brother
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# Rethinking the role of Reuse, Remanufacture and Recycle

## Design for reuse: the key to a circular economy

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# Let’s stop sending waste to landfill

Each and every one of us is increasingly aware of the impact of our consumption. We know the products we use and the packaging they come in have to end up somewhere. And that somewhere is all too often buried in landfill.

The European Union (EU) aims to achieve a carbon-neutral, environmentally sustainable, toxic-free, and fully circular economy by 2050.[1] But in 2022, 30.2% of waste was landfilled in Europe.[2]

Did you know?

**Brother’s European remanufacturing facilities are both certified as carbon-neutral and zero-waste-to-landfill.[3]**

Carbon-neutral

zero-waste-to-landfill

## There’s still work to be done

Given our ever-growing reliance on technology, e-waste is one of the fastest growing waste categories globally. A record 62 million tonnes of e-waste was produced in 2022, and this amount is expected to rise another 32% by 2030.[4]

More than 20 years ago, we recognised this problem and set out to intricately understand and proactively act on the hierarchy of waste management, so we could most effectively minimise our impact.

Our work is nowhere near finished, but we’ve learnt a lot. And one thing our two decades of commitment and evolution has taught us is the power of remanufacturing in driving product design.

Remanufacturing holds the key to not letting e-waste go to waste, but to make remanufacturing successful, scalable and impactful, it has to be considered from design. A more sustainable future depends on it.

Achieving it requires the continued support of our customers and channel partners. The Waste from Electrical and Electronic Equipment (WEEE) Directive requires EU Member States to collect and recycle or remanufacture at least 65% of the average weight of electrical and electronic products sold over the past three years.[5]

To help meet this goal, we encourage our customers to return their used Brother ink and toner cartridges for us to remanufacture.

This paper draws on over 20 years of experience to deepen understanding of how - through customer collaboration - we can advance the circular economy and help maximise the impact of every element of the waste hierarchy.

# What does remanufacturing actually mean?

**Many businesses and consumers are familiar with the 5Rs: Refuse, Reduce, Reuse, Repurpose, Recycle.**

At Brother, refuse and reduce heavily influence our product design. But remanufacturing - which is less talked about, and sits across reuse, repurpose and recycle - is absolutely critical to establishing a true, global circular economy. And ensuring precious resources within products aren't allowed to slip away.

Remanufacturing is the process of rebuilding a product to its initial state and specification. It keeps every element of a product at its highest value for as long as possible. Anything that cannot be reused in its original form will then be moved into recycling - only when its highest value lies in making the materials into something else.

Design for remanufacture creates products that can have multiple lives. So nothing goes to landfill and fewer virgin materials are needed to manufacture products in the first place.

Its importance is increasingly recognised by Non Governmental Organisations (NGOs) and Intergovernmental Organisations (IGOs) across the world, and formed a key part of the UN Secretary General's message for 2024;[6] 'Governments at all levels must… invest in modern waste-management programmes anchored in reuse, remanufacturing, recovery and waste prevention.'

## Reframing remanufacturing in the recycling hierarchy

Remanufacturing has an image problem. When mistaken for 'refurbished' or simply 'second hand', consumer perceptions have seen remanufactured products cast as 'second class'; a 'lesser than' alternative to buying new.

For ink and toner cartridges, this can be largely attributed to the fact that not all remanufacturing is created equal. As an Original Equipment Manufacturer (OEM), we remanufacture to an 'as-good-as-new' standard. All Brother remanufactured ink and toner cartridges have the same quality as new products, use original parts and ink or toner powder, have full traceability and follow stringent processes and quality assurance checks.

A remanufactured cartridge is sometimes seen as one that is merely taken and refilled. While this does extend the life of the cartridge, it's not the same as genuine OEM remanufacturing; it's a lower cost approach, fraught with potential issues like leaks and lower quality outputs.

