

# Designing a reusable packaging solution for KPN

## Master Thesis

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# Preface

Those who know me, know how much I enjoyed this project. Turning two of my greatest interests, packaging and circularity, into my graduation thesis and my last contribution to this university as a student feels like a great way to say goodbye. However, this is not 'my' project, but 'our' project. I could not have completed this without the support of a big list of people. I know that your name and a short text is not enough to express my gratitude, but I am going to do it anyways.

First and foremost, I would like to acknowledge my supervisory team, who were instrumental in helping me complete this project. Their combination provided me with the trust, freedom and energy to deliver something I am very proud of. **Conny**, your calmness and knowledge gave me the right peace and self-confidence to keep going. You are an example to me. **Maurits**, your empathic ability to listen and understand my struggles took away a lot of barriers in this project. You always stood by me on a professional and a personal level. I will miss our weekly Friday talks. To both of you, I hope we meet again.

I want to thank KPN for providing me with this great opportunity and allowing me the freedom to implement my ideas. Specifically, I would like to thank **Jeroen**, my company mentor, who helped me shape this project. You taught me a lot about 'the game' and showed me how to turn normal ideas into valuable ideas. Your critique, which was always constructive by the way, gave me a lot of headaches but turned this project into really something.

Other people at KPN who deserve more than just their name in this preface are Edwin Rutten, Frans Molenaars, Noël Vos, Anton Lucas and Vincent van der Wekken. The list is way longer, but these five helped me in truly understanding this company and orchestrating my ideas.

And of course; my family! What would I have done without them?! My mother (the fashion & manufacturing expert in this project) who helped me endlessly and regardlessly with making the perfect prototypes. My father who never failed to provide me with the best product ideas and the best jokes. My little sister, who provided me with a critical eye and loving soul. Just as important, are all my friends who kept me spirited and provided me with the right distraction to keep going. Puck, Abe, Koen and the rest (you know who you are), thanks for all the Fridays.

That's it. I hope you enjoy reading and find inspiration to make this world a little better.

**Casper**



“Being less bad is no longer enough.  
The time has come to transform  
how we get our products to people  
by building truly regenerative  
supply chains”.

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# Executive summary

**This project proposes a no-waste, reusable packaging approach for networking equipment used in KPN's business-to-business market. The goal of this project was to create a first proof of concept of reusable packaging in KPN's logistical and manual processes, and therefore create a stepping stone towards further scaling-up reusable packaging across their operation.**

## Explore

KPN, one of the leading telecom companies in the Netherlands, wants to accelerate the journey to become near 100% circular by 2025, in which the reduction of packaging waste plays an important role. To reduce this to virtually zero, a reusable packaging approach is suggested. In order to find the right conditions for an initial introduction of this concept, a list of general requirements for reusable packaging has been drawn up to serve as guidelines in the search for this circular opportunity. These five points are logistics (as short, internal and complete as possible), volume (as high as possible), consistency (in order volume and product size), packaging waste (what and where to reduce) and product damage (due to improper use of packaging).

## Understand

Four business services of KPN (VPN, SDLAN, Premium Wifi, KPN EEN) were targeted to investigate their internal processes and packaging operations in order to find a circular opportunity according to the 5 focus points of reusable packaging. It was found that the redeployment of refurbished Company A devices in the VPN service is best qualified for a first implementation for reusable packaging. This service meets the requirements as it has an existing forward and return process, enough order volume and consistency, a relatively small product portfolio and proven logistic issues due to improper use of packaging.

## Define

This resulted in the following design challenge: "Design a reusable packaging solution for the redeployment of refurbished Company A routers used in the VPN service". This scope opens an opportunity to cover a yearly amount of ±1500 orders with reusable packaging, resulting in potential waste reduction of ±1000kg, or ±1500g of CO2 emissions. Additionally, it was calculated that approx. 5% of product damage in the return process could be prevented by providing the right packaging.

## Make

With insight from the research a packaging prototype was designed and developed to be tested in a pilot. A 'messenger bag' concept was selected, as it is durable, relatively cheap, size efficient and an already known, and valued packaging concept among mechanics and the refurbishment partner. To support the distribution of the packaging in an effective way, a logistic concept is proposed. This mechanic-centred system architecture ensures the availability of packaging at all times, potentially solving the return issues that were found in the research.

## Release

The accessibility of logistics, workflow of employees and the functionality of the product are tested in an actual order of the VPN service. In this pilot, a Company A device including reusable packaging is sent to the client and installed, after which the empty reusable package is sent back. Along the way, all involved distribution stages were observed and employees were interviewed. This small-scale pilot showed a successful forward and return trip of reusable packaging using only existing processes, validating the KPN's logistic resilience to such a concept. The biggest challenge in adapting this concept lays at the initiator of the return process; the mechanic. The packaging must be stored and managed from his working vehicle (the mechanic-centred distribution system), however it was found there's not much space for storage of packaging. The final prototype showed improvements in the workflow of involved stakeholders, however did not offer enough protection to ensure an undamaged delivery and did not offer enough space for the (essential) address and product labels. Alongside the pilot, a business case was developed in which it was calcu-

lated reusable packaging could save a yearly €1700 in the VPN service. This is mainly caused by the potential reduction in product damage. With a fast-track LCA it was calculated that reusable packaging saves up to 60% of CO2 emissions and finds an environmental break-even between 4 - 7 use-cycles compared to the current single-use packaging approach.

## Concluding

This project shows a successful proof of concept and a first stepping stone towards the implementation of a zero-waste, reusable packaging approach for KPN. With a small-scale, technical implementation of this concept, it was shown that reusable packaging has the potential to not only reduce packaging waste, but also increase the workflow of involved stakeholders, improve the return logistics of electronics and therefore also reduce costs. This resulted in a positive and profitable business case for further development of this concept.

The biggest limitation was the small and narrow scope of testing (n=1). This made it difficult to actually validate if the return logistics were improved by a reusable packaging, as logistics manifest itself at scale. As a further roll-out of the concept shows to be interesting for KPN, the first next step would be to scale up the testing over the entire VPN service to validate the logistic concept and functionality of the product.

