



Inspiration guide **Circular design**

with 12 example cases

VANG
MORE AND BETTER RECYCLING

CIRCO
creating business through
circular design

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Introduction

The economy in the Netherlands circular in 2050, that's the ambition! It seems far away, but the transition is in full swing. There are plenty of opportunities for entrepreneurs to be part of the circular economy and to become front runners. Preservation of the value of materials and products is the central challenge for a circular economy. It requires a different way of designing and using products and collaboration in the production chain. To achieve this, new design strategies that focus on long product life, sustainable choice of materials and closing the material chain are crucial. The transition to a circular economy also requires new revenue models that are not based on growth in sales volumes. The transition to a circular system therefore presents a major challenge for all parties involved in the chain: designers, producers, service providers, retailers, buyers, users and recyclers.

This inspiration guide

With twelve diverse examples of circular products, this guide inspires every party throughout the chain to start working in a circular way. The examples vary from packaging to electronic products and materials for construction, and each case uses a different angle and approach to connect to a circular economy. There is no single solution for all products, and this is reflected in the cases described.

The cases are approached from different perspectives. For each case, we indicate the design solutions applied, the way the chain is organised and how the business model is designed. The emphasis lies on the organisation and the design for recycling. This way, you gain insight into the roles that different parties in the chain can take on in order to achieve the transition to the circular economy. The different cases provide good insight into the current state of circular design.

This guide focuses on products. Circular design is essential to make a success of the transition to a circular economy. Before you dive into the cases, you can read more about the different aspects of designing products for a circular economy in the first chapter. Different design strategies are discussed, which give you tools and inspiration to get started yourself.

The circular economy

The circular economy demands a different way of dealing with products and materials. It starts at the design stage by opting for the efficient utilisation of safe and sustainable materials, perhaps recycled. To achieve long-term use, repair, modification, and reuse of products and parts are paramount. When this is no longer possible, the raw materials are recovered and reused in new products in order to close the material chain.

The transition to a circular economy requires **product innovation and new technologies**. As early as during the design stage of a product, reuse, repair, disassembly or recycling have to be taken into account, so that the products can be used as effectively as possible. New design strategies are needed to keep the use of raw materials and energy consumption to a minimum, to extend product lifespan, and to preserve the value of the product as much as possible.

The parties in a circular economy are dependent on each other. This is because the product design needs to be in line with the planned reuse and recycling during the life cycle of the product. Organising return logistics and providing services to customers is also a requirement. To achieve this, effective **chain collaboration** in relation to a product is essential.

To make circular products profitable, **new revenue models** are needed so that companies no longer depend on the volume of products they sell. A service-oriented approach or a switch from ownership to use are examples of this. These revenue models are necessary to maintain and recover the value of products, components and materials. New business models also create opportunities for companies to improve their service and increase customer loyalty.

The Netherlands circular

The Netherlands has the ambition to be fully circular by 2050. As early as 2030, we will have to be using 50% fewer primary raw materials. To achieve this ambition, transition and implementation agendas have been drawn up for five sectors: biomass and food, plastics, manufacturing, construction and consumer goods. Within the agendas, cross-cutting themes are mentioned, and one of these themes is circular design. This guide discusses product examples that have interfaces with the different sectors, with the exception of biomass and food.

If you would like to know more about the Netherlands going circular in 2050, click [here](#).

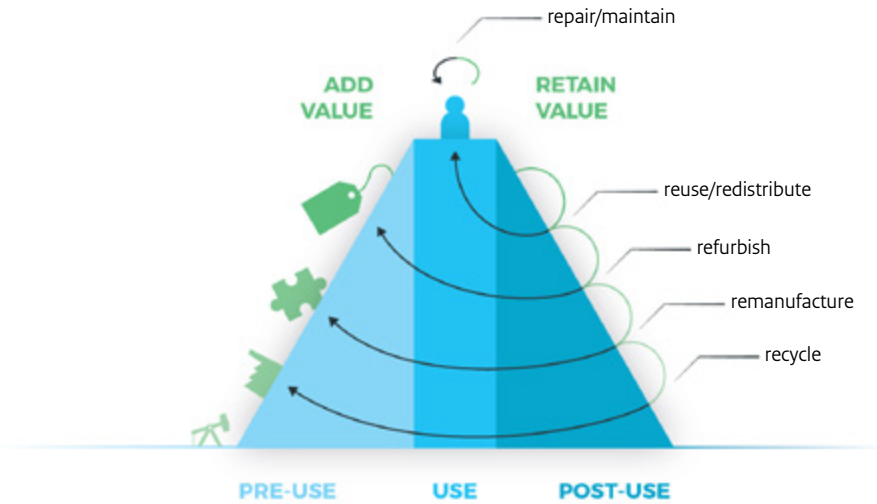
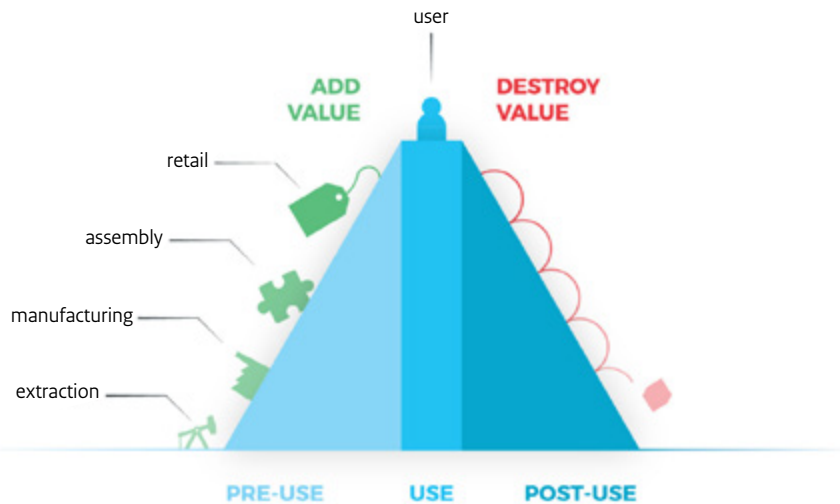
Products in a circular economy

Every step in a product's production process adds value, from extracting the materials to assembling the parts. This is also shown in the **value hill** in the illustration below. The product is higher on the value hill than the material, so the value of the product is higher than the value of the material. In a circular economy, parties in the chain aim to preserve the value of products and materials for as long as possible, so as to remain at the top of the value hill. This requires a different way of dealing with these materials and products.

For products, **value retention** means using them as long and intensively as possible. In this way, we make optimal use of the value (energy, materials, production) that has been put into the products. By maintaining and repairing a product properly, its lifespan is extended and the value of the product remains high.

Even after a product has fulfilled its function, value retention is central. When a user discards the product, part of the product value is lost. As can be seen in the illustration below, the product drops down the value hill. In order to be able to add value to the product again, a subsequent high-quality application for the product must be found.

Perhaps the product can be reused by a new user, or the product can be **refurbished** so that it can be returned to a new user as good as new. In this way, value is added to the product again. As a last option, the product goes to the recycler for reuse of the materials. **Recycling** is essential for closing the material cycle, but it is also the process step where the most value is lost from a product. The image below makes it very clear that recycling is at the bottom of the value hill.