Genuine remanufacturing holds great promise in directly eliminating waste to landfill, minimising $CO_2$ production and driving down the amount of raw minerals we extract from the earth. By remanufacturing toner cartridges alone, we already save around 5,300 tonnes of $CO_2$ every year. But to do this, we've had to fundamentally change how we make and view new cartridges. It's a huge challenge, but one worth tackling.

**Did you know?**

**Brother remanufactured ink and toner cartridges save around**

**30% of the $CO_2$**

compared to making a new cartridge

# We've invested significantly in reducing our impact

Through our remanufacturing programme, Renew by Brother, we've reimagined and reshaped our manufacturing for a zero landfill world. Building up the human skills and machine resources to move manufacturing forward, in a way that protects the planet and our company's place within the global economy. Building up these capabilities is hard - but we've proven it can be done, and that it's worth it.

It's been a long journey of redesigning cartridges and reengineering complex, global supply chains. But our remanufactured cartridges are now totally indistinguishable from new ones. This was possible, because we accepted early on that we, as the manufacturers, have the best knowledge of our products and are best placed to create a circular process around them.

Since 2004, as part of our strategy to do the right thing by our customers, our business and our planet, we've built two state-of-the-art carbon-neutral remanufacturing facilities in Europe.

And state of the art they are, creating remanufactured cartridges that are as-good-as-new, and subject to identical final inspection. We think this could provide a model for many other industries and products, for a future where recycling isn't the default waste management process, and allowing something to go to landfill is simply not acceptable.

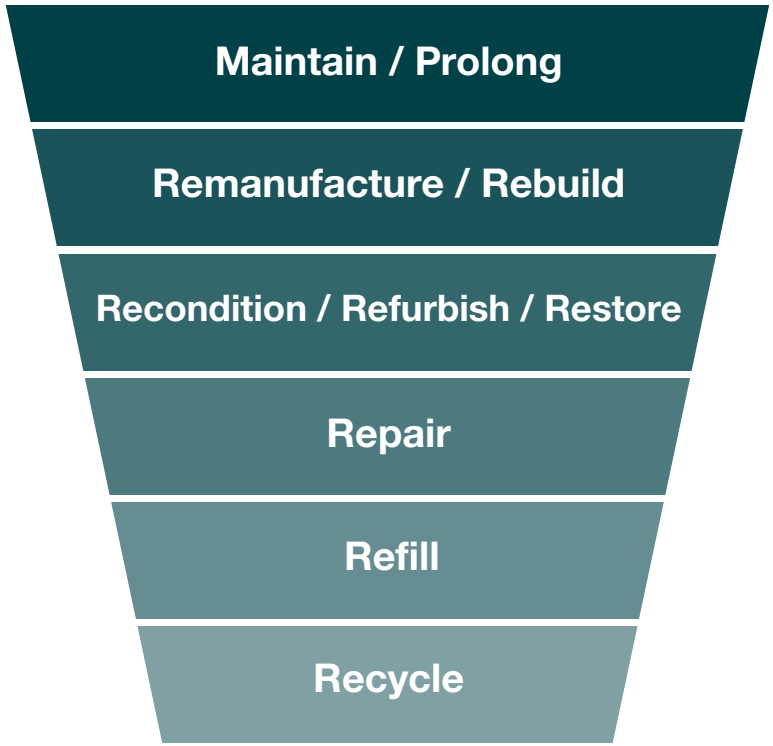
These long term commitments to continuous improvements offer impactful short term ESG advancements for our customers. Because remanufactured cartridges are identical to new ones, many businesses already use them without realising. Proactively asking for remanufactured consumables is an easy win to improve sustainability credentials without compromising on cost, performance or warranty. It's a practical, immediate step you can take towards meeting ESG goals and reducing waste.

> *"It is difficult to design a product so after use it can be taken back to a factory and remanufactured to as good as new quality. Brother does this."*
>
> David Fitzsimons, Director, European Remanufacturing Council

# The hierarchy of resource reuse

Every part of the circular economy plays an important role in driving down the environmental impact of consumers and businesses - and in preventing us from running out of precious resources.