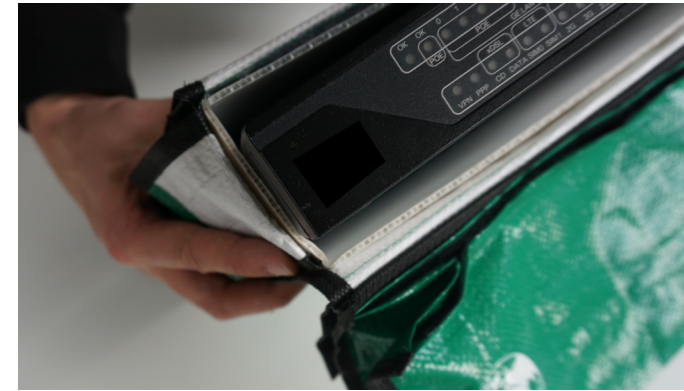
In further development, it is advised to reconsider the 'mechanic-centred system architecture', as it showed some difficulties in adaptation. An alternative approach would be to implement a more direct and (since recently) existing process, where the mechanic automatically receives a reusable packaging every time he has to de-install a device. Also, as the reusable messenger bag did not offer enough protection, it is advised to look into hard-shelled (off-the-shelf) packaging alternatives to ensure a safe delivery.





# The Final Product

**The outcome of this project shows a new, zero-waste packaging approach for networking equipment used in KPN's business-to-business market. By introducing a reusable packaging concept, accompanied by a proper forward and return logistic system, KPN takes a step towards a more circular future.**



## The Reusable Messenger bag

With insight from this research and pilot, a final product is developed; a reusable messenger bag. It is a durable, relatively cheap, functional product that's already known, and valued, among the manufacturer and mechanics of KPN. The reusable 'messenger bag' is made to package three of the most popular Company A devices being used in KPN's business market.

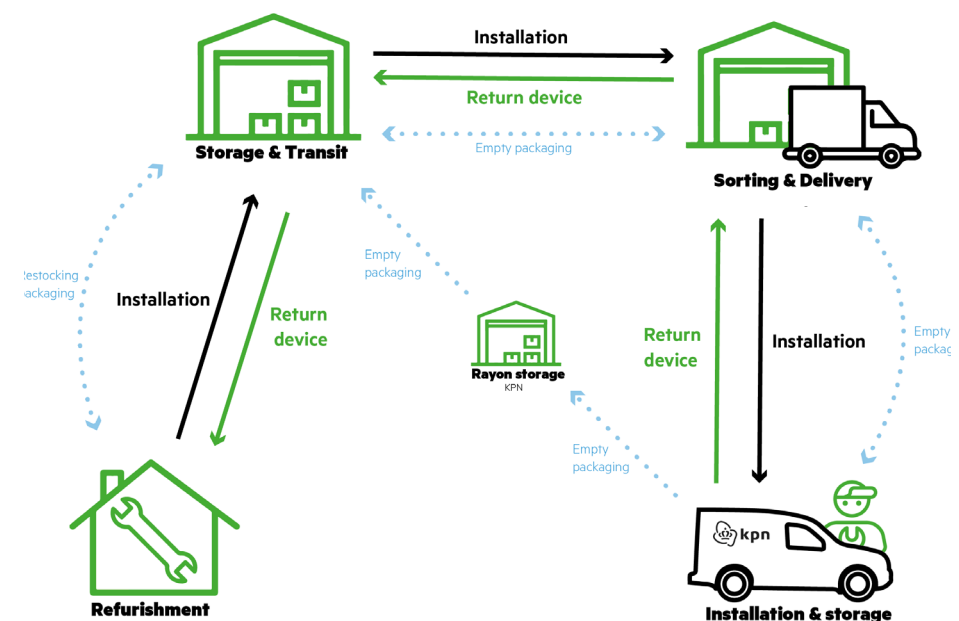
The exterior of the messenger bag is made of a water- and dustproof polypropylene liner. The interior consists of a stiff container with a soft padding to ensure protection throughout the delivery process. The cables and accessories that come with the Company A device are separately stored in a pouch, to improve overview and workflow during installation. The bag is opened with a roll-top, which is secured by velcro and two buckles. This option is cheaper and more durable than a zipper. The packaging has three designated sticker areas for the 6-8 stickers it needs during one use cycle. This sticker area is made of a special underlayer

## Back & forth on existing logistics

Just as important as the packaging itself, is the logistic system on which it is distributed. By analysing the logistics of KPN, it was found that the reusable packaging can be forwarded and returned using all existing processes. This way, no additional distribution mechanisms have to be introduced for the packaging to be implemented. With a distribution model that's built around the mechanic (see scheme below), who is the initiator of return, the return logistics can potentially even be improved. This 'mechanic-centred system architecture' makes sure the mechanic always has a stockpile of reusable packaging to allow a smooth and quick return process. The supply of the packaging to and from the mechanic is regulated using an automated stock system.

## Successfully tested in a pilot

In a pilot, the forward and return process of KPN were successfully tested, showing that the current, existing logistic system is resilient to reusable packaging.





Enable better return logistics

Introducing reusable packaging has the potential to enable return logistics and decrease turnaround time as it introduces clear return packaging guidelines for all involved stakeholders. The pilot showed that the return process was hindered due to a lack of proper packaging, which caused unnecessary delay in return times, product damage and frustration at employees. This could be solved with providing the right packaging, at the right time and location. Additionally, the reusable packaging increases recognizability throughout the supply chain, decreasing risk of loss.



Decreasing product damage

It was also found that electronics are potentially damaged due to improper use of return packaging in a rough return process. By consistently providing the right return packaging to the mechanic, electronics could be packaged more safely and therefore decrease the product damage. By introducing a reusable packaging, in combination with an efficient supply system, the product damage could potentially be reduced. This not only enables a better circularity of electronics, but also saves significant costs. It is estimated that ±5% of discarded devices could be prevented by providing the right packaging.



Reduce packaging waste

The reusable messenger bag is made to replace the current single-use packaging that's used to package refurbished devices of KPN. It is estimated that the reusable saves around 0.8 kg of cardboard and plastic waste per trip. In its entire lifetime, the reusable packaging has the potential to reduce 8kg's of CO2. This results in an environmental CO2 break-even between 4 - 7 use cycles. use cycles.