Products with a short lifespan

For short-lived products, such as single-use packaging and disposable products, a different approach to value retention is required. These products are used only once and for a short time, so they lose their value quickly. Extending lifespan, reuse or refurbishing is often difficult; value can only be added to the materials through recycling. For products with a short lifespan, it is therefore particularly important that the product is easy to recycle.

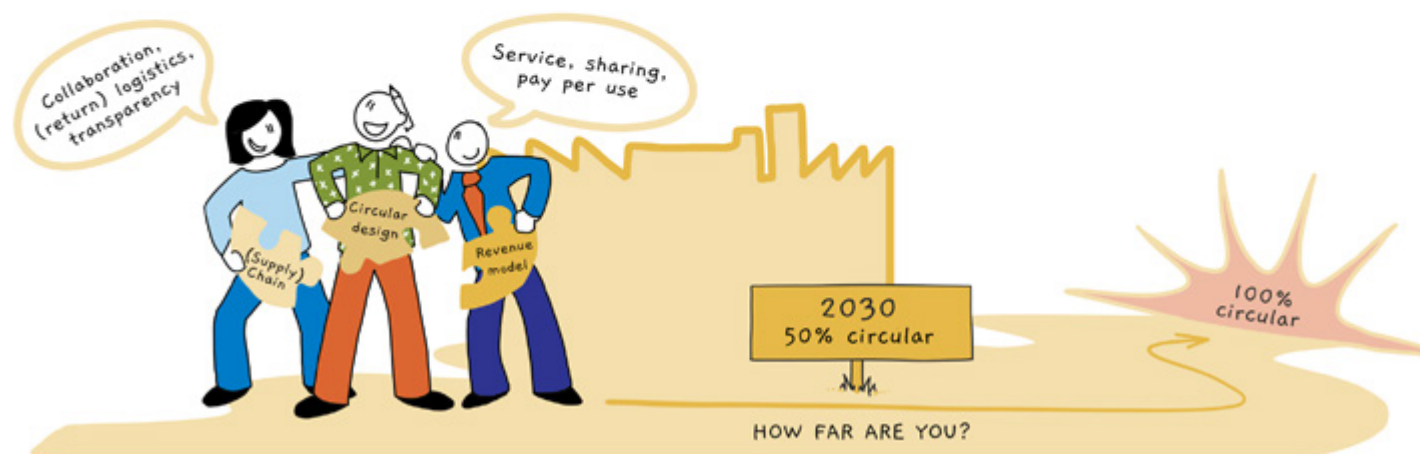
Achieving circular products

To effectively preserve the value of a product in a circular economy, changes are needed in the chain, the revenue model, and the product design:

- **The chain:** repairing, reusing, refurbishing and recycling products requires a different organisation of the chain. Including, for example, partners who carry out repairs, organise return logistics or recover raw materials. By working together, companies can bring their products and services to the market in a circular way.

- **The revenue model:** in a circular economy we shift from product ownership to use. This means that other revenue models are also required. For example, providing a service or leasing a product instead of selling it.
- **The product design:** product design adjustments are needed to enable efficient repair, refurbishing and recycling of products. By searching for new product solutions, the value of a product can be preserved. You can read more about this in the next section on 'circular design'.

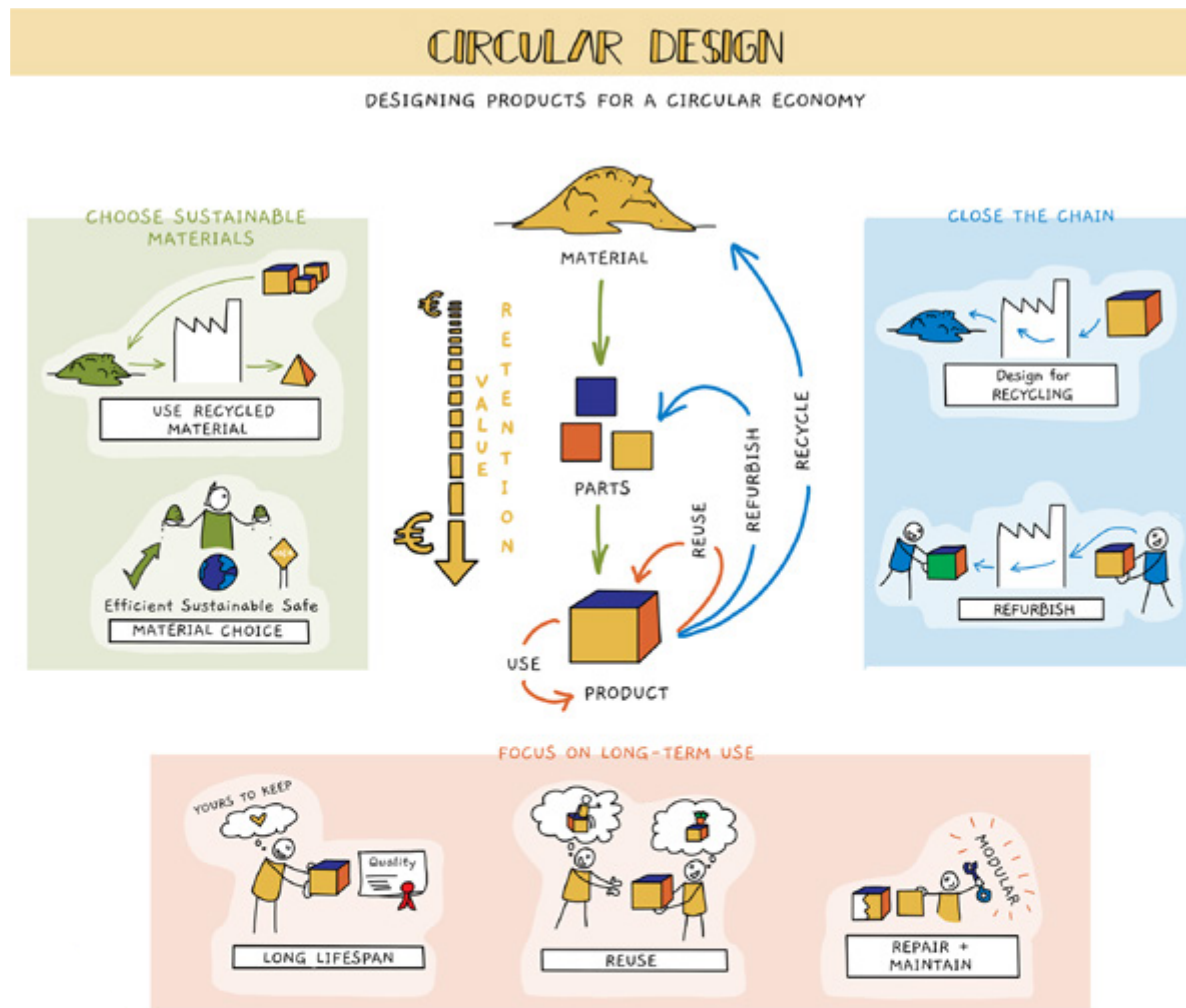
Choices made concerning the revenue model influence the product design and also set the requirements for organising the chain. For successful circular concepts, it is important that these three aspects are well aligned. So that these puzzle pieces, as shown in the illustration, fit together seamlessly to achieve the circular transition. The cases in this guide are examined from these three perspectives; what choices were made to market the product in as circular a fashion as possible?



