REFASHIONING
ACCELERATING CIRCULAR PRODUCT DESIGN AT SCALE

A Practical Guide

Acknowledgement of Country
The Refashioning team respectfully acknowledges the Traditional Custodians and their Ancestors of the lands and waters across Australia, where we live and work.

Acknowledgements
Refashioning (2023-2025) was supported by the Victorian Government's Circular Economy Innovation Fund as part of the Circular Economy Business Innovation Centre (CEBIC). This project would not be possible without the generous support of all the Country Road Group staff involved.

Project partners: RMIT University, A.BCH World, Julie Boulton Strategy and Sustainability, Country Road Group
Graphic design: Regine Abos
Photography: Lily Clatworthy

How to reference this document
Holm, C., Boulton, J., Payne, A., Samie, Y., Underwood, J., Van Amber, R., Islam, S (2025). Refashioning: Accelerating Circular Product Design at Scale.

Published March 2025
Version 1.0

A NOTE ON THE CONTENTS OF THE GUIDE

There are three sections that take you through the "Refashioning Circular Design Method".

1. FUNDAMENTALS

Covers background information on the circular economy and circular design principles

2. METHOD

Steps through how to create circular products and solutions

3. APPLICATION

Links to the templates and other useful resources.

This guide is open-source and has been developed through an iterative design process. While this guide focuses on clothing, the method can be adapted for other materials and products.

The underlined text is clickable and will take you to definitions and further reading.

For a printable version, please visit Refashioning website: refashioning.org

Examples from real businesses are featured throughout the guide to show how different design teams have adopted circular design processes in practice.

The green tabs let you know there are interactive buttons to click on to provide additional information.

The yellow tabs are prompts and actions to encourage deeper thinking and to show alternate applications for specific business requirements.

CONTENTS OF THE GUIDE

1. FUNDAMENTALS

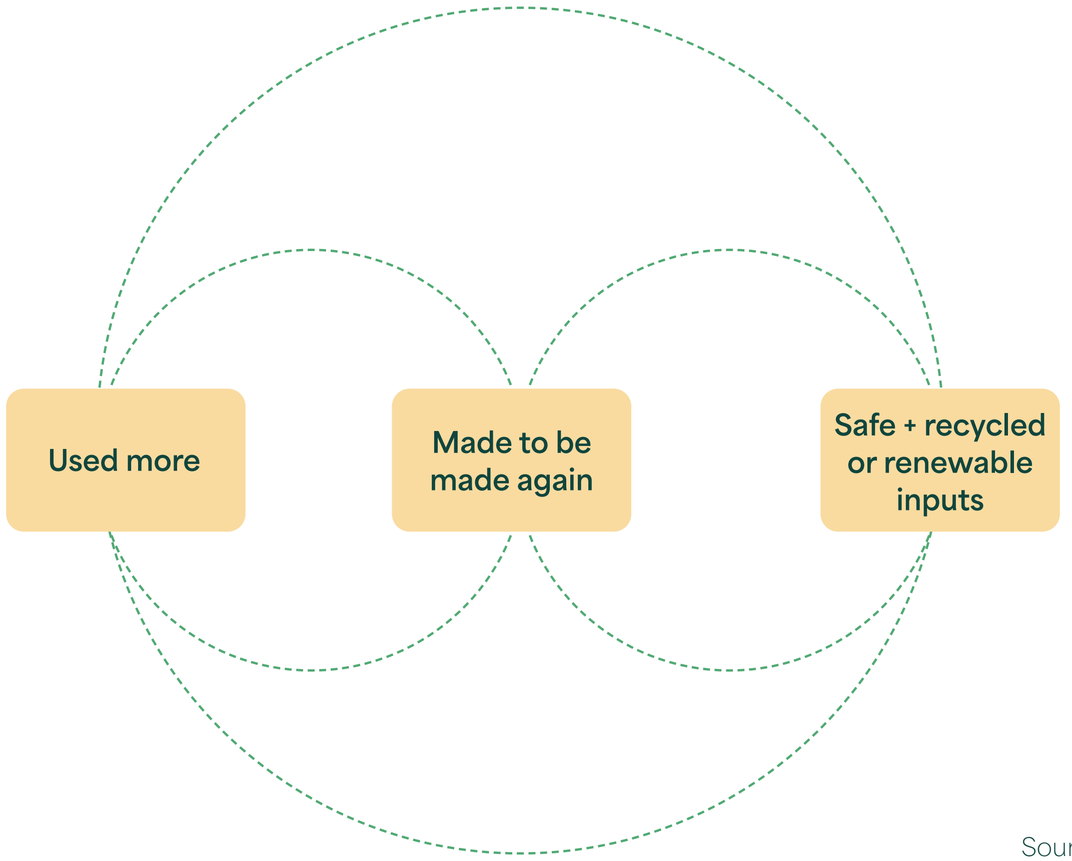
Principles for a Circular Economy

Linear Economy
is a dominant economic model where products are made, used and then discarded, also known as the 'take, make, waste' economy.[1]

Circular Economy
is a model of production and consumption which eliminates waste throughout the lifecycle of materials and products by ensuring that safe, recyclable or renewable inputs are used, and that what we make is used more and made to be made again.

FIGURE 1: Three Principles of a Circular Economy

→ Eliminate waste and pollution
→ Circulate products and materials (at their highest value)
→ Regenerate nature



Source: Adapted from 'Principles for Circular Fashion'[1]

Circular Design: Definitions and Concepts

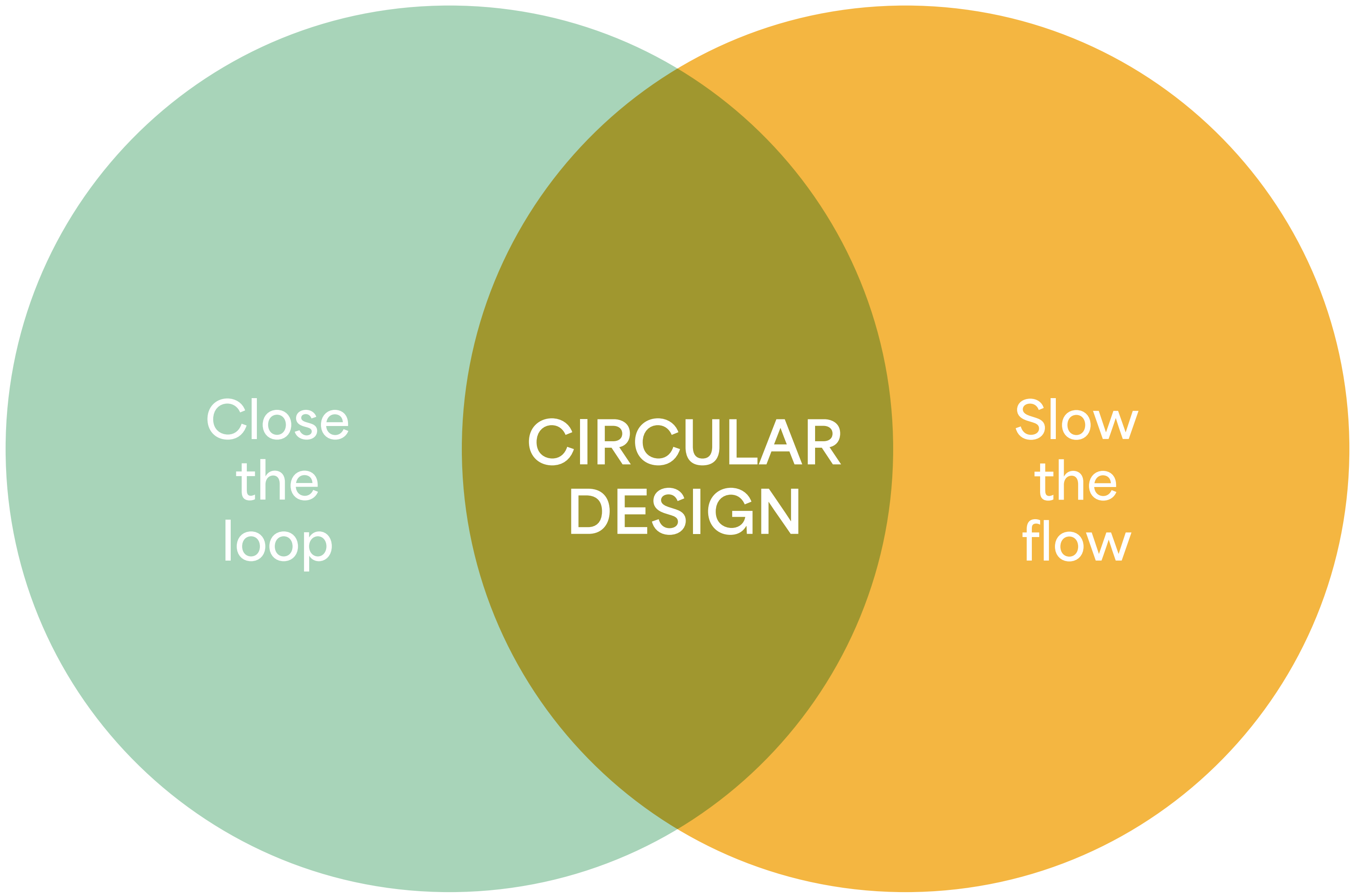
Design
to create, fashion, execute, or construct according to plan[2]

Circular Design
is more holistic than pure design as it embeds circular economy principles into the design process, specifically through slowing the flow and closing the loop. The objective is to produce products that can participate fully in a circular system.

Slowing the Flow
is about designing for long life – planning and designing products to be kept in use, at their highest value, for longer.

Closing the Loop
is about designing for end of life – identifying how material value can be captured and reclaimed from the beginning. It requires smart material choices, planning, communicating, and executing lifecycle strategies beyond the point of sale.

FIGURE 2: Refashioning Circular Design Method



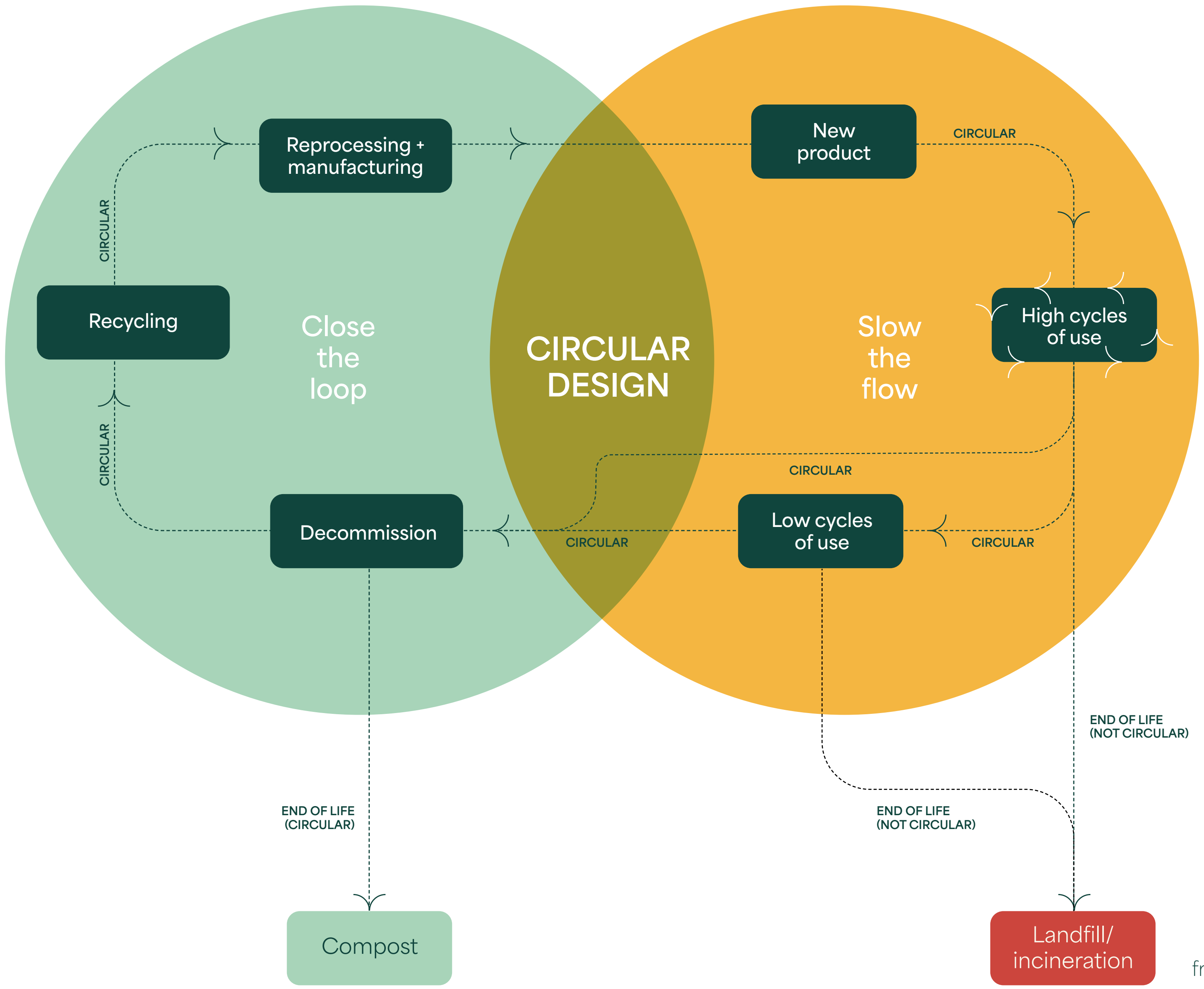
Taking a Systems Approach to Circular Design

The diagram on the right illustrates Refashioning's approach to circular design; a combination of 'slowing the flow' and 'closing the loop'. Both concepts are to be embedded in tandem at the design stage in order to create circular products for a circular system.

Recognising that the current production and consumption system is inadequate to execute circularity at scale, Refashioning invites designers to lean into the challenge, outlining specific strategies to ensure the garments they design are circular-systems-ready. In so doing, designers will stimulate system-wide transformation, encouraging the development of circular business models and end of life infrastructure.

Importantly, designing in this way will trigger changes in product and material flows to actively regenerate the world's natural systems, going beyond merely minimising environmental impact.

FIGURE 3: Refashioning Circular Design Systems Approach



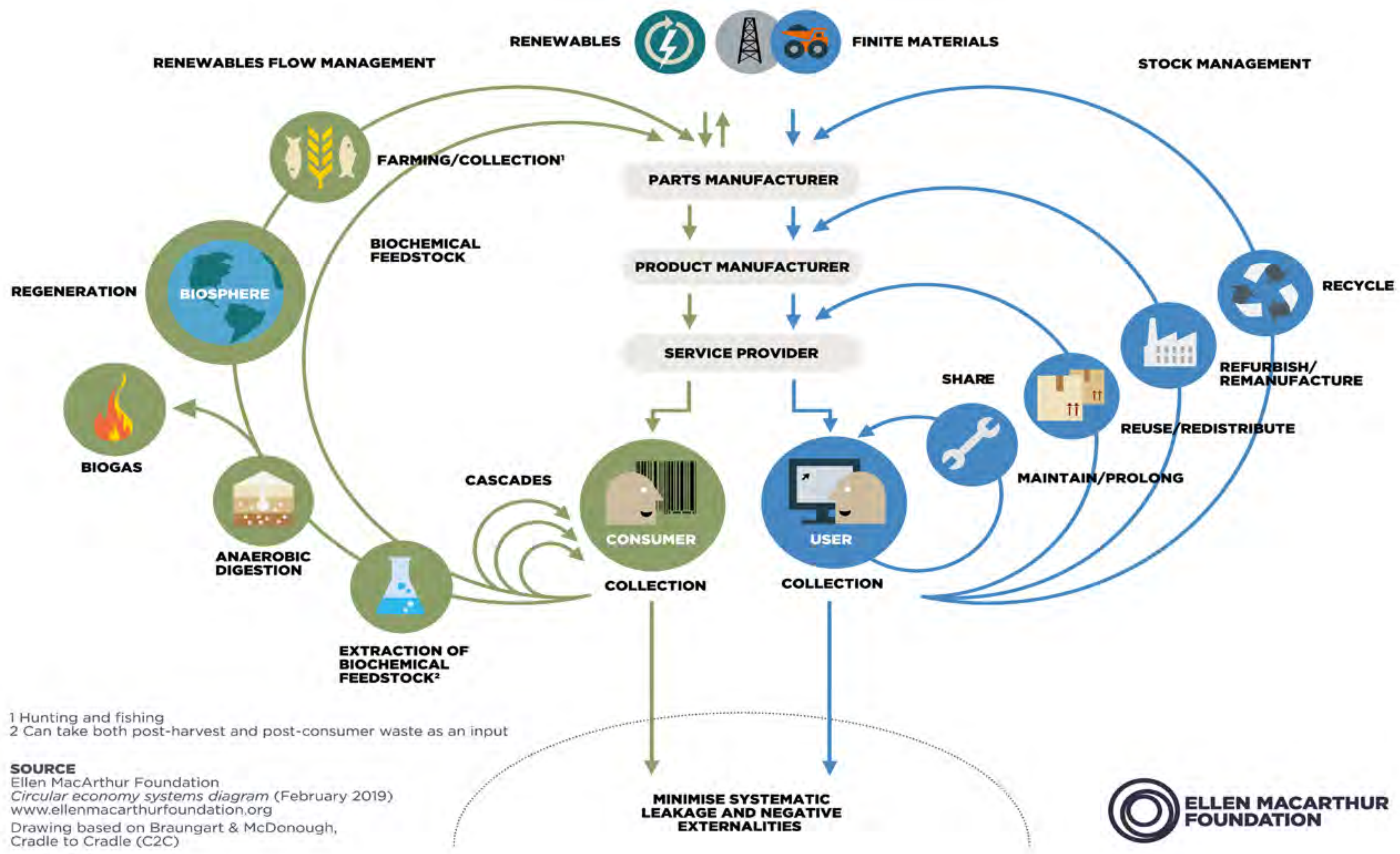
Source: adapted from A.BCH World

Circulating Products and Materials

Circular designers play a critical role in identifying how to keep products and materials in circulation, eliminating waste and enabling regeneration.

To assist with understanding how to do this, Ellen MacArthur's Circular Economy Systems Diagram provides a useful illustration of how a circular economy can ensure the continuous flow of materials through two cycles: biological and technical.[1]

FIGURE 4: Ellen MacAurthur's Circular Economy Systems Diagram[1]



Learn more about the Biological Cycle next.

Circulating Products and Materials: Biological Cycles

The **biological cycle** refers to a natural systems process for materials that are generated, consumed and returned to the earth safely (e.g., regenerative farming, anaerobic digestion, composting).

Circular design within the biological cycle requires the use of safe and regenerative materials that can return to and regenerate the biosphere.