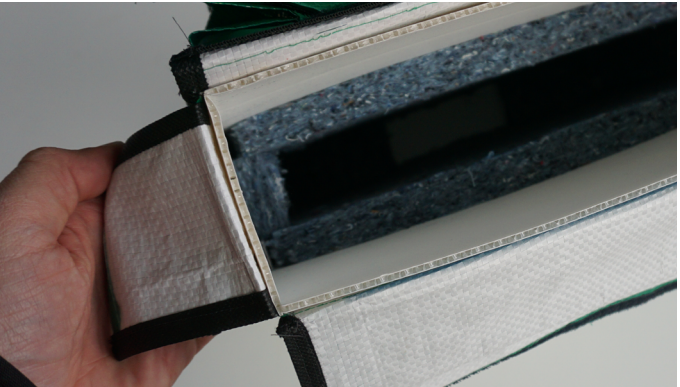
Reduce costs

During the pilot it was also found that electronics are potentially damaged due to improper use of return packaging and a rough return process. By offering the right return packaging to the mechanic, electronics could be packaged more safely and therefore decrease the product damage. This not only enables a better circularity of electronics, but also saves significant costs. It is estimated that 5% of discarded devices could be prevented by providing the right packaging.



Upgrade Workflow

Reusable packaging can not only improve logistical processes, but also the workflow of employees. The pilot showed that the manufacturer could potentially save 15% of time spent on packaging by introducing the reusable packaging. The mechanic also saves time and hassle, because he no longer has to get rid of packaging waste. Additionally, small functionalities like handles to easily carry the packaging and a pouch to store adapters add to a smooth workflow for all involved.



A design that allows for recyclability

The material of the packaging has been carefully thought out to ensure recyclability at end-of-life. The exterior (inc. buckles etc.) and boxy interior are all of polypropylene, which is an excellent plastic to recycle As all these parts are sewed together, it can be recycled in its integrity. The only part that's not mono-material is the inside padding, which is made of recycled felt, produced from 80% disposed garments. As this is a different material, it is not permanently fastened to the packaging, allowing it to be separated easily.

A 'Sustainable Business Card'

As packaging is a visual and tangible product, it can be used as an excellent tool to communicate KPN's circular ambitions to clients and partners. This is done by a visual design that literally describes the function and impact of the packaging.





# 1. Introduction

**Now more than ever, our world starts to feel the consequences of the extreme human urge for enormous consumption. The imbalance with our the world's ecological systems and resources is leading to one of the biggest problems ever to face humanity; climate change. This all becomes painfully clear with a constant stream of disasters, pandemics, forest fires and floods taking countless lives. The time has come to switch our lifestyle back to one that's more balanced with nature. We're desperately in need of an eco-system where resources circulate, opposed to being directly discarded in our current linear economy.**

**This report contains a research and proposition on such a 'circular' system, where resources flow, instead of drop. Together with KPN, a Dutch telecom company, a reusable, circular packaging concept was designed and tested for networking equipment used in their business-to-business market. Insights from this pilot project could contribute as a building block for a more circular packaging strategy for the entire operation of KPN, and eventually the world.**

## 1.1 Project Aim

KPN wants to accelerate the journey to become near 100% circular by 2025 and net zero emission by 2040. In the efforts to achieve these ambitious goals, KPN is looking for ways to reduce the amount of waste they generate, which includes packaging waste. The aim of this project is to reduce packaging waste by designing a reusable packaging solution for networking equipment used in the business market segment of KPN.

**“Reducing packaging waste by introducing a reusable packaging solution for KPN's business-to-business market.”**

Since the concept of reusable packaging is new to KPN, the aim of this project is to validate a first proof of concept and therefore create a stepping stone towards further scaling-up the reusable packaging across the operation of KPN. A big part of this validation is testing if the existing logistic processes are capable of the forward and return distribution of reusable packaging. This will be tested in a first pilot case, in which the manual and automatic distribution systems are validated.

A second aim of this project is to improve the operational workflow of all involved stakeholders by truly understanding the role of packaging in their current processes. The packaging solution will be designed in close collaboration with employees, suppliers and (sub)contractors, leading to a product that fits and improves in the logistic distribution and workflow of KPN's B2B market. To validate this, a prototype will be developed and tested with all involved stakeholders in an actual order.

To test the logistic system and workflow of involved stakeholders, a 1:1 physical packaging will be designed and prototyped. Apart from preventing packaging waste and adding functionality, another aim is to design the packaging following the circular design principles. This not only means the use-phase is taken into account, but also the production and end-of-life of the product.

**See Appendix 1** for full project brief.

## 1.2 Approach

As this hands-on project is conducted in the 'trenches of a company', an agile and flexible project approach is more suited than a framed scientific research method. However, to give the design process enough logical structure, the 'Circular Design Guide' (IDEO, 2017) was used to outline the project. The process of the Circular Design Guide (normally) consists of four general stages; understand, define, make and release. I added a fifth step; explore. This step runs simultaneously with the 'understand'-stage and is used to gather all background information on the specific topic. These 5 steps are fairly general, which gives enough structure to be the guiding principle for every chapter but leaves enough freedom to explore and add spontaneous directions within these chapters.

Additionally, I used multiple pressure cooker sessions throughout this project. Suggested by project mentor Conny Bakker, I used a '1-10-100' approach, in which you run through your complete graduation project in one single day, 10 days and 100 days (in which the latter obviously is the completed project).

**See appendix 2** for an article I wrote for the Circular Design Labs dedicated to the '1-10-100' method.

**See appendix 3** for the outcomes of the '1-10-100' method.



Figure 1: a slightly modified overview of the Circular Design Guide by IDEA & MacArthur foundation.



# 2. Explore

## Background information

**In the explore phase of this project, all relevant background information regarding the project aim is investigated and documented. This starts by understanding the client's history, key values and their future plans. After this, the functions, values and problems packaging brings along as a product are described. The concept of a circular economy is then explained, followed by arguments why a circular approach of reusability could be the solution to packaging waste. In counter to that, the challenges and problems of reusable packaging are clarified after. This all concluded in a list of theoretical considerations for a successful implementation of a reusable packaging within KPN.**



# 2.1 The Client

## 2.1.1 Royal KPN

KPN, or Koninklijke PTT Nederland N.V, is one of Netherlands' biggest providers of telecom, TV and internet. Last year, KPN counted 3.55 million active households connected to their network and over 5.5 million mobile users. The total number of KPN shops is around 140, giving it national coverage. Next to the consumer market, KPN is also active in the business segment, where they provide companies with complete telecommunication- and ICT services. Additionally, KPN has 14 XL stores which are responsible for the business market. KPN is headquartered in Rotterdam (KPN, 2021).

The company was founded in 1893 as ‘Administration of Posts and Telegraphy’ (or P&T) as an independent institution operating under the Dutch ministry. With the rising popularity of telephones around that time, the Dutch government starts rolling out a national telecom network. In 1915, the Telephony department and the Administration of Posts and Telegraphy were merged into one governmental institution; PTT (KPN, 2021).

