Module 02 – CE in the Context of Textiles

1 Introduction to Circular Economy (CE)

2 CE in the context of textiles

3 CE policies and enablers for textiles

4 Need and Potentials in India

5 Developing Policy Instruments

6 Best Practice Examples

7 Repository of Toolkits



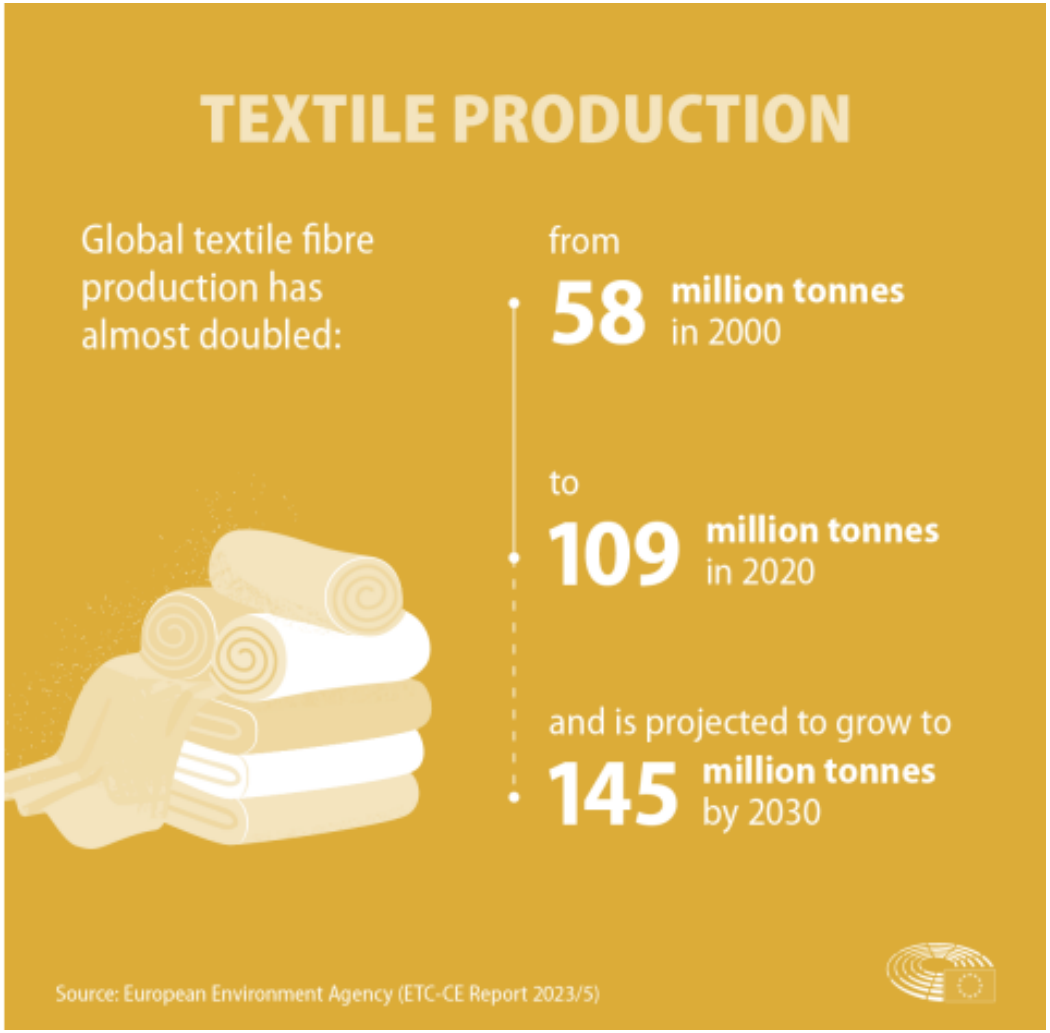
Objective: This chapter has the objective of putting CE economy into the **context of textiles**. It will showcase the textiles value chain and environmental hotspots as well as current facts and figures about the textiles industry´s impact. Furthermore CE strategies and business models along the different value chain steps will be explained and an overview of best practice examples along the value chain steps will be given. In this chapter there will only be given an overview of the best practice cases, while in chapter 6 one selected case study for each value chain step will be explained more in detail.

Production and consumption patterns

- The **fast fashion** phenomenon shapes production and consumption patterns across the world.
- This business model is based on offering consumers quicker turnaround of new styles and a **high number of collections** each season, often at **lower prices**.
- As a result, brands are now producing almost twice the number of clothing collections as they were pre-2000, when this phenomenon started, and the overall increase in **clothing production demand** is estimated at an annual 2%.
- Fast fashion a source of **ecological stress** for the region, generating environmental hotspots like water scarcity, water and air pollution, and material waste.
- Strikingly **low rates of clothing utilization** that lead to an increased environmental footprint. It is estimated that more than half of fast fashion items are **disposed of** in under a year.

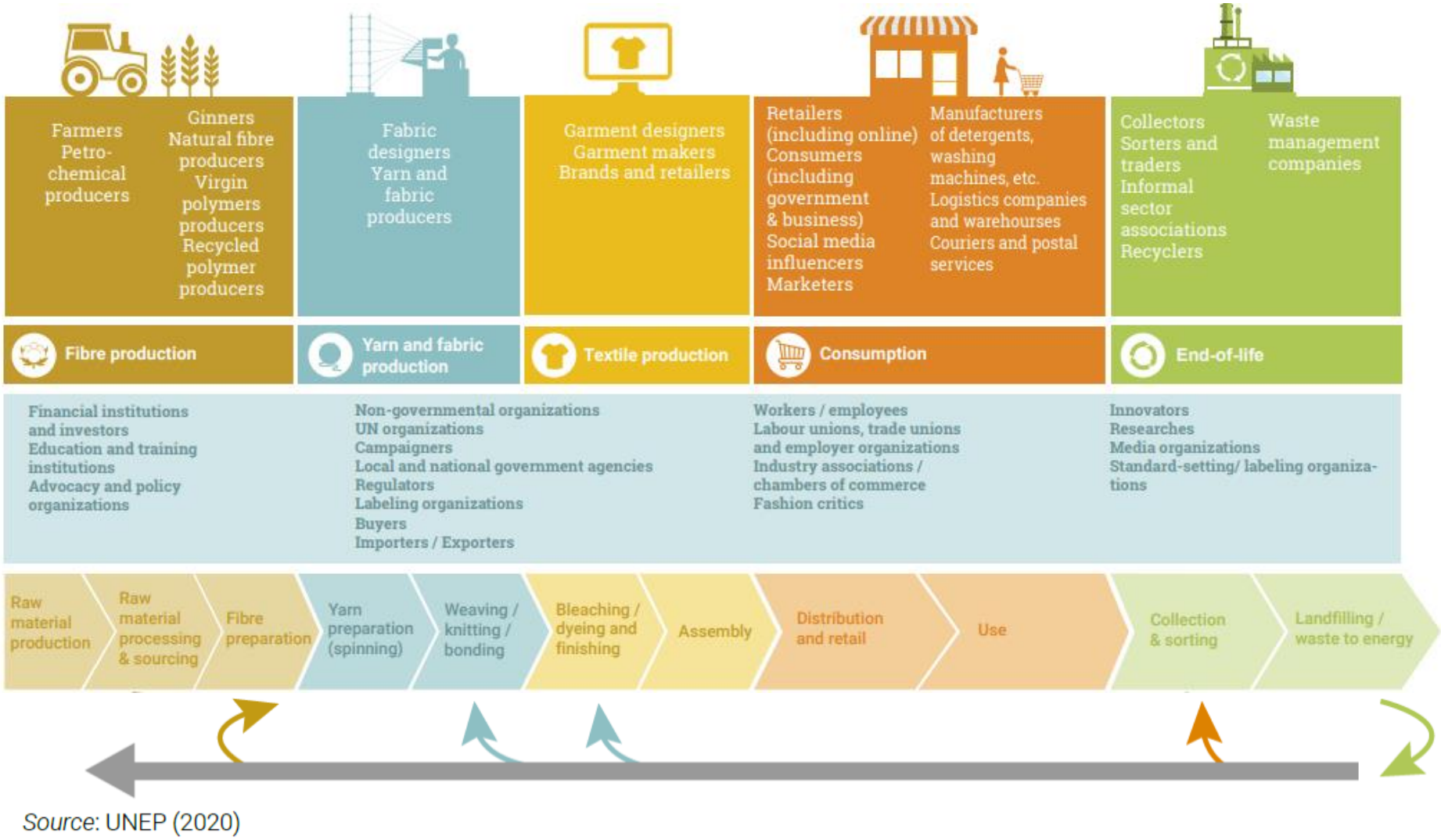
Sources:
Niniimäki et al. (2020): (PDF) The environmental price of fast fashion (researchgate.net);
SPC/RAC (2020): SCP/RAC report: "Circular business opportunities in the south Mediterranean report: how can businesses lead the way to sustainable fashion?" is now available | | SCP/RAC - Regional Activity Centre for Sustainable Consumption and Production (cprac.org);
Ellen MacArthur Foundation (2017): https://www.ellenmacarthurfoundation.org/a-new-textiles-economy

Production and consumption patterns



Source: European Parliament (2020): The impact of textile production and waste on the environment (infographics) | News | European Parliament (europa.eu)

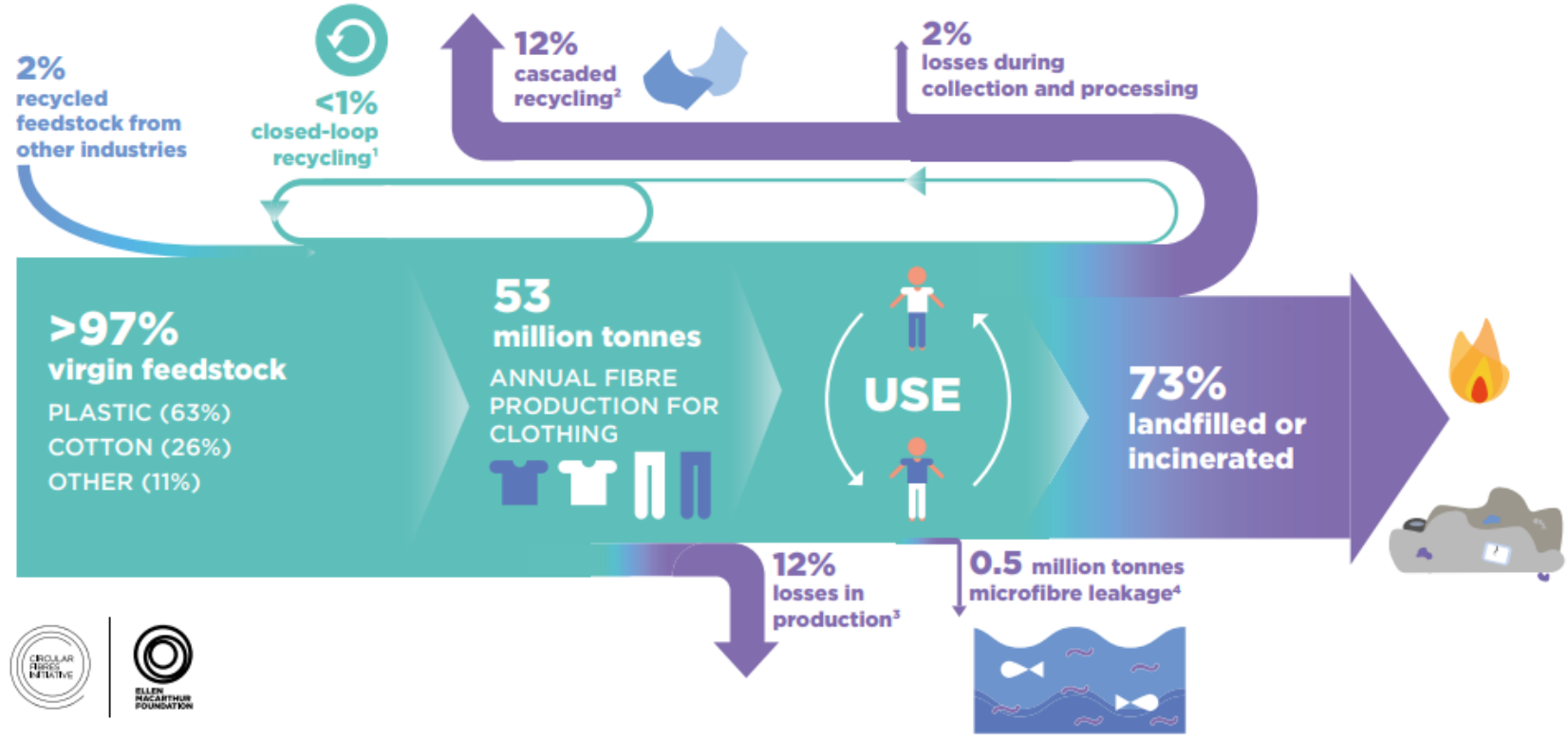
Linear value chains



Source: UNEP (2020)