Circular design

To enable a product to fit into the circular economy, a 'circular design' is needed. Different circular design solutions are possible, as shown in the illustration. This drawing was made to show the possibilities of circular designs, and the interdependence between the design, the chain, and the revenue model. Depending on the market positioning and the use of the product, designers can choose a matching design approach.

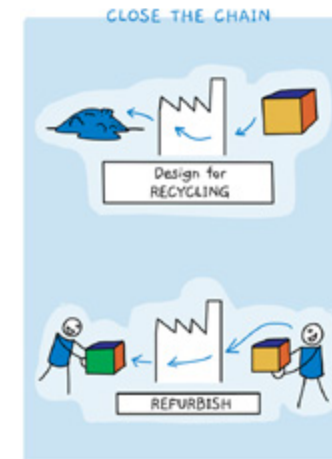
Three themes guide the design phase: a focus on long product use, choosing sustainable materials, and closing the chain. These three themes and the associated design strategies are explained below.



Focus on long use

By designing products for a long life, their value is retained longer and fewer new products are needed. Develop products with a focus on quality, reparability and product attachment.

- **Long lifespan:** a high-quality product is less likely to break down and retains its value for longer. The balance between sound design and use is essential.
- **Attachment & trust:** to achieve a long lifespan, it is not only the strength of a product that is important. The user must also want to use the product for a long time. The creation of attachment and trust between the user and the product is therefore essential; the product must have and retain value in the eyes of the user.
- **Repair and maintenance:** when a product is easy to maintain and repair, it lasts longer. If vulnerable parts are easily replaceable, the product's lifespan is extended.
- **Reuse:** by reusing a product, its value is retained longer. In the case of reuse, no adjustments are made to the product, but it is essential that the product is suitable for a long lifespan and can be easily repaired and maintained.



Close the chain

In order to create a closed system, the product design must fit in with processes that take place within the chain, such as reuse, refurbishing and recycling.

- **Refurbish:** when a product is discarded by the user, refurbishing can add value to the product again. By replacing vulnerable and damaged parts, a product is as good as new again, ready for a new user.
- **Design for recycling:** by specifically taking recycling into account in the product design, more value is recovered from the product material at the end of its life. The different materials must be easy to separate and the design must be suitable for common recycling processes.
- **Modular design:** a strategy to achieve long-term use and chain closure. Building a product from different functional modules makes repair and refurbishing easier and cheaper and promotes recycling. In modular products, the connections of the components are particularly important, and must allow the product to be assembled and disassembled several times.



Choose sustainable materials

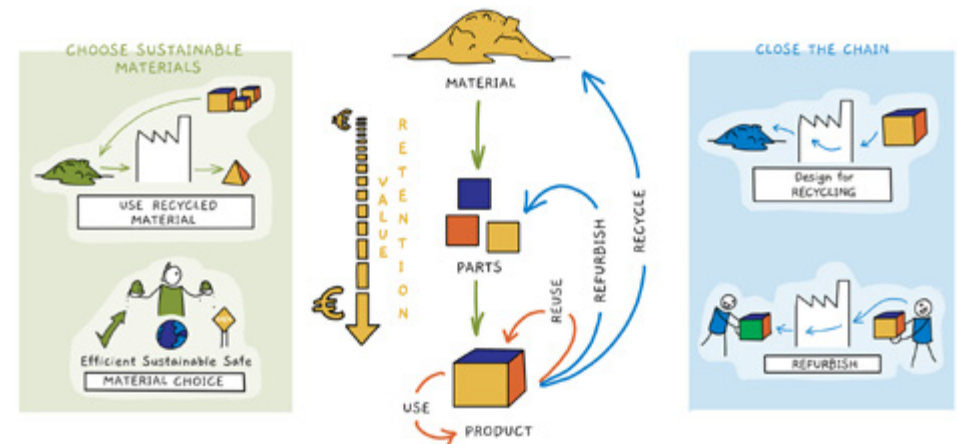
Using recycled and safe materials in the product reduces the environmental impact.

- **Use recycled material:** use recycled materials to reduce the demand for primary raw materials.
- **Material choice:** choose safe and sustainable materials. So materials without harmful effects on people and the environment after discarding or reusing them.

Determine a design approach

Depending on the use of a product and the market positioning, a suitable design approach is chosen. The design process for a product with a short lifespan has a different focus than for a product with a long lifespan. For example, with a short lifespan, design for recycling is very important because the product quickly enters the recycling cycle and therefore the most value can be gained here. With a longer lifespan, the design focus is on maintaining the product value for as long as possible, for instance by developing a high-quality and popular product that is also easy to repair. Products that are sensitive to trends or technological developments present a challenge, because they quickly become obsolete and lose part of their value as a result.

Often several design strategies are applied simultaneously, so that the end product fits in well with the usage scenario, the revenue model and the organisation of the chain.















The cases

The cases discussed in this inspiration guide all relate to the circular economy in their own unique manner. This visual table of contents reveals the design strategy adopted by the various cases. Design for recycling is the focal issue in every case; after all, to achieve a circular economy, it is essential that we close the material chain. For each case, we also look at the organisation of the chain, and the revenue model.

Not all these examples are completely circular, but the cases shown here do reflect how far the parties concerned are down the road to a circular product chain. How far down the road are you?

Are you interested in circular production too?

Have you been inspired by this guide and are you interested in circular production too? Take part in our CIRCO training and discover the business opportunities for your organisation. For more details, turn to page 36.

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<p>BarrierPack Recyclable</p>  <p>23</p> <p>Design for recycling Material choice</p>	<p>Modular headphones</p>  <p>25</p> <p>Repair and maintenance Refurbishment</p>	<p>Circular paving</p>  <p>27</p> <p>Reuse Material choice</p>	<p>Reusable delivery packaging</p>  <p>29</p> <p>Reuse Material choice Longevity</p>	<p>Circular mattress</p>  <p>31</p> <p>Design for recycling Material choice</p>	<p>Watermarks on packaging</p>  <p>33</p> <p>Design for recycling Use of recycled material</p>

Circular safety shoes

EMMA Safety Footwear



EMMA Safety Footwear crafts high-quality safety shoes for every sector. Sustainability is in their DNA. Therefore it is a logical step for EMMA to reduce the environmental footprint of their shoes. Safety and comfort are paramount in the design of safety shoes, but durability and low environmental impact are just as important.

In recent years, EMMA has mapped out all the materials of its products in detail. They know exactly what the composition of the materials is and where opportunities lie for enhancing sustainability of the shoe.

Throughout the entire collection, harmful and non-recyclable materials have been replaced by alternatives.

Safety shoes are used intensively and, in the toughest jobs, replaced once a year. This results in a large residual flow of shoes. That is why EMMA developed a circular work shoe collection, including the Amazone: the first circular and fully recyclable safety shoe.

EMMA controls the chain up to the point of sale. “We need to convey our story to customers so that we can motivate them to join in and close the loop together, for example by returning used shoes.”