In the following century, PTT grew into a telecom monopolie and became largely responsible for all other available communication services in the Netherlands. Eventually, PTT was made independent on 1 January 1989 and got a listing on the Amsterdam Stock Exchange. The company was split into two; TNT post (responsible for all postal services, now PostNL) and Royal KPN (responsible for telecom, tv and internet). Without the involvement of the government and the emergence of internet and mobile telecom, KPN lost market share to competitors like Ziggo (KPN, 2021).

Since then, the competition in the Netherlands grew quickly, making the financial stability of KPN rocky sometimes. Since 2006, the company went through 3 large rounds of redundancy and multiple rumours of complete acquisition by foreign companies.

## 2.1.2 Strategy & Values

In the last decade, KPN is committing strongly to a digital society with cloud services, glasfiber connections and the rollout of a 5G network. This seems to pay off as the company has found her financial stability back. Since the introduction of the ‘digital strategy’ of KPN, the company uses three core values for their business; trust, courage and growth.

Trust refers to the reliable and decent character KPN has among its customers. People choose KPN because they can trust them and count on their quality and reliability. This value is found back in the continuously high customer rating they receive. Courage refers to a character that’s needed for innovation and growth. Together they want to show leadership and dare to make decisions, but won’t back down to say when something is not right. This value is found back in radical decisions and investments regarding sustainability. At everything KPN does, Growth is central. Not only growth in their business and innovation, but also in their management methods and company culture. This value is found in the radical roll-out of glasfiber throughout the Netherlands. (KPN, 2021)

## 2.1.3 Trendsetters in Design

Apart from its importance in building the Dutch communication system, KPN has been influential in designing our country's appearance and has helped to put Dutch design in the international spotlight. Consequently, KPN (then still PTT) appointed a dedicated design team that carefully curated their public visibility by combining insights from modern marketing with contemporary visual arts. It was called the ‘Dienst Esthetische Vormgeving PTT’, which turned the Dutch postal and telecom service into an international visual trendsetter with a distinguished policy in the field of art and design. Famous Dutch designers and artists like Ootje Oxenaar, Chris de Moor and Bob Bonies served as ‘aesthetic advisors’ for PTT.

The ‘Dienst Esthetische Vormgeving PTT’ gave advice about most visual expressions of the company like the graphic design of corporate documents, interior design of postal offices and other architecture. In collaboration with often young Dutch designers, PTT developed many innovative industrial products like the T65 phone, the classic phone booth and striking red, and later orange mailboxes. The ‘Dienst’ also started buying art from mostly Dutch artists, which were displayed in their many offices and shops, resulting in one of our country's most interesting art collections.

Perhaps the most prestigious cultural assignment was the design of stamps. Several times a year, PTT invited designers to design stamps on the occasion of current events. This resulted in an impressive series of collectors items. The idea behind these art commissions was to spread affordable art among a very large part of the Dutch population.

In 2002, the Dienst Esthetische Vormgeving was discontinued due to financial cuts, after which KPN lost its image and role as a design pioneer. (RKD, 2002)

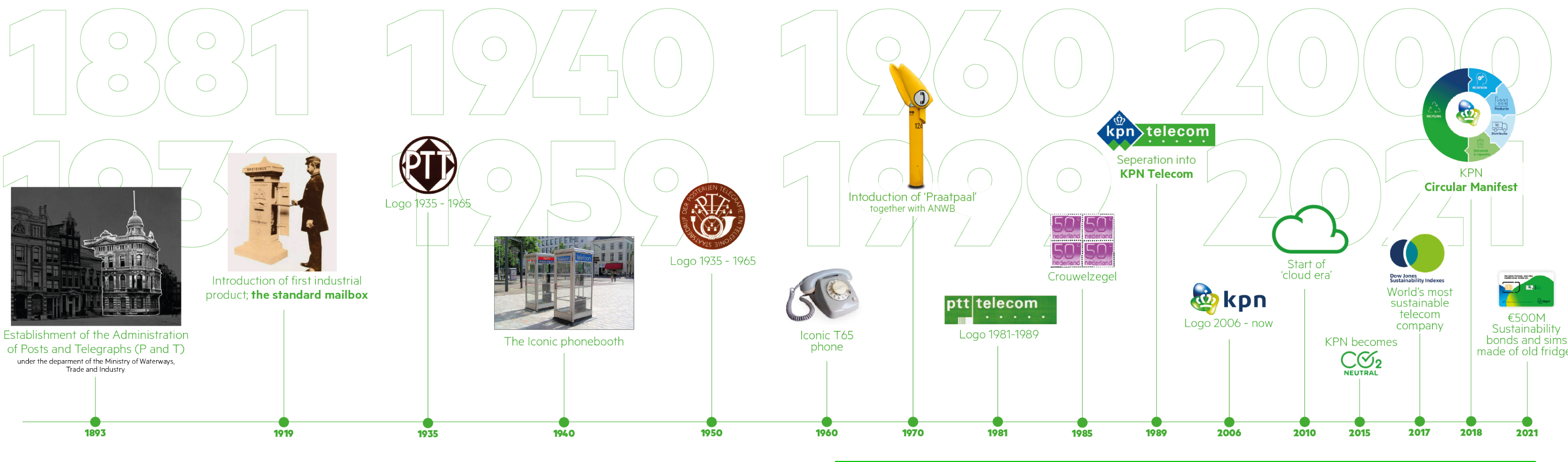
## 2.1.3 Leaders in Sustainability

Where KPN slowly lost prestige in the field of design and art, it gained prestige in sustainability and circularity. And with success. KPN is the only telecom company to have been in the top 10 most sustainable companies for 10 consecutive years, according to the Dow Jones Sustainability Index. This ranks KPN among the top 10% most sustainable companies worldwide.

Since 2015, KPN has been operating on a 100% climate-neutral basis and only uses green energy. By 2025 they aspire to become near 100% circular by virtually phasing out all waste and introducing 10 to 20 products with circular design. By 2050, KPN aspires to reduce the CO2 emissions in the entire chain to 0%. (KPN, 2017)

“From 2025 virtually no waste and 10-20 iconic products with circular design.”

In 2018, KPN established a ‘Circular Manifest’ with eleven of its most important suppliers to work towards a fully circular chain. The manifesto aims at a 100% reusability and/or recyclability of all parts and raw materials used in KPN-equipment by 2025. The companies that are part of this manifest are for example Company A, Huawei, Nokia and Dell.