Source: UNEP (2020): https://www.oneplanetnetwork.org/sites/default/files/from-crm/unep_sustainability_and_circularity_in_the_textile_value_chain.pdf

Linear value chains

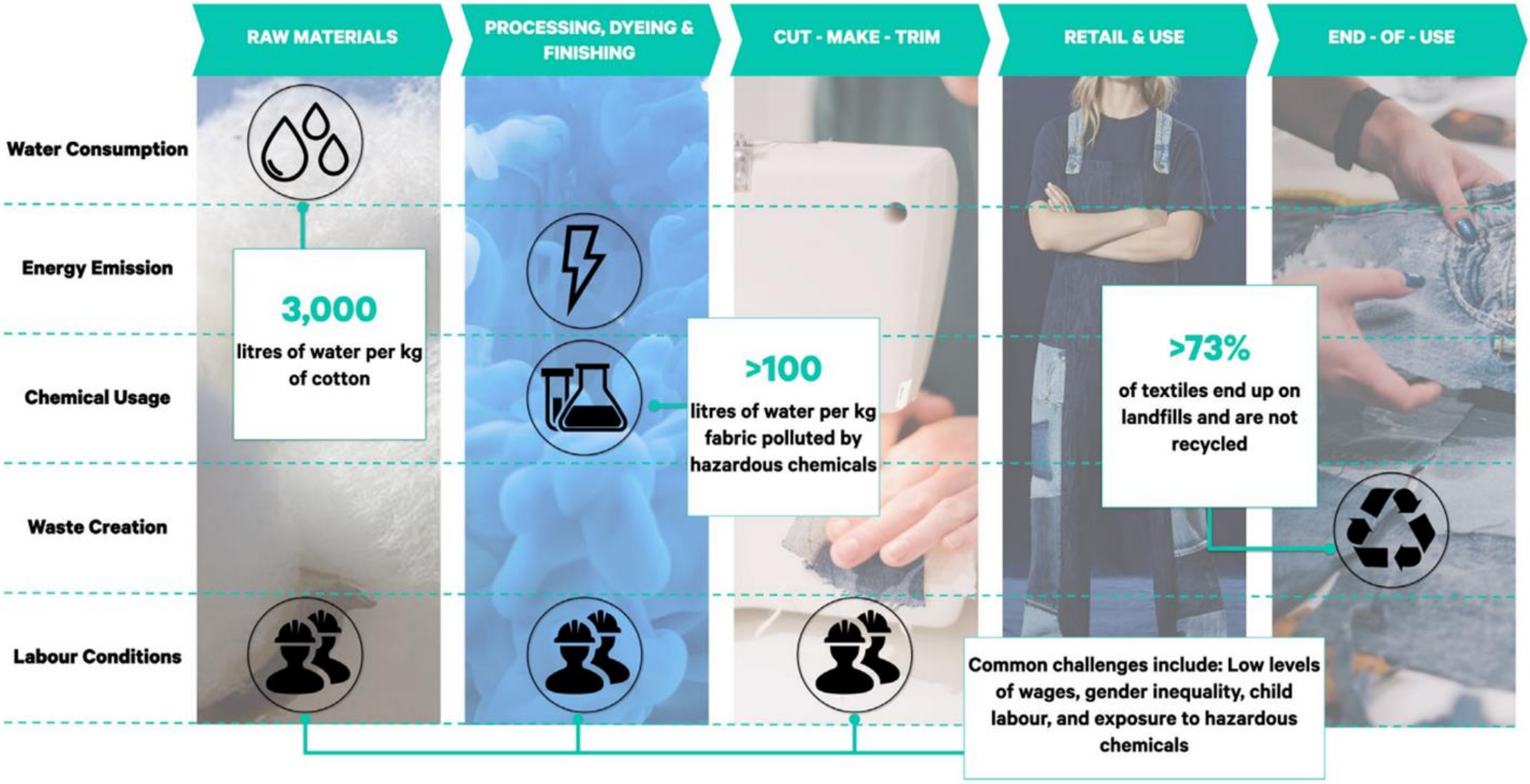


1 Recycling of clothing into the same or similar quality applications
2 Recycling of clothing into other, lower-value applications such as insulation material, wiping cloths, or mattress stuffing
3 Includes factory offcuts and overstock liquidation
4 Plastic microfibres shed through the washing of all textiles released into the ocean

In the current predominantly linear textile value chain, very few textiles *(<1%) are recycled back into clothing*, with another 12% going into cascaded recycling, where they are used in products such as cleaning cloths, insulation material and mattress stuffing.

Source: Ellen MacArthur Foundation (2017): https://www.ellenmacarthurfoundation.org/a-new-textiles-economy

Environmental, social and economic impacts



Source: FashionForGood (2020): https://reports.fashionforgood.com/wp-content/uploads/2020/07/20201019_State-of-Circular-Innovations-in-the-Indian-Fashion-and-Textile-Industries-Final.pdf

Environmental, social and economic impacts



- It is estimated that the fashion industry is accountable for 10% of worldwide carbon emissions, surpassing the combined emissions of international flights and maritime shipping.



- It is approximated that in 2015, the worldwide textile and clothing sector consumed 79 billion cubic meters of water, whereas the entire economy of the EU required 266 billion cubic meters in 2017.
- Textile manufacturing is believed to contribute to roughly 20% of the world's freshwater pollution due to dyeing and finishing processes. The washing of synthetic garments is responsible for releasing 35% of primary microplastics into the environment.



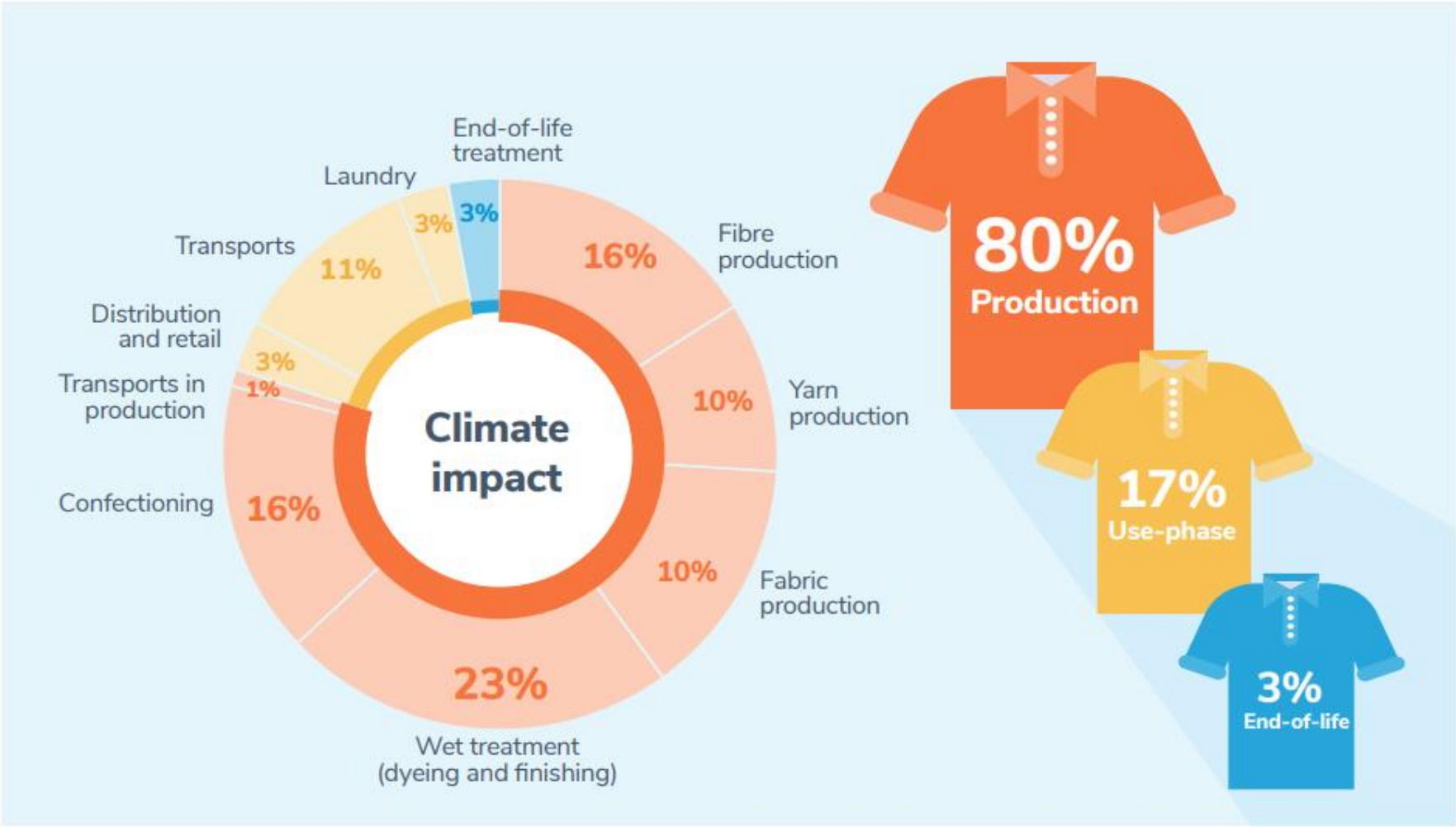
- The disposal of unwanted clothing has also evolved, shifting from donation to disposal. Less than 50% of used clothes are collected for potential reuse or recycling, and merely 1% of used clothing is recycled into new garments, as the necessary technologies for converting old clothes into virgin fibers are just beginning to emerge.



- Textile production processes use a large amount and wide variety of chemicals.
- The production of 1 kg of cotton t-shirts, for example, requires about 3 kg of chemicals.