But there is often confusion across businesses and disparities across regions about what these words mean. With that in mind, we've outlined the most common processes within the hierarchy of resource reuse - from best case to last resort - and indicated the level of complexity required to deliver each of them:




### Maintain / Prolong

Keeping a product in its existing state of quality, functionally and/or cosmetically, to guard against failure or decline. It is a practice that retains the highest value of a product by extending its use period.

**Process complexity: Low**

### Remanufacture / Rebuild

Returning a product to at least its original performance with a warranty that is equivalent or better than that of a newly manufactured product. Remanufactured (rebuilt): Used, repaired by replacing worn parts and filled with new toner or ink. Remanufacturing does not necessarily use original spare parts. Whilst at Brother we use original spare parts, remanufacturing may involve components that are not original.

**Process complexity: High**

### Recondition / Refurbish / Restore

Returning a product to good working condition by replacing or repairing major components that are faulty, and making cosmetic changes to update appearance, using methods such as resurfacing or repainting. Any subsequent warranty may be less than issued for a new or remanufactured product, but is likely to cover the whole product and performance may be less than 'as new'.

**Process complexity: Medium**

### Repair

Returning a faulty or broken product or component back to a usable state to fulfill its intended use.

**Process complexity: Medium**

### Refill

Used printer cartridges cleaned and refilled at their end-of-use with toner or ink. Refilling is generally less rigorous than remanufacturing, with less technical equipment and procedures, usually producing a lower quality product.

**Process complexity: Low**

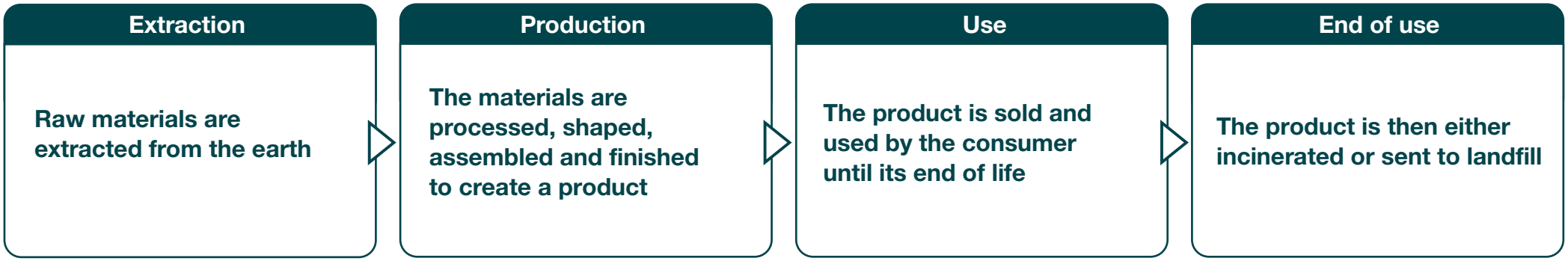
### Recycle

Converting products or components that would otherwise be discarded into their basic materials, which are then reprocessed into new ones. However, this often results in the loss of embedded energy and value. In a circular economy, recycling is considered a last resort.

**Process complexity: Medium**

# Understanding remanufacturing's place in the circular economy

## Let's start by looking at the traditional, linear life cycle of a consumable product...




While recycling is more desirable than landfill, it has limitations. When a product's recycled, it loses structural integrity and purpose. It's broken down into its raw material form, which uses energy in itself. And every time the process happens, the raw materials lose quality.

Through true remanufacturing, component parts are kept in their 'final' form for as long as possible. Extending the life of each element, so that recycling becomes a necessary last action in the circular journey.

Value-Retention Processes (VRPs) (namely remanufacturing, comprehensive refurbishment, repair and direct reuse) and recycling are complementary processes that, if pursued strategically, can enable faster achievement of a circular economy.[7]

Did you know?