## 2.2 Packaging as a product

**Imagine... A world without packaging. Without packaging, food waste would be one of our biggest polluters, our hospitals would not work and our cities could not be bigger than 1 million inhabitants (Packaging Federation, 2008). The first proven use of packaging goes back to 2000 BC in Ancient China, where thin paper was used to wrap bundles of money into gifts. 4000 years later, packaging has become one of the most important and most consumed products we know. Without packaging, our world would have looked very different. Here's why;**

### 2.2.1 An essential product

- **Protection;** One of the main functions of packaging is to protect a product from external influences like temperature, impacts, UV or humidity. Packaging does not only keep a product safe from a health perspective, but also makes sure it does not break or goes bad. Due to proper use of packaging, the amount of food waste in the UK amounts to around 3 percent. In countries like India or Russia, this can run up to 40 to 50 percent due to wrong use of packaging (Packaging Federation, 2008).
- **Logistics;** many products have organic shapes or soft structures, making them difficult and sometimes unhandleable during transport. Think of football for example. By adding a square box around it, it can be easily stacked during transport and won't roll when it's put on a conveyor belt.
- **Branding;** packaging is a company's business card on the supermarket shelves. You want to show your clients that you have the best and striking product, which is done with the (graphic) design of it's packaging.

- **Information;** to show instructions, safety warnings, ingredients etc.
- **Dosing;** every product is sold in a certain quantity and the size of this portion is defined by packaging.
- **The unbox experience;** a beautiful packaging can increase the value that the consumer awards to a certain product.
- **And some extras** like ease of storage, decoration and theft prevention.

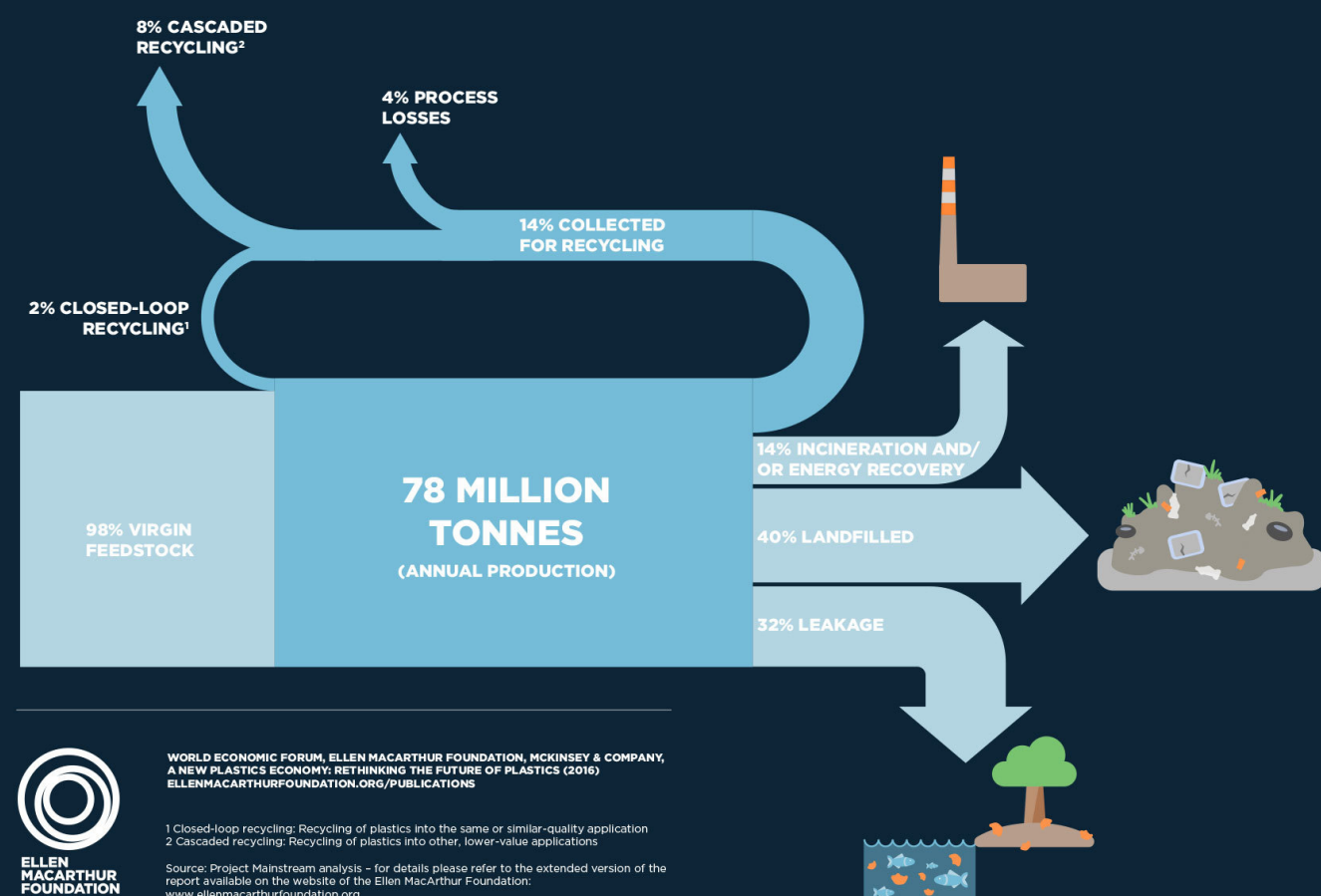
### 2.2.2 A rising problem

However, the essential role of packaging, combined with a high consumption society, has it negative consequences. Over the last few decades, we've become dependent on the use of single-use packaging for our products. In fact, packaging has become the symbol for our linear economy. Packaging, in all its forms, is the biggest consumer of virgin material AND the biggest culprit of waste. In Europe, 40% of plastics (Plastics Europe, 2018) and 50% of paper (CEPI, 2018) is used for the production of packaging, while it accounts for 36% of all municipal solid waste.

The problem lies with the way this solid waste, especially plastic waste, is handled. Only 14% of plastic packaging is recycled, and only a small portion of that (±2% of all plastic packaging) is recycled in a closed-loop, with the remainder being downcycled. The rest are either incinerated, landfilled or even worse; end up in the ocean. It is estimated that 60% of all waste in the oceans comes from packaging. (Ellen MacArthur Foundation, 2016) Apart from the toxic and damaging trail it leaves behind in our ecosystem, it also causes a major leak in our depleting resource supply as most ingredients for packaging are finite, like crude oil.