Several materials in fashion begin in a biological system (for example cotton may be grown from the soil in a regenerative way) however, given the resources required to create clothing, garments should, as a general rule, also move through the loops of the technical cycle to keep them in use for as long as possible.

These loops include reuse and repair, remanufacture, repurpose and recycle. The biological cycle is important to understand and design for as eventually, clothing made from biological materials will wear out and reach their limitations for recycling.

When these products are designed, made, used and cycled appropriately they are able to re-enter the biological cycle for natural digestion, reverting into nutrients for soil health and enabling new biological material regeneration.

Learn more about the Technical Cycle next.

Circulating Products and Materials: Technical Cycles

In the technical cycle, products and materials are designed to be kept in circulation for as long as possible so as to maintain the value embedded in the product. This means processes to maintain and prolong a product's life such as repairing and reusing (the inner loops in the diagram on page 9) are prioritised before the more destructive and de-valuing actions of remanufacturing and recycling (the outer loops in the diagram on page 9). The inner loops are also seen as lower effort and keeping higher product value, while the outer loops require greater efforts with, typically, lower value outcomes.

In theory, clothing should move continuously through the loops of the technical cycle.

However, the majority of the clothing today ends up either in landfill or incinerations; a massive loss of value (both physical and perceived).

This is because most clothing today is not designed for circularity: operationalising both the technical and biological cycles remains unfulfilled.

A new mindset – one of circular design – is therefore crucial to ensure products, materials and by-products align to both the biological and technical cycles.

The Resource and Waste Hierarchy (on page 12) provides further guidance of the hierarchy that clothing should follow in the technical cycle.

Discover the Resource and Waste Hierarchy

Resource and Waste Hierarchy

The Resource and Waste Hierarchy further illustrates the loops within the technical cycle.

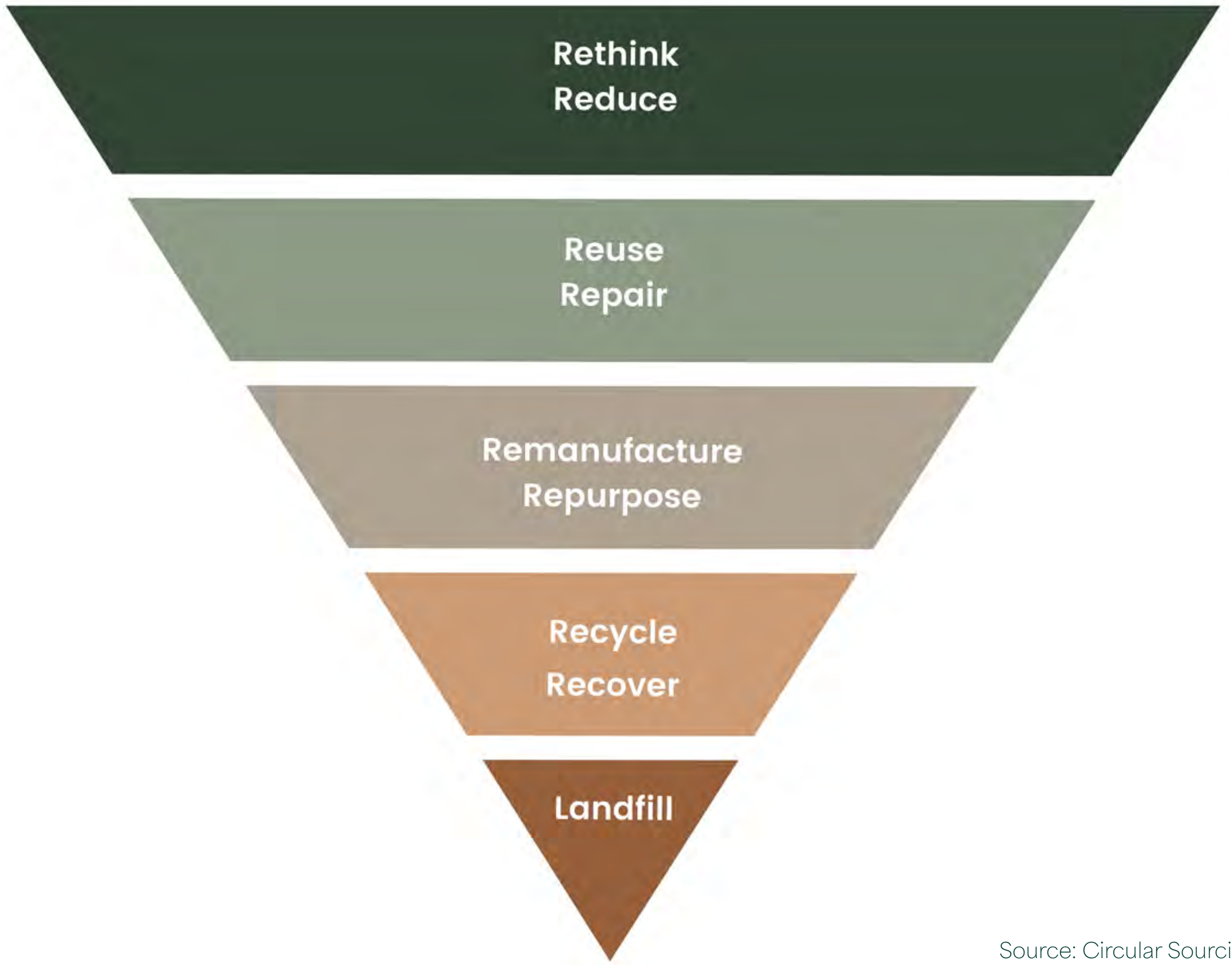
The diagram's logic applies to the circular system as a whole, meaning that strategies and actions which both 'slow the flow' and 'close the loop' should be pursued.

The diagram is to be interpreted as having two priorities:

1. to regenerate nature by reducing what is produced and consumed (the top of the triangle)

2. to eliminate all waste (the bottom of the triangle) by ensuring that no garments or textiles are ever destroyed in incineration or landfill

FIGURE 5: Resource and Waste Hierarchy



Source: Circular Sourcing

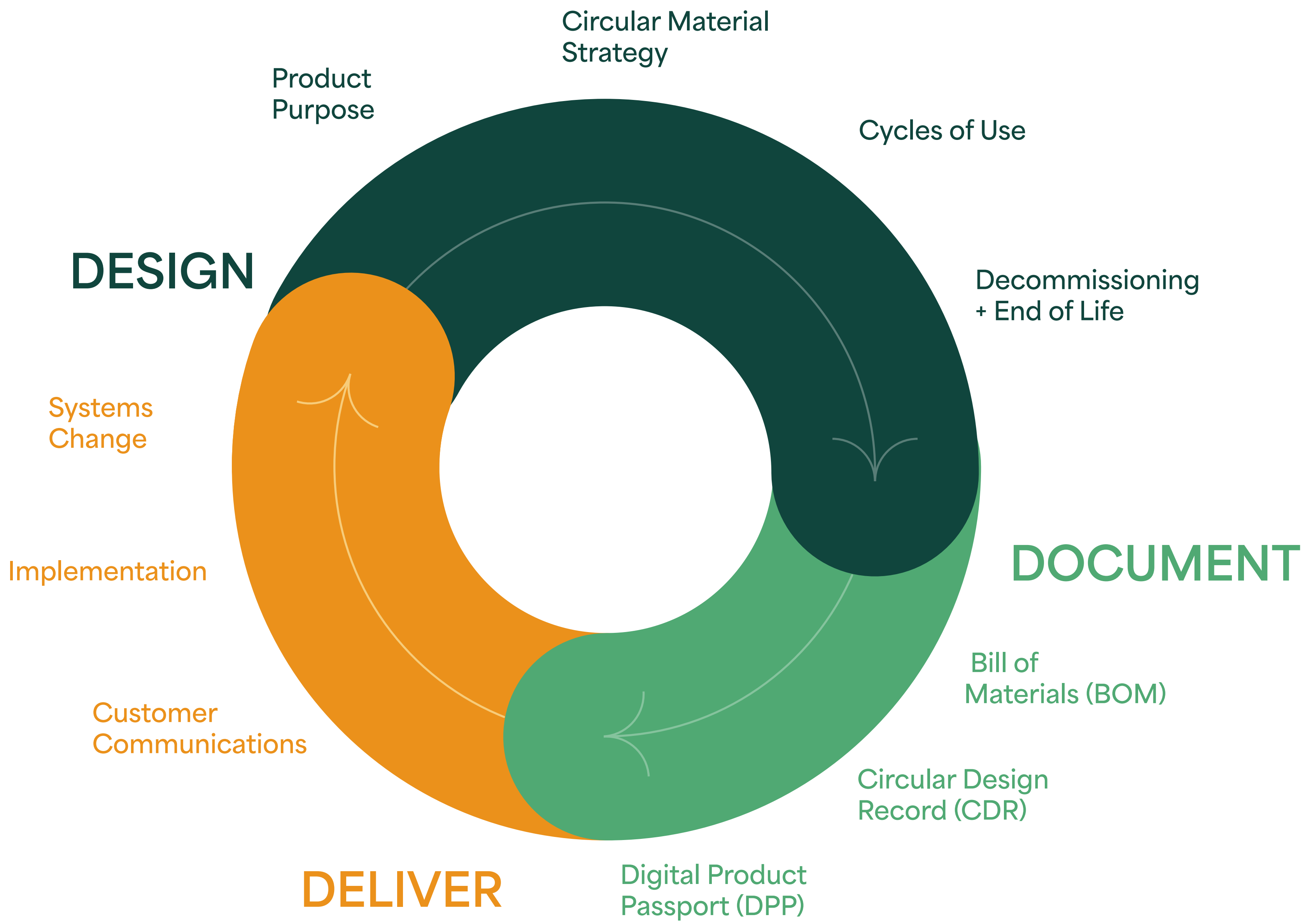
Refashioning Circular Design Method

The Refashioning Circular Design Method is a thorough and tested approach to circular design. The diagram on the right highlights all steps that a designer must take to design for circularity, covering product purpose, material strategies, use and end of life planning plus documentation and implementation.

At the heart of the Refashioning method are the three principles of circular fashion design: using safe, recyclable or renewable inputs; products are used more; and are made to be made again. To achieve this, a circular designer will need to stretch beyond the current processes of design.

Circular design using the Refashioning method is an iterative process. It's expected that designers continuously learn from and improve upon previous design iterations to create increasingly circular products and solutions over time.

FIGURE 6: Refashioning Circular Design Method



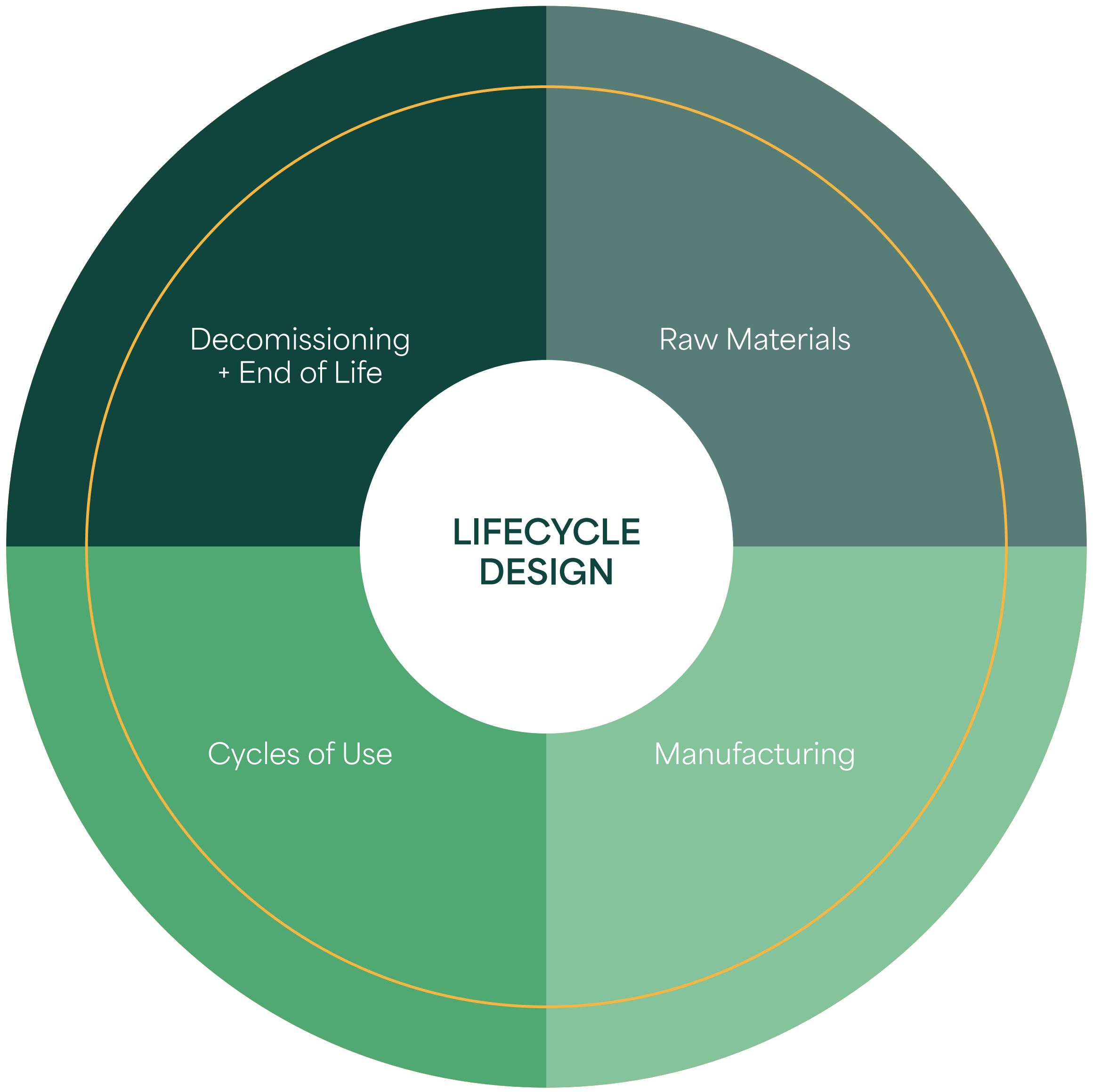
Circular Design Extending to Lifecycle Design

To achieve full circularity, circular design processes must extend beyond material selection to cover the entire lifecycle of a product and the system it cycles within.

For circular clothing design, the lifecycle stages are Raw Materials, Manufacturing, Cycles of Use, and Decommissioning and End of Life.

Design that engages with all four stages is called Lifecycle Design where a circular designer ensures each stage is planned for, documented and communicated. The integrity of Lifecycle Design is maintained through excellent and detailed record keeping and communications with internal and external partners and stakeholders. This requires circular designers to look beyond the point of sale and become excellent multi-stakeholder communicators across a product's entire value chain.

FIGURE 7: Refashioning Lifecycle Design



Refashioning: Future Systems Transformation

Refashioning is an ambitious invitation for designers to lead the charge in circular economy transformation, while recognising the need for greater systems change.

Design teams can control the circular attributes of a garment and businesses can leverage communications to educate consumers. However, broader systems-wide transformation of the entire value chain, as well as the principles and procedures which regulate how the system operates will be critical to enable full circularity for fashion and clothing.

Systemic challenges for transformation include:

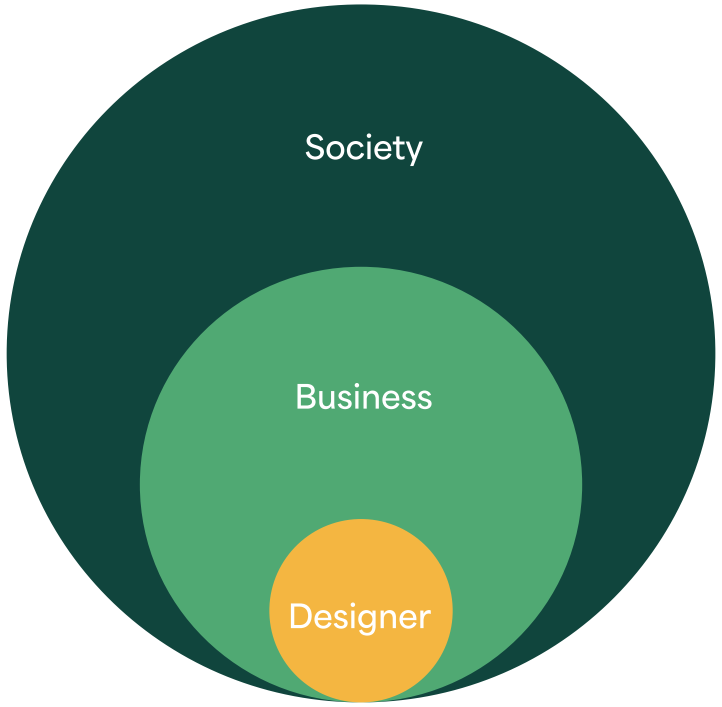
- recycling infrastructure, including recycling facilities, collection and sorting operations;
- circular material sourcing;
- citizen behaviour around consumption, particularly regarding use and care practices; and
- regulation for circular solutions.

Refashioning calls for further collaborative action on each of these areas so as to embed and accelerate circularity at scale.

Systems-transformation actions include:

- Working with other designers and businesses to share solutions, e.g., sourcing materials collaboratively.
- Engaging in multi-stakeholder forums (to share, learn and advocate).
- Educating customers on their role in circularity.
- Investing in circular raw materials and zero waste manufacturing systems.
- Pushing for regulatory change, including industry standards.
- Extended Producer Responsibility Schemes such as Seamless in Australia.
- Establish or fund circular businesses models, such as rental, repair, donations and re-styling to meet circularity ambitions, particularly around extending cycles of use.