Brother is the first printer manufacturer with a

**Blue Angel DE-UZ 177**

certified cartridge model

**In fact the only manufacturer that has achieved the latest 2021 version of the standard[8]**

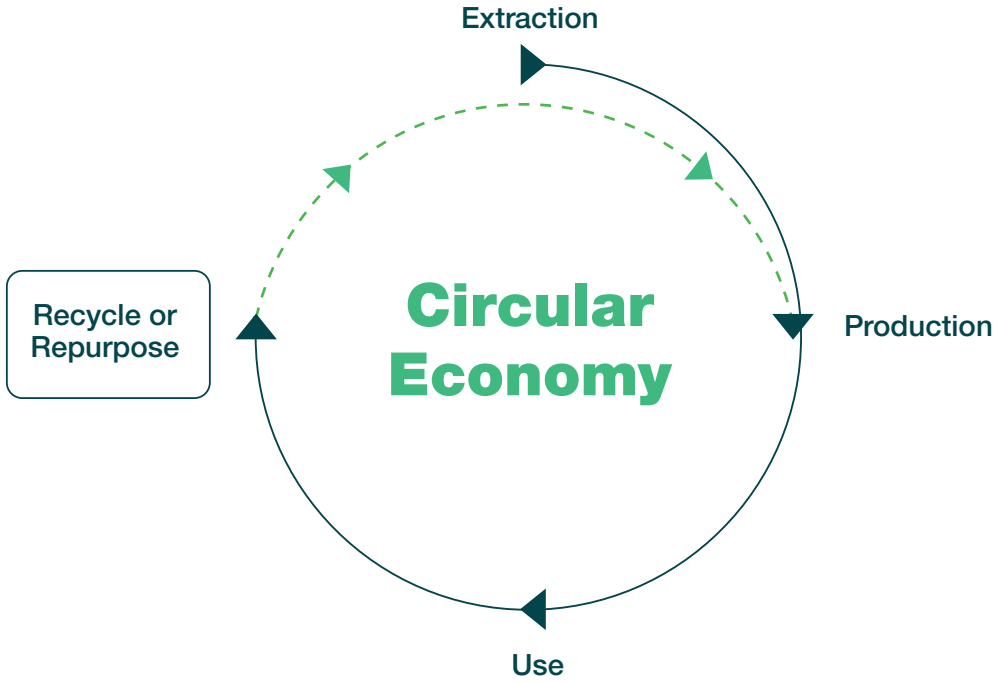
## The diagrams below highlight the stages of the linear vs circular economy

### Linear economy

The linear economy follows a one-way trajectory. It's resource-intensive and relies on repeated extraction of virgin materials from the earth.