Figure 2  
The linear flows of plastic packaging, by Ellen MacArthur Foundation

### TODAY, PLASTIC PACKAGING MATERIAL FLOWS ARE LARGELY LINEAR



### 2.2.3 The future

Despite all environmental alarm, the amount of packaging material has been growing in past years, as a consequence of increasing population, consumption behaviour and the rising convenience of single-use packaging (McKinsey & Company, 2020). At the same time, the group of environmentally aware consumers has also been growing. Already in 2015, a report found that 73 percent of the Millennial generation was willing to pay more for sustainable goods (Nielsen IQ, 2015). This popularity has led to a gradual increase in a focus on new ways of packaging that prevent unnecessary resource extraction.

Policies are the main driver behind this change. Up to now, European policies on single-use packaging have been focused on recycling and small steps of rethinking like the reduction of packaging materials or change to bio-based materials. Other countries use a more rigorous strategy like taxing single-use plastics (Finland, Belgium). With increasing volumes, large investments and improved technologies, the recycling rates in Europe have been rising to around 65%. Still, these numbers can be deceiving as plastic accounts for 35% of the waste generated, of which still only 14% is recycled (EEA, 2021).

**“Progress has largely been driven by recycling, but that is not enough to solve plastic pollution - much more focus is urgently needed on eliminating single-use packaging.”**

Only recently has the EU (re)started to pay attention to different ways of waste prevention, as recycling is proving to be a limited option to tackle this massive problem (Coelho, 2021). An example of a leading initiative is the New Plastics Economy Global Commitment. This commitment unites over 500 of the largest multinationals, together responsible for 20% of the plastic pollution, behind a common vision of a circular economy for plastics, in which plastics never become waste. The second key objective in this vision, is to explore and invest more in reuse business models. The commitment led 56% of the affiliated companies to start pilots with reusable packaging (The New Plastics Economy, 2021).

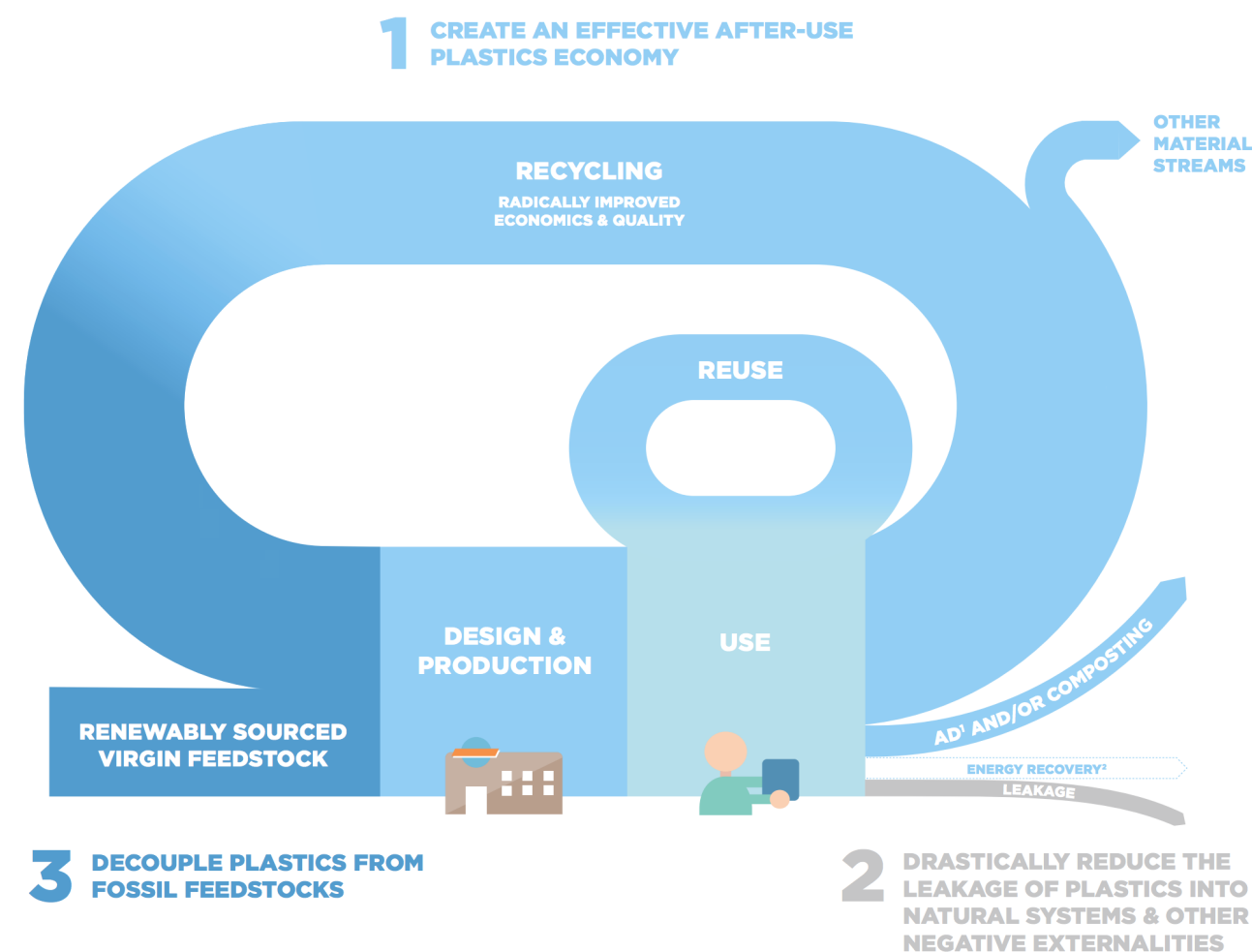


Figure 3  
A circular approach of packaging, by Ellen MacArthur Foundation



## 2.3 The Circular Economy

'A circular economy' seems like the solution to our enormous urge to consume and pollute. In this chapter, the circular economy is explored and relevant fundamentals of reusability are researched.

### 2.3.1 From linear to circular

As previously described, packaging is often subordinate to the product it's protecting and thus considered waste right after use. This often leads to downcycling of resources or worse; incineration, landfill or leakage into the ocean. Packaging is designed in a very linear way; only taking the production and use phase into consideration. As we live in a world with a very high consumption rate yet a finite supply of resources, this model is unsustainable and creates an enormous amount of waste.