Circular safety shoes

Product design

- The circular safety shoe is designed for a long lifespan. The leather heel has been replaced by the more wear-resistant TPU. The remaining exterior consists of oil nubuck; this leather stays supple without requiring maintenance and wears less quickly. The TPU heel has grooves accommodating the stitching, to slow down wear and tear. The fragile upper lace hook has been replaced by an eyelet.
- As all materials in the shoe are mono-materials, they can be fully and safely recycled. For example, the linings were previously made of a polyamide/polyester blend, but have been replaced by 100% polyester, with a wear-resistant 100% polyamide heel.
- EMMA selects materials that are suitable for reuse in 'next use applications'. PU, for instance, is used in insulation materials as an alternative to cork, and the leather is used to make pressed products.

The chain

- A partner company organises the collection of the shoes, placing collection trolleys at dealers and facilitating logistics.
- At EMMA the shoes are manually taken apart using a multitool. The possibilities for automising this process are being explored, for example through cooperation with partners. At the moment the volume is not yet large enough, but there are opportunities to scale up.
- EMMA has always had a great deal of control over their supply chain to guarantee the quality of their shoes. EMMA aims to trace all their materials and is therefore expanding control over the supply chain by contacting the suppliers of their suppliers. This stronger bond results in improved materials and alternatives.

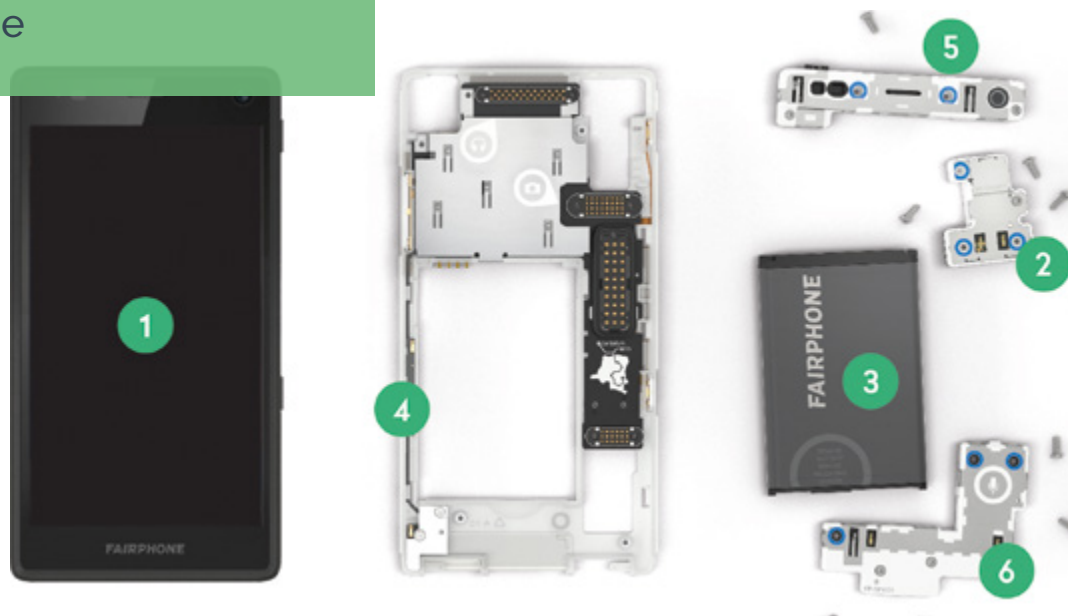


Business model

- Tracing the materials in their products and collecting and recycling the work shoes is currently an investment, but EMMA does not subscribe the extra costs to customers. The company is convinced that customers should not have to pay more for sustainable products. EMMA expects that this strategy will pay for itself in the long term, thanks to their leading position and the development of high-quality new applications for reused materials.
- Ever since the founding in 1931, EMMA has been a social enterprise and the majority of its employees are distanced from the labour market. This makes the labour-intensive disassembly of the shoes feasible.

Fairphone 2

Fairphone



On average, smartphones are exchanged for a newer model every two years. Old telephones often end up tucked into the back of a drawer, either because they are broken or because they no longer meet the user's needs. This is a real waste, since producing a telephone requires a huge amount of energy and rare materials.

Fairphone has developed a response to fast moving consumer electronics with the production of fair smartphones. The Fairphone 2 has been on the market since 2015 and was specially developed with a longer lifecycle in mind. The modular design allows

users to carry out product repairs. When something breaks down, they can order a new module and repair the device in a few simple steps. Via this approach, which is highly innovative for a manufacturer of consumer electronics, Fairphone hopes to achieve an average lifecycle of five years. This represents a sustainable alternative to the standard telephone because the longevity means much more value is derived from the materials.

The various modules were selected by identifying the most common defects in smartphones. Whenever something breaks down on the Fairphone, it is easy to repair.

Fairphone 2

The design

- The telephone consists of six modules that can be easily replaced to repair the product. These modules were selected by identifying the most common defects in smartphones.
- Since 2017, Fairphone 2 owners have been able to simply upgrade their camera module with an improved version. Upgrading electronics is extremely challenging, but Fairphone proves that it is possible.
- Software updates are critical for the performance of a telephone, but become more difficult to implement as the chipset ages.
- The modular design improves the recyclability of the telephone. The various modules can be handled in specific recycling processes so that more value is recovered. This, however, is not yet standard practice in the recycling sector. At present, only batteries, gold, copper and other costly materials are collected, while rare materials are simply lost.

The chain

- Fairphone is a social enterprise. Their primary aim is not to make money but to act as a means of achieving environmental and social sustainability. For 4 conflict materials, the company has mapped out the complete supply chain, from mine to consumer. Fairphone is currently in the process of mapping out 8 other materials and improving the working conditions for thousands of miners.
- Now that Fairphone 2 has been on the market for three years, the company is seeing a rise in demand for new batteries and connector modules (for plugging in the charger and headphones). The demand for new screens remains fairly constant.
- Many of the components are bought in. The producers of these components are dependent on volume sales and do not yet operate according to circular principles. In other words, these components have not been designed for a long life. That makes reparability of the telephone even more important.

The revenue model

- The Fairphone 2 is available for sale or as part of a deal plan. Since 2013, Fairphone has sold around 160,000 telephones.
- Fairphone is investigating the possibility of supplying telephones 'as a service' and is looking for partners to test this model. The user pays for use of the telephone while Fairphone retains ownership and remains responsible for the correct functioning of the product. This business model delivers an additional stimulus to design with cheap repair and maintenance in mind while ensuring greater control over the resources used in the telephone because Fairphone remains the owner.



Modular sofa

Landal Greenparks and OTDesign



The motto of Landal Greenparks is 'Unforgettable holidays with a positive impact'. The company's ambition is to be climate neutral by 2030 and to use the fewest possible new raw materials. To achieve these goals, Landal has entered into cooperation with suppliers, including OTDesign. Together, they have designed a circular sofa.

Furniture at holiday parks is often intensively used. Sofas sometimes end up in the rubbish after just 3 years, for example as a result of (cigarette) burns and tears. Re-upholstering is time-consuming and often

too costly, because most sofas are glued together and the upholstery fabric is stapled into place. Repairs also involve considerable logistic processes. At the same time, recyclers are not keen on standard sofas; they are made up of too many different materials that are difficult to separate. Landal and OTDesign have together come up with solutions for all these challenges.

