:
- What is included in all waste, how much is textiles, where does it currently go?
- Data - volume and value

Questions:

Waste

01. Please provide an overview introduction of your factory.

02. What is your waste and how do you dispose of it?

(do not read out list, prompt after interviewee has responded if needed)

- Fabric
 - Rolls
 - Scraps
 - Other
- Paper & cardboard, plastics
- Trims
- Rejected, unsold garments
- Chemical sludge
- Metal
- Food

03. What are your fabric scrap materials made of?

(do not read out list, prompt after interviewee has responded if needed)

- Cotton
- Poly
- 80/20
- Viscose
- Elastane

Production Capacity

04. How many employees do you have?

- Amount of lines in their factory, amount of people in a line.

Annex A: Standardised Interview Questions

05. How do you measure your fabric waste?

(do not read out list, prompt after interviewee has responded if needed)

- Per production run
- Per day / week / month / other
- In another way

06. What is your % allowance for fabric waste? How many kg / tonnes is this?

- Data
- Monthly / annual production capacity
- Amount of fabric purchased, produced, wasted
- Kg / tonnes of waste

Scraps

07. How do you dispose of your fabric scrap waste?

(do not read out list, prompt after interviewee has responded if needed)

- Waste management (Cintri or Sarom)
- Burn
- Landfill
- Sell it
- Export

08. What is required of you during this process?

- Fee
- Sort by fabric type, colour etc
- Measure kg / tonnes

Financial data

09. What is the cost of disposal if working with a provider? eg; Cintri, Sarom

10. If people are purchasing the cutting scraps, what is the price per truck / tonne etc?

Fabric rolls

11. Do you end up with fabric waste as rolls or large pieces? Why is there fabric remaining?

12. Do you order more fabric than needed for the PO? Why?

13. What happens with the remaining fabric, is it used for production at your factory?

14. Then where does it go?

15. Is there anything else you think we should understand about the previously discussed processes or your textile cutting waste?

Annex A: Standardised Interview Questions

Buyers of fabric scrap waste

Introduce project and explain goals:

- To learn about the waste pathways in garment manufacturing:
- Volumes, collections costs / sale, current recycling, any other processes.
- To understand factory waste:
- What is included in all waste, how much is textiles, where does it currently go?
- Data - volume and value

Explain about our research and attempt to map the full system of fabric waste in Cambodia. Provide examples that they will understand.

Questions:

01. Can you explain how your business works?

If they don't provide much detail use prompts:

- What product do you make, buy and sell?
- Do you run your business alone?
- Who are your suppliers?

02. How did you start in this business?

03. Can you explain the process of sourcing from your supplier?

*consider drawing a map if more helpful

04. Have participants identify stakeholders involved in the process

05. How much fabric scrap can you buy from your supplier at one time?

06. How often? What does it cost you?

07. Who can you sell it to? What can you sell it for?

08. Do you know anyone else involved in fabric scrap recycling?

09. Why do you work in this business?

10. What are your challenges?

11. Will you keep doing this for a long time?

Annex A: Standardised Interview Questions

Sellers of fabric scrap waste

Introduce project and explain goals:

- To learn about the waste pathways in garment manufacturing:
- Volumes, collections costs / sale, current recycling, any other processes.
- To understand factory waste:
- What is included in all waste, how much is textiles, where does it currently go?
- Data - volume and value

Explain about our research and attempt to map the full system of fabric waste in Cambodia. Provide examples that they will understand.

Questions:

01. Can you explain how your business works?

If they don't provide much detail use prompts:

- What product do you make, buy and sell?
- Do you run your business alone?
- Who are your suppliers?

02. How did you start in this business?

03. Can you explain the process of sourcing from the factory or your supplier?

04. Who are your customers?

05. How much fabric scrap do you normally sell to your customers?

06. What would the price be?

07. How much fabric scrap can you source from the factory or your supplier at one time?

08. How often? What does it cost you?

09. Would you sell very large amounts at one time?

10. Why do you work in this business?

11. What are your challenges?

Annex A: Standardised Interview Questions

Ministry of Environment

Introduction and Overview

We are conducting research on the viability of an industrial textile waste manufacturing project.

A recycling centre would run as a business, so we need to understand the volume of waste available, potential costs, impacts of creating a new segment in the existing waste management system.

Our Goal:

- To map the fabric waste pathways in garment manufacturing
- To understand factory waste; What is included in all waste, what portion is textiles, where does it currently go?
- Data; volume and value

Questions

01. What is the role of The Ministry of Environment in waste management in Cambodia?
02. How is textile waste involved in Cambodia's overall waste?
03. How is Cambodia's country-wide waste being measured and recorded?
 - Is there a publicly available summary of the waste data?
04. Is textile waste currently exported?
 - Is this for fabric recycling companies?
 - Do you know how much waste (general) is being exported? And fabric waste?
05. What are the future Ministry of Environment or the Cambodian government (other ministries) strategies for waste management as Cambodia grows?
06. Would The Ministry of Environment be supportive of an industrial waste recycling facility?
07. Is there anything else you think we should understand while we are researching an industrial textile waste recycling facility?

Additional notes to discuss:

- Factories are describing the sale of waste as 'illegal'. Discuss 'legal' vs avoidance of tax on imports.
- Chip Mong Insee (waste to cement) are experiencing slow uptake from factories as a result of fees. Please share your thoughts.