FIGURE 8: The Designer in Context

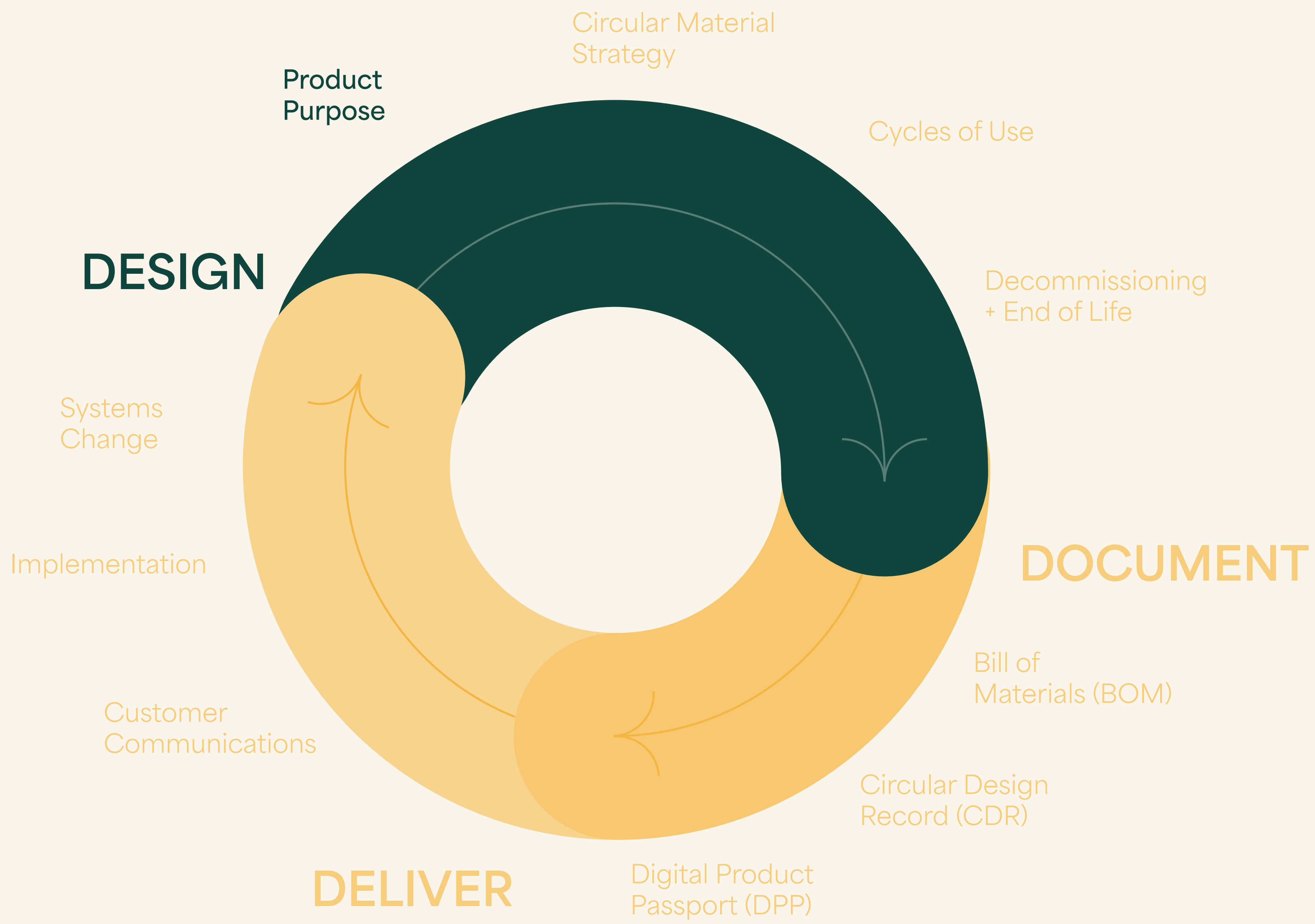


2. METHOD

Design: Product Purpose

THIS SECTION COVERS

- Product Purpose Statement
- Design for Highest Value
- Introduction to Lifecycle Partners



Product Purpose → Product Purpose Statement

The Product Purpose Statement outlines the garment's expected:

- function;
- type;
- lifespan (see page 29);
- core test performance standards (see page 29);
- design durability (see page 29); and
- user behaviour.

The Product Purpose Statement frames all decisions on the circular design journey of the garment by the designer. It is a crucial step in designing for circularity and should be revisited at every stage of the circular design process.

Note on user behaviour: To understand and communicate how the garment is expected to be valued by the user, draw on existing data or collect data on specific user behaviours such as purchase frequency and repair practices.

PRODUCT PURPOSE STATEMENT EXAMPLE
COUNTRY ROAD HERITAGE SWEATSHIRT

Function	Type	Lifespan
Everyday Wear	Sweatshirt	>6 years

Core Tests
Dimensional Stability to Wash, Colourfastness to Wash

Design Durability	User Behaviour
The garment will be designed in a classic cut, in timeless and repeatable (non-trend) colours, focus on comfort of fit and materials, quality tested materials and stitching, brand recognition and clear care instructions printed within.	Garment worn and properly cared for by user/s. Product is repaired and reused. When no longer wearable, product is returned by current user to specified collection facility for sorting and mechanical recycling.

Product Purpose → Design for Highest Value

Design for highest value means:

- Appropriately valuing the raw materials, resources and skills required to make the product;
- Actively creating opportunities for the user/s to value the product over a long time period;
- Designing for high value material recovery and recycling; and
- Investing in communicating the product's lifecycle plan to the relevant stakeholders.

Less than 1% of the global fibre market comes from recycled textiles[3], meaning most clothing ends up in landfills around the world.

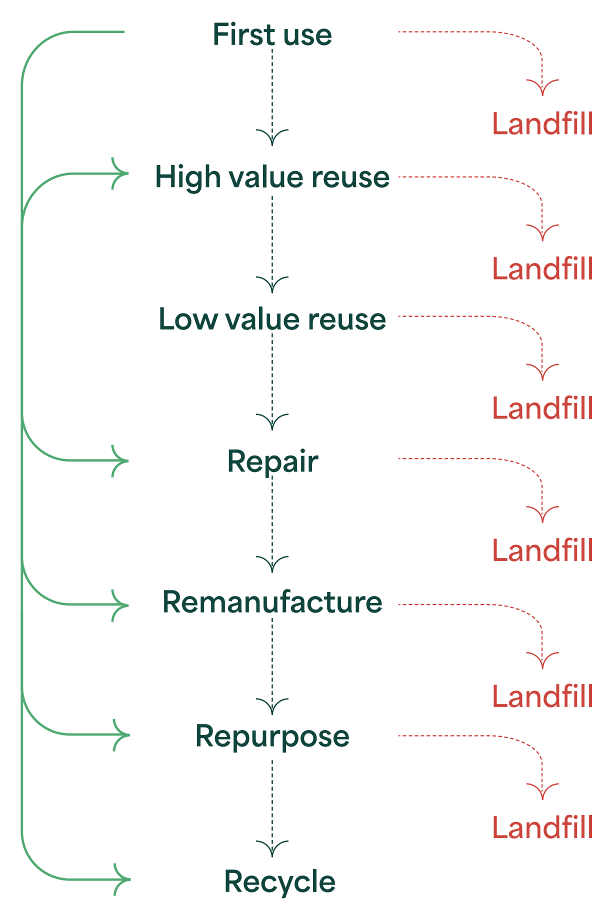
There are several reasons for such low textile recycling rates, including that post-consumer clothing waste is not of high enough quality (or value) to invest the effort and energy required to reclaim and recycle it into new materials; that landfill remains the cheapest place for textile waste to flow to; and virgin fibres are, generally, more competitive on price and simpler to process and manufacture into textiles and products.

While greater incentives are needed to build the infrastructure and processes for textile to textile recycling at scale, design can help accelerate this by focusing on the **Lifecycle Design** (see page 14).

Lifecycle Design requires building value into a garment, both at the materials and product level, improving feedstock quality and incentivising circular business models and flowing through the loops of the technical cycle (see Downstream Clothing Flow diagram on the right).

The integrity of Lifecycle Design is maintained through excellent record keeping and communications with internal and external partners and stakeholders.

FIGURE 9: Downstream clothing flow



Source: Adapted from A.BCH World

PROMPT
Landfill is the easiest and cheapest place for discarded textiles to flow in every stage of the value chain, so, how could you design for highest value at each stage? What needs to change?

Product Purpose → Introduction to Lifecycle Partners

Lifecycle Partners are stakeholders who **provide an associated service integral to ensuring a garment can flow through the circular system**. Understanding and working with Lifecycle Partners at the design stage is especially relevant when developing use cycle plans, and preparing for decommissioning and end of life scenarios.

Lifecycle Partners can be:

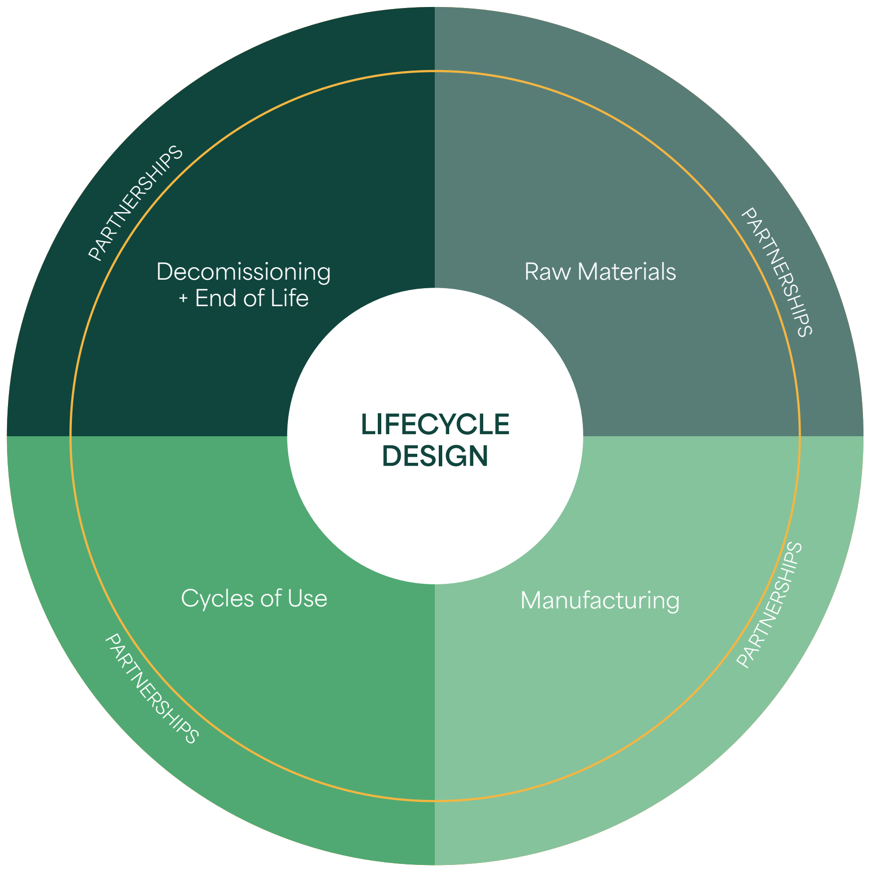
- internal or external to your business; and
- pre-existing or new partners.

Working with Lifecycle Partners is an opportunity to both engage with new suppliers and to develop or support new business models as part of your existing business offering and supplier relationships.

Documenting the agreed relationship and responsibilities of each party should be recorded as part of the Circular Design Record (CDR) outlined further on page 49.

ACTION 1
Create your Product Purpose Statement, documenting it in your Circular Design Record. Plan and action any Lifecycle Partners (internal or external) that may be relevant to this step.

FIGURE 10: Lifecycle Design

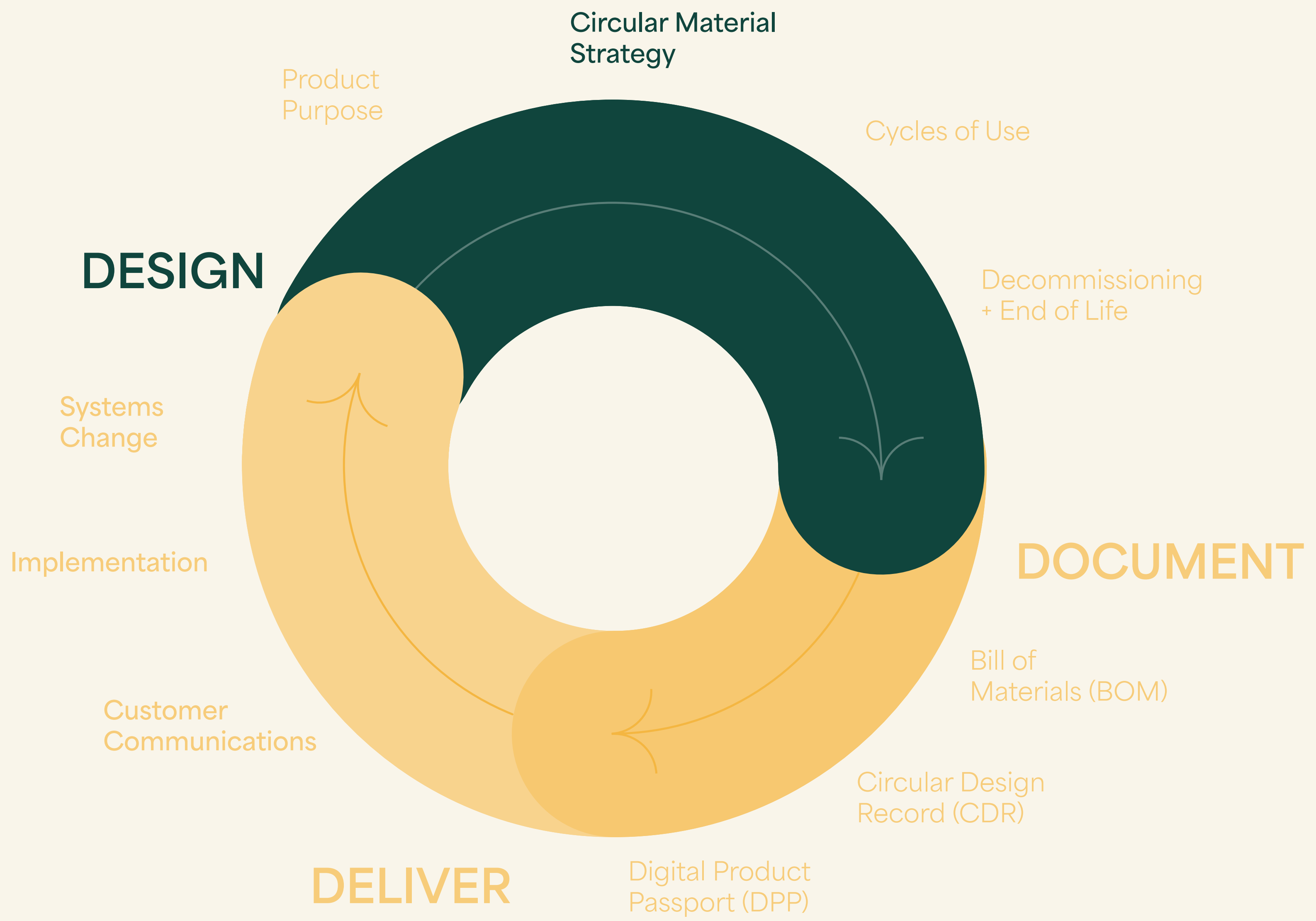


Source: Adapted from A.BCH World

Design: Circular Material Strategy

THIS SECTION COVERS

- Material Catagories for Circular Design
- Material Strategies
- Bill of Materials (BOM)
- BOM: Circular Inputs, Chemistry, Traceability
- BOM: Examples
- Durability Stratagies
- Baseline Durability
- Core Tests and Design Durability
- Circularity Potential and Circular Design Testing
- Production Efficiencies
- Lifecycle Partners



Circular Material Strategy → Material Categories for Circular Design

Materials for circular design fall into three categories: Biological, Technical and Mixed. In the figure on the right, the further down the triangle, the greater the difficulty for a product to flow through a circular system, in particular the biological cycle to ultimately regenerate nature.

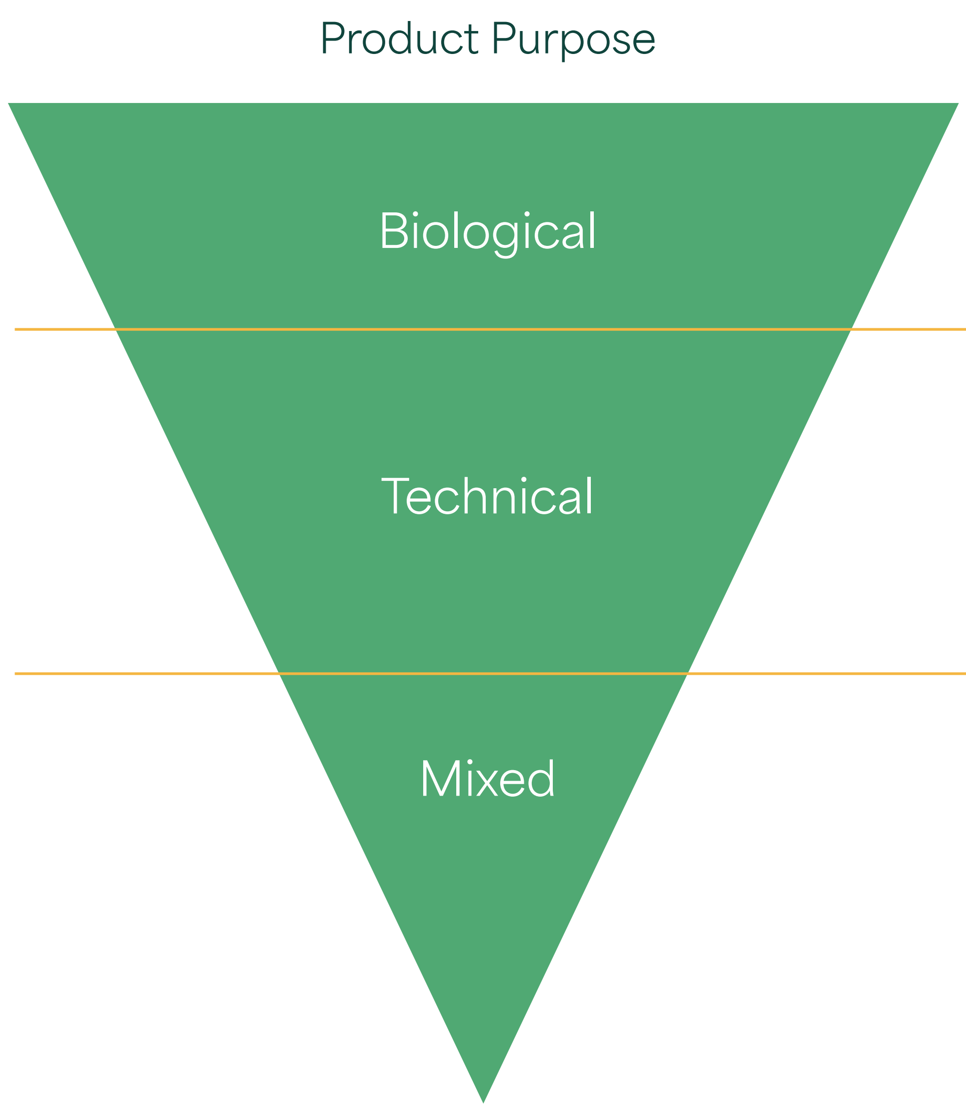
Biological materials are derived from natural fibres, are not augmented with technical materials or inputs, and can return safely to the earth through natural decomposition.