The people in production had to learn a different approach to construction, for example replacing staples with Velcro strips. The transition proved difficult at the start. The people were finally convinced by showing them photographs of how the products are handled at the end of the user phase. Photographs of three year-old sofas being crushed under the wheels of bulldozers were so shocking that everyone immediately understood the need for change.

Modular sofa

The design

- The sofa has a solid frame with traditional, high-quality no-sag springs (in hardened steel). The springs are attached with a clamp system for easy removal. The frame has a design life of at least two 7-year lifecycles.
- Every component of the sofa has a separate cover that can be easily removed thanks to the use of Velcro strips. The covers can be sent by post and fitted by the park staff.
- The armrests (optionally either slimline or tough-look) are screwed on and exchangeable. The park can also exchange the (wooden and metal) feet with other parks.
- So far, no solution has been found for recycling the foam material. The product must offer good sitting comfort, be fire-retardant and guarantee a longer lifecycle. The higher specific weight means that the selected foam material lasts approximately two lifecycles.
- The advantage of artificial leather is that it is easy to clean and maintain. It is uncertain whether the material is also recyclable.

The chain

- Suppliers understand perfectly how to make a comfortable sofa, but are not yet always aware of how materials can be reused or recycled. Landal Greenparks and OTDesign joined forces with Renewi, who could provide valuable information on the reuse and recycling possibilities.
- It is not possible for one company to determine a circular value proposition on its own. That process requires cooperation with chain partners. Landal and OT decided not to wait, but to take action: start somewhere, identify partners, start testing and make improvements. Taking action accelerates the development process!
- Landal has seen recognition for its motto among its suppliers. New suppliers are now coming to Landal with a range of new circular developments, including beds, camp beds and children's beds.



The revenue model

- Landal purchases the sofa with a service contract and returns the product to OTDesign following use. Another option that will be investigated over the next few years is a lease construction with service contract.
- The purchase price for the circular sofa is 12-15% higher, but the huge savings on handling costs mean a quick earn back time for the higher price. The cover can be replaced for less than half the price. And with a low investment, the sofa can easily be given a second lease of life.
- Fabrics made from recycled materials that still offer high wear resistance are very expensive (>€100/m, as compared with €15/m). Qvadrat has developed a recycled material that meets the requirements, but it is still too expensive for use in a holiday park.

Cup2Paper

SUEZ and Boodi



Many a working day starts with a cup of coffee at the dispenser. But what do you drink your coffee from? The paper coffee cup has become increasingly popular over the years, but what happens to it when it is thrown out?

SUEZ encourages the creation of pure raw materials through separation at source. Starting with the idea of creating more recyclable materials in an office environment, the need emerged for a solution for coffee cups. Because the cups were incinerated, valuable raw materials were destroyed. Many businesses today want to recycle their cups. In

response, SUEZ joined forces with cup manufacturer Boodi to produce a sustainable coffee cup. The result is the Cup2Paper, which has been on the market since 2012.

The Cup2paper is a fully recyclable paper cup with a biological (PLA) coating on the inside. Cups are delivered to the customers by Boodi in the same Cup2Paper box that is used for collecting used cups. When the box is full, SUEZ collects it together with the used paper, and delivers the full box to the recycler. The cups are then recycled into raw material for new products such as new Cup2papers.

Throughout the design process for the cup and the chain organisation process we constantly asked ourselves the question: “what happens when it becomes waste?”

Cup2Paper

The design

- In the design phase, the primary focus was on lifecycle extension. The user can write his name and his coffee preference on the Cup2Paper cup. Personalising the cup means it is used for longer, so customers use between 10 and 20% fewer cups.
- Effective design for recycling was achieved by involving recyclers in the design process. The cup has a PLA coating on the inside that is dissolved during the recycling process. It is important to avoid overprinting the cup since this reduces the quality of the recyclate.
- Because the Cup2Paper is produced within a closed chain, SUEZ knows exactly what material will be delivered for recycling. Bioodi is responsible for producing new cups using 30% old cups. Using recycled materials reduces the environmental impact.

The chain

- The Cup2paper is the result of a chain approach. Waste collection organisation SUEZ and cup designer Bioodi worked closely together with the recycler and customers to optimise the Cup2Paper.
- To ensure the effectiveness of the closed Cup2Paper chain, the cup collection was integrated in the existing business waste stream for used paper. When SUEZ come to collect the used paper they also take away the discarded cups and deliver them to a recycler.
- During the development process, the real value of collected cups for a recycler was thoroughly tested. To ensure a quality recyclate, it is essential that the customer makes sure the collected cups are clean. This point is heavily emphasised for new customers, for example by providing special collection boxes.

The revenue model

- The Cup2Paper is around 20% more expensive than a traditional coffee cup. Effectively this means that customers often pay the same price, because fewer cups need to be purchased thanks to the longer lifetime.
- Higher cost price and CO₂ compensation. The cup is CO₂ neutral thanks to compensation for all emissions in production and transport.



Reparable pallet

Schoeller Allibert



Plastic pallets are strong, easily cleaned and have a long lifetime. The market for plastic pallets is growing. However, when used with forklift trucks and (electrical) pallet trucks, they are quite often damaged. Because the pallets are usually produced in one piece, this damage is irreparable and the user has to replace the entire pallet

Schoeller Allibert has developed a patented solution for the most common forms of damage. When wrongly used, electrical pallet trucks in the past regularly caused the entire top section of the pallet to break

away from the bottom section. Thanks to this innovation, instead of the entire pallet, only the cheap plug is broken. The plugs are replaceable and so, if necessary, are the skids. Customers can order all parts separately and repair the pallet themselves, with ease.

As a result, plastic pallets are an excellent alternative for wooden pallets. They have a longer lifecycle (at least 10 years), they can be repaired by the user, the material is easily recyclable, and can then be used for making new plastic pallets.

Sustainability can be achieved in many different ways. The best solutions are often combinations.

**In this case:
reusability+
repairability +
recyclability.**

Reparable pallet

The design

- The skids are attached using a plug with bayonet coupling. This includes a breakable ring that can be adjusted to a preset breaking strength. As a result, the plug can be adjusted to break before the rest of the pallet is damaged, when handled incorrectly on a pallet truck.
- The skids and the plugs are all identical. As a result customers only need to keep one type of each item on stock (SKU: *Stock Keeping Units*)
- The pallet is produced from virgin plastic in order to achieve high performance without steel reinforcement. The fact that there are no steel parts makes the pallet far easier and hence cheaper to recycle.
- Many recycling installations find it difficult to reduce large plastic pallets into small ground pieces. The removal of skids makes this recycling process easier.

The chain

- Many customers of Schoeller Allibert are pallet pooling companies. In the case of large open pools, businesses often have a contract with these pool providers. Other companies operate their own small closed pools. The utilisation level in an open pool is generally far higher but the pallets are also damaged more often. Pool providers are therefore very keen about repair and recycling.
- On request, Schoeller Allibert operates a buyback guarantee for its pallets. When a follow-up order is received, they write off (part of) the material factor from the cost price.
- Schoeller Allibert will sell spare parts for its reparable pallets. In the future, customers can order these spare parts via the webshop.
- Material performance data are required for carrying out strength calculations. Schoeller Allibert has observed that suppliers of bulk plastics such as polyolefins do not invest a great deal of time in such calculations. Without accurate figures, designs are based on inefficient safety margins which themselves are then often stacked. In designing its reparable pallets, Schoeller Allibert called in an external agency to carry out additional strength calculations to ensure the optimum design.