Sources:
European Parliament (2020): The impact of textile production and waste on the environment (infographics) | News | European Parliament (europa.eu);
Swedish Chemical Agendy (2014): https://www.kemi.se/download/18.6df1d3df171c243fb23a98f3/1591454110491/rapport-6-14-chemicals-in-textiles.pdf

Division of environmental impact along the value chain

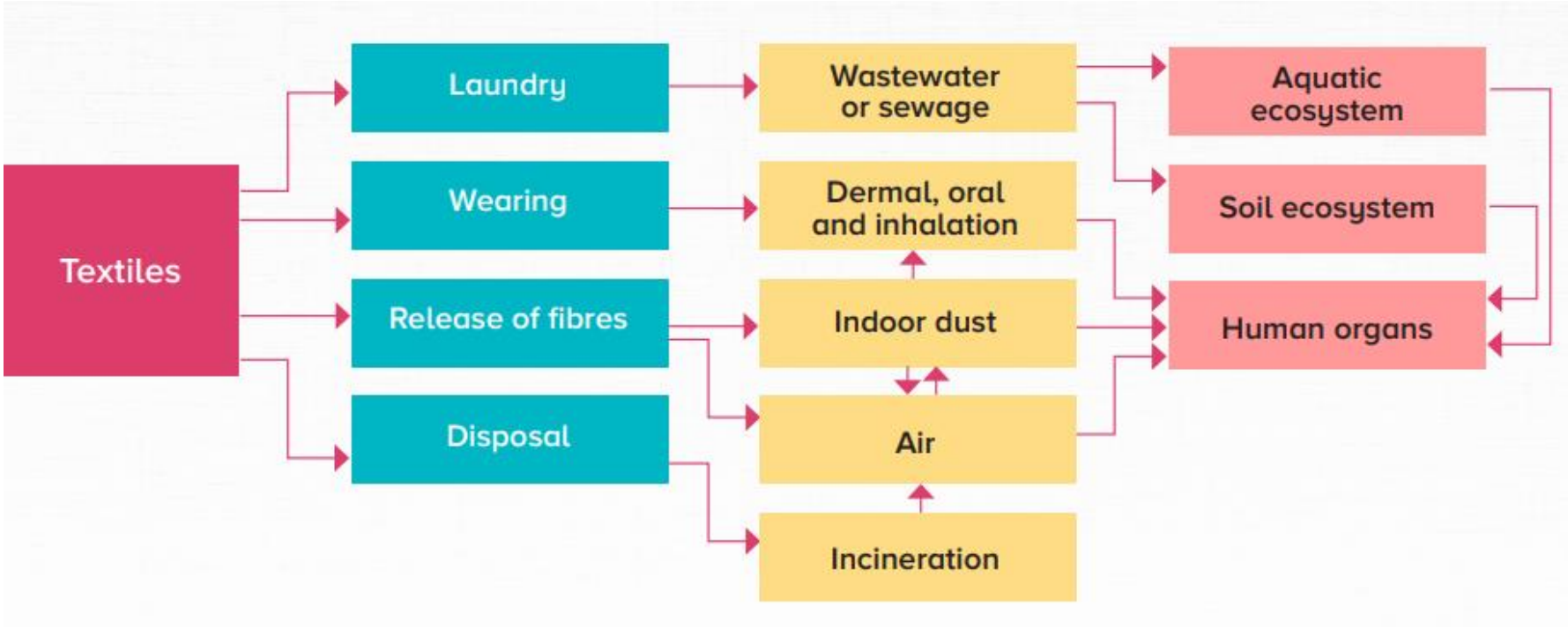


Source: ecos (2021): https://circulareconomy.europa.eu/platform/sites/default/files/ecos-report-how-ecodesign-can-make-our-textiles-circular.pdf

Environmental, social and economic impacts

Chemical use and hazardous substances along the value chain

- Excessive use of chemical fertilizers and pesticides particularly in cotton production.
- Manufacturing involves a wide variety of chemical use. Up to 3500 chemical substances are used to turn raw materials into textiles. Approximately 10% of these chemicals are hazardous to human health or the environment.
- Some of the chemicals may persist in the environment, build up in the body, and affect immune and reproductive systems.



Source: Gaonkar (2021): https://www.researchgate.net/publication/358804949_AN_OVERVIEW_OF_TOXIC_CHEMICALS_IN_TEXTILES

Environmental, social and economic impacts

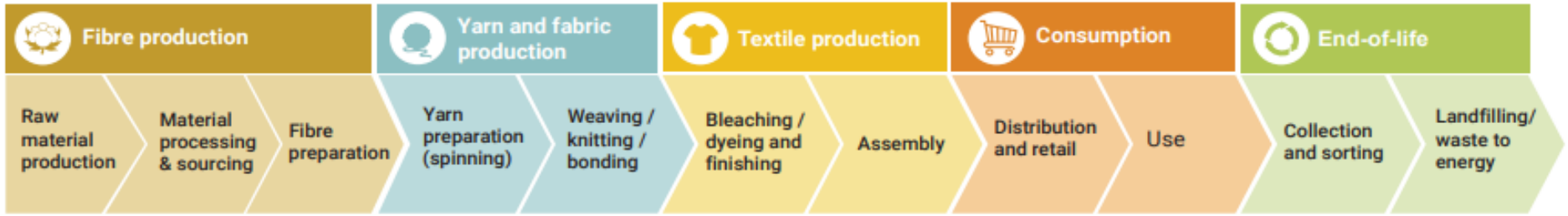
Chemical use and hazardous substances along the value chain

- Chemical use increase the pollution load during production; raise the wastewater, waste and air emissions management costs.
- They have adverse impact on the circularity of the products and the overall value chain.
- Chemicals involved in products/materials hinder them to be cycled in the biological cycle.

Process step	Chemicals or chemical groups used	Function/product specifics
Fibre production	Pesticides, detergents	Remove wool impurities
	Heavy metals	Viscose, Polyester
Knitting	Mineral oils, including polyaromatic hydrocarbons	Lubricating/emulsifying
Washing	Organic solvents, nonylphenols/nonylphenol ethoxylates (NPEOs)	Detergents in washing
Desizeing	Pentachlorophenol	Remove starch sizes
Dyeing or printing	Azo dyes	Used for dyeing
	Heavy metals	Attach dyes to fibre
	Organochlorines (chlorinated solvents, chlorinated benzenes)	Carriers
	Solvents, formaldehydes, NPEOs	Auxiliary substances
Stabilizing	Formaldehyde, triazones, carbamates	Stabilizing of cellulose fibre
Fire-proofing	Heavy metals, halogens, salts, formaldehyde, brominated flame retardants (BFRs), short-chain chlorinated paraffins (SCCPs), and asbestos	
Biocide treatment	Metals, SCCPs, triclosan, organotins	Anti-mould or anti-microbial
Anti-pilling, water proofing	Phthalates, heavy metals, organotins, perfluorinated compounds (including PFOS, PFOA)	Cotton, polyester
Protective printing inks	Phthalates, heavy metals, organotins	Depend on fabric and use
Water, oil, stain, and wrinkle-resistant coatings	Formaldehyde, perfluorinated compounds (including PFOS, PFOA)	
Dry cleaning	Tetrachloroethylene, trichloroethane, chlorofluorocarbons	
Transport and storage	Chlorinated phenols	Added as biocides

Source: Gaonkar (2021): https://www.researchgate.net/publication/358804949_AN_OVERVIEW_OF_TOXIC_CHEMICALS_IN_TEXTILES

Environmental impacts – Hotspots



Impacts	Hotspots									
Climate	Fossil fuels used in production of synthetic textiles				Coal-based energy used in textile production			Electricity used in washing and drying		
Water scarcity	Water used in cotton cultivation							Water used in washing		
Land use	Land used in cultivating cotton leads to habitat loss and impacts on biodiversity									
Ecosystem quality	Fertilisers, herbicides and pesticides used in cotton cultivation				Chemicals and water pollution in textile production			Electricity and detergent used in washing and drying; microfibres releases		

Source: UNEP (2020): https://www.oneplanetnetwork.org/sites/default/files/from-crm/unep_sustainability_and_circularity_in_the_textile_value_chain.pdf

Environmental impacts – Hotspots

		Productions of fibres and raw materials	Textile manufacturing	Retailing and transport	Consumer use	End-of-life
Input	Land use	Primary				
	Water use	Primary	Primary		Primary	
	Energy use	Secondary	Secondary	Secondary	Secondary	
	Chemicals use	Secondary	Primary		Tertiary	
Output	Emissions to air	Tertiary	Tertiary	Tertiary	Secondary	Primary
	Emissions to water	Tertiary	Primary		Primary	
	Material waste		Secondary	Primary	Primary	Primary
	Biodiversity loss					
	Toxic subtances	Secondary	Secondary			

Source: SPC/RAC (2020): SCP/RAC report: "Circular business opportunities in the south Mediterranean report: how can businesses lead the way to sustainable fashion?" is now available | | SCP/RAC - Regional Activity Centre for Sustainable Consumption and Production (cprac.org);

Social impacts – Hotspots

	Fibre production			Yarn and fabric production		Textile production		Consumption		End-of-life	
	Raw material production	Material processing & sourcing	Fibre preparation	Yarn preparation (spinning)	Weaving / knitting / bonding	Bleaching / dyeing and finishing	Assembly	Distribution and retail	Use	Collection and sorting	Landfilling/ waste to energy
Human health	Agrochemicals used in cotton cultivation; risk of injury and exposure to toxins and hazards			Risk of injury and exposure to hazards		High use of chemicals (risk of exposure to toxins and hazards); high use of coal-based energy	Risk of unsafe working conditions				
Social risk	Risk of child labour, forced labour, excessive working time, below minimum wage pay, gender inequality and conflict			Risk of child labour, forced labour, excessive working time, below minimum wage pay, gender inequality and conflict			Risk of child labour, forced labour, excessive working time, below minimum wage pay, gender inequality and conflict				
Governance risks	Risk of corruption and fragility in the legal system			Risk of corruption and fragility in the legal system			Risk of corruption and fragility in the legal system				

Source: UNEP (2020): https://www.oneplanetnetwork.org/sites/default/files/from-crm/unep_sustainability_and_circularity_in_the_textile_value_chain.pdf

Economic impacts/value loss – Hotspots



Value loss										Materials and resources lost in landfill and incineration
							Economic value add highly skewed to top end of value chain			Textile "dumping" disrupting local industries

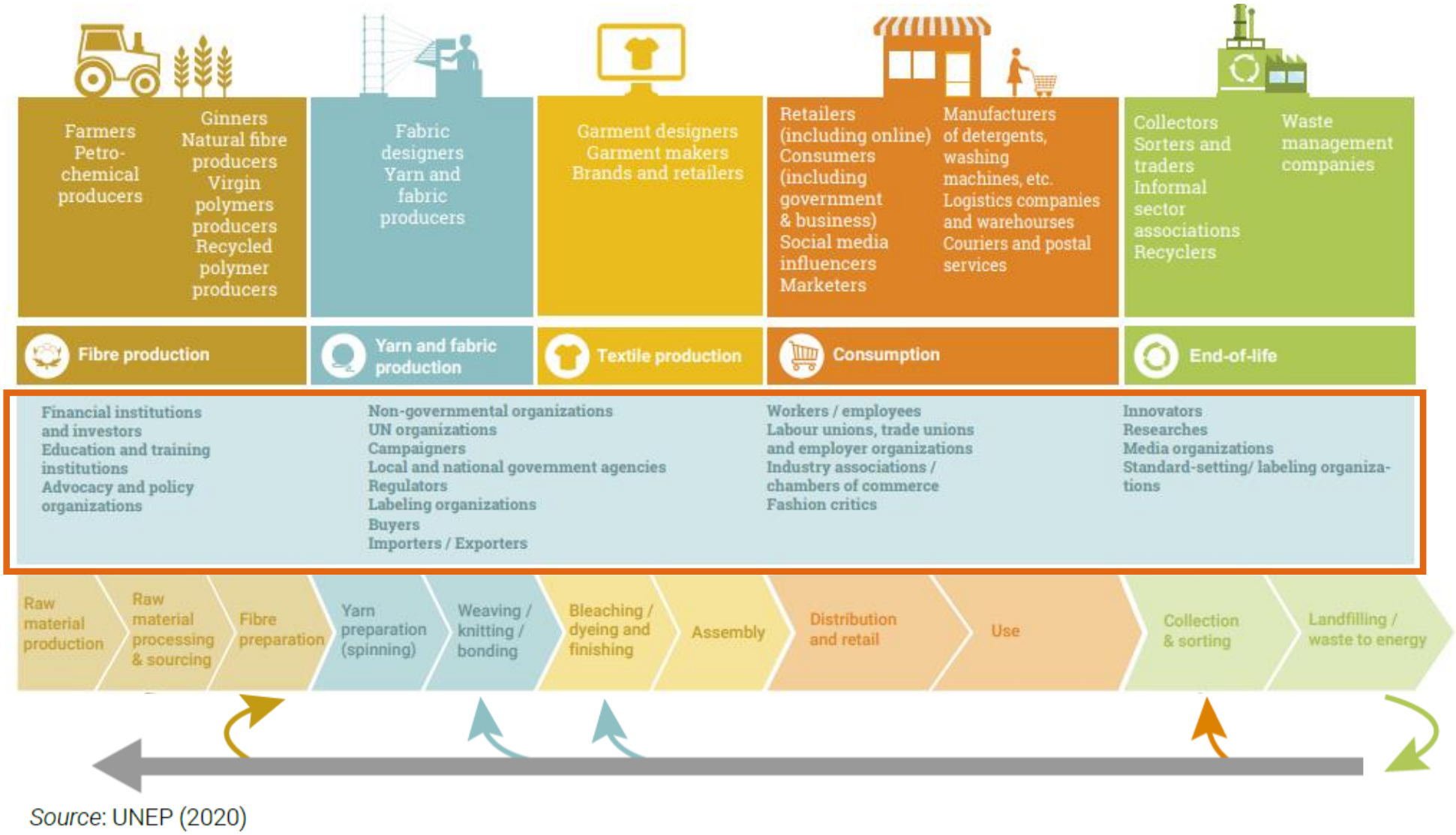
Source: UNEP (2020): https://www.oneplanetnetwork.org/sites/default/files/from-crm/unep_sustainability_and_circularity_in_the_textile_value_chain.pdf