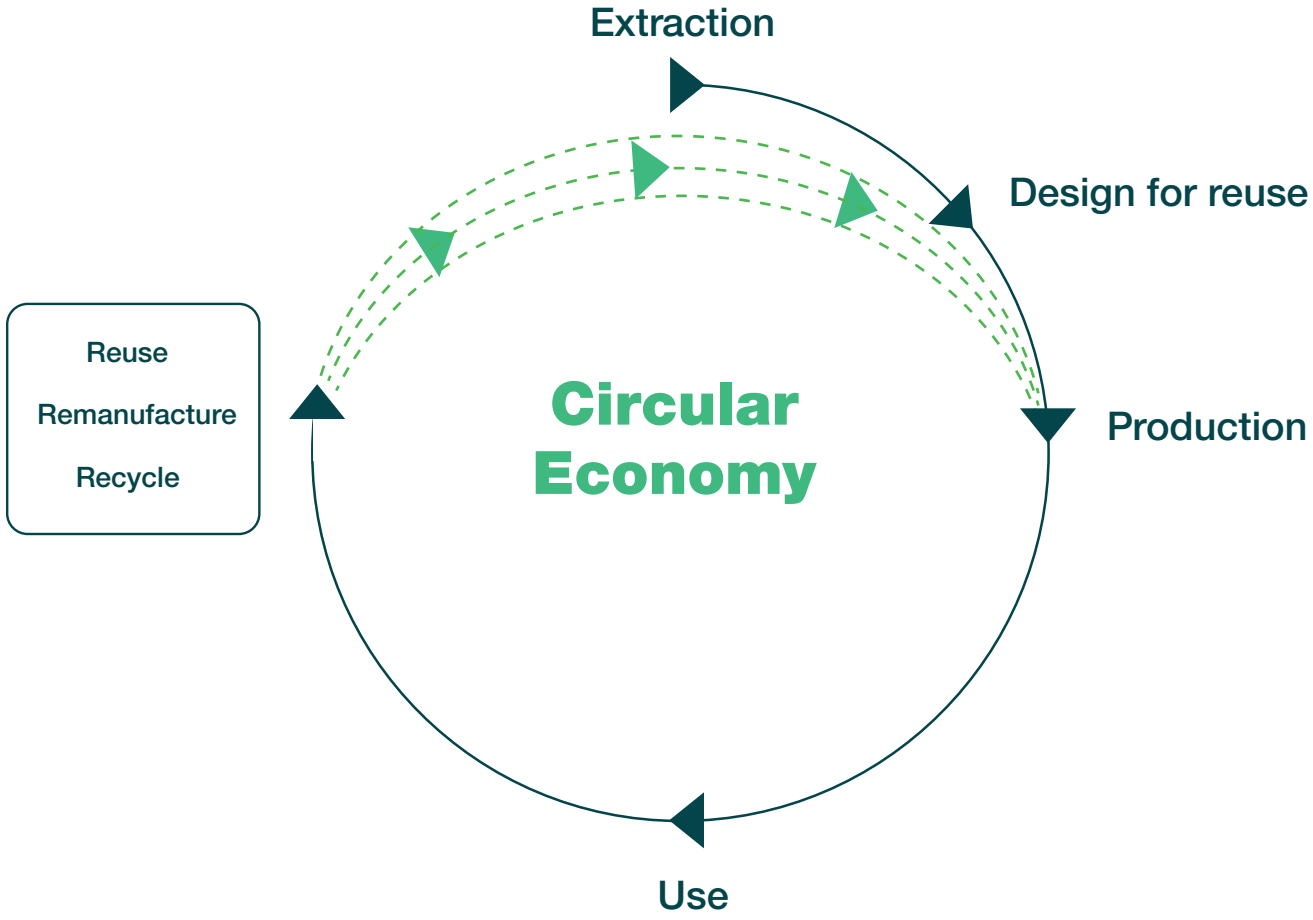

### Circular economy with no design for reuse

The circular economy model is a step forward. Materials can be recycled or repurposed, putting elements back into production to minimise the extraction of raw materials.



## Circular economy including design for reuse

By adding design for reuse into the circular economy model, the options for materials that have been used multiply. Individual components can be kept in their final form for longer - extending the useful life from materials and avoiding further extraction.



# Linear economy vs Circular economy

## Linear economy:
TONER CARTRIDGE

### Extraction
Raw materials (plastic, metals, toner powder) are extracted for single-use manufacturing.

### Designed for single use
Cartridge is designed to be disposable; hard to refill or repair.

### Already obsolete
Quickly becomes obsolete due to model changes or lack of refill infrastructure.

### End of life
Ends up in landfill and valuable materials are wasted.

## Circular economy:
TONER CARTRIDGE

### Extraction
Materials are extracted or recycled inputs are used from old cartridges or other sources.

### Designed for reuse
Engineered for reuse; easy to disassemble, fill and reassemble. Labels and parts support multiple life cycle.

### Repair, refurbish or remanufacture
Returned cartridges are remanufactured: cleaned, refilled, and quality-tested for resale.

### Given new life
Multiple uses across the life cycle, with components kept at the highest possible value.

As you can see in this simplified example, design is absolutely critical to creating a product for the circular economy.


# It starts with product design

Brother started collecting cartridges for remanufacturing in 2004. It's been a long process of learning to understand how to get useful collection numbers up and redesign cartridges to support remanufacturing.

At first, most returned cartridges were broken, meaning we could only remanufacture about 20% of what was collected. That wasn't good enough.