The revenue model

- The cost of investing in or purchasing these pallets is higher than for a normal pallet, but the total cost of ownership is lower. Customers that operate a closed pool system tend to focus on the purchase value. The pool provider in an open system has access to data about failure and damage rates, and an insight into the related costs. Pool providers calculate according to the total cost of ownership, and know that repairs pay for themselves.
- Schoeller Allibert has launched the pallet on the market in 2019 under the slogan: “Hard to break, easy to repair”.



Hybrid circular wall system

Knauf and New Horizon



The sustainability of construction is a hot topic. Which is just as well, given that at the moment 40% of the world's resources are being used in the construction industry. And 23m tonnes of waste is generated in the Netherlands by the construction and demolition industry. This represents nearly twice as much as the waste generated by all households in the Netherlands.

Fortunately, there are also companies who want to approach the problem from a different angle. For instance, Knauf came up with a new circular wall system that recycles used construction materials.

The walls are used to divide a large room into a range of smaller rooms. This circular wall was developed in collaboration with New Horizon. New Horizon strips old buildings and looks for new uses for the materials they find, such as in the Knauf wall system. Old drywall boards can be sawn out of the stripped buildings and re-used in a new wall.

Knauf and New Horizon needed just 100 days to get from the initial idea to the finished product. In their opinion, companies that want to make a contribution to the circular economy should just GO FOR IT! The product doesn't need to be 100% circular right from the start: just get started.

Hybrid circular wall system

The design

- New Horizon gathers the drywall boards from the buildings and takes them to a sawmill. There, they are cut to size for **reuse** in the circular wall system.
- The wall system is built up of a framework of metal uprights with insulating material, to which the recycled drywall boards are attached. The wall is then finished with new drywall boards. The circular wall is pretty much identical to the old wall. The sole difference is that the recycled boards are assembled horizontally, rather than vertically. This is because the dimensions of the recycled boards are smaller, because they have been sawn out of a building.

The chain

- Reuse in the wall system means that the construction industry generates less waste. In addition, fewer new raw materials are required for the circular wall. As a result, the circular wall system has a 25% smaller carbon footprint.
- Where things are recycled, quality control is important. Before collecting the materials, New Horizon assesses the quality of the walls in the building and ascertains the standard to which the drywall boards were made, and whether or not they meet the required quality standards. Knauf provides a warranty for the performance of the wall system after fitting. Drywall board that have screws in them cannot, for instance, be reused as the screws would compromise the acoustic and fire-safety properties.
- The supply of materials for the circular wall system is not constant, and depends on New Horizon's projects. This means that there is sometimes still a discrepancy between supply and demand.



The revenue model

- The starting point for the project was a **feasible business case** with a finished product that would not be more expensive than the conventional system and would offer the same level of performance in terms of fire safety and acoustics. This was successful, but at present the greatest challenge is making the collection of walls from old buildings profitable.
- The product specifications are identical to the old wall. This means that the system could also be used where the construction plans were already complete. This immediately resulted in substantial interest in the product. So compatibility was an advantage.

BarrierPack Recyclable

Mondi



Whether or not the material loop is completely closed depends on where and how the packaging is used, collected and processed.

In a circular economy the material loop is closed. At the moment this is not yet the case for many types of packaging, which also applies to food (and other) packaging made from laminates. They cannot be recycled, and are thus excluded from the circular economy. A laminate is a composite film made up of two or more layers of different materials. The materials are combined in order to create the right properties (a barrier) and protect the product. Laminates boost shelf life, but the combination of different materials makes it impossible to recycle them.

Since 2019, Mondi has had an alternative: the BarrierPack Recyclable, a laminate that can be recycled. The laminate is completely made up of PE and can thus be easily recycled. And it has the same barrier properties as other common laminates, so it can be used for packaging both food and non-food products. The composite sheet can be used to make pouches and bags. Its wide field of use and ability to be recycled means that the packaging world is coming a step closer to being a circular system.

BarrierPack Recyclable

The design

- The design process started with the development of a material for non-food use that could be recycled. In testing, however, the material appeared to be bursting with potential: it could be used in both horizontal and vertical filling lines. This spurred Mondi on to develop a PE aroma and gas barrier, so that the material could also be used for the packaging of foodstuffs.
- The design of the barrier film in the BarrierPack Recyclable is optimised for recycling. Because it is made from PE alone it can be easily recycled using the usual processes. When the film is used in a pouch, a resealable PE fastener can be added.
- The new material can be used easily in existing filling lines by changing the line's settings. For instance, the processing temperature is lower.

The chain

- The barrier layers and the resealable fastener have an adverse effect on the quality of the recycle. The material is not suitable for the production of new barrier film, but can be processed to make plastics for agricultural use or rubbish bags.
- So the Mondi BarrierPack Recyclable can easily be recycled, but this does not necessarily mean that this actually happens. Many countries are 'dragging their feet' in respect of the collection and recycling of plastics; for instance, such countries recycle only hard plastics. So whether or not the material loop is completely closed is also dependent on where and how the packaging is used, collected and processed.
- The recycling testing with the BarrierPack Recyclable was carried out by CeDo Recycling in the Netherlands.

The revenue model

- The market has shown significant levels of interest in the new Mondi packaging. Sustainability is becoming ever more important for companies, and they are keen to move away from packaging that cannot be recycled. The fact that BarrierPack Recyclable can be used on existing filling lines, lowers the threshold for manufacturers to make the switch.
- As the processing temperature on the filling line is lower when using BarrierPack, the manufacturer will also save on his energy consumption.



BOSS – the modular headphones

Gerrard Street



Each year, 15m kg-worth of headphones are thrown away. They have slight defects or have been replaced by a more recent model. A load of materials are thus lost, which is not really necessary. This inspired Gerrard Street to market a pair of modular headphones.

What makes Gerrard Street's headphone design unique is that they are not for sale; rather, they can be leased.

For a small monthly subscription fee, the consumer gets access to a pair of high-end headphones. If something goes wrong, Gerrard Street sends out a new part and the customer can carry out the repair himself simply, due to the modular design. If the customer no longer wants to use the headphones, they can just be sent back to Gerrard Street. The headphones are then refurbished, before being used by a new customer.

The modular design means that the headphones are not only easy to repair, they can also be disassembled so that they can fit through a letterbox. So Gerrard Street also saves a lot on the costs of carriage.

BOSS – the modular headphones

The design

- The headphones are made up of five **modules**: the headband, padding of the headband, two earpads, two sound boxes and a cable. The customer assembles the headphones himself.
- The modular construction is also good in terms of **reparability**; one broken module can simply be replaced with a new one. And it is easy to add **upgrades**: for instance, all customers received a new cable with microphone so that they would be able to make telephone calls.
- The speaker is the most valuable part of the headphones and is thus designed to have a **long service life**.
- The headphones can be fully disassembled, nothing is bonded together, even within the modules themselves. So the product can be disposed of in single-material waste streams, which helps in recycling. However, Gerrard Street is not yet reaching the sort of volume to make **recycling** feasible, so they are trying to reuse materials where possible.