Hotspots summarized

Fibre Production	• High use of **fossil fuels** to produce **synthetic fibres** (which involves climate, human health and ecosystem quality impacts) • High use of **agrichemicals, land** and water to produce **natural fibres**, especially cotton (leading to biodiversity and ecosystem quality impacts) • **Unsafe working conditions** and **fragility of the legal system** (leading to human health impacts and social risks)
Textile Production	• High use of **fossil fuels** for heat and electricity generation in energy-intensive textile processes (which involves climate, human health and ecosystem quality impacts) • Use of **hazardous chemicals** (leading to high human health and ecosystem quality impacts, particularly via water pollution) • **Release of microfibres** (leading to ecosystem quality impacts and potential human health impacts) • **Unsafe working conditions** and **fragility of the legal system** (leading to human health impacts and social risks)[18]
Use Phase	• High use of **electricity** in the care of textiles over their lifetime (fossil fuels used for energy production, leading to climate, human health and ecosystem quality impacts) • High use of **water** and releases of **microfibres** in washing textiles over their lifetime (leading respectively to water scarcity, ecosystem quality and potential human health impacts)
End-of-Life	• **Low rates of recovery** of textiles at end-of-life leading to high material value loss and non-renewable resource depletion

Source: UNEP (2020): https://www.oneplanetnetwork.org/sites/default/files/from-crm/unep_sustainability_and_circularity_in_the_textile_value_chain.pdf

Actors along the value chain



Source: UNEP (2020)

Source: UNEP (2020): https://www.oneplanetnetwork.org/sites/default/files/from-crm/unep_sustainability_and_circularity_in_the_textile_value_chain.pdf

Actors along the value chain



Policymakers: Can have an influence on each step of the value chain by elevating goals, adopt innovative sustainable policies, align funding with intentions, take a comprehensive approach to policy impact, engage in extensive consultation for policy design, and collaborate with key stakeholders.



Financial institutions: Can especially influence the sourcing process by overcoming systemic funding obstacles, enhance internal capabilities, strategize for the transition, foster genuine innovation in solutions and processes, introduce innovative financial products, and expand funding options for sustainable and circular initiatives.



Raw material producers and manufacturers: Optimize production sites through the adoption of top-tier technical practices for environmental impact reduction, while simultaneously safeguarding and empowering workers.



Brands and retailers: Generate revenue through innovative business models, prioritize problem prevention in the design stage via low-impact and circular design, and implement evidence-based business enhancements to reduce environmental and social impact

Source: UNEP (2020): https://www.oneplanetnetwork.org/sites/default/files/from-crm/unep_sustainability_and_circularity_in_the_textile_value_chain.pdf

Actors along the value chain



- **Consumers**: buying fewer, higher-quality clothing items, supporting eco-friendly brands, recycling and upcycling clothing, and raising awareness about the environmental and ethical impacts of the fashion industry



- **Innovators and recyclers**: introduce innovative circular solutions and technologies, make these solutions accessible and adaptable across various user contexts.



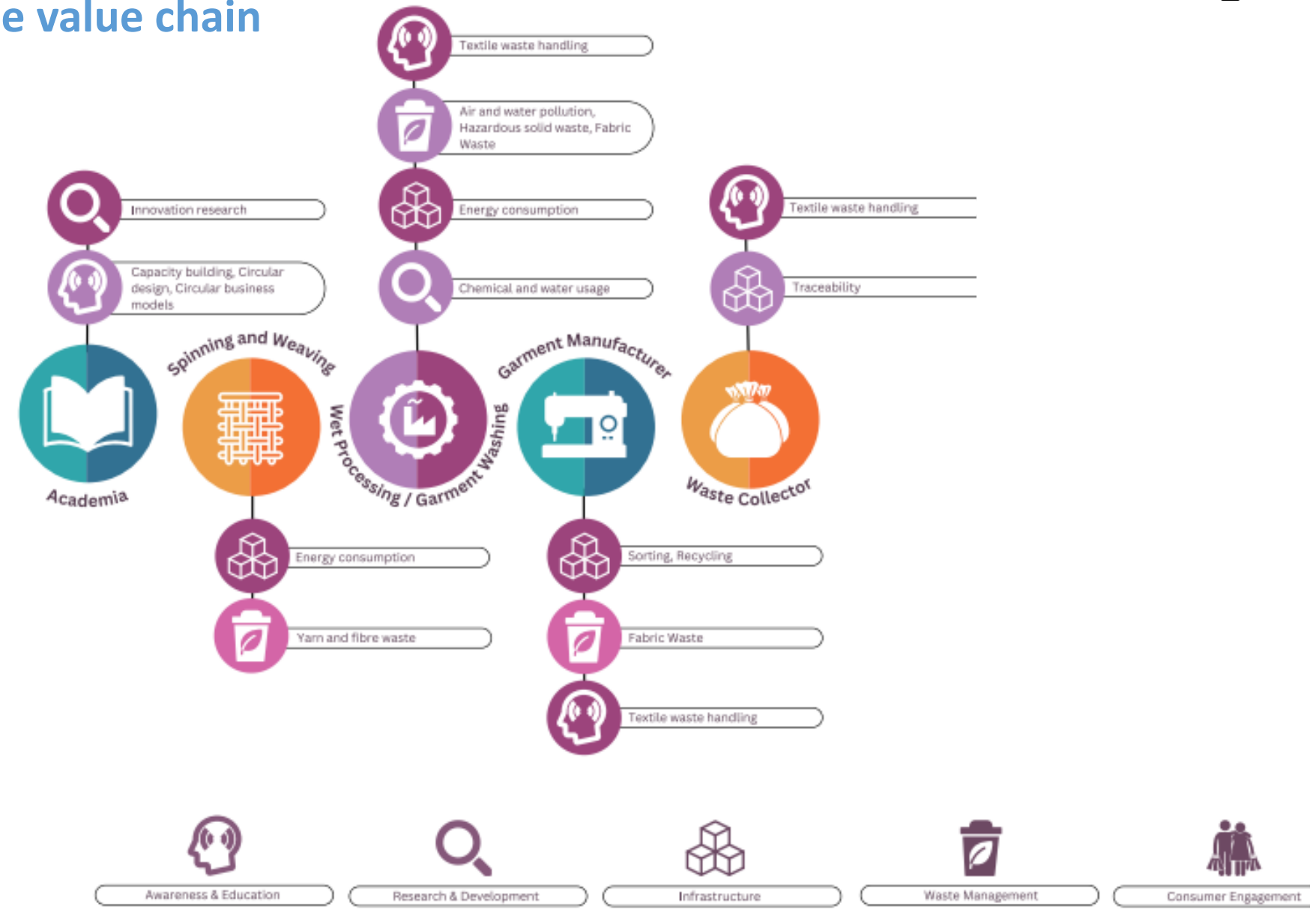
- **Non-governmental, representative, and technical organizations**: promote and bolster swift action from both the industry and policymakers, instigate heightened ambition and advancements, offer trustworthy mechanisms, recommendations, and data to guide prioritization and accountability.



- **Communication and consumer engagement actors**: Transform consumer behavior by making sustainable choices aspirational, acknowledging consumer diversity, and shifting mindsets away from the norm of excessive consumption

Source: UNEP (2020): https://www.oneplanetnetwork.org/sites/default/files/from-crm/unep_sustainability_and_circularity_in_the_textile_value_chain.pdf

Actors along the value chain



Source: GIZ, ABFRL, CEE (2023): https://www.ceeindia.org/pdf_files/Baseline%20Assessment%20Report%20(Digital%20Version).pdf

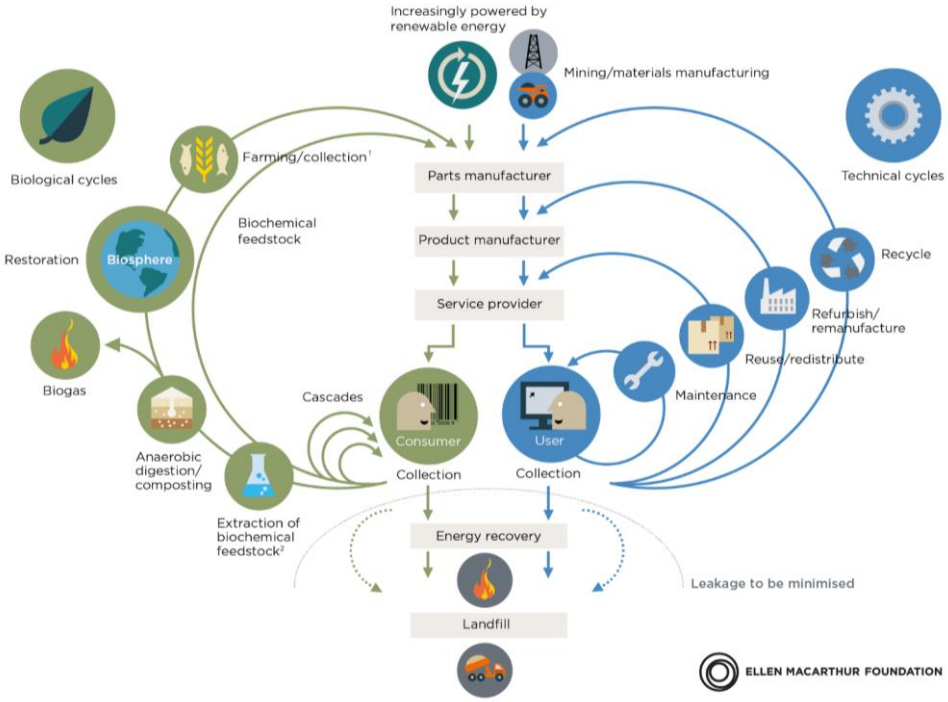
Actors along the value chain



Source: GIZ, ABFRL, CEE (2023): https://www.ceeindia.org/pdf_files/Baseline%20Assessment%20Report%20(Digital%20Version).pdf