Technical materials are derived from synthetic fibres and are not augmented with any natural materials.

Mixed materials are combinations or blends of both biological and technical materials.

Note: the decision of what material will be used must be aligned to the Product Purpose.

FIGURE 11: Circular Design Material



- Designed with 100% biological monomaterials
- Designed with 100% biological materials that are easily separable/disassembled

- Designed with 100% technical monomaterials
- Designed with 100% technical materials that are easily separable / disassembled

- Designed with technical and biological materials that are easily separable / disassembled
- If design does not fit into any of the above, it is not yet circular

Source: Adapted from A.BCH World

Circular Material Strategy → Material Strategies

Based on currently available end of life options for textiles (at the time of publication), there are six circular material strategies for a designer to choose between.

These strategies align with the circular economy principles of eliminating waste and pollution and regenerating nature. The Cycles of Use section covers the principle of keeping materials in use in their highest value.

The six strategies are a hierarchical list based on:
- Monomateriality or Simple Disassembly;
- the highest lifecycle material value; and
- the simplest, most scaled processes for end of life pathways.

To aid in the decision of which material strategy is most appropriate refer to the Product Purpose first.

If none of the strategies can be applied, designers are encouraged to still continue through the Refashioning circular design method as even 'Not yet circular' products can be designed to flow through the circular system.

The Circular Material Strategy is to be revisited throughout the design process, especially if design changes are made to the garment. This will ensure that the end product remains suitable for the intended purpose.

The circular economy is a dynamic landscape. As innovations for textile recycling launch and scale, more material strategies may open up in the future.

Click on each of the interactive buttons on the right to learn more about your Material Strategy options

Monomaterial Biological

Monomaterial Technical

Simple Disassembly Biological

Simple Disassembly Technical

Simple Disassembly Mixed

Simple Disassembly Poly-Cotton

Not yet circular

Circular Material Strategy → Bill of Materials (BOM)

The Bill of Materials (BOM) is a document (record keeping tool) that captures, measures and tracks every input material (including all components and trims) that make up the garment.

While there is no requirement or regulation as yet for what a BOM should contain, the global industry is moving towards a future where Digital Product Passports (DPP) are expected to be mandatory (read more about DPP on page 50). With this in mind, at a minimum, capture the following information:

- whether the material is a circular input (see page 25),
- the material weight/s (for each input and the full sample garment to create a total metric),
- chemistry certifications,
- traceability certifications,
- component disassembly; and
- chosen end of life pathway.

This information should be compiled and accessible to all relevant parties on a database. The simplest way to do this is to record each of these details in a spreadsheet (see template on page 58), or to use the inbuilt BOM tool within Quadrant Circular © by A.BCH World and Style Atlas.

Because a BOM measures and tracks circular inputs it can also play an important role in identifying the product's Circularity Potential and will prove extremely useful when measuring a product's environmental footprint.

Circular Material Strategy → BOM: Circular Inputs, Chemistry and Traceability

Circular Inputs

Every raw material used in the final product is an input.

A circular input is a raw material that is:

- Recycled; and/or
- Reused; and/or
- Renewable

AND

falls within the selected Circular Material Strategy (see page 28).

The selected Circular Material Strategy applies without compromise. This means that all inputs should adhere to the Circular Material Strategy and no incompatible inputs should be used, irrespective of whether or not they are circular. (e.g., Product: T-shirt; Chosen Circular Material Strategy: Monomaterial Biological; Compatible Circular input: Cotton sewing threads; Incompatible circular input: Recycled polyester sewing threads).

Chemistry

Recording chemical certifications and verifications for each material input will assist with addressing minimum chemical safety standards and to ensure chemistry is compatible with downstream actions such as recycling.

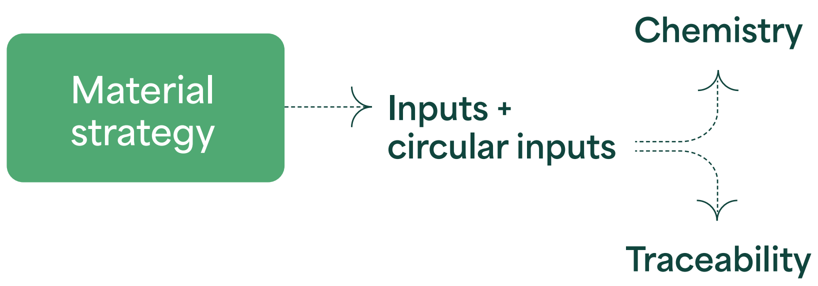
Per and polyfluoroalkyl substances (PFAs) are forever chemicals that can impact a product's recyclability and could have damaging environmental effects when entering the biosphere. Due diligence should be taken to ensure these are not used in manufacturing for any inputs .

Recommended chemistry verifications include minimum best practices as outlined by ZDHC and Oeko Tex.

Traceability

Each input's traceability credentials must be described to maintain accurate records and ensuring claims are verified. Recommended minimum traceability certifications include certifications with a Chain of Custody system such as Textile Exchange's Standards or technologies like FibreTrace.[4,5] Other non-chain of custody certifications can be included in the BOM and marked for areas of potential improvement.

The BOM should include the following input data:



(Additional information on Decommissioning and End of Life are covered on pages 39 – 46)

Circular Material Strategy → BOM Examples within the Material Strategy

EXAMPLE STRATEGY: **NOT YET CIRCULAR**

Circular Material Strategy: *NOT YET CIRCULAR*

BILL OF MATERIALS

Input list	Input Weight	Circular Input	Chemistry Verification	Traceability Verification	De-commission Steps	Input End-of-Life Pathway
100% Cotton Jersey 150gsm - White	*210 grams*	*Renewable*	*None*	*None*		
100% Recycled PET Threads - 35 Tex - White	*18 grams*	*Recycled*	*None*	*RCS*		
100% Recycled Cotton Labels - Optic White / Soy Ink Screen Print - Black	*7 grams*	*Recycled*	*OEKO TEX 100*	*RCS*		
100% Polyester Woven Brand/ Size Label - White / Black Yarns	*10 grams*	*None*	*None*	*None*		

EXAMPLE STRATEGY: **BIOLOGICAL MONOMATERIAL**

Circular Material Strategy: *BIOLOGICAL MONOMATERIAL*

BILL OF MATERIALS

Input list	Input Weight	Circular Input	Chemistry Verification	Traceability Verification	De-commission Steps	Input End-of-Life Pathway
100% Organic Cotton Jersey 150gsm - Optic White	*267 grams*	*Renewable*	*OEKO TEX 100*	*ORGANIC COTTON STANDARD*		
100% Organic Cotton Threads - 40 Tex - White	*37 grams*	*Renewable*	*Cradle to Cradle Material Health: Gold*	*GOTS*		
100% Recycled Cotton Labels - Optic White / Soy Ink Screen Print - Black	*7 grams*	*Recycled*	*OEKO TEX 100*	*RCS*		
100% Cotton Woven Brand/ Size Label - Undyed / Black Yarns	*12 grams*	*None*	*OEKO TEX 100*	*None*		

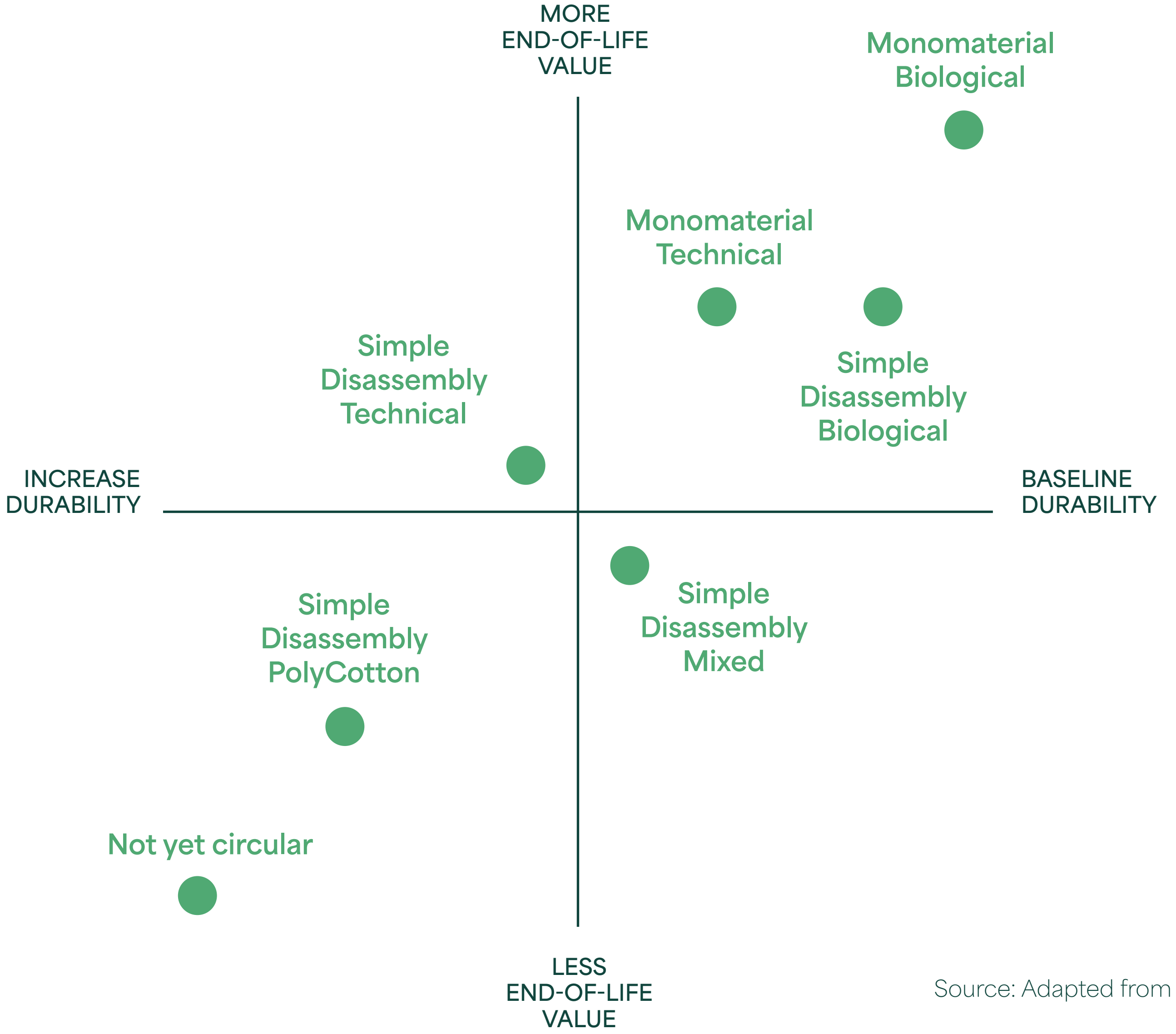
Circular Material Strategy → Durability Strategies for Materials

In order to keep products in use in their highest value, a minimum level of durability, referred to as baseline durability (see page 28), is required for all garments.

Efforts to increase a garment's durability should be done in conjunction with efforts to increase the garment's value through each stage in the downstream value chain, through reuse and repair (high cycles of use) and, if applicable, remanufacture or repurpose (low cycles of use) and finally, decommissioning and recycling.

As the Durability to Value figure opposite illustrates, when 'technical' and 'mixed material' circular material strategies are chosen, a higher level of durability should be applied to offset the greater environmental impacts and lower end-of-life value associated with these materials.

FIGURE 11: Durability x Value Matrix



Source: Adapted from A.BCH World

Circular Material Strategy → Baseline Durability

All garments should meet the following baseline durability standard. Using the WRAP Clothing Longevity Protocol[6] as the reference, baseline durability is met when:

- the specified product meets its target lifetime for longevity, calculated by reference to hours of wear; and
- the specified product meets its average number of washes with no/or little change* to the garment based on a set of core performance tests (see page 29).

*Note that reasonable wear and tear is normal and should be expected – especially for natural fibres which will show signs of patina more so than synthetic fibres. It is recommended that consumer education be undertaken to not conflate durability with "looking brand new".

TABLE 1: Clothing Longevity Protocol [6]

Row	Longevity factors	Knitwear	Shirt	Jeans	Socks	T-shirt
A	Current lifetime estimate (years) [i]	3.7	3.6	3.1	1.8	3.3
B	Target lifetime (years) [ii]	5	5	4	2.5	4.5
C	Average wear days per year [iii]	30	16	75	50	25
D	Implied wear days per month [iv]	2.5	1.3	6.2	4.2	2.1
E	Total days of wear for the target lifetime [v]	150	80	300	125	112.5
F	Hours of wear for the target lifetime [vi]	1,800	960	3,600	1,500	1,350
G	Assumed days of wear per wash [vii]	5	2	10	2	2
H	Hours of wear per wash [viii]	60	24	120	24	24
I	Average number of washes for the target lifetime [ix]	30	40	30	62	56

i Based on WRAP data
ii Based on lifetime increase of one third
iii Working assumption (validated by industry interviews)
iv Row C / 12
v Row B x Row C
vi Row E x 12 (assumed avarage 12 hours wear per day)
vii Working assumption (validated by industry interviews)
viii Row G x 12
ix Row F / Row H

Circular Material Strategy → Core Tests and Design Durability

The Product Purpose Statement outlines the garment's expected:

- function;
- type;
- lifespan (see page 29);
- core test performance standards (see page 29);
- design durability (see page 29); and
- user behaviour.

Lifespan is guided by the WRAP UK Clothing Longevity Protocol.[6] Designers should use this to outline the target lifetime of the garment.

Design Durability refers to the tangible (physical durability) and intangible (emotional durability) aspects of the garment together.

Core Test Performance Standards are the physical durability tests a product needs to meet requirements and/or regulations.

TABLE 2: Core Test Performance Standards [6]

Core test	Knitwear	Shirt	Jeans	Socks	T-shirt
Number of washes to conduct before testing	**30**	**40**	**30**	**62**	**56**
Dimensional stability to washing/dry clean	+ or -5%	+ or -3%	+ or -3%	to fit sock boards or volumentric legs	+ or -5%
Pilling	4	n.a.	n.a.	4	4
Care label wash with visual assessment	expert judgement	expert judgement	expert judgement	expert judgement	expert judgement
Colour fastness to: •Washing* / dry clean • Water or perspiration* • Light • Rubbing *includes shade change and staining	 4 4 4 4	 4 4 4 4	 4 4 n.a. 4	 4 4 n.a. 4	 4 4 4 4
Spirality	3%	n.a.	n.a.	n.a.	3%
Seam slippage	n.a.	80N for 60mm opening	n.a.	n.a.	n.a.
Seam strength	n.a.	100N for 60mm opening	n.a.	n.a.	n.a.
Fusible lamination	n.a.	appearance after wash	n.a.	n.a.	n.a.

Circular Material Strategy → Circularity Potential and Circular Design Testing

Circularity Potential is the circularity rating of a garment determined by alignment to the Circular Design Record (CDR). It is a quantifiable rating that designers (and teams) are encouraged to implement and use internally to measure and track improvement over time.

The Circular Design Record (CDR) captures both the design methodology and the agreements made with Lifecycle Partners to assist with the product meeting its Circularity Potential.

Circularity Performance refers to the success rate of a product designed for circularity to flow through each stage of the lifecycle including Cycles of Use, Decommissioning and End of Life. Circularity Performance is a future metric as it requires the addition of Digital Product Passports or Digital Twin technology to facilitate a traceable record of actual material flows.

Circular Design Testing is additional testing performed to ensure that circular design changes do not result in unintended consequences to product quality or safety.

It's recommended that all circular design changes, including seemingly minor changes such as material swaps for sewing threads or care labels, are tested for impacts to the overall construction or garment performance. Common circular design testing may include the following:

Materials

- Fibres are appropriate for function or product performance (e.g., ski jacket meets abrasion test).
- Material construction is in accordance with the purpose (e.g., a workwear pant is constructed with appropriate weave and weight to withstand expected wearer behaviour).

Components and Finishes

- Closures or trims are appropriately strong (but not over engineered so as to allow for simple disassembly) for intended purpose (e.g., bar tack vs. rivet).
- Chemical finishes, treatments and dyes are both safe and perform for intended purpose (e.g., colourfastness for hi-vis safety gear).

Construction

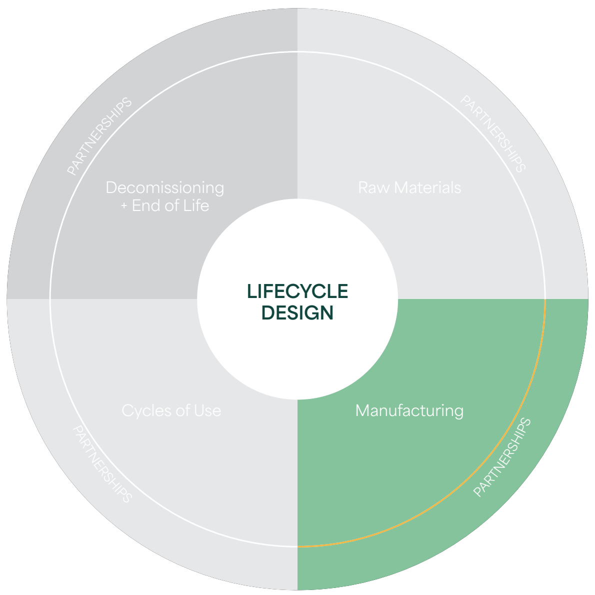
- Stitching/sewing thread is appropriate for product purpose (e.g., strength, elongation, stretch, seam placement/displacement).

Fit

- Longevity of style/aesthetic is justified.
- Product has ability to be reconstructed or size altered (e.g., increased seam allowances and tailoring features such as adjustability).

Circular Material Strategy → Production Efficiencies

Implementing production and manufacturing efficiencies that capture and re-circulate or eliminate material waste is aligned to the circular economy principles of 'circulating materials in their highest value' and 'eliminating waste and pollution' and are critical if fully circular products are to be developed.



Methods for reducing or eliminating waste in production often require changes at a company or facility level, or they are specific to a niche product type (e.g., 3D knitwear). While it is recommended these are addressed with each business and their Lifecycle Partner facilities, the waste reducing or eliminating manufacturing efficiencies themselves are considered supplementary to this guide which is primarily product focused.

It is recommended that each organisation within the textile and clothing supply chain employ facility-wide production efficiency mapping, analysis and system updates in order to reduce waste in both materials outputs and costs. Each business will, depending on their products and supply chains, have a unique approach to this, and they should sit alongside the Refashioning Circular Design Method.