The chain

- Where a customer stops the subscription the headphones are sent back to Gerrard Street. They **refurbish** the product so that it can be put back onto the market. All modules are inspected and cleaned. Components that are seriously damaged are replaced, but customers tend not to mind a few traces of previous use.
- Gerrard Street ran a pilot project in which another party replaced the damaged sound-box caps. That meant that the modules could be used again, as new. **Remanufacturing** the modules turned out to be really good business!

The revenue model

- Under the **lease model**, users pay €7.50 per month for the use of high-end headphones.
- The biggest challenge is to convince people that they don't have to buy a particular product and would be better off paying to use it. Gerrard Street has invested a lot in market research and focus groups to determine the best way to position the product. More than anything else, the target group appears to be prepared to pay for quality and convenience. The fact that the headphones are also a sustainable product takes second place for them.



Circular paving

Studio Wae



Consumers purchase the tiles because they like the unique design – the fact that they're circular is a welcome bonus.

Construction is one of the sectors that consumes the most material. However, according to prospects there will be virtually no raw materials available in Europe for this sector by 2050. Circular alternatives are therefore of great importance.

This insight motivated Tynke van den Heuvel to start Studio Wae in 2017. She developed the Circular Cityscapes tile: a tile made of recycled concrete with an innovative design, suitable for paving gardens, driveways and squares. ProRail is interested in using this circular paving on new platforms. Studio Wae

developed a new tile for ProRail, which can now be admired on the platform in Bunde. In 2020 the platforms in Etten-Leur will also be renewed with circular tiles.

In addition to paving, Studio Wae develops modular rugs made from rejected carpet tiles.

Circular paving

Product design

- The tiles contain 76% circular material. Concrete from demolished buildings or old platform tiles is shattered and used in new tiles. The recycled material is supplemented with (partly) non-circular cement, non-circular sand and dyes to create the desired colour.
- The unique design of the Circular Cityscapes tile is modular, allowing the tile to be laid in different patterns. Because the tiles have a slightly conical shape, the water drains away easily and is thus suitable for a climate-adaptive garden.
- The tiles have a robust look, as bubbles form on the surface during the production process. For ProRail, the slanted edges of the tile were adjusted. By giving the edges of the tile a slight curve a smoother surface is created, facilitating easy maintenance.

The chain

- The reused concrete for the Cityscapes tile is recovered from old buildings, for example by partner New Horizon, a circular demolition company. For the production of the platform tiles ProRail supplied worn tiles from a former platform in Anna Paulowna, which are completely reused.
- The tiles are not produced by Studio Wae, but by a manufacturing partner that uses special moulds. Studio Wae also offers the partner's entire range in circular concrete, named 'The Right Wae Collection'.
- The production of new cement and thus concrete has a major environmental impact. Consequently, reuse of these materials thus results in considerable environmental gains. The new platform in Etten-Leur is to be paved with 2,500m² of circular tiles. Compared to new tiles, this means a saving of 61,611 kg CO² (about 60%) and 190,000 kg of raw materials.



Business model

- The circular tiles are about 15-20% more expensive than conventional tiles. The Circular Cityscapes tiles are available through various dealers since 2017. Studio Wae coordinates big projects themselves.
- The tiles are a great success. For many consumers, the unique design is the deciding factor. The fact that the tiles are also sustainable is a welcome bonus.
- Business customers often choose the tiles for reasons of sustainability. A Life Cycle Analysis (LCA), an Environmental Cost Indicator (MKI) and a Madaster Circularity Indicator (MCI) are available to support purchase decisions.

Reusable delivery packaging

PostNL and FuturumShop



Every year, PostNL delivers more than 200 million packages, almost all of which are packed in a box or plastic bag. This translates into large amounts of packaging materials, while at the same time creating considerable waste.

Consumers are not pleased with all the empty boxes and bags they end up with and the non-sustainable approach. The amount of packages delivered each year is increasing exponentially. This makes it even more pertinent to explore alternative packaging methods. This is why, at the end of 2018, PostNL created reusable packaging in a pilot study conducted together with FuturumShop.

FuturumShop is an online shops for road cyclists and mountain bikers. FuturumShop sent thousands of packages in the Zwolle region in the reusable packaging developed by PostNL. The concept is simple: The deliverer rings the doorbell and the customer opens the delivery package on the spot. The recipient then only keeps the contents of the package, while the deliverer takes the packaging with him or her. The deliverer sends the empty, reusable packaging to the distribution centre, which then returns it to FuturumShop, ready to be used for packing new products.

The flexibility of the reusable packaging eliminates the transport of air, thereby saving space in the delivery van and resulting in greater sustainability.

Reusable delivery packaging

The design

- The reusable packaging is made of a flexible plastic material with a metal zipper for closure and a pocket for the address label.
- The flexibility of the packaging eliminates the transport of air, thereby saving space in the delivery van and resulting in greater sustainability.
- The packaging was specially developed for the pilot, so the design is not yet optimised. During the pilot, for example, the zipper proved difficult to open. And since it took longer for the consumer to open the package, the deliverer spent too much time on each delivery. Changes will be made to the zipper in a new version.
- The final design of the packaging must be easily recyclable by using only one type of plastic for the back and integrated label envelope. Possibilities to use recycled plastic or other sustainable materials are also being explored.

The chain

- If a package is reused 1,000 times, 138 g of CO₂ is saved per delivery since disposable packaging materials are no longer needed.
- The deliverer takes the reusable packaging with him or her after the package has been opened. As a result, fewer packaging materials are needed and the customer is no longer burdened with the resulting waste.
- During the pilot, customers returned their products in packaging they had at home from previous deliveries. If the concept is scaled up, a different solution will have to be found for returns.



The revenue model

- The pilot was successful and was received positively by customers. PostNL is now exploring possibilities for a second pilot project for testing the packaging on a larger scale and for different types of products.
- If the reusable packaging is successful in follow-up tests, PostNL will explore the best way to market the packaging, for example as a service for online shops.
- The role of the deliverer is essential for the reusable packaging. This role is different than with standard deliveries because the deliverer must wait until the consumer has opened the package and take the empty package with him or her. This takes more time and, consequently, is costlier. But cost savings are achieved in other areas due to the longer service life of the packaging.

Circular mattress

Auping and DSM Niaga



Every year, we discard 1.5 million mattresses in the Netherlands. This sizable volume poses a considerable problem for waste collectors. Only a small percentage is collected in clean enough condition for recycling and the possibility to recover the materials from the mattresses is limited. The foam is not recyclable and can only be reused in such lower-grade applications as insulation or judo mats.

Auping has come up with a solution: the circular mattress. This mattress is designed to be easily

disassembled and is fully recyclable. Together with DSM, Auping developed an alternative to foam made of 100% recyclable polyester. This is an important development for the mattress industry because it offers the possibility to close the material loop. The circular mattress remains the property of Auping to ensure that it is recycled at the end of its service life. The mattress is currently only available to business customers, but Auping is preparing an attractive proposition for consumers.