CE strategies and business models for textiles

*"A circular textiles economy describes an industrial system which produces **neither waste nor pollution** by redesigning fibers to circulate at a high quality within the production and consumption system for as long as possible and/or feeding them back into the bio- or technosphere to restore natural capital or providing secondary resources at the end of use." (GIZ, 2019)*



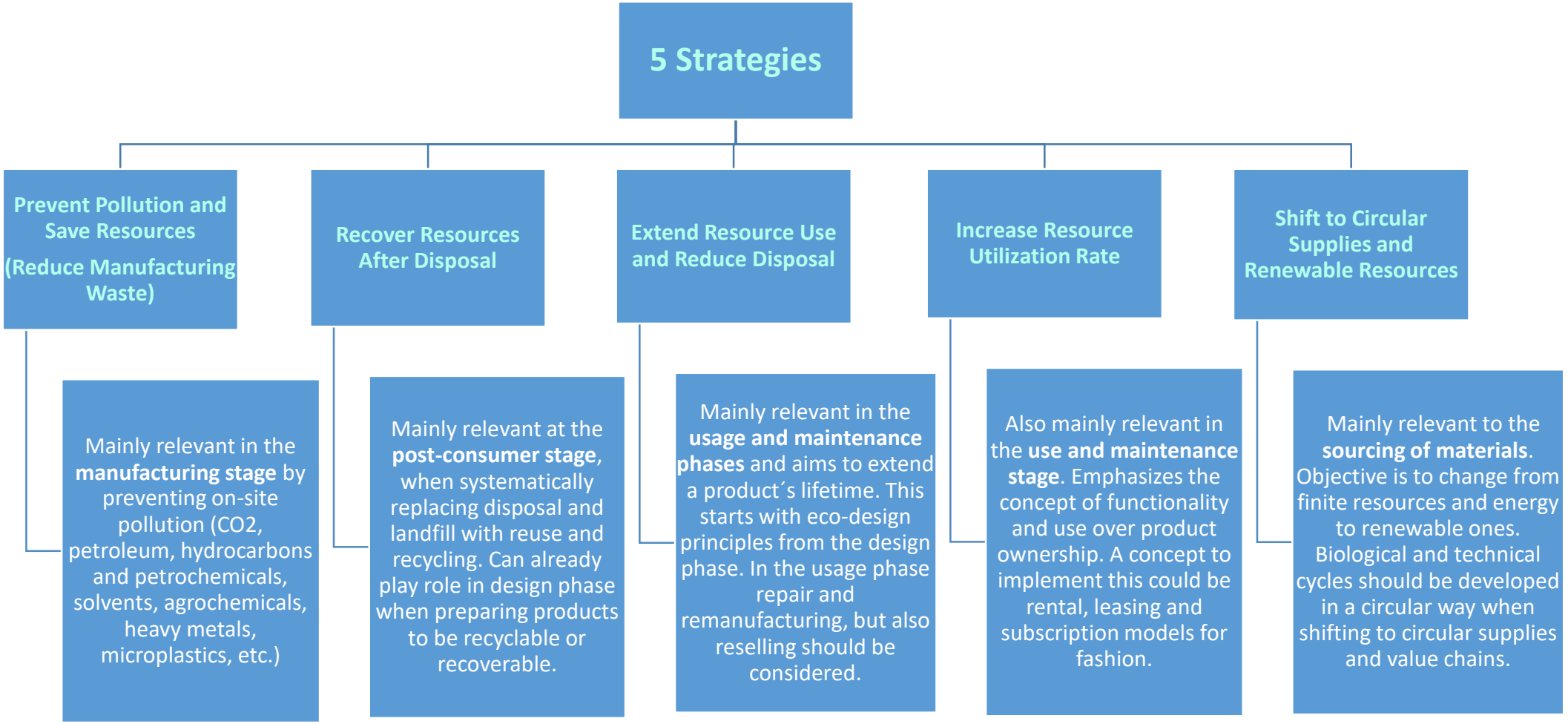
Full "cyclability" in biological cycles can only be ensured if the raw materials (e.g. pesticide-free organic cotton) and all involved dyestuffs and other chemicals applied throughout the production processes are fully biodegradable and do only contain substances that are beneficial to human health and the environment.

Otherwise, the products needs to be part of the technical cycle by ensuring recyclability, reusability, repairability, etc. through circular product design and circular business models.

→ The transformation towards a circular textile industry calls for fundamental changes throughout the entire lifecycle of textile apparel products.

Source: Hemkhaus et al. (2019): https://circulareconomy.europa.eu/platform/sites/default/files/giz_report_circular_economy_textile_sector_2019_final.pdf

CE strategies and business models for textiles



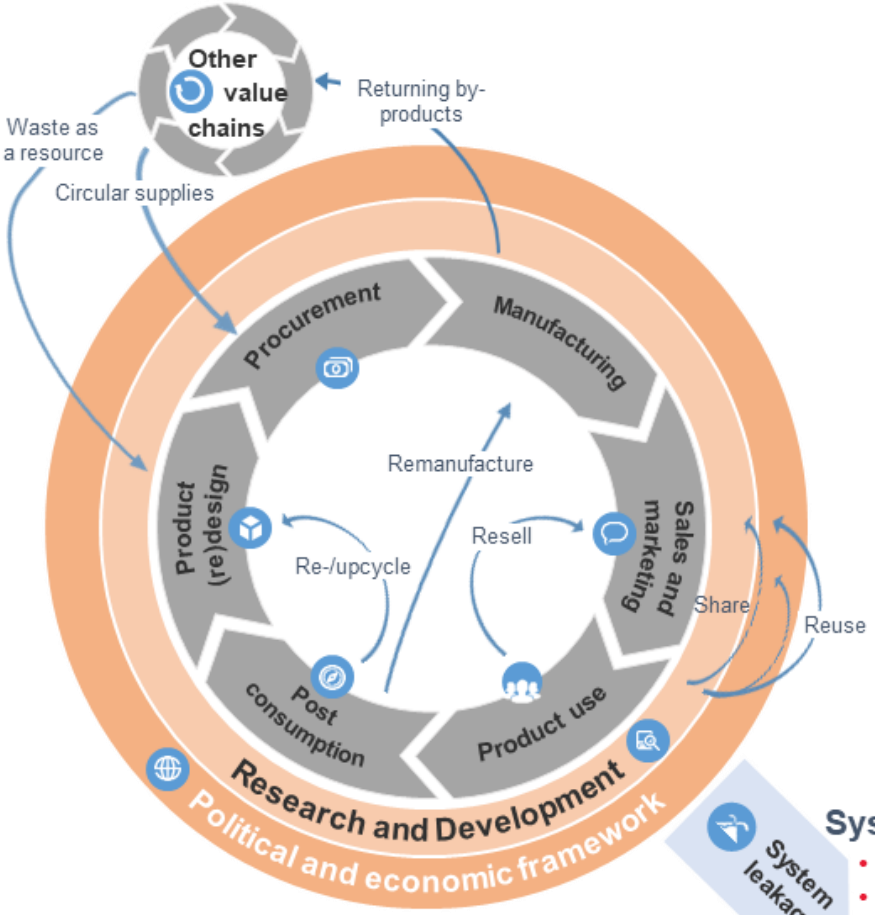
Source: SCP/RAC; BCSD (2020): SCP/RAC report: "Circular business opportunities in the south Mediterranean report: how can businesses lead the way to sustainable fashion?" is now available | | SCP/RAC - Regional Activity Centre for Sustainable Consumption and Production (cprac.org)

CE strategies and business models for textiles

Shift to Circular Supplies
- Reconstruct value chains with alternative, low-impact, regenerative or recycled fibers
- Create slow fashion culture

Provide textile products as a service
- Develop new models of ownership: Rental, leasing and subscription
- Reselling

Recover after disposal
Either post-industrial or post-consumption
- Separation, collection, recycling and upcycling
- Design for disassembly, reassembly or recycling
- Industrial symbiosis



Reduce Manufacturing Waste
- Cleaner Production and pollution prevention
- Design for Zero Waste Production

Facilitate demand for circular products and services
- Raise awareness among consumers
- Reduce resource consumption during use

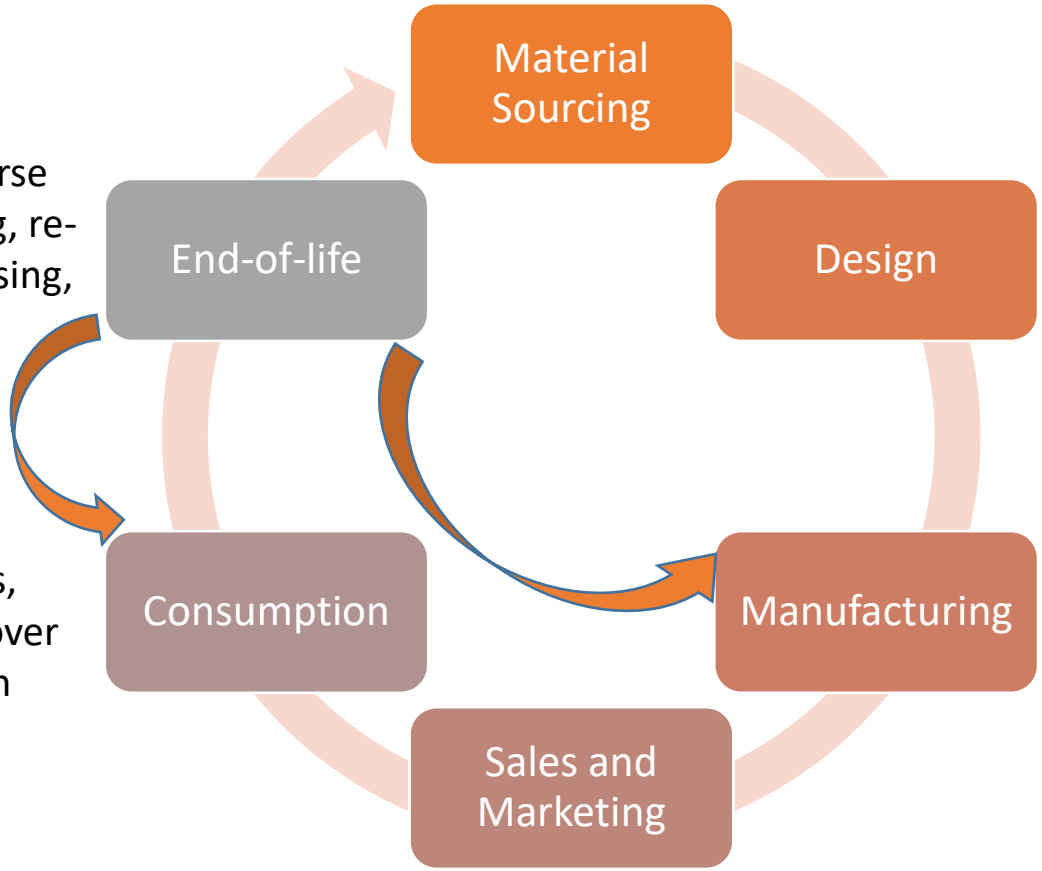
Extend the product life-time of textiles
- Design for durability and modularity
- Repairing and upgrading
- Reuse/repurpose

System Leakage
- Downcycling
- Waste to energy
- Co-incineration

Source: adelphi (2022)

Examples of business models and practices applicable at different stages of the value chain

Usage of organic, renewable, recycled or innovative/alternative materials; energy management



Take-back schemes, reverse logistics, collection, sorting, re-using, recycling, re-processing, upcycling

Close loop design, design for durability/ disassembly/ recyclability/reusability

Repair/renewal services, reselling, renting, access over ownership, subscription models

Apply sustainable production strategies (water & energy saving, chemicals reduction, waste reduction and recovery, etc.)