So we started to look into why they were broken - what were the common failures or issues that meant a cartridge could not be remanufactured? Having identified failure points, we fed back to our product designers in Japan, who have worked tirelessly to evolve our cartridges.

> *"Brother is a pioneer in ecodesign. They design for remanufacture - creating consumables that are easy to disassemble and reuse - all from their own remanufacturing facilities."*
>
> David Fitzsimons, Director, European Remanufacturing Council

Here are just some of the ways we've reengineered and continuously improved our products since…

**Surfacing:**

Finding that bright finishes scratch more easily and can't be considered 'as new', the outward facing design was modified.

**Accessibility:**

To gain most value from every component, each element of the cartridge needs to be easily accessible for disassembly.

**Durability:**

Updating design to reduce damage over an extended life and protect the component during shipping.

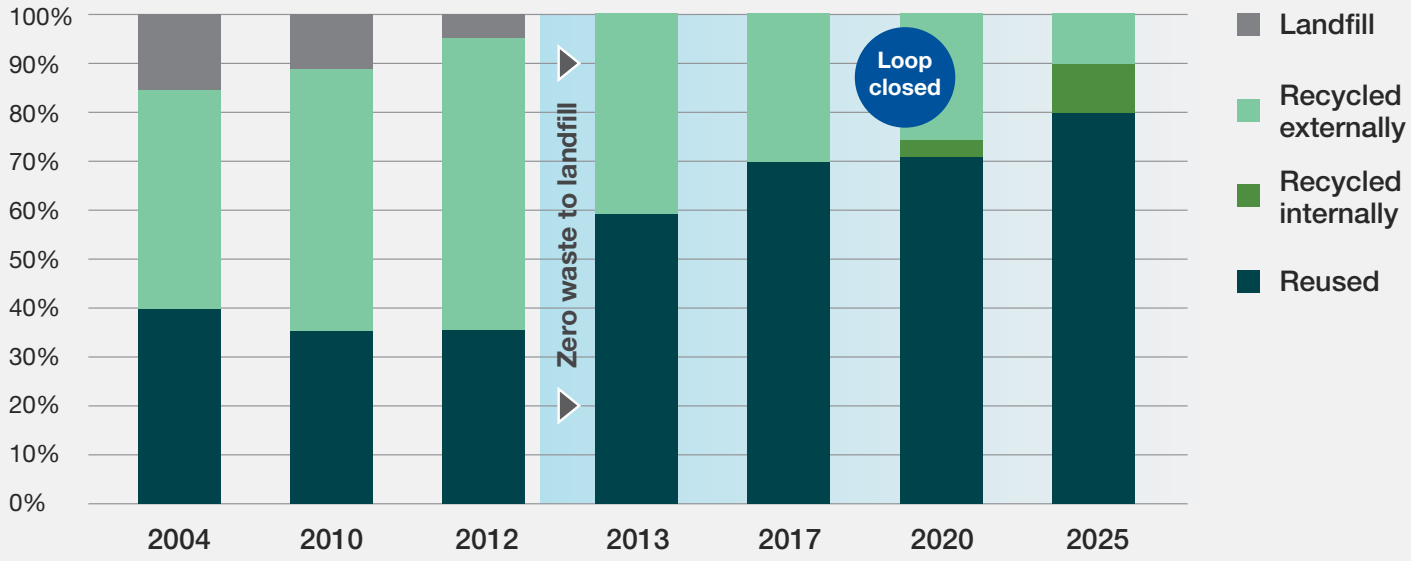
**Packaging:**

To overcome the issue of broken returns, we modified packaging and methods of delivery so each cartridge has the best chance of coming back without damage. We also prefer to reuse the original packaging to return a product for remanufacture.

Carefully evaluating the problems with collected used Brother cartridges has led us to eco-design products and parts to be tougher, more protected and resist damage.

## Linear vs Circular economy in practice

Average material usage rate




It's been a long journey. But worth the significant resources invested. By 2020, the loop was closed. And the simple fact that our products will be coming back to us after use has created an incentive to design them better in new ways.