Shifting towards a paradigm where waste is considered a resource becomes critical to not deplete all the resources our planet has to offer. This resource-based paradigm is called the 'Circular Economy' and is advocated by the Ellen MacArthur foundations. A circular economy employs reuse, sharing, repair, refurbishment, remanufacturing and recycling to create a closed-loop system, minimising the use of resource inputs and the creation of waste, pollution and carbon emissions (Ellen MacArthur Foundation, 2020)

This approach is not only vital to stop pollution, it also offers strong economic, social, and climate benefits. By 2040 a circular economy has the potential to:

- Reduce the annual volume of plastics entering our oceans by 80%
  - Reduce greenhouse gas emissions by 25%
  - Generate savings of USD 200 bn per year
  - Create 700,000 net additional job
- (Ellen MacArthur Foundation, 2020)

### 2.3.2 The Circular Concept

A circular economy is an economic system in which the reusability of products and raw materials is maximised and wastefulness is minimised. A circular system is characterised by two cycles for materials (figure 4)

- **a biological cycle**, in which residual materials are safely returned to the natural environment after use, and
- **a technical cycle**, for which products and components are designed and marketed in such a way that they can be reused in a high-quality manner.

To keep resources in the loop, the usage phase of products is extended as long as possible. Circular products should therefore be designed closely together with stakeholders and according to three principles of 'contin-use':

#### Reuse

Reusability is the preferred option as 100% of resources are kept inside the loop and there is no material degradation. The bigger the amount of usage loops, the smaller the environmental impact.

#### Repair & Remanufacturing

If a product is broken, this is usually caused by a single malfunctioning part. Replacing the broken part should always be prioritised before discarding as it is more sustainable and (most of the time) cheaper. Repair and remanufacturing is improved by applying principles of design for reparability and modularity.

#### Recycle

When it's not possible or economic to repair a product, recycling is the last resort. This way the resources can be repurposed. (Ellen MacArthur Foundation, 2020)

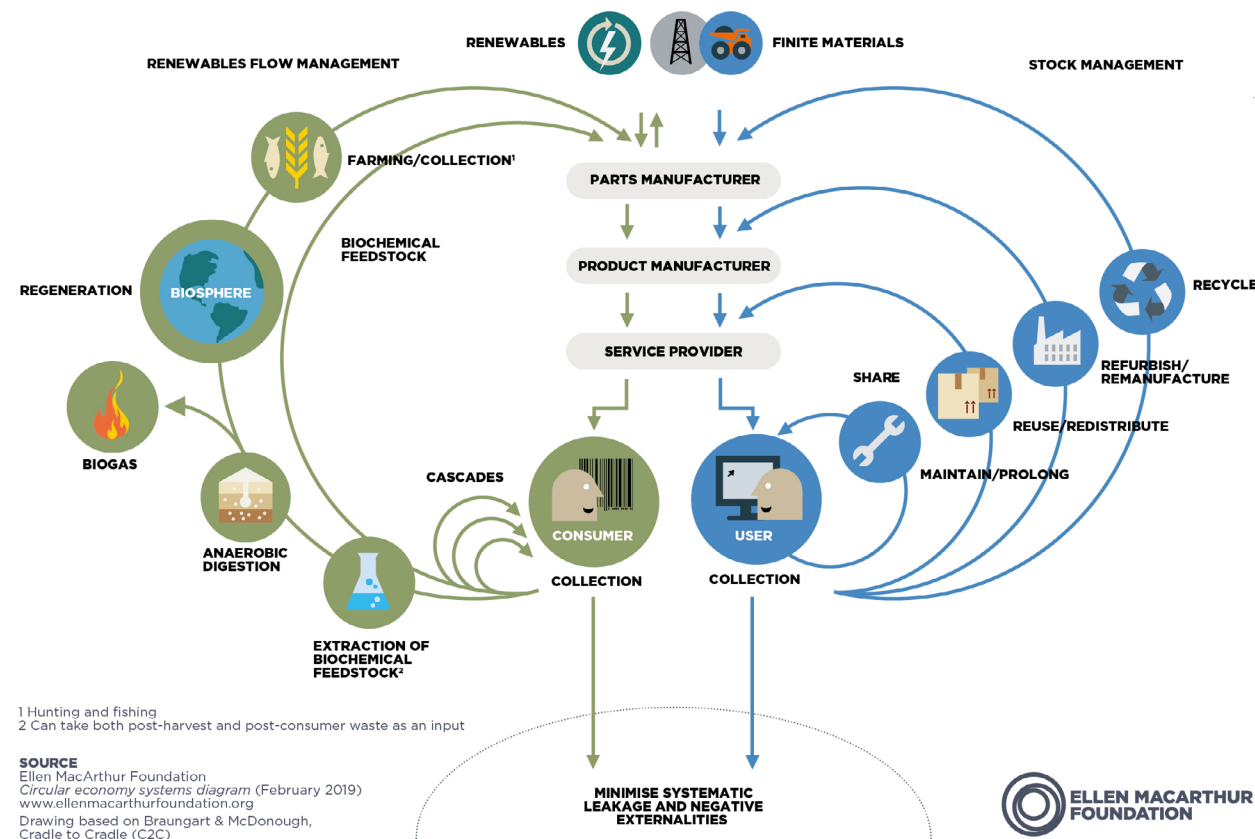


Figure 4  
Circular Economy Systems Diagram

## 2.4 Reusable Packaging

To decrease the amount of waste created, we need to drastically change the way we use and design packaging. And since we now know some more about packaging and the circular economy as two separate concepts, a circular design approach seems like the overarching solution to the waste problem.

### 2.4.1 Design for contin-use

So how can we design packaging in order to capture this waste potential? There are three main considerations when it comes to circular product design:

- **Re-think**; minimising the use of raw materials by using fewer materials for the development of packaging materials, but also wasting less product;
- **Re-new**; ensuring that the raw materials used for packaging materials come from renewable sources whenever possible. It is important that these sources are properly managed, so important nutrients are preserved for the environment;
- **Re-use**: designing product-packaging combinations, materials, and processes in such a way that raw materials continue to cycle. This is realised by reusing packaging materials whenever possible and recycling materials in a lasting manner.

In this project, the emphasis is on the latter consideration, in which a reusable packaging solution is the main goal. Reusability has preference over refurbishment or recyclability as it retains the resource value in the best way. The other two considerations, rethink and re-new, will also play a role in the design and materialisation of the final product.