EXAMPLES OF FACILITY LEVEL PRODUCTION EFFICIENCIES

- Zero or low waste pattern making
- Digital sampling
- Cross business or brand material sharing
- AI or predictive software to create more accurate product planning and allocation
- Accurate data collection on unsold stock
- Made to order manufacturing
- Just in time manufacturing
- Material waste flow management to reduce or eliminate material waste (industrial offcuts, pre-consumer or post-consumer inputs/outputs)
- Surplus use, reuse and remanufacturing strategies
- Lower impact processes, (such as reduced water and energy use)

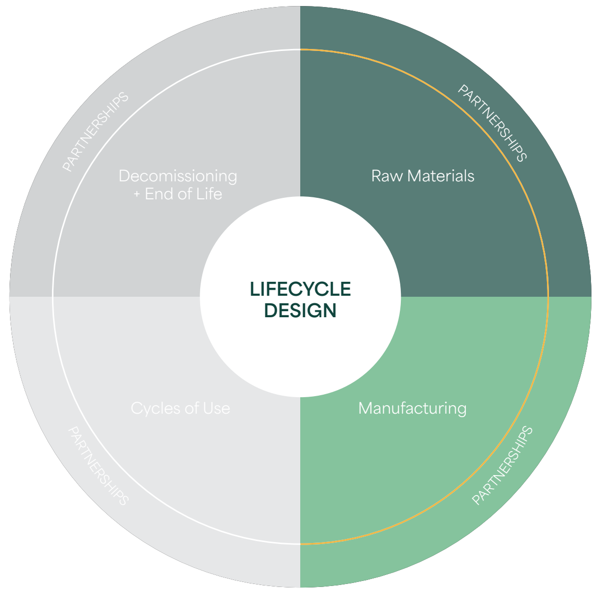
Circular Material Strategy → Lifecycle Partners

Circular Material Strategy Lifecycle Partners (stakeholders who provide an associated service integral to ensuring a garment can flow through the circular system) may include:

- raw material suppliers (e.g., farmers and technologists);
- yarn and textile producers;
- wet processors (e.g., dye houses);
- manufacturers; and
- accreditation, certification and testing organisations

The Circular Material Strategy phase is one of the most important steps in the Refashioning Circular Design Method; one where accuracy of information is vital. It's imperative to work closely with suppliers to ensure inputs are recorded precisely. It's anticipated that this step may take longer to complete than others, given the reliance on Lifecycle Partners for information. As the process is not linear, it's okay to skip ahead and start working on the next steps while waiting for test results or to hear back from suppliers or other key Lifecycle Partners.

Documenting the agreed relationship and responsibilities of each party should be recorded as part of the Circular Design Record (CDR) outlined further on page 49.

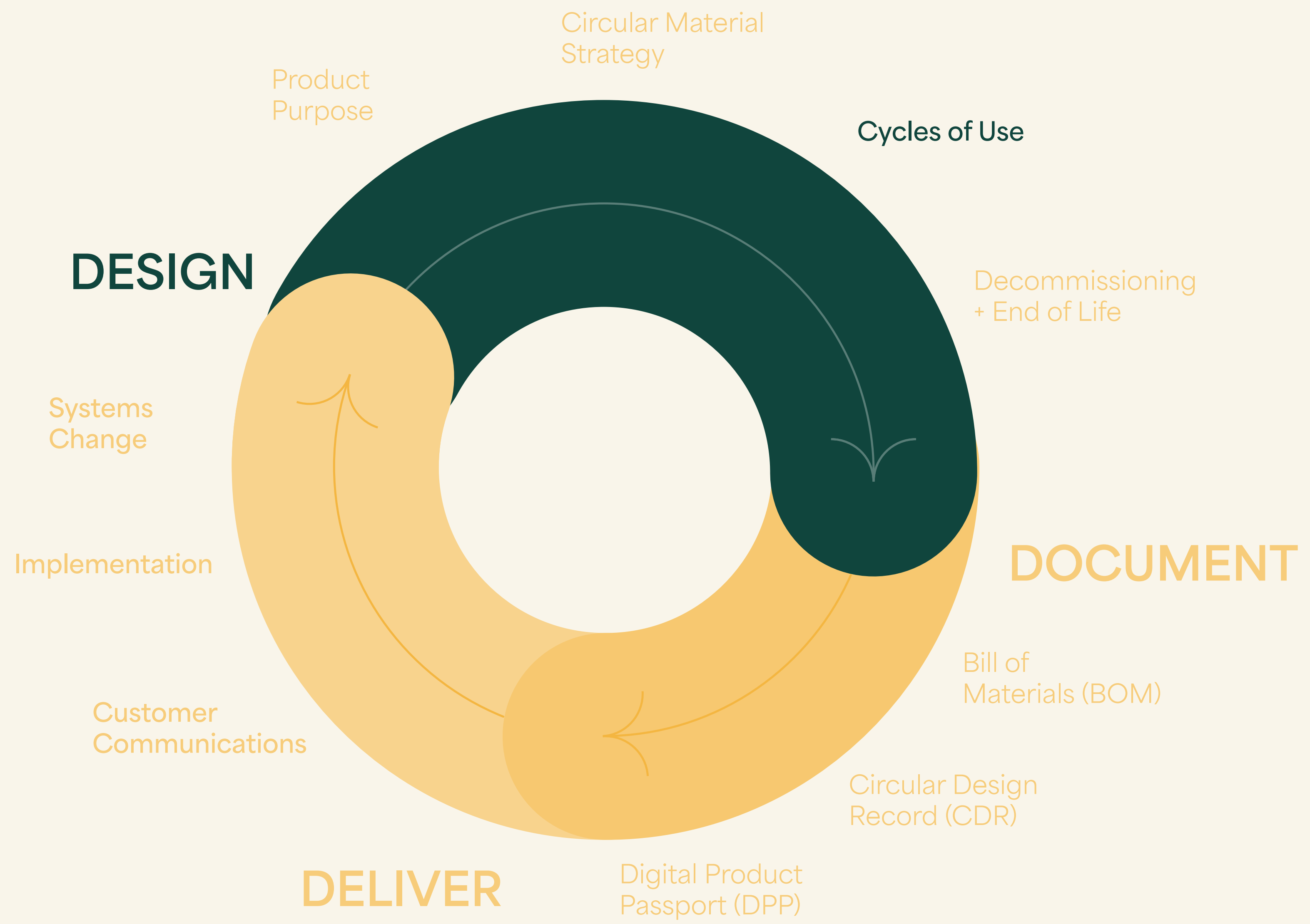


ACTION 2
Choose your Circular Material Strategy, complete the Inputs section in the Bill of Materials and outline any Circular Design testing to be completed. This should be documented within your Circular Design Record. Plan and action any Lifecycle Partners (internal or external) that may be relevant to this step.

Design: Cycles of use

THIS SECTION COVERS

→ Use Strategies within the Lifecycle
→ High and Low Cycles of Use
→ Examples of Use Strategies
→ Lifecycle Partners



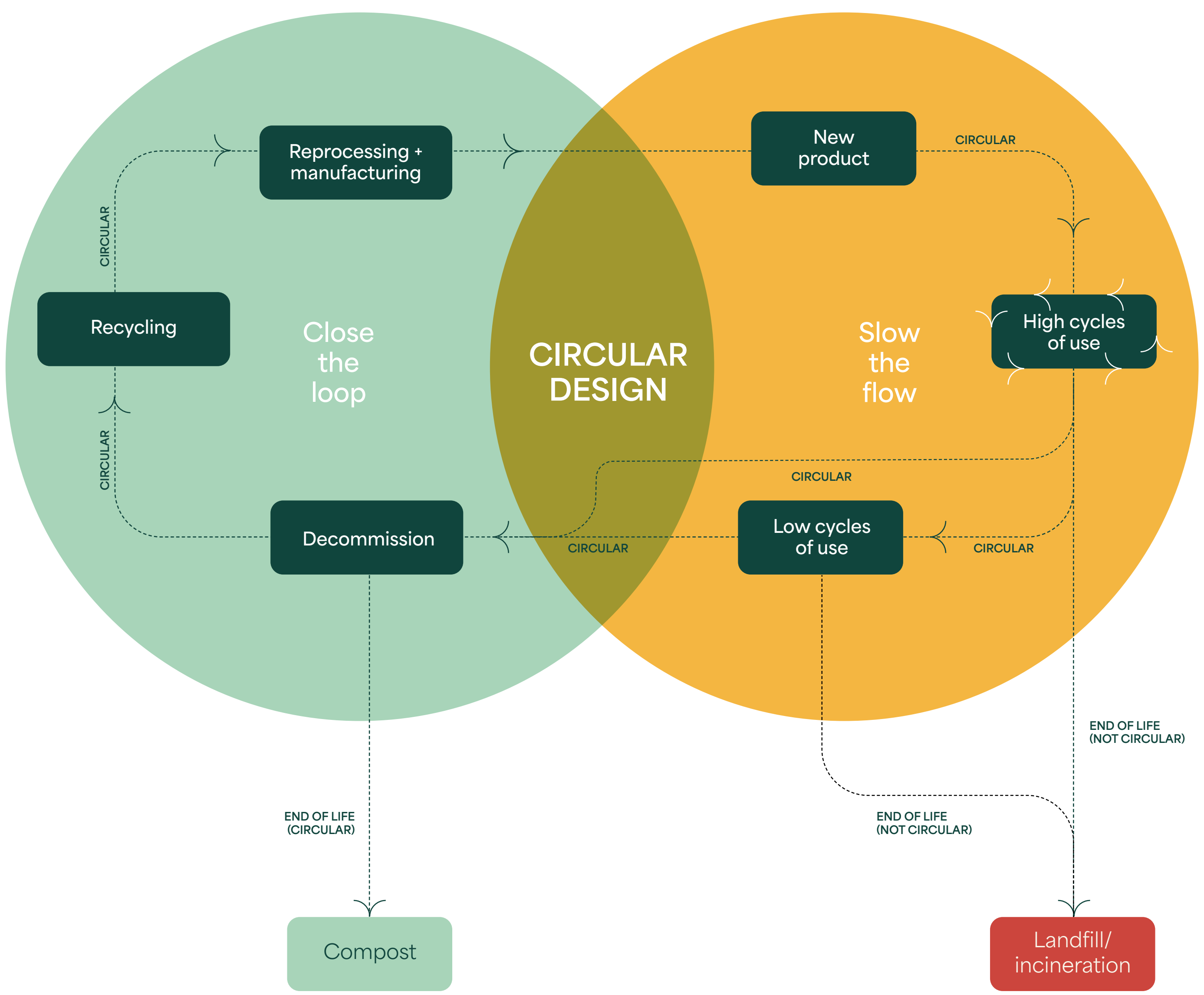
Cycles of Use → Use Strategies within the Lifecycle

While the responsibility for fulfilling circularity in the Use phase often sits outside the remit of the designer, the designer (and/or team) should prepare and document a use plan. This plan should describe how a product will flow through (and stay within) the chosen cycles of use, including expectations for how the garment should be used, reused, repaired and if appropriate, remanufactured or repurposed.

The Refashioning Circular Design Method defines two distinct cycles of use derived from the Resource and Waste Hierarchy (outlined on page 12). These are **High Cycles of Use** and **Low Cycles of Use** (further defined on page 35).

The decisions around employing use plans with high or low cycles of use must align to both the Product Purpose and selected Circular Materials Strategy.

FIGURE 12: Refashioning Circular Design Systems Approach



Source: adapted from A.BCH World

Cycles of Use → High and Low Cycles of Use

The High and Low Cycles of Use are derived from the Resource and Waste Hierarchy and refer specifically to clothing items as they flow through the value chain.

High Cycles of Use refers to use interventions higher up the Resource and Waste Hierarchy that maintain a product in its **original form** making maximum use of embodied value. These interventions are considered highest value and lowest effort to enact and include:

- **Reuse**: used by multiple users through resale, rental, swapping or sharing
- **Repair**: damages or wear-and-tear are mended for cycling back into reuse for original or subsequent users

(e.g., in-house resale and repair services)

Almost all fashion/clothing should be designed with a view to enact High Cycles of Use.

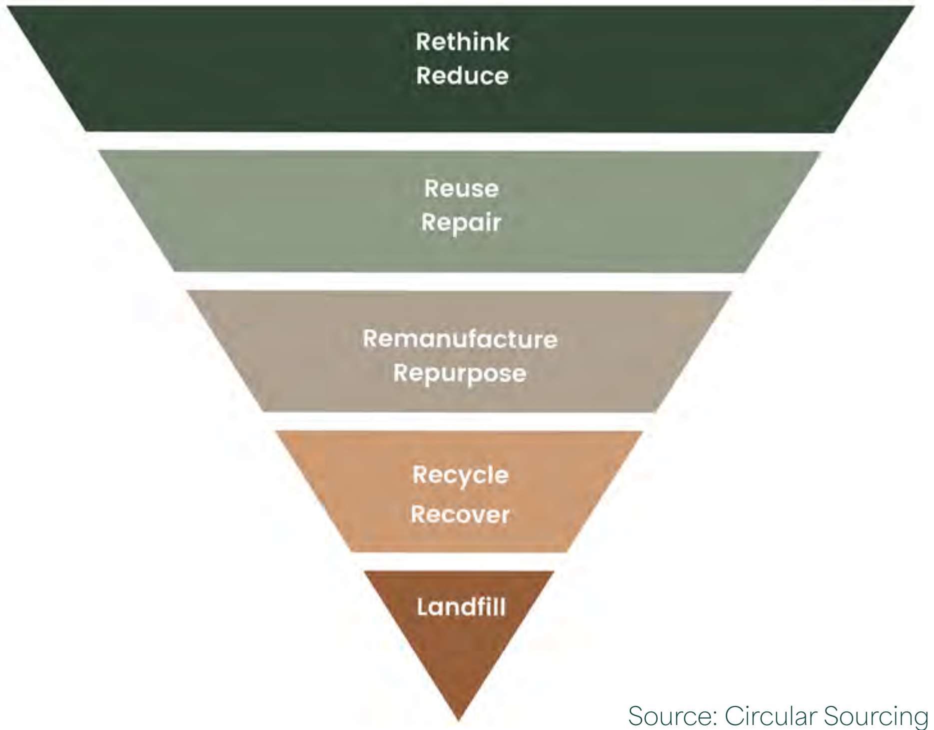
Low Cycles of Use refers to use interventions lower down the Resource and Waste Hierarchy. These actions fundamentally alter the **original form** and value of the product and may include one or both of the following:

- **Remanufacture**: high effort/high value actions also referred to as 'upcycling'. Example: existing t-shirts spliced together to create a new design
- **Repurpose**: low effort/low value actions also referred to as 'downcycling' (e.g., old t-shirts torn into wiper rages)

Due to the destructive nature and greater potential for contamination of Low of Cycles Use, products designed with high Circularity Potential may deliberately avoid a Low Cycles of Use plan, moving directly from High Cycles of Use to Decommissioning and End of Life. This should be documented clearly in the Circular Design Record.

In contrast, 'Not Yet Circular' products are ideal for creating both a High and Low Cycles of Use plan for.

FIGURE 13: Resource and Waste Hierarchy



Source: Circular Sourcing

PROMPTS
Return to the Product Purpose to understand where the most value can be extracted throughout the Lifecycle. What makes sense for this design?

Cycles of Use → Examples of Use Strategies

EXAMPLE ON HOW TO DOCUMENT CHOSEN CYCLES OF USE, STRATEGIES AND LIFECYCLE PARTNER/S

HIGH CYCLES OF USE	**STRATEGIES**	**PARTNER/S**
Reuse	e.g., White label in-house resale and rental program	e.g., RNTR
Repair	e.g., In-house + preferred repair provider network provided for customers	e.g., In-house: Sustainability + Marketing Departments
LOW CYCLES OF USE	**STRATEGIES**	**PARTNER/S**
Remanufacture	e.g., Products are cut, re-worked and combined with other materials to make new products	e.g., Loop Upcycling
Repurpose	e.g., Products are torn into wiper rags	e.g., Sam's Rags

The example on the left shows how a designer can plan and document for the Cycles of Use.

When documenting the intended Cycles of Use, keep in mind that not all products will be suitable for Low Cycles of Use. Low Cycles of Use require destructive actions to the original form, or may result in disruptions to a product's material strategy.

While generally suitable for products that are 'Not Yet Circular', products designed with high Circularity Potential may deliberately avoid Low Cycles of Use, moving directly from High Cycles of Use to Decommissioning and End of Life.

PROMPTS

Outline the desired use phases for your product. Which phases are appropriate for your product and how does this relate to the product's purpose? What changes might need to be made within the material strategy?

Cycles of Use → Lifecycle Partners

Cycles of Use Lifecycle Partners (stakeholders who provide an associated service integral to ensuring a garment can flow through the circular system) include:

- Consumers
- Rental businesses
- Repairers
- Second life sellers (resale platforms, charities)
- Remanufacturers; and
- Collection and sorting operators

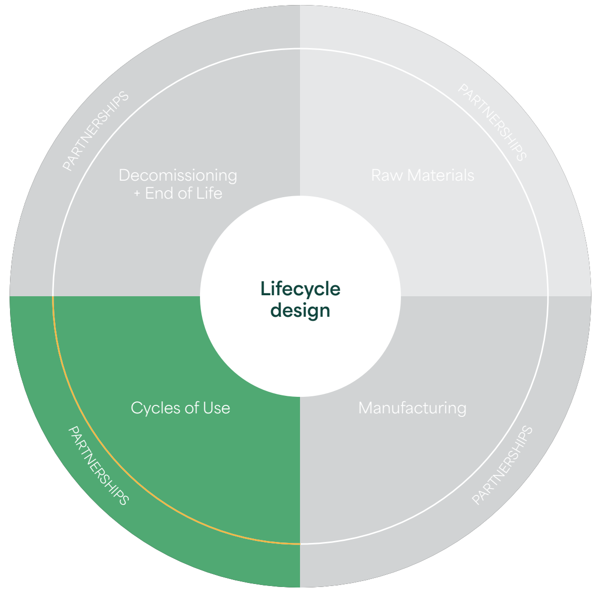
Consumers (users) are key Lifecycle Partners in the use phase. Revisiting the Product Purpose statement can help you understand and define the actions you want your user to take with the product during use.

To understand how the garment is expected to be valued by the user, you may wish to draw on existing customer data or to collect data on specific user behaviours such as purchase frequency, repair practices and engagement.

It's key to then consider how you will communicate actions like care, repair, reuse and returns to the user.

For Lifecycle Partners, you will need to consider, research and plan for how the product will flow to both the High and, if applicable, Low Cycles of Use partners.

Documenting the agreed relationship and responsibilities of each party should be recorded as part of the Circular Design Record (CDR) outlined further on page 49.