Awareness raising, sustainable product labelling, providing transparency and traceability, optimization of packaging, circular packaging solutions, etc.

Examples of "supportive" business models and practices

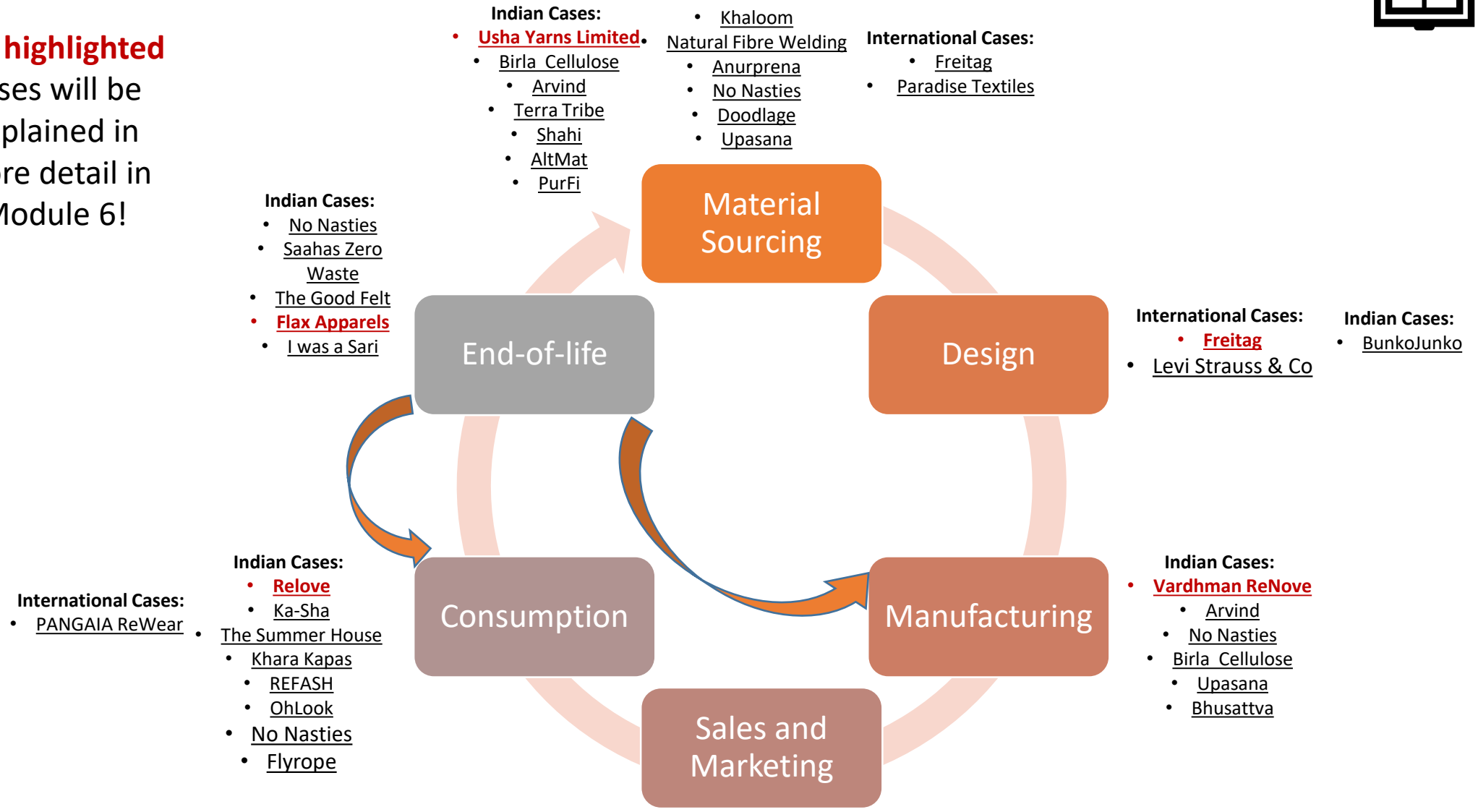
(Development/deployment of tools, applications, and services enabling circular economy strategies)

- Digital tools and applications to facilitate reverse logistics (tracking, take-back of products for reuse, repair or recycling), improve resource efficiency and avoidance of waste production
- Virtual marketplaces for secondary raw materials or second hand/repaired products
- Digital material passports and related data repositories to facilitate the tracing, marketing and trade of secondary raw materials in end-of-life products
- Methodological frameworks and tools for measuring and monitoring of progress in the transition to a circular economy
- Digital tools and applications for consumer awareness raising/education on the application and benefits of different circular economy strategies
- Advisory services to companies and public authorities for strategizing, preparing and implementing circular economy transition
- Secondary material certification services, etc.

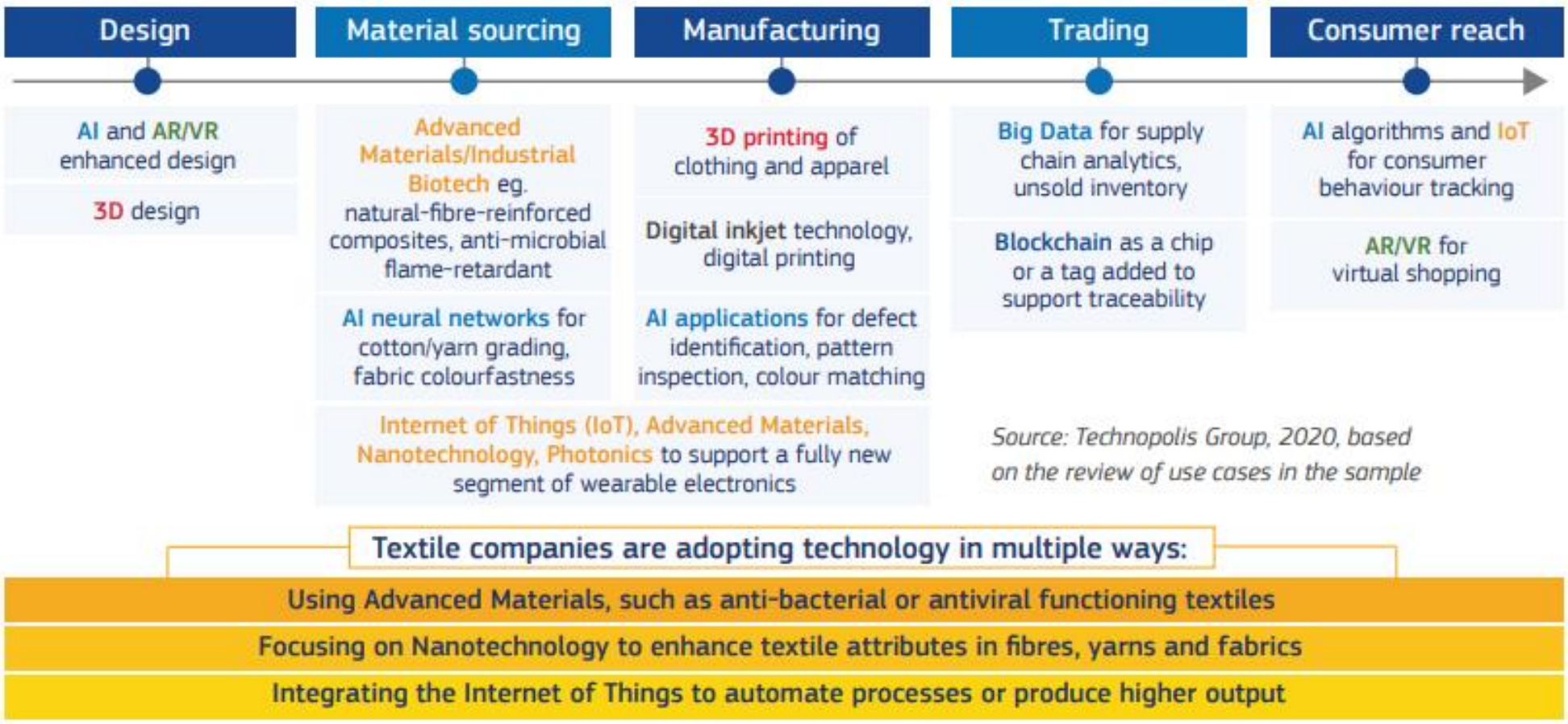
Source: European Union (2020): https://circulareconomy.europa.eu/platform/sites/default/files/categorisation_system_for_the_ce.pdf

Module 02 – 2.4 Best Practice Examples (business examples)

The **highlighted** cases will be explained in more detail in Module 6!

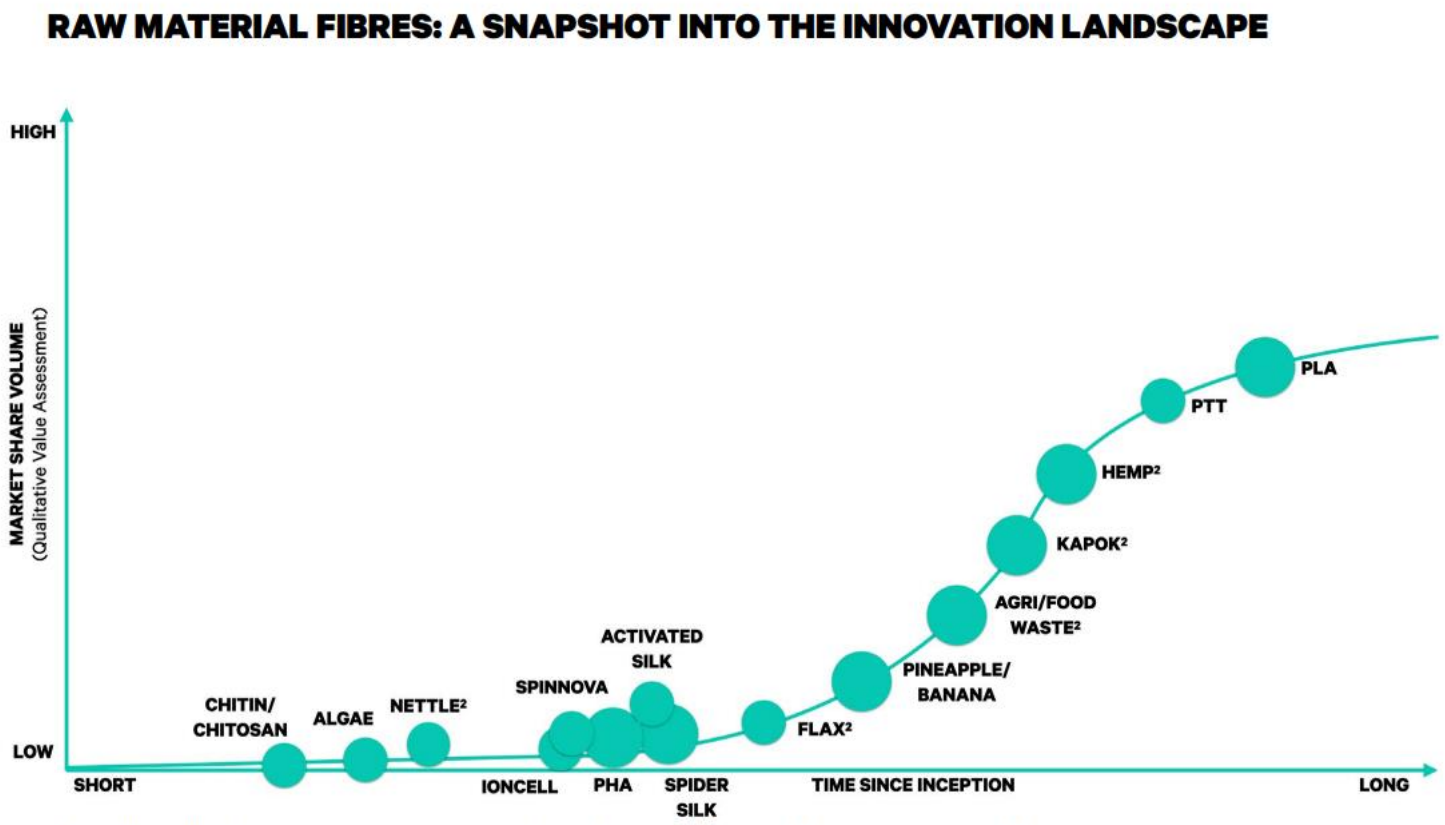


Technological trends in the textile sector



Sources: European Union (2021): https://ati.ec.europa.eu/sites/default/files/2021-07/Leaflet%20Technological%20trends%20in%20the%20textiles%20industry.pdf

Technologies Used for Material Sourcing



[2] Bast fibres like flax, nettle and hemp, as well as fibres such as kapok and banana have been around for centuries are well established. What is shown here are innovations in quality and efficiency.