The economic aspect is essential for the success of circular products. This demands not only changes to the design of products, but also a new and attractive proposition in the market.

Circular mattress

The design

- As an alternative to foam, Auping is using a 3D weave/texture made of polyester for the comfort layer. It is fully recyclable, breathable and offers the same comfort level as conventional foam.
- The mattress is made of mono-materials to promote recycling. The springs are made of metal, while the mattress cover, comfort layer, spring covers and adhesive are all made of different grades of polyester. This makes the mattress much easier to recycle.
- The various layers of the mattress are adhered to one another with polyester glue. This adhesive has a lower melting temperature than the rest of the mattress and can be removed by heating the mattress. Adhesive residue is not a problem because, apart from the springs, the mattress is made entirely of polyester.

The chain

- Auping assumes responsibility for the end-of-life management of the product by remaining the owner of the mattress and collecting it for recycling after use. Auping also takes care of organising the recycling of the mattresses. They are currently working to optimise the recycling process to create a high-quality recycled material for reuse in new mattresses.
- All suppliers are located no more than 150 kilometres from the production facilities in Deventer in order to minimise transport distances.

The revenue model

- The circular mattress is currently only available to business customers. The first guests at Landal Greenparks will soon have the opportunity to sleep on the mattress.
- For consumers, Auping wants to develop a service model in which the consumer pays for use and Auping remains owner of the mattress. In 2019, they will be examining possible target groups and studying the details of this proposition. A service model may also be applicable for the bed frames, which are highly suitable for refurbishing.
- A discussion was held in the lower house of the Dutch Parliament last summer on a take-back obligation for mattresses. The circular mattress may very well meet this requirement and could provide Auping with considerable cost savings.

Watermarks on packaging

Procter & Gamble and Filigrade



Much of our food is packed in plastic, which offers advantages for the shelf life of the product and for safe transport to consumers. In Europe, around 30% of such plastic packaging is collected and recycled after use. Recycling the material enables its reuse as a raw material for new products. Currently, however, there are few possibilities (with the exception of PET) to use plastic packaging waste for the production of new food packaging. To guarantee food safety, plastic packaging recyclates must comprise >95% materials that have already been used as food packaging (food grade). In the current sorting process, apart from returnable bottles,

no distinction is made between food and non-food packaging, making it extremely difficult to meet this requirement.

Filigrade, a company that implements watermarks, has come up with a solution. Together with Procter & Gamble (P&G), they have placed watermarks on various types of packaging. P&G is the project leader of HolyGrail, which brings together the entire chain in implementing this new 'barcode' for recycling. A sorter can read the watermark, thereby identifying the type of packaging. This makes it possible for food

Watermark technology can be used not only for sorting food and non-food packaging, but also for other difficult-to-sort packaging, such as multilayer and multi-material packaging, black packaging and packaging with interferants (silicon, coatings, paint, etc.)

and non-food packaging to be recognised and separated in order to create food-grade recyclates.

Watermarks on packaging

The design

- The watermark is a digital information carrier, comparable to a QR code. It cannot be seen with the human eye, but requires a high-speed camera. All kinds of information can be incorporated into the watermark. Apart from registering whether the packaging is for food or non-food products, information can be added on, for example, the manufacturer, package contents, colour and specific properties of the plastic. Consumers can also read the watermark with a smartphone.
- The watermark is applied to the entire packaging. This is done so that dirt, deformation or positioning of the packaging in the sorting sample does not affect detection by the camera.
- The watermark can be printed invisibly on the packaging, as well as integrated directly into moulds.

The chain

- Collaboration within the chain is essential for the success of the watermark. All packaging manufacturers and brand owners of food and non-food consumer goods must use the same system. In addition, all sorters must be able to recognise the watermarks.
- The 'Holy Grail' project based on 'The New Plastics Economy' (Ellen MacArthur Foundation) entails the development of a vision and roadmap for implementing the watermark with the support of the industry. Companies throughout the chain (brand owners, plastic manufacturers, packaging manufacturers, sorters, recyclers and technology suppliers) will be publishing a white paper in May 2019 on their vision on this transition, so that policymakers can incorporate it into European regulations.

The revenue model

- To be able to recognise the packaging, sorters will have to invest in cameras on the sorting line. Air pressure can be used to 'blow' the different types of packaging in the relevant directions.
- Watermark technology will result in more sorting flows in the sorting process. The PET, PE and PP flows will be divided into a food and non-food flow. This requires extra conveyor belts and containers.
- These investments can probably be recovered within a relatively short time since the sorted materials represent a higher value compared to standard recyclates.
- Brand owners will have to invest in adapting moulds or packaging labels. For them, the business case is first and foremost the extra added value provided by watermarks. Using their smartphones, consumers can access all information that the brand owner wants (or must) provide and, moreover, it is more easily customisable, from nutritional information and information on origin to marketing communications.

Conclusion

The cases you have just read provide an overview of the current state of circular products. Companies are making major advances, and mainly by doing and experimenting they are getting ever closer to a circular product chain.

A number of challenges still remain for the realisation of a circular economy, and these are covered in the next paragraph.

Challenges for circular products

On the basis of the twelve cases, insight was gained into the challenges in developing and implementing circular products. We have identified the main challenges, which are listed below:

Recycling

- Designing products and materials so that they can be recycled properly in multiple cycles.
- Careful separation and sorting of products to create reusable flows and limit pollution.
- Optimising recycling processes to achieve the high-quality recovery of as many materials as possible.
- Organisation of the chain: how do you get the products back?
- Collaboration between manufacturing companies and recyclers to optimise recyclability.

Extending lifespan

- A product design aimed at a long lifespan and reparability is sometimes at the expense of the recyclability of the product. By making other design choices, more value can be derived from recycling, but the product also lasts longer. So sometimes design choices are difficult because different considerations play a role. It is important to strive for a balance between design and use. The value of the product, the strategy and the market position of the company are also contributory factors.

New revenue models:

- The switch from product sales to product use. It is still difficult to convince consumers that they no longer need to own a product, but that there are advantages in only using it.
- What quality does the customer expect in a refurbished product?
- Collaboration in the chain must lead to a revenue model for all the parties involved.



Getting started in the circular economy with CIRCO

In a circular economy you look further than the idea of ‘ready tomorrow’. The profit of a product no longer lies only in producing and selling it: a circular producer also makes a profit from the product’s use and from closing the chain. Value can be created around the life of a product in many ways – for companies, users and the living environment. Focusing on use instead of consumption, and on cultivating value rather than selling, means recognising new challenges and business opportunities. The development of new value begins with entrepreneurs. Design is the key to creating circular products, services and business models. New forms of value chains are indispensable while the creative and manufacturing industries, business and design acting in tandem is equally important. CIRCO offers an approach for working together, a network of professionals to realise upscaling and a community to share inspiration and knowledge.

Discover new business opportunities, step into a circular design process and develop a vision and step-by-step plan. Share your experiences and insights. Contribute to the move towards a circular economy! The Circular Business Design Track consists of three one-day workshops that take place within a period of two months. You discover the possibilities of circular entrepreneurship and design, explore opportunities for your own business and take tangible first steps in the development of new products, services and business models.

Visit www.circonl.nl for more information.

Afterword

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