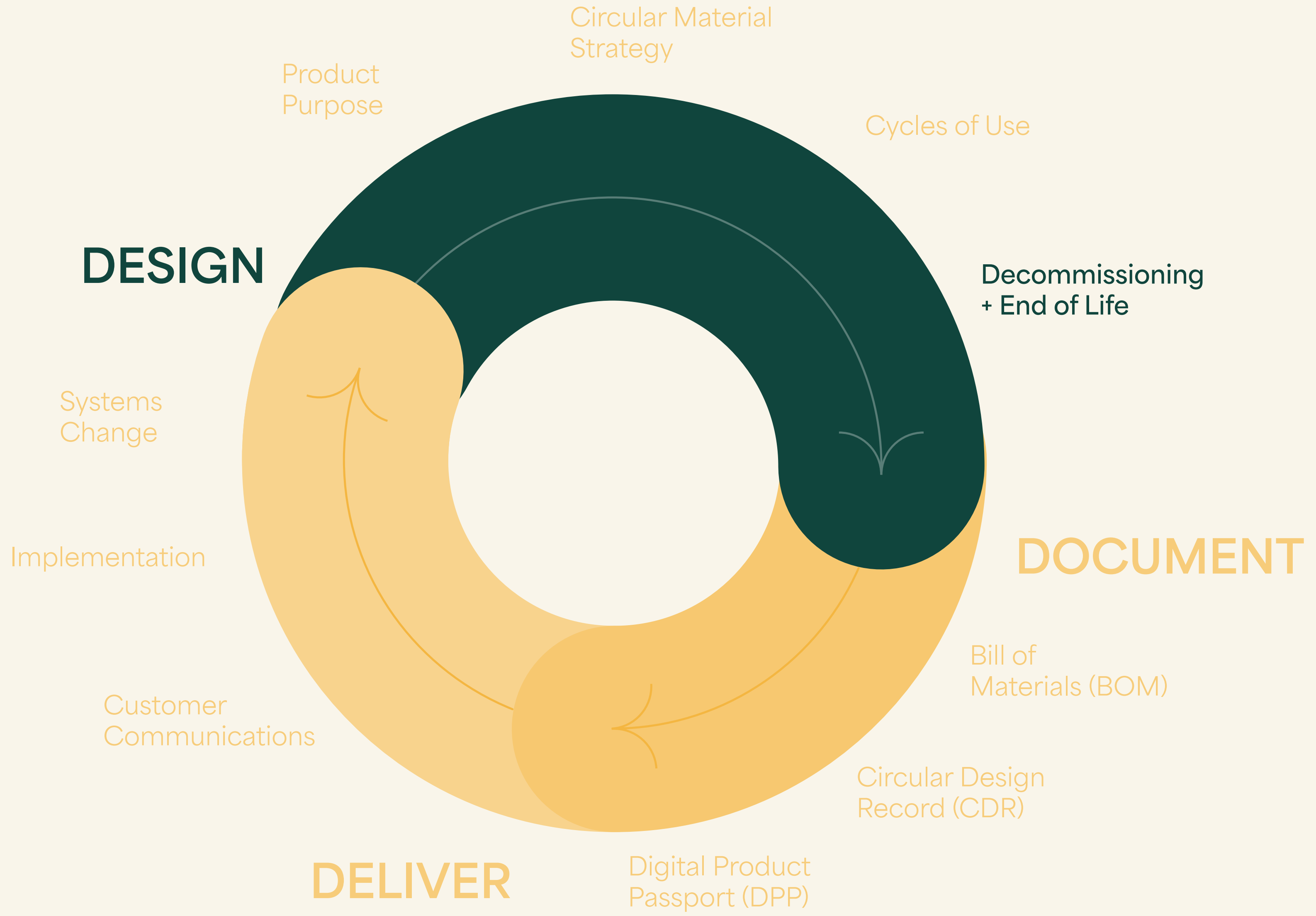


ACTION 3
Create your Cycles of Use plan, documenting it in your Circular Design Record. Plan and action any Lifecycle Partners (internal or external) that may be relevant to this step.

Design: Decommissioning + End of Life

THIS SECTION COVERS

- Decommissioning Feasibility
- End of Life Pathways
- Inputs and Outputs
- Bill of Materials
- Linking Circular Material Strategy to End of Life Pathways
- Planning for Recirculation
- Examples + Prompts
- Lifecycle Partners



Decommissioning + End of Life → Decommissioning Feasibility

Decommissioning refers to when a garment is no longer fit for cycles of use and is disassembled (pulled apart) for end of life processing (recycling or in some cases, composting).

While many garments could technically be decommissioned for recycling today (e.g., a t-shirt might be unpicked to separate the cotton fabric from the polyester threads), the reality is that it's not always feasible.

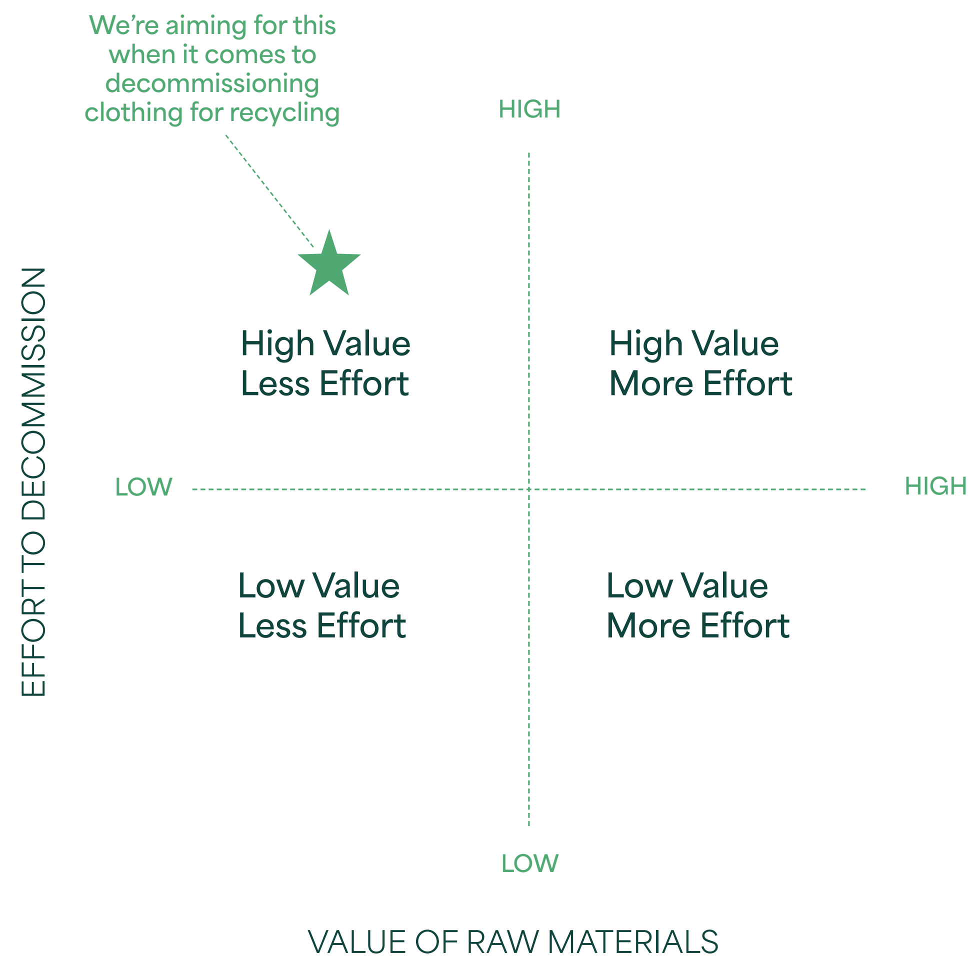
Feasibility in decommissioning garments at scale requires that the value of the recovered materials be high enough to warrant separation efforts.

The **Disassembly Effort Factor** considers the complexity and number of steps involved in disassembly. Ideally, this process should be as simple as possible. Higher recovery effort and lower material value make decommissioning and quality fibre-to-fibre recycling less likely.

This makes it important to incorporate a decommissioning plan from the beginning (during the design process) and to outline this within the Bill of Materials (see pages 24 and 42).

The Material Value to Decommissioning Effort Matrix on the right shows the aim of designing products with highest material value and least effort to decommission. It is likely that design changes will be necessary to achieve this and will raise important decision making for the design team.

FIGURE 14:
Material Value x Decommissioning Effort Matrix



Source: Adapted from A.BCH World

Decommissioning + End of Life → End of Life Pathways

End of Life refers the stage where a product is no longer able to flow through the loops of the technical cycle due to deterioration and/or unusability. Circular end of life pathways include Composting (within the biological cycle) and Open or Closed Loop Recycling (within the technical cycle).

Circular designers should know and plan for product end of life, at the beginning. The diagram on the right shows available End of Life Pathways that exist for textiles at the time of publishing.

Composting is when biologically safe and suitable products or disassembled materials enter or re-enter the biosphere via aerobic or anaerobic digestion. While a majority of modern clothing is unsuitable for composting, more work should be done to understand the full potential for composting certain textiles.

Recycling (Open Loop) is when products or disassembled materials are broken down to the fibre stage and are reprocessed into materials for a different end market to what the fibre originally came from. e.g., post consumer t-shirts recycled and processed into print paper. Note the difference between open loop recycling and repurposing.

Recycling (Closed Loop) is when products or disassembled materials are broken down to the fibre stage and reprocessed into yarns and materials of similar quality and function e.g., post consumer t-shirts recycled and processed into yarns for t-shirt fabric.

It's critical to consider and plan for end of life pathways for each decommissioned output at the design stage and to outline this within the Bill of Materials (see page 42).

END OF LIFE PATHWAYS FOR TEXTILES AND CLOTHING

- Mechanical recycling: closed or open loop
- Chemical recycling: closed or open loop
- Compost
- Incineration
- Landfill

Each End of Life Pathway above is an interactive button. Click on each to expand their definitions.

Decommissioning + End of Life → Inputs and Outputs

Inputs are all the resources that are put in or added to a system, process or product.

Outputs are the resulting resources (including waste, auxiliaries and finished materials) expended from a system, process or product.

BUSINESS AS USUAL OUTCOMES

Mechanical Recycling	Chemical Recycling	Compost	Incineration	Landfill (Local or Abroad)
Input: Industrial mono-materials **Output**: high quality same fibre **Input**: Mono pre/post consumer materials **Output**: mid quality same fibre **Input**: Mixed materials **Output**: Low quality mixed fibre	**Input**: Cotton, Viscose, Polyester, Nylon mono materials **Output**: High quality MMCF (Manmade Cellulose Fibre) and MMF (Manmade Fibre)	**Input**: Biological Materials **Output**: neutralised compost	**Input**: Any Materials **Output**: Negative environmental impacts (GHG emissions, waste, soil, water and air toxicity) or neutralised output (waste to energy)	**Input**: Any Materials **Output**: Negative environmental impacts (GHG emissions, waste, soil, water and air toxicity)

← Return to previous view

Decommissioning + End of Life → Bill of Materials

At this stage, it's essential to revisit the Bill of Materials (outlined in the Circular Material Strategy on page 24) to fully complete it with the Decommissioning steps and End of Life Pathway outlined per input.

Decommissioning steps should detail instructions for how the inputs should be deconstructed (if at all)and whether any inputs become combined. Finally, the chosen End of Life pathway for those inputs should be described.

It's critical to complete this in consultation with Lifecycle Partners such as local sorters and textile recyclers (read more about how to do this on page 46).

PROMPTS
What is the intended purpose for the product at End of Life? What options exist right now and where? Which Lifecycle Partners do you need to speak to?

COMPLETED BOM EXAMPLE

Circular Material Strategy: *BIOLOGICAL MONOMATERIAL*

BILL OF MATERIALS

Input list	Input Weight	Circular Input	Chemistry Verification	Traceability Verification	De-commission Steps	Input End-of-Life Pathway
100% Organic Cotton Jersey 150gsm - Optic White	*267 grams*	*Renewable*	*OEKO TEX 100*	*ORGANIC COTTON STANDARD*	*Shred or cut into pieces smaller than 15cm*	*Mechanical Recycling (Fibre to Fibre)*
100% Organic Cotton Threads - 40 Tex - White	*37 grams*	*Renewable*	*Cradle to Cradle Material Health: Gold*	*GOTS*	*Remain with cotton fabric*	*Mechanical Recycling (Fibre to Fibre)*
100% Recycled Cotton Labels - Optic White / Soy Ink Screen Print - Black	*7 grams*	*Recycled*	*OEKO TEX 100*	*RCS*	*Clipped off from fabric*	*Mechanical Recycling (Open Loop)*
100% Cotton Woven Brand/ Size Label - Undyed / Black Yarns	*12 grams*	*None*	*OEKO TEX 100*	*None*	*Clipped off from fabric*	*Mechanical Recycling (Open Loop)*

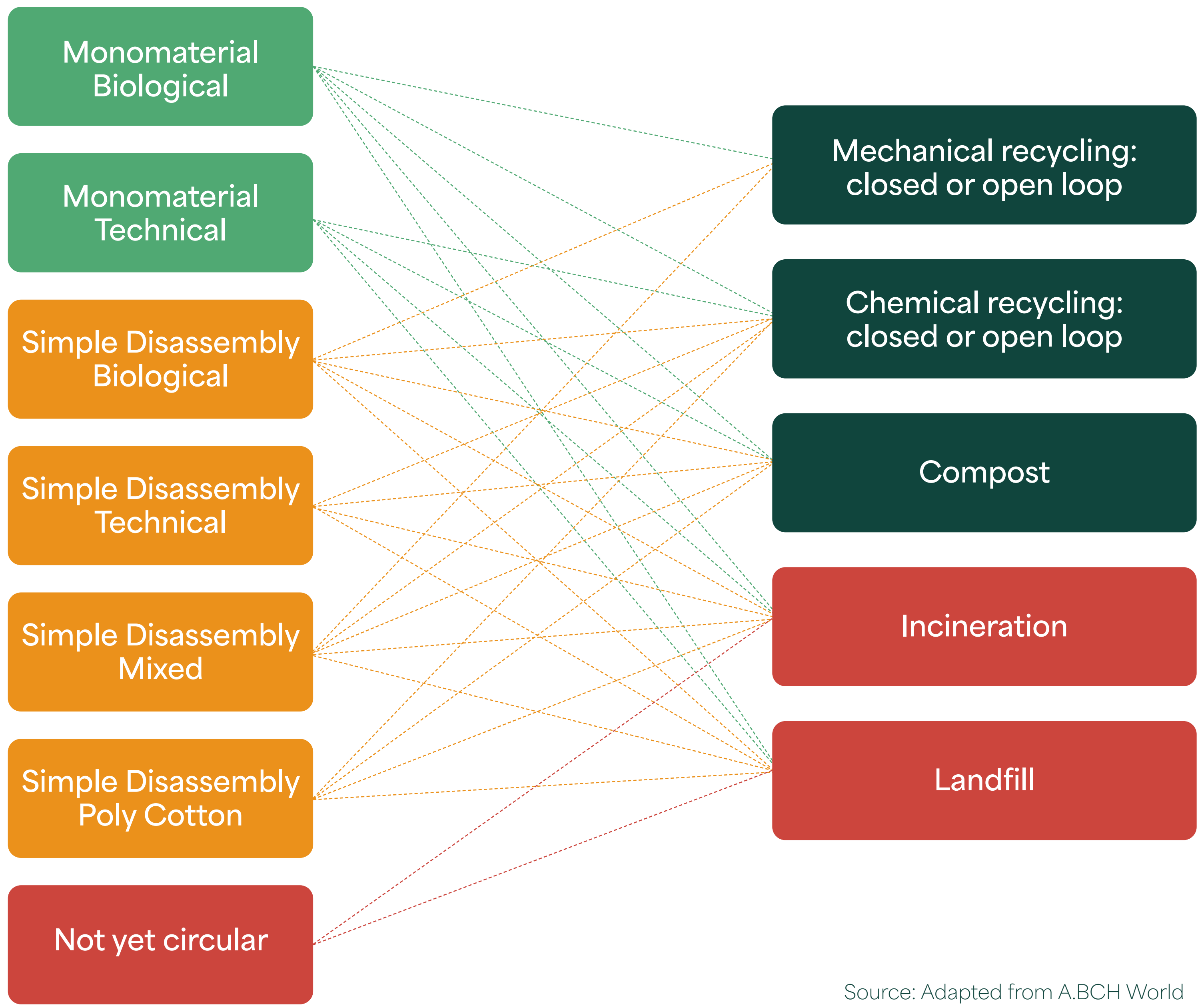
Decommissioning + End of Life → Linking Material Strategy to End of Life Pathways

Only certain end of life options will be available for certain products. It's important to consider the Circular Material Strategy and which pathways they can connect to for both decommissioning and end of life processing.

As illustrated in the diagram on the right, a garment that has employed a 'Monomaterial Biological' material strategy should theoretically have every End of Life pathway open to it – and the more of these available, the better.

In contrast, a garment that is 'Not Yet Circular' will only be able to flow to landfill or incineration at the end of life stage. It's important to understand this at the beginning of any circular design process to ensure that the integrity of the Lifecycle Design can be maintained.

FIGURE 15: Circular Material Strategies and End of Life



Source: Adapted from A.BCH World

Decommissioning + End of Life → Planning for Recirculation

To realise a circular economy for clothing, many more post consumer textiles will need to become future circular inputs than there are currently.

To increase the amount of circular inputs entering new products and to influence the collective quality of feedstock being generated and re-circulated in the system, it is necessary to consider how current design feeds into upward material flows. It's key to remember that **high quality outputs** (outputs that are able to be used again in future circular product) only come from **high quality inputs**.

This is why circular product design should include objectives to reclaim the raw materials at the end of the product's life and businesses should track and develop metrics on circular inputs over time.

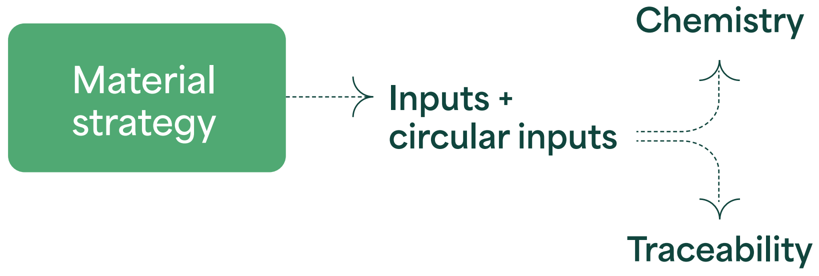
For a designer, this means linking the current product's post consumer feedstock from one Lifecycle Partner (e.g., recycling) through to the next (e.g., yarn spinning).