Sources:
FashionForGood (2020): https://reports.fashionforgood.com/report/state-of-the-circular-innovations-in-the-indian-fashion-and-textile-industry/chapterdetail?reportid=181&chapter=4

Technologies Used for Material Sourcing

Plant-based natural fibers:

- **Bast fiber**, also known as phloem or skin fiber, is derived from the phloem—the inner bark or bast—encircling the stem of specific dicotyledonous plants. It bolsters the conductive cells of the phloem and fortifies the stem, with flax and hemp being prime examples.
- **Leaf fibers**, termed hard fibers, are utilized primarily for cordage or vegan leathers. These fibers, found in fleshy leaf plants like pineapple and agave, boast heightened lignin content, rendering them the toughest among plant fibers and are used for materials like sisal.
- **Fibers from seeds and fruit** are often attached to hairs or enclosed within a fibrous husk, as seen in cotton, coir, and kapok.
- **Wood fibers** are sourced from trees, grasses, and bamboo. They tend to be stiffer and typically require an additional process to soften.
- **Hemp** offers incredibly versatile and beneficial fibers known for their antibacterial properties, durability, resilience, and natural cooling abilities. It's a fast-growing plant that requires minimal water, doesn't need herbicides, pesticides, synthetic fertilizers, or GMO seeds
- **Coffee fibers** which consist of post-patented processed coffee ground and polymers offer excellent natural anti-odour qualities, in addition to UV ray protection and a quick drying time

Sources:
FashionUnited (2017): https://fashionunited.com/news/business/6-sustainable-textile-innovations-that-will-change-the-fashion-industry/2017100917734
West (2021): https://www.textileworld.com/textile-world/features/2021/04/fiber-world-sustainable-alternative-plant-fibers-for-textiles/

Technologies Used for Material Sourcing

- Regenerative protein fibers: man-made fibres produced from either animal or vegetable non-fibrous proteins which have been reconfigured to take up a fibrous form to emulate the natural protein fibres of wool or silk (cupro fibres, casein fibres, groundnut protein fibres, zein fibres, soya bean fibres, silicate fibres and alginate fibres)



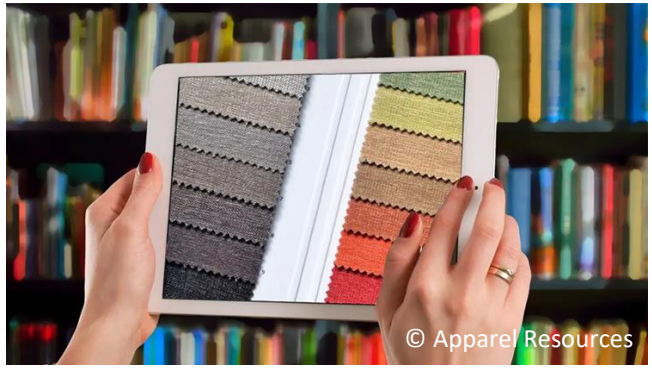
- Man-made cellulosic fibers are crafted from natural origins through the extraction of cellulose, converting it into pulp, and subsequently spinning it into yarn. Cellulosic materials like wood, food waste, or agricultural remnants undergo either chemical or mechanical treatments to produce a fresh fiber. Numerous innovative processing technologies are revolutionizing the cellulosic industry, such as Lyocell and the more recent Eastman's Naia™ fiber.



Sources:
FashionForGood (2020): https://reports.fashionforgood.com/report/state-of-the-circular-innovations-in-the-indian-fashion-and-textile-industry/chapterdetail?reportid=181&chapter=4
TradeKey (n.d.): https://www.tradekey.com/product-free/Cupro-Fiber-And-Non-Woven-Waste-2908595.html

Technologies Used for Design and Manufacturing

- Digital textile library for design: A digital textile library is an online resource facilitating designers and brands in sourcing a wide array of textiles, grappling with the challenge of adapting to rapid industry changes and showcasing material textures virtually, especially in the context of increased digital exhibitions since the pandemic.



- Digital printing, an almost waterless process, relies on factors like color variations, print layers, and fabric type for color durability. Its most promising innovation involves pigment use, potentially suitable for all materials, albeit requiring ready-for-dye fabric and heat press post-treatment. This technology marks a sustainable shift from traditional dyeing, saving water, chemicals, and energy, while enabling near-shoring, on-demand production, and customization



Sources:
Apparel Resouces (2022): https://apparelresources.com/fashion-news/innovation/five-latest-technologies-plant-based-sustainable-innovations-textile-fabric-domain/#:~:text=Five%20latest%20technologies%20and%20plant-based%20sustainable%20innovations%20in,Armor%20...%208%20Insect%20Proof%20...%20Weitere%20Elemente
TexIntel (n.d.): https://www.texintel.com/press-room/digital-textile-printing-expected-to-drive-the-global-textile-printing-machine-market-to-139-bn-by-2025

Sorting Technologies

Near-Infrared (NIR) and Visual Spectroscopy (VIS) Sorting: This technology utilizes near-infrared and visual spectroscopy to sort textile waste by fiber type and color.

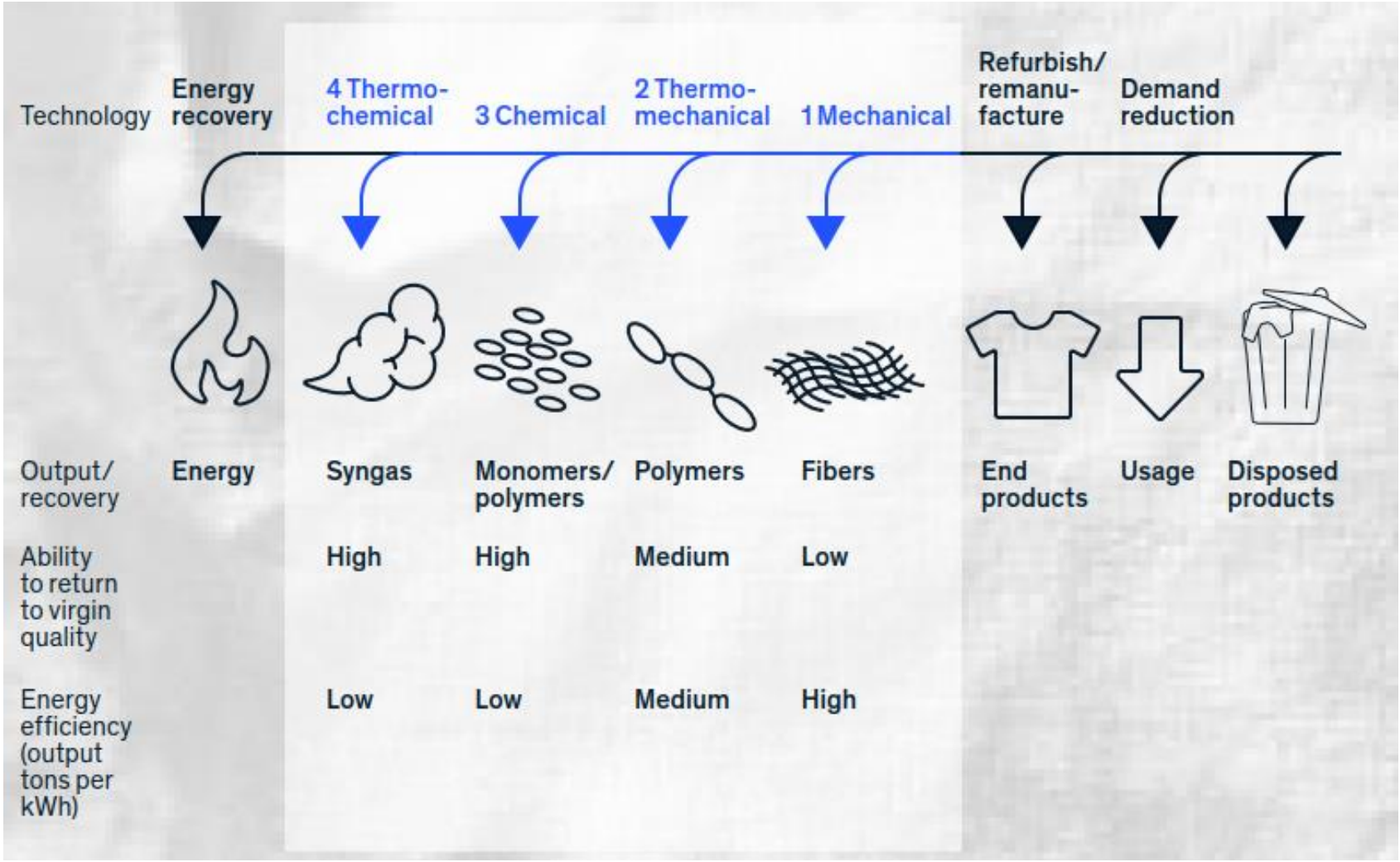
Automated Sorting Systems: Automated sorting systems use advanced technology to separate whole and shredded textiles by color and type while removing impurities like buttons and zippers, contributing to efficient textile waste sorting.

Hyperspectral Vision Technology: This technology is based on hyperspectral vision, allowing for automated separation of materials, including textiles, leading to a greater recovery of value through precise and accurate material classification for recycling.



Sources:
TOMRA (n.d.): https://www.tomra.com/en/waste-metal-recycling/applications/waste-recycling/textiles
Innovation in Textiles (2021): https://www.innovationintextiles.com/first-fully-automated-sorting-plant-in-sweden/
Recycling Inside (2022): https://recyclinginside.com/recycling-technology/separation-and-sorting-technology/hyperspectral-vision-and-the-classification-of-textiles-for-recycling/
Glover (2020): https://www.ecotextile.com/2020111727004/materials-production-news/first-industrial-textile-sorting-system-launched.html

Recycling Technologies



Sources: McKinsey (2022): https://www.mckinsey.com/industries/retail/our-insights/scaling-textile-recycling-in-europe-turning-waste-into-value#/

Recycling Technologies

Technology	Definition of recycling process
Mechanical recycling	Process based on physical forces, which may be used in isolation for fabric or fibre recycling or as pre-processing for thermo mechanical or chemical and biochemical recycling processes. • Closed-loop recycling: recycling the material to create a product that is nearly identical to the original. • Open-loop recycling: recycling the material to produce a different category of product.
Thermo-mechanical process	Process based on heating with the aim to recover either polymers or low molecular weight building blocks.
Chemical recycling	Process using chemical dissolution or chemical reactions which is employed in polymer or monomer recycling.
Thermo-chemical recycling	Process using partial oxidation reaction of polymers to produce low molar mass components or heat to degrade polymers to monomers that can be used as feedstock for the chemical industry, with the exclusion of fuels used for energy production or other combustion or energy recovery processes.