> *"Even at the design stage, we keep in mind a structure that is easy to regenerate, allowing for repeated remanufacturing."*
>
> Daisuke Ishizuka, Recycling Technology Engineer

We built our eco-design practices from the ground up, thoroughly designing and evaluating each component to make them last longer. We also track every product and part we receive, which helps us consistently refine our circular economy approach.

Take the developer roller, for example, which is an integral part of a toner cartridge. We design it to work perfectly with Brother toner powder, and we've developed specific processes to reuse them. We've even managed to reduce their weight by minimising size and materials, so they create less $CO_2$ during transport.

It's a challenging process, but we're really proud of the positive difference we're making for society and the environment.

# Putting circular principles into practice

## From our learnings over the years, here are the key considerations for starting or accelerating your circular journey.

### 1. Start conversations with customers:

Engaging with customers to raise awareness of and promote participation in OEM remanufacturing schemes. These conversations should discuss simple actions they can take that will make a difference, such as the need to take care in packaging. Rough handling and sending to municipal waste will more than likely damage the products, making recycling the only option.

### 2. Scale of the process:

Return on remanufacturing investment won't happen overnight. Cost efficiencies in the process depend on the ability to scale and catch up with the linear economy through volume and automation. Often, this is further complicated by costs competing with Asian manufactured products with lower labour costs.

### 3. Consider compliance:

Remanufactured products are newly placed on the EU market, meaning they must meet legislation such as RoHS and REACH. This requires investment in traceability systems to track historical material use and ensure ongoing compliance.

### 4. Establish reverse logistics:

Be prepared to navigate operational hurdles such as products being classified as waste, managing regulatory compliance across EU borders, and the often high cost of transporting goods back for remanufacture. Partnering with and purchasing from OEMs who already have these systems in place can be a shorter term solution to overcome these challenges.

### 5. Redesign for reuse:

Track and measure the quality of returned products, and their longevity. Learn from recurring issues, to inform future product design. This is a long term commitment over decades.

### 6. Build customer acceptance:

Often, customers expect remanufactured products to come with a lower price tag, making it challenging for lower value products. Green public procurement may stimulate the requirement for remanufactured products - but societal demand for circular products is required to continue the shift. We need a groundswell of awareness and acceptance to accelerate sustainable change.

Did you know?

**Brother has pioneered remanufacturing for toner and ink cartridges. On average,**

we reuse **80% of the weight**

of each cartridge we remanufacture

# Conclusion

There's still a long way for businesses and consumers to go to hit the EU's target of a carbon-neutral, environmentally sustainable, toxic-free and fully circular economy by 2050.

But what will be key to us achieving it is genuine commitment to continuous improvement. And in particular, designing products to be remanufactured, to keep them at their highest possible value for the longest possible time.

We won't stop there. We're taking direct action and committing to values-based partnerships to minimise our impact, aiming to achieve carbon neutrality in all business operations by 2050.

We'll achieve this by focusing on the areas we can directly influence - such as powering our operations with renewable energy - and by continuing to strengthen our partnerships with organisations like Cool Earth, to combat deforestation and safeguard the planet's most biodiverse and essential ecosystems.

You can make a difference too. By returning your used Brother ink and toner cartridges, you're not only supporting us - you're actively driving the shift towards a more sustainable future.

**For more information about our market-leading remanufacturing, visit:**

https://www.brother.ch/fr-ch/brother/environnement-et-developpement-durable/leader-du-marche-du-reconditionnement

**To return your used Brother ink or toner cartridges for remanufacturing, visit:**

https://www.brother.ch/recycling

**We take over 100 steps to remanufacture a single Brother ink or toner cartridge.**

But the first step starts with you.

brother
at your side

## A Leader in Hardcopy Remanufacturing

Brother has been recognised as a Leader in the IDC MarketScape:
Worldwide Remanufacturing 2025 Vendor Assessment.
Key strengths include: Knowledge base and resources, Eco-design,
Dual toner and ink offerings, Ample capacity, Sustainability.[9]

**Sources**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