Because of the many stakeholders involved in a garment's lifecycle, it will not work for one business to take these actions alone. It's critical to simultaneously develop and take collective action on:

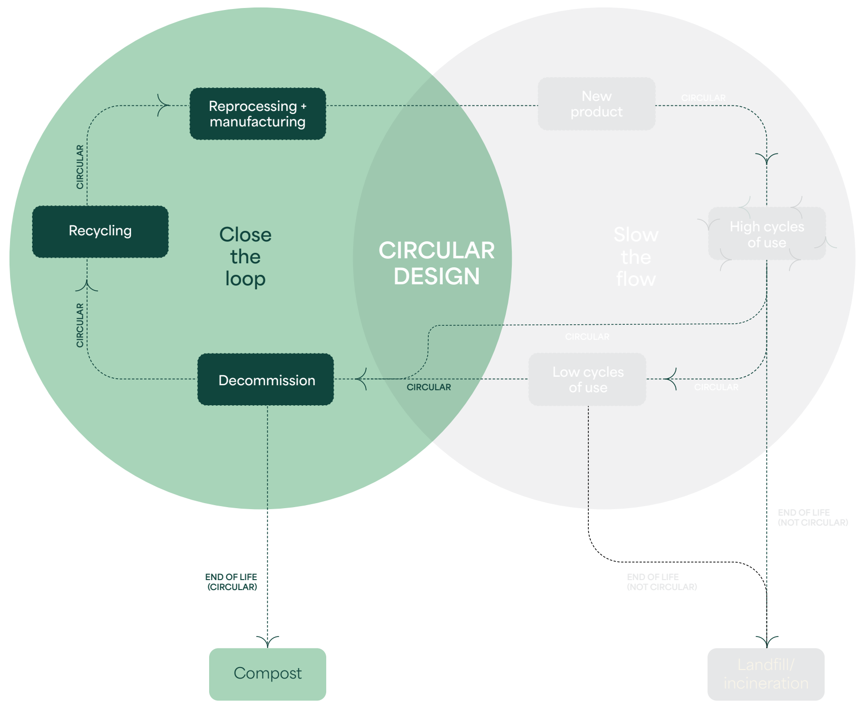
- re-circulation standards for recycled materials;
- improving the quality, consistency and volume of post-consumer recycled materials; and
- securing demand for recycled feedstock to other end markets

PROMPTS
What will be done NEXT with these outputs? Can you begin to incorporate this very feedstock into future product lines? Can you begin working with similar recycled inputs from other sources to prepare for this?

PRODUCT



SYSTEM



Decommissioning + End of Life → Example and Prompts

DECOMMISSIONING + END OF LIFE EXAMPLE
THE VERY GOOD BRA

Circular Material Strategy
Simple Disassembly: Biological

Decommissioning Steps • Clip off metal hooks • Cut the remaining bra into pieces (smaller than 10cm)	**End of Life Pathway** Compost: Home or Indsutrial Compost or Worm Farm tested
Combined Inputs • 100% Tencel Lyocell Fabric • 100% Tencel Lyocell Threads • 60% Tencel Lyocell / 40% Natural Rubber Elastic • 100% Organic Cotton Labels	**Lifecycle Partner** WORMTECS

Recycle for progress, not perfection!
While recycling and composting are not yet perfect solutions for clothing end of life (e.g., 100% closed loop recycled product is rare), it's critical that we simply begin.

When materials are safe, renewable and high quality, even incremental blends of recycled fibres into new textiles will help reduce reliance on virgin materials and help build the circular system sustainably.

PROMPTS
Can the raw materials be reclaimed at end of life and go back into a similar design in the future (e.g., if it is a t-shirt, can the cotton go back into another similar quality t-shirt)? How?
If this is not yet possible, or the product is 'Not yet Circular', can the raw materials reclaimed at end of life go into into lower grade item or alternate end market (e.g., building insulation)? How?

Decommissioning + End of Life → Lifecyle Partners

Decommissioning and End of Life Lifecycle Partners (stakeholders who provide an associated service integral to ensuring a garment can flow through the circular system) include:

- Sorters
- Decommissioning agents
- Recyclers (both mechanical and chemical)
- Composters

Note: Documenting the agreed relationship and responsibilities of each party should be recorded as part of the Circular Design Record (CDR) outlined further on page 49.

DISCUSSION PROMPTS FOR LIFECYCLE PARTNERS

Decommissioning

1. Identify steps required for decommissioning (ie removal of buttons and trims)
2. Identify and engage responsible parties for collection, sorting and decommissioning

End of Life

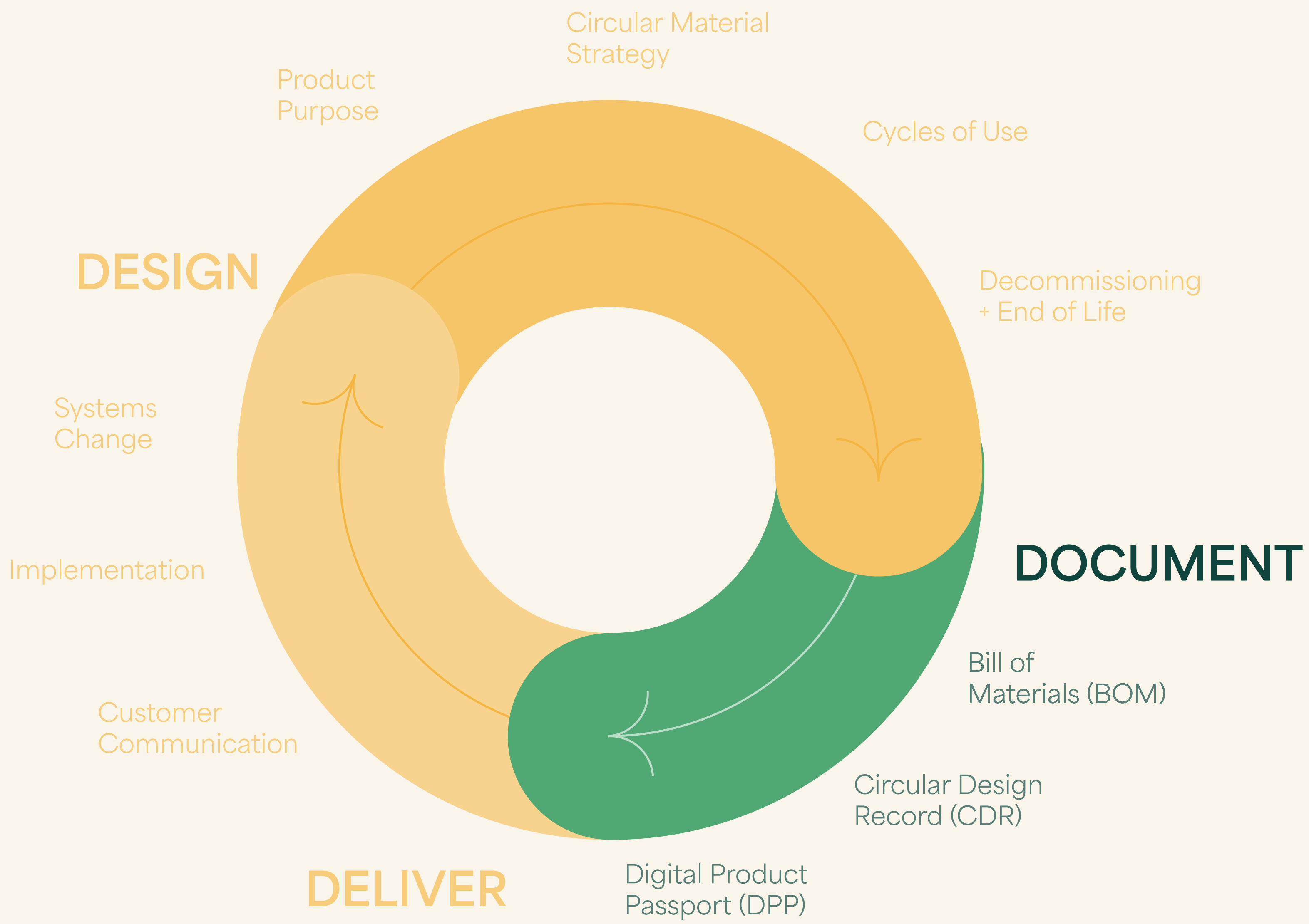
1. Identify options and processes required for end of life (referencing material strategy)
2. Identify and engage suitable partners for end of life processing
3. If the materials can be recycled, is it closed loop or open loop? Identify who else might be able to use the recycled feedstock or if further value-add in required

ACTION 4
Update your Bill of Materials with a Decommissioning and End of Life plan. Document this in your Circular Design Record. Plan and action any Lifecycle Partners (internal or external) that may be relevant to this step.

Document

THIS SECTION COVERS

- Bill of Materials
- Circular Design Record (CDR)
- Digital Product Passport (DPP)



Document → Bill of Materials (BOM)

As outlined on pages 24, 25, 26, and 42, the Bill of Materials (BOM) is a document (record keeping tool) that captures, measures and tracks every input material (including all components and trims) that make up the garment.

The BOM should be created during the Design Stage, within the Circular Materials Strategy and Decommissioning + End of Life sections of this guide.

While there is no definite requirement or regulation as yet for what a BOM should contain, the global industry is moving towards a future where Digital Product Passports (DPP) are expected to be mandatory (read more about DPP on page 50).

It is therefore recommended that a BOM for every single product made should capture the following information: whether the material is considered a circular input, material weight, chemistry certifications, traceability certifications, component disassembly and chosen end of life pathway.

This information should be compiled and accessible to all relevant parties on a database. The most intuitive way to do this is to use the Bill of Materials Tool in Quadrant Circular © a software solution developed directly from the guide by A.BCH World and Style Atlas that enables streamlined data entry and inbuilt database and reporting functionality. Alternatively, each of these details can be recorded within a spreadsheet.

Because a BOM measures and tracks circular inputs it can also play an important role in identifying the product's Circularity Potential and will prove extremely useful when measuring a product's environmental footprint.

Document → Circular Design Record (CDR)

The Circular Design Record (CDR) is where each stage of the Circular Design Method as well as the agreements made with Lifecycle Partners will be captured. It sits alongside the BOM and will assist in calculating the product's Circularity Potential.

Circularity Potential is the circularity rating of a garment determined by alignment to the CDR. It is a quantifiable rating that designers (and teams) are encouraged to implement and track internally to measure and improve on over time.

The CDR should include:

- Product Purpose Statement
- Circular Material Strategy
- Use Plan
- Decommission and End of Life Plan

Just like the BOM, the information collected in the CDR should be compiled and accessible to all relevant parties on a database in order to prepare for future DPP requirements.

The most intuitive way to do this is to use Quadrant Circular, a software solution developed directly from the guide by A.BCH World and Style Atlas that enables streamlined data entry and inbuilt database and reporting functionality. Alternatively, each of these details can be recorded within a spreadsheet.

The Document stage is not a new step; rather it is a prompt to ensure accurate records of the Design stage are collected.

Document → Digital Product Passport (DPP)

Digital Product Passports (DPPs) are critical to achieving circularity and broader sustainability goals across the fashion and textile industry because they enable both the producer and the consumer to **track and trace resource use and lifecycle impacts across the value chain**.

There is currently no standard in Australia for the types of information to be included in a DPP. However, some overseas jurisdictions, including the EU and New York, are currently adopting or are in the process of adopting legislation on DPPs, including specificity around what information DPPs should include, such as in the EU DPPs Circular Economy Action Plan and the Eco-design for Sustainable Products Regulation (e.g., EON and CircularIDTM, Fibretrace).

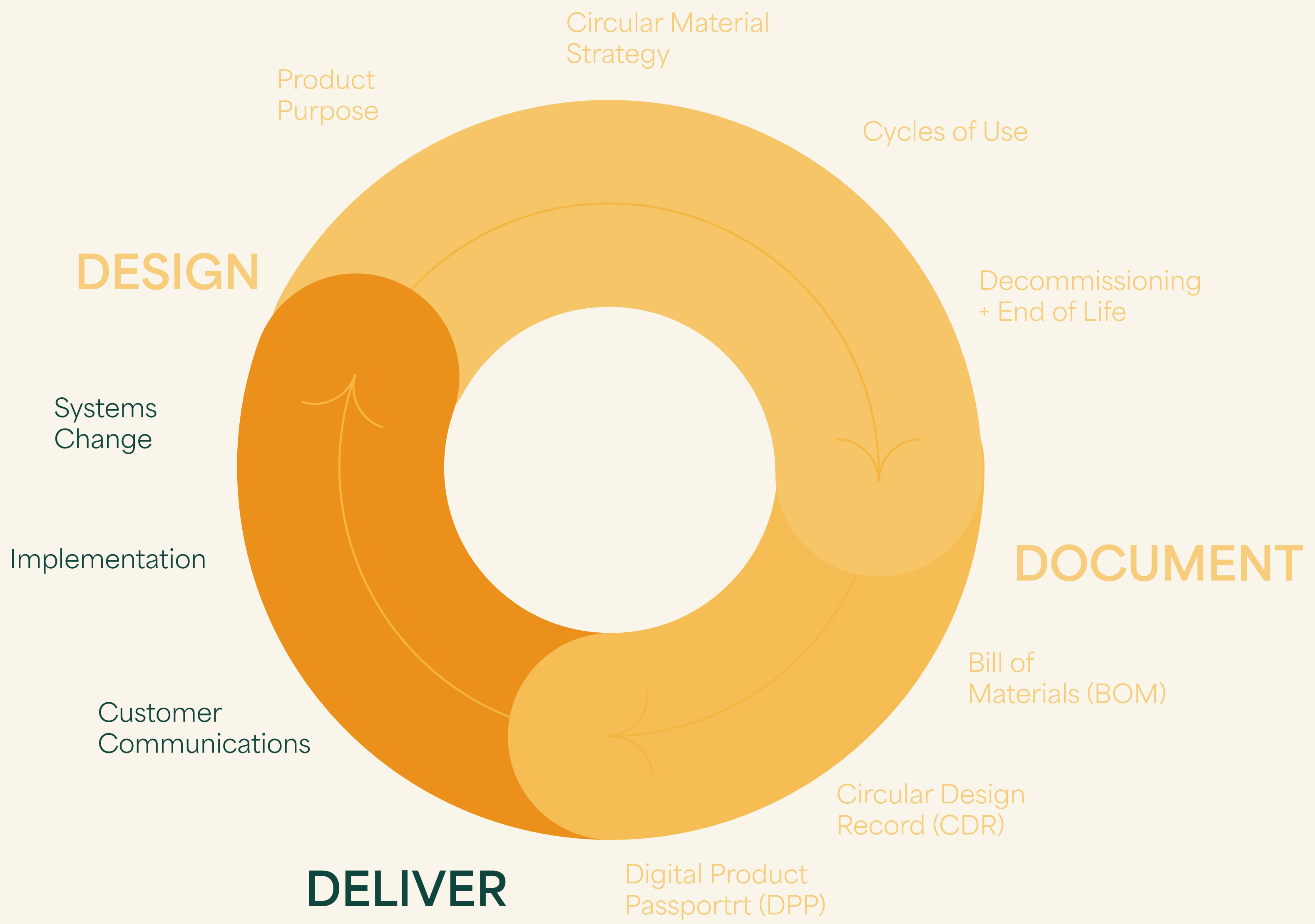
DPPs may contain information about:

- product provenance (origins);
- authenticity;
- material description;
- identification of all components used in production processes;
- recycled contents;
- product history;
- third party certifications/verifications;
- adherence to relevant standards;
- recycling instructions;
- product environment impacts (including data on raw material extraction, production, recycling, carbon footprint and water footprint) – ideally carried out in accordance with set standards;
- information on washing/cleaning; and
- repair instructions.

Deliver

THIS SECTION COVERS

- Customer Communications
- Implementation
- Systems Change



Deliver → Customer Communications

The customer (user) has a critical role to play to ensure the garment fulfils its circularity potential.

Actions required by the customer fall into two categories:

1. **Buying circular designed products** (shifting what is consumed); and
2. **Adopting circular behaviours** (shifting patterns of consumption and use)

Design teams can work with marketing teams to drive change across both areas. While the designer cannot control if the lifecycle design instructions are followed, the more information that can be provided to the customer, the more likely the occurrence of circular behaviours.

For point 1, designers should highlight the different decisions that have been made to create a product that is circular by design. Telling the story about why these decisions are necessary for circularity is also recommended.

For point 2, customers must be informed about what they can do with the garment while it is in their possession, e.g.

- care instructions (e.g., washing)
- repair guides and/or services
- reuse and recovery options
- end of life options

Communications may also cover user practices such as rates of consumption and embracing used clothing through restyling, swapping and sharing. The customer must also have access to information regarding next steps for the garment, once they are no longer able to use it.

EXAMPLES

- In-store or online instructions at point of sale
- QR codes on care label/tag
- Scannable thread embedded into clothing, ie smart yarns
- Near field communication (NFC)
- Follow-up messaging (email, SMS, chat, forums) covering use, care, repairs and options for when the garment is no longer needed

Deliver → Implementation

Through the Design stage, the designer will have already identified strategies, and engaged with Lifecycle Partners (stakeholders who provide an associated service integral to ensuring a garment can flow through the circular system) who can assist with the implementation of the Use and Decommissioning + End of Life phases in the Lifecycle Design.

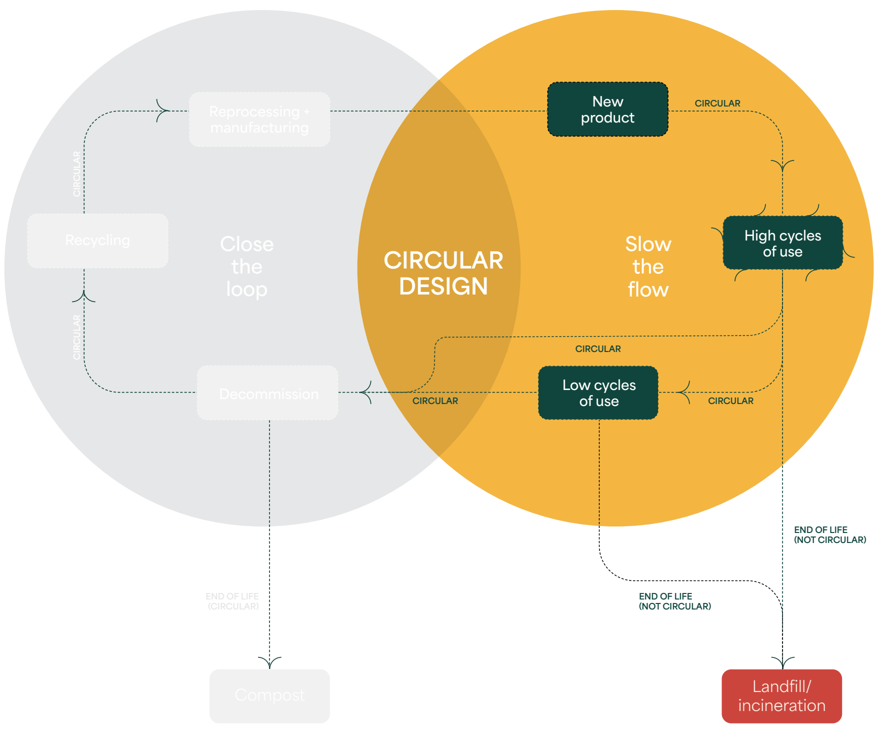
Lifecycle Partners may be internal or external partners who deliver some or all of the following functions:

- marketing and communications;
- retail;
- collection;
- logistics (rental, resale, restyling, repair, donations);
- sorting;
- decommissioning;
- dispatch;
- recycling; and/or
- composting.