Source (adapted from): Gustav Sandin, Greg M. Peters (2018): https://doi.org/10.1016/j.jclepro.2018.02.266

Best Practice Examples – Raw Material

Spinnova: Clean manufacturing through advanced technology:
→ Spinnova, produces a cellulose-based fibre that emulates the properties of traditional cotton, but without toxic chemicals. It takes 99 per cent less water to produce than cotton and can be recycled repeatedly without loss of quality to the fibres.





Spintex: Clean manufacturing through advanced technology:
→ Creates next generation fibres and materials from a liquid silk solution. The artificially spun silk filaments are produced sustainably and efficiently. Fibres are spun from a waterbased silk solution, purely by applying a small pulling force, which forms the solid fibres through self-assembly.

AltMat (India): They have developed a proprietary process to extract usable bast fibre from agricultural produce, sourcing hemp and banana agri-waste directly from organisations and farmers. The fibre is natural, environmentally sustainable and socially inclusive by enhancing farmer's livelihoods. Although, still need to be blended with other materials, like cotton, viscose and polyester.

AltMat

Best Practice Examples - Wet and Dry Processing

Sasmira's Institute of Man-made Textiles (SMMT) (India): They developed a patented technology for waterless dyeing and has built two systems that use supercritical CO2 technology with a capacity of 3 and 20 litres

Nano-Dye: Salt free cationic treatment that changes the charge of the cotton molecule to the opposite charge of the dye to enhance the absorption of the dye into the fibre. Resulting in a significant reduction of waste dye, other auxiliaries and water (75%) and energy (90%) usage.

NTX – Cooltrans: They provide a digitally enabled gravure printing method for both artworks and solids. They distinguish themselves from other printing technologies through their superior fastness, precision and proprietary inks that are manufactured in-house. The technology is applicable to natural, man-made and synthetic fibres.



Best Practice Examples - Cut-Make-Trim

Unspun: On-demand fashion technology company has developed 3D fit algorithms and a 3D weaving machine for intentional and localised manufacturing. With a three second body scan, unspun creates fully customised garments, perfectly matching supply and demand; by using only the fabric that is needed, no waste is produced.

E-Shakti (India): eShakti's custom capabilities allow women to tailor any item to their specific tastes such as changing neckline, sleeve or hem, or tweaking the measurements to ensure a flattering fit. Their patented methodology helps them overcome barriers of sizing and fit concerns as clothes are virtually designed and draped.

Microspin (India): Chennai-based yarn spinning enterprise that holds patents for revolutionary spinning machines that make small lots of yarn on IoT-enabled machinery. Operated via proprietary, energy-efficient algorithms, makes them five times more energy efficient than conventional methods. The resultant crafted yarn that is natural and holds dyes better than conventionally spun yarn and therefore requires half the water in their process.

Best Practice Examples - Retail and Use & End-of-life

Flyrobe (India): India's only VC-funded clothing rental platform, which was acquired by Myntra, a popular shopping platform. With a focus on occasion wear, the platform rented out clothing worth over $10 million in retail value in 2017. It offers pick-up and drop-off logistics and also has brick-and-mortar stores in seven cities around the country

Blocktexx: has developed a patent pending process that combines chemical recovery technology and advanced manufacturing to separate and recycle polyester and cotton blends. The company raised seed funding of over $500k in mid-2019, which enabled the optimization of their technology in a pilot plant alongside trial projects with supply and demand partners

TrusTrace: provides brands such as Filippa K, Decathlon and the Fenix Group, with a blockchain-based software platform for tracing their supply chain from fibre to garment. The information is used by brands to communicate this information to their customers, perform internal risk analysis and manage their supply chain better.

Re4Circular's: Their business model centers on an AI-driven technology and B2B platform streamlining textile waste sorting, digitization, and redirecting used clothing towards circular fashion destinations, in line with upcoming EU mandates on waste collection.

Business Case Development Examples

Promotion of Multi-Stakeholder Projects for Sustainable Textile Supply Chains in Jordan

THE CHALLENGE

- Production of **ready-made garments** (RMG) in **industrial zones** such as the Al-Hassan Industrial Estate (HIE) results in considerable amounts of **solid textile waste** in Jordan
- Textile waste is disposed of **in municipal landfills**
- Ministry of Local Administration announced that **Al-Ekeider Landfill will no longer accept textile waste from HIE**
  - → Decision was overruled and landfill **continues to receive RMG waste** from the HIE

THE OPPORTUNITY

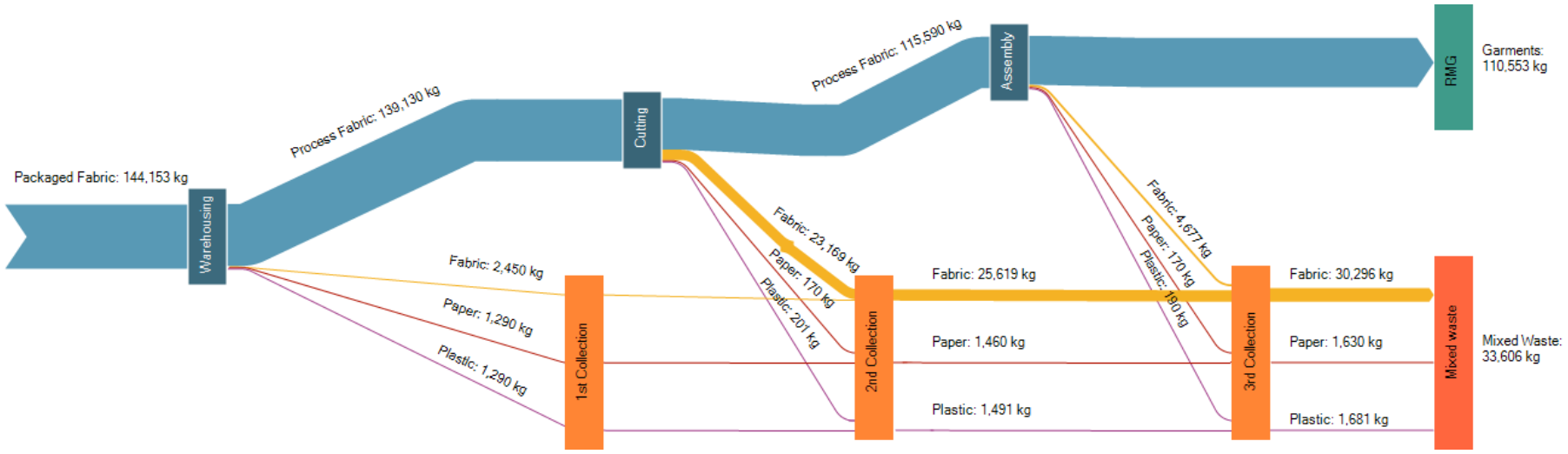
- Assessment of **data on RMG waste from the HIE**
  - → Collection of **quantitative and qualitative data** from **9 RMG manufacturers** and **3 other HIE management stakeholders**
  - → Conduction of a **Material Flow Analysis**
- Development of **business cases** for the **prevention** and **revalorisation of waste**
- Identification of **pilots for implementation**

Project Info: https://adelphi.de/en/projects/promotion-of-multi-stakeholder-projects-for-sustainable-textile-supply-chains-in-jordan

Business Case Development Examples

Promotion of Multi-Stakeholder Projects for Sustainable Textile Supply Chains in Jordan

Material flow analysis and waste characterization



1. *The figures are daily amounts, and refer to the year 2021.*
2. *The collection point in reality are mixed waste containers. The distinction between waste flows has been done only for illustrative purposes.*
3. *No distinctions between RMG products has been conducted.*
4. *Other types of waste (e.g. food from canteens, packaging wood, etc.) are neglected in this assessment.*
5. *It considered that all imported goods in 2021 have been used in the same year, and not material from years before have been processed in 2021.*

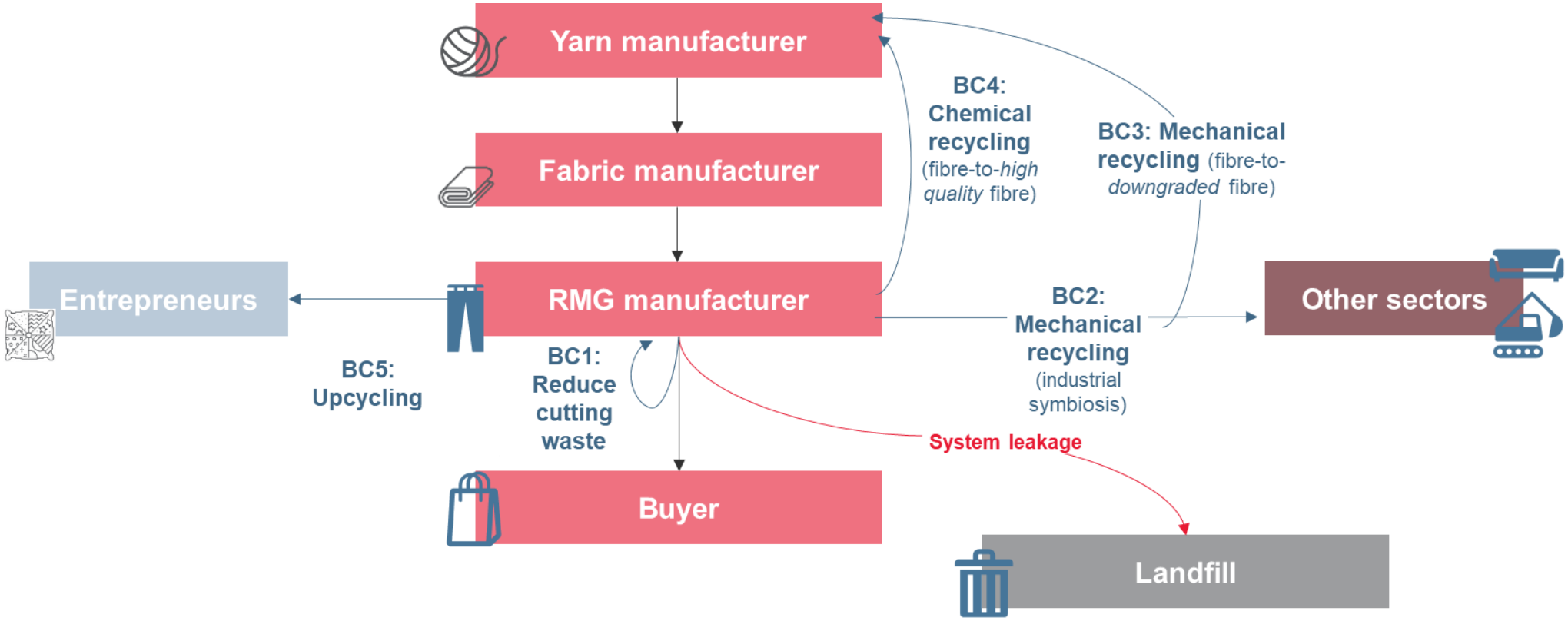
- Process Fabric
- Fabric waste
- Paper waste
- Plastic waste
- Finished RMGs
- Mixed Waste
- Collection Points
- Manufacturing Processes

Project Info: https://adelphi.de/en/projects/promotion-of-multi-stakeholder-projects-for-sustainable-textile-supply-chains-in-jordan

Business Case Development Examples

Promotion of Multi-Stakeholder Projects for Sustainable Textile Supply Chains in Jordan

Circularity opportunities were studied and business cases were developed



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Business Case Development Examples

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Source: adelphi, GIZ (2023): https://www.giz.de/en/worldwide/102349.html