For circular implementation to be realised, it's first essential that the agreed relationship and responsibilities of Lifecycle Partners be recorded as part of the Circular Design Record (CDR) outlined on page 49.

Secondly, tracking implementation will become very important to measuring the Circularity Performance of a product. Where possible, Lifecycle Partners (internal and external) should provide implementation data. Looking to the future, product tracking via Digital Product Passport technologies will become essential.

THE CLOTHING LIFECYCLE



Deliver → Systems Change

As outlined in the Fundamentals section, design teams can control the circular attributes of a garment and businesses can leverage communications to educate consumers to engage with circular practices, however, broader systems-wide transformation of the entire value chain is required.

Additionally, transformation to the principles and procedures which regulate how the system operates will be critical to enable full circularity for fashion and clothing.

Further collaborative action is needed to embed and accelerate circularity at scale. It is recommended that circular designers, their teams and their Lifecycle Partners, engage with ongoing systems-transformation actions to ensure continued momentum towards a fully circular textile economy.

SYSTEMS-TRANSFORMATION ACTIONS:

- Working with other designers and businesses to share solutions, e.g., sourcing materials collaboratively
- Engaging in multi-stakeholder forums (to share, learn and advocate)
- Educating customers on their role in circularity
- Investing in circular raw materials and zero waste manufacturing systems
- Pushing for regulatory change, including industry standards
- Supporting industry regulation of Seamless and other EPR schemes
- Establish or fund circular businesses models, such as rental, repair, donations and re-styling to meet circularity ambitions, particularly around extending cycles of use

3. APPLICATION

Application Templates

PRODUCT PURPOSE STATEMENT

Function	Type	Lifespan

Core Tests

Design Durability	User Behaviour

Application Templates

Circular Material Strategy:

BILL OF MATERIALS

Input list	Weight	Circular input	Chemistry verification	Traceability verification	De-commission steps	Input End-of-Life pathway

Application Templates

CYCLES OF USE, STRATEGIES AND LIFECYCLE PARTNER/S

HIGH CYCLES OF USE	STRATEGIES	PARTNER/S
Reuse		
Repair		
LOW CYCLES OF USE	**STRATEGIES**	**PARTNER/S**
Remanufacture		
Repurpose		

Application Templates

DECOMMISSIONING + END OF LIFE

Circular Material Strategy

Decommissioning Steps	End of Life Pathway
Combined Inputs	Lifecycle Partner/s

CDR Template

1. DESIGN	○
A. Product Purpose Statement Outlined	○
Product Function	○
Product Type	○
Target Lifespan Years (Within High Cycles)	○
Core Tests	○
Design Durability	○
User Behaviour/s	○
B. Circular Material Strategy Chosen	○
Durability Baseline	○
Circular Design Testing	○
BOM Phase 1	○
Circular Inputs %	○
Certified Chemical Compliance %	○

C. Use Plan Prepared	○
Reuse	○
Strategy	○
Communication	○
Confirmed Lifecycle Partner/s Repair	○
Strategy	○
Communication	○
Confirmed Lifecycle Partner/s Repurpose*	○
Strategy	○
Communication	○
Confirmed Lifecycle Partner/s Remanufacture*	○
Strategy	○
Communication	○
Confirmed Lifecycle Partner/s	○

D. Decommission + EOL Planned	○
Decommission Effort/Value	○
Decommission Action	○
BOM Phase 2	○
Instructions	○
Confirmed Lifecycle Partner/s	○
Recovered Materials	○
EOL Pathways Outlined per Output	○

2. DOCUMENT	○
3. DELIVER	○

*If applicable

Material Strategy Definitions and Examples

MATERIAL STRATEGY	DEFINITION	DESCRIPTIVE EXAMPLE	ON MARKET EXAMPLE
Mono Material (Biological)	100% Biological Material of the same fibre. Requires no manual separation of materials at End of Life.	T-Shirt: 100% organic cotton jersey, 100% organic cotton rib, 100% organic cotton threads, 100% organic cotton care, brand/size labels	A.BCH
Mono Material (Technical)	100% Technical Material of the same fibre. Requires no manual separation of materials at End of Life.	Outerwear Jacket: 100% rPET fabric shell, 100% rPET lining, 100% rPET threads, 100% polyester care, brand/size labels	Napaprijri
Simple Disassembly (Biological)	A mix of 100% Biological Materials that are specifically designed into a product for simple separation of materials for further processing.	Elasticated Trousers: 100% cotton drill fabric, 100% cotton pocket lining, 100% tencel thread, 50% natural rubber 50% organic cotton elastic (loose encase), 100% vegetable dyed corozo buttons, 100% cotton care, brand/size labels	KowTow
Simple Disassembly (Technical)	Mix of 100% Technical Materials that are specifically designed into a product for simple separation of materials for further processing.	Waterproof Trousers: 100% nylon ripstop fabric, 100% nylon threads, 100% Nylon Zip, 100% PET buttons, 100% PET Toggles, 100% nylon care, brand/size labels	Norse Projects
Simple Disassembly (Mixed - Biological and Technical)	Mix of biological and technical materials that are specifically designed for simple separation of biological and technical materials into multiple reclaimable material streams.	Tailored Trousers: 100% wool fabric, 100% Tencel Lyocell Pocket lining, 100% Tencel Lyocell Threads, 100% Resortecs Threads (Waistband, zip, hook) 100% Cotton with Bio Fuse, 100% Brass hook, 100% PET Zip, 100% Tencel Lyocell care, brand/size label	Unspun Uniqlo
Simple Disassembly Polyester/Cotton Blended Material	Mix of only polyester (PET) and cotton fibres (either as a blended fabric or mixed materials) specifically designed into a product for simple separation of individual components e.g., removing buttons. Requires additional chemical separation of biological and technical materials from a specialist provider OR mechanical recycling into next generation poly/cotton fabrics.	Work Shirt: 45% cotton 55% polyester drill fabric, Core Spun Poly/Cotton thread, 100% PET buttons, 100% Polyester care/brand/size labels.	Cargo Crew
Not Yet Circular	Mix or blend of fibres and/or materials that are not easily separated e.g., wool/nylon blend fabric. Requires time consuming and manual separation of bio and technical materials that are generally considered too high effort/low value to perform. These product should be reserved for the most complex of items with performance restrictions e.g., Fire fighter uniforms, Extreme weather gear with a view to develop circular innovations specifically for these products.	Knitted Cardigan: 90% Cotton 5% merino wool, 5% elastane Main, 100% polyester button hole thread, 100% Rayon Embroidery threads, 100% PET buttons, 100% Nylon care label, 100% Polyester brand label/size label	

Glossary

Bill of Materials (BOM)
a document that outlines all raw materials, components, and processes used.

Biological Materials
derived from natural resources, including plants and animal hair and skin irrespective of additional processing or finishes applied, (biological materials are not affected by any non-biological additive (ie chemicals) used in processing, unless the additives adhere to the material in which case the material's properties will be altered to a synthetic or blended material).

Biological Monomaterial
a biological material that consists only of one (100%) of the same fibre or contents- see also Monomaterial (Biological).

Chemical Compliance
where chemicals used meet applicable standards or regulations, policies or methods of governance regarding the use of chemicals in the manufacturing of textiles, garments, and accessories.

Chemical Recycling (Biological)
a process of breaking down biological textiles (typically cotton or Man-Made Cellulose Fibres (MMCFs) at the molecular level and then reprocessed into new MMCF fibres or other cellulosic raw materials.

Chemical Recycling (Technical)
a process of breaking down technical/synthetic textiles (typically polyester or polyamide) at the molecular level and then reprocessed into new synthetic fibres or other technical raw materials.

Chemical Separation
a process of chemically extracting specific components or fibres from discarded textile (typically cotton and polyester blended textiles), used to separate blended fibres from two different material sources. This is most typically done with cotton and polyester blended textiles.

Circular Design Record (CDR)
a document that captures both the design methodology and agreements made with Lifecycle Partners

Circular Input
a raw material that is recycled and/or reused and/or renewable AND complies with one of the six Circular Material Strategies.

Circularity Performance
the ability of a product designed for circularity to flow through each stage of the Lifecycle Design. Circularity Performance is a future metric as it requires either a Digital Product Passports or Digital Twin technology to enable a traceable record of material flows.

Circularity Potential
a numerical circularity rating of a garment, expressed as a percentage, as determined internally by designers by calculating alignment with the CDR.

Circular Material Strategy
A selected circular strategy chosen by the designer at the beginning of the Lifecycle.

Clothing Utilisation
how often an item of clothing can be expected to be used over its expected lifespan, measured by both Intensity of Wear and Frequency of Wear.

Compost
a biological process whereby materials are broken down and are able to be returned to the natural systems as soil nutrients.

Glossary

Cycles of Use
the use phase of a product's **lifespan**, including repair, reuse, remanufacture and repurpose) within and further categorised within Low Cycles of Use or High Cycles of Use.

Circular Design Disruption
an unintended action that disturbs the intended cycle of use and end of life actions,

Circular Design Plan (CDP)
a record that outlines the anticipated pathway that a product will flow through within the lifecycle

Circular Design Testing
is additional testing performed to ensure that circular design changes do not result in unintended consequences to product quality or safety.

Digital Twin technology
a digital replica, or augmentation, of a physical asset (product, system, or process), including its functionality, features and behaviour, in the virtual environment.

Digital Product Passport
a digital identity card or document of products, components, and materials, which stores relevant information about the product, such as materials and their origins, authenticity, technical performance, repair activities, recycling capabilities and lifecycle environmental impacts

Disassembly Effort Factor
the complexity of disassembly task X number of tasks.

Downcycling
repurposing of a product and its materials into a product or materials of lower value, both in terms of quality and functionality

Durability
the ability of a product to be functional and relevant over time when faced with the challenges of normal operation (EMF) Durability can relate to either or both Physical Durability and Emotional Durability

Decommissioning
the separation of materials and components from a product to perform an end of life action (e.g. recycling) where there is no/minimal loss or waste.

Disassembly
the separation of materials from a product to perform a reuse action (e.g. remanufacture) or end of life action (e.g. recycling) without damaging the materials and where there is no/minimal loss or waste, and each separated component can flow to a reuse or recycling stage. See Simple Disassembly for further definition on design actions.

Emotional Durability
relevance and desirability of a product, contributing to its longevity

End of Life (EOL)
the lifecycle stage where the product no longer flows through cycles of use and its materials are either recycled, composted, landfilled or incinerated.

Glossary

Frequency of Wear
how often a product is worn during a specified time period, often combined with Intensity of Wear to determine optimal Clothing Utilisation.

High Cycles of Use
use interventions that occur higher up on the Resource and Waste Hierarchy *(please link to where the diagram first appears in the guide)* and that keep a product in use in its *original form* with highest value and lowest effort.

Input
a raw material used within a product.

Intensity of Wear
how vigorously a product is worn over a specified time period, often combined with Frequency of Wear to determine optimal Clothing Utilisation.

Lifecycle
a series of stages a product and its raw materials will flow through, from raw material extraction, through to manufacture, use and end of life.

Lifecycle Design
the design of a product flow through a chosen lifecycle plan to ensure optimal Circularity Potential of a product.

Lifecycle Partners
organisations or individuals that designers engage to assist with fulfilling the Lifecycle Design.

Lifespan
the length of time for which a product functions as per its intended purpose

Longevity
how long a product lasts in use, regardless of its condition

Low Cycles of Use
use interventions that occur lower down on the **Resource and Waste Hierarchy** and that *fundamentally change or intervene in a product's original form* to extend the material's use with variables to both effort and value outcomes.

Made to be Made Again
when a product is specifically designed to be recycled into new products.

Man-Made Cellulose Fibres (MMCF)
regenerated fibres made from the cellulose of plant cells (and includes cellulose from wood, bamboo and other plant matter) that require a "man-made" chemical process to produce a fibre suitable for textile production. Viscose, lyocell, and modal are all classified as MMCFs. In their final form, MMCFs are pure cellulose and are therefore considered Biological Materials as an output.

Mechanical Recycling
a process of tearing and loosening fibres within a material back into a base fibre that is typically shorter in length than its original state.

Mixed Material
a material or product made from two or more different fibres

Monomaterial
a material that consists only of one (100%) of the same fibre or contents

Monomaterial (Biological)
a biological material that consists only of one (100%) of the same fibre; see also Biological Monomaterial.

Glossary

Monomaterial (Technical)
a technical material that consists only of one (100%) of the same fibre fibre or contents; see also Technical Mixed Material

Not Yet Circular
a product that is either:

- a mix of fibres and/or materials that requires manual and complex separation of bio and technical materials,
- Or a product that does not yet meet a Circular Material Strategy criteria.

Output
products or by-products produced as a result of a process

Physical Durability
ability of a product to resist damage and wear, contributing to its longevity

Product
for the purposes of the Refashioning Guide, product refers to a physical garment designed for wear

Recycled
Material remanufactured and made into a new product or a component part for incorporation into a product.[1]

Recycling
The process of reducing a product back to its basic material level, reprocessing those materials, and using them in new products, components, or materials.[1]

Recycling (Closed Loop)
a manufacturing process that uses the recycling and reuse of products to supply the material used to create a new version of the same product.

Recycling (Open Loop)
a manufacturing process where the product is reprocessed and the recycled material produced is used for an application different to the original.

Regenerate
the rebuilding of natural capital using technologies that actively improve and revitalise soil and rebuilds biodiversity, enabling nature to thrive

Regenerative Production Practices
practices that build soil health and carbon content, increase water quality and biodiversity, and improve the resilience of ecosystems.[7]

Remanufacture
a process by which a product is created from existing products, materials or components. The process can include disassembly, re-dyeing, restyling, or other manufacturing processes to create new products for use. See also Upcycling.

Renewable Material
a material made of biomass from a living source and that can be continually replenished.

Repair
the process of restoring a damaged, faulty, or worn product to a good condition .

Repurpose
using something for a different purpose to the one for which it was originally intended.

Reuse
the act of repeated use, either by one user or multiple, in its original purpose and with the exception of repairs, is not significantly modified, remanufactured or recycled.

Glossary

Reused
Where a product has been used repeatedly, either by one user or multiple, for its original purpose and with the exception of repairs, is not significantly modified, remanufactured or recycled.

Safe
A product that has been designed so that substances hazardous to health or the environment are designed out, ensuring no pollutants are released into the environment and enabling safe material circulation.[7]

Simple Disassembly
a design strategy that utilises a simple Disassembly Effort Factor (complexity of disassembly task X number of tasks) in order to allow for the straightforward and fast separation of materials for either Reuse or End of Life.

Simple Disassembly (mixed biological and technological)
a Circular Material Strategy for products containing a mix of biological and technical materials that are specifically designed for simple separation of biological and technical materials into multiple reclaimable material streams.

Simple Disassembly (biological)
a Circular Material Strategy for products containing a mix of differing biological materials, specifically designed into a product where simple separation of materials for further processing is required.

Simple Disassembly (Polyester/Cotton)
a Circular Material Strategy for products containing a mix of polyester (PET) and cotton blended materials (either as blend fabric or mixed materials) specifically designed into a product where simple separation of individual components (like removing buttons) is required. This strategy also requires additional chemical separation of bio and technical materials from a specialist provider OR mechanical recycling into next generation poly-cotton fabrics.

Simple Disassembly (technical)
a Circular Material Strategy for products containing a mix of differing technical materials, specifically designed into a product where simple separation of materials for further processing is required.

Synthetic Fibres
man-made fibres derived from either non-renewable or renewable resources, processed using chemicals and resulting in a non-biodegradable fibre output

Technical Materials
derived from either non-renewable or renewable resources and processed into a synthetic fibre or component

Technical Monomaterials
a technical material that consists only of one (100%) of the same fibre or contents- see also Monomaterial (Technical).

Technical Chemical Recycling
a recycling process through which technical textiles (typically polyester or polyamide) are broken down at the molecular level and then reprocessed into new synthetic fibres or other plastic materials.

Transparency
the public disclosure of credible, comprehensive and comparable information about production processes, supply chains, business practices and the impacts of these practices on workers, communities and the environment (e.g., Fashion Revolution).

Glossary

Upcycling
the process of reusing and, through redesign and remake techniques, transforming a product or its materials/ components into new, higher-quality product, see also Remanufacture.

Used more
when a product is specifically designed for durability, reuse, repair, remanufacturing and repurposing in order to keep the product and its components and materials circulating in the economy for longer.[7]

Use Plan
how a product is intended to flow through (and stay within) the chosen cycles of use, including expectations for how the garment should be used, reused, repaired and if appropriate, remanufactured or repurposed.

Waste
Materials or substances discarded and no longer used, typically resulting in landfill, incineration, or leakage into the environment.[7]

Help + Troubleshooting

To learn more about this guide, download updated versions or to contact our team, please visit **refashioning.org**

References

1 Ellen Macarthur Foundation (2017) A new textiles economy: Redesigning fashion's future . Available at: https://www.ellenmacarthurfoundation.org/a-new-textiles-economy (accessed 04 February).

2 Merriam-Webster (2025) Design, verb . Available at: https://www.merriam-webster.com/dictionary/design (accessed 4 February).

3 Textile Exchange (2024a) Materials Market Report 2024 . Available at: https://textileexchange.org/knowledge-center/reports/materialsmarket-report-2024/ (accessed 04 February).

4 Textile Exchange (2024b) Our standards help companies and consumers to verify sustainability claims . Available at: https://textileexchange.org/standards/ (accessed 4 February).

5 Fibre Trace (2024) FibreTrace® embeds traceable ID's into raw fibres, creating verified products and secure supply chain maps, in real-time . Available at: https://www.fibretrace.io/ (accessed 04 February).

6 WRAP (2024) Clothing longevity protocol . Available at: https://www.wrap.ngo/resources/guide/extending-clothing-life-protocol (accessed 04 February).

7 Ellen MacArthur Foundation (2020) A circular economy vision for fashion and textiles industry . Available at: https://www.ellenmacarthurfoundation.org/our-vision-of-a-circular-economy-for-fashion (accessed 04 February).

refashioning.org