### 2.4.2 Reusable packaging; the time is now!

Reusable packaging is not common in the industry, as it only accounts for 1.9% of all packaging worldwide. Reusability is strongly underrated and here's why:

- **Business potential**  
Replacing just 20% of our global single-use packaging with reusable alternatives would open an opportunity of at least \$10 billion. reusable packaging needs a larger initial investment than single-use solutions, but it delivers a fast return on investment. Typically, the cost of purchasing a new packaging is higher than the cost of returning the reusable packaging. On average, 40 - 70% of the cost can be saved when using reusable packaging.
- **Global alignment to act on plastic pollution**  
More and more organisations see that we cannot simply recycle our way out of this issue and that rethinking how we bring products to people without relying on disposable packaging is a crucial part of the solution. This results in companies joining forces in commitments and manifesto's. As described earlier, KPN initiated one of these circular manifesto's with over 80% of their suppliers. Another big bond is the New Plastics Economy Global Commitment, which over 350 organisations are part of. With the popularity of these circular commitments, more interest, effort and thus money is put into new concepts to replace single-use.
- **Climate and other environmental benefits.**  
Reusable packaging can not only reduce (plastic) waste and pollution but also reduce other greenhouse gases and toxins, for example due to reduction of energy usage. Additionally, reusable packaging is often designed in a more robust and durable way, which gives the product better protection, minimising product damage and rejection.

(New Plastic Economy, 2019)

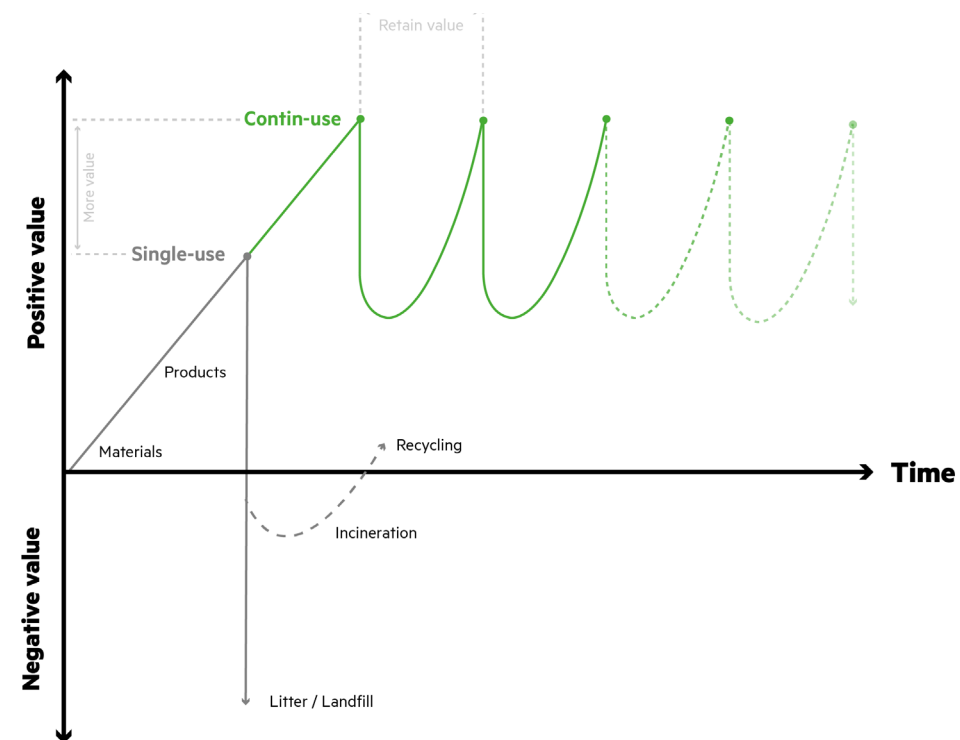


Figure 5  
Model for Contin-use. Retrieved from "Products that Flow" by Haffmans and Gelder, modification inspired by graduation thesis of Gijs Gillissen.



2.4.3 Other benefits

Next to the environmental, socio and general packaging functions (chapter 3.3), reusable packaging has a handful of extra benefits;

- **Less dependency;** with the rising costs and shortages of resources, it becomes more probable that operations must stock due to lack of a certain product, like packaging. Because reusable packaging does not need resource extraction, but rather works in a closed loop, a company becomes independent from uncertainties in resource availability.
- **Social benefits;** reusable packaging can improve ergonomics and usability. Because the packaging has a way longer life, it can be designed with more care for its stakeholders.
- **Gather intelligence;** RFID tags, sensors and GPS tracking can be added to the packaging systems. This will give the company valuable information about user preference and system performance.
- **Improve user experience;** The look, feel or functionality can be more high-end as the production cost is divided over many uses.

2.4.2 Challenges of reusable packaging

- **Mindset;** reusable packaging sometimes disappears because it's stolen or breaks during use. Commercial reusable packaging (like RePack for example) have return rates between 60 to 90% at its highest. This means that such packaging can never be used more than 10 times before it disappears. As reusable packaging is often more expensive and intensive to manufacture, this sometimes makes it hard to compete with cheap single-use packaging.

- **Volumes;** the higher the volumes, the more sustainably and economically profitable the reusable packaging will become. An example; the Dutch beer bottle deposit system only became profitable when +10.000 bottles were returned per month. (KIDV, 2017)
- **Distance;** the smaller the distance the packaging has to travel for return, the more profitable and sustainable the packaging becomes. A good example for the car industry is the reusable packaging that's often used to transport parts within a manufacturing plant.
- **Return rates;** reusable packaging sometimes disappears because it's stolen or breaks during use. Commercial reusable packaging (like RePack for example) have return rates between 60 to 90% at its highest (RePack, 2020) . This means that such packaging can never be used more than 10 times before it disappears. As reusable packaging is often more expensive and intensive to manufacture, this sometimes makes it hard to compete with cheap single-use packaging.
- **Logistics;** most logistic systems of organisations are fully dedicated to sales; only focussing on what's going out. To add return logistics to their distribution centres can sometimes be a challenge. Also, a reusable packaging system needs a behavioural change among employees, as new actions are added to their workflow.
- **Cleaning;** some packaging solutions carry goods that leave residue or that need a high hygienic environment. This requires the operation of a company to add a cleaning line to keep the packaging neat at all times.

2.4.3 Mini use-case

RePack

**What is it?**  
Reusable shipping bags, used by online webstore to eliminate single-use packaging.

**Scale**  
Used by 50+ e-tailers, 50.000 end-users worldwide.

**How it works**  
RePack provides packaging-as-a-service for online retailers and web stores. When customers order from the web store, they can opt for RePack's alternative reuse packaging. The order is then delivered to the customer in a RePack shipper with a prepaid return label. Subsequently, customers send the shipper back to repack for a central quality check and redistribution. Each shipper has a unique barcode that ensures individual shippers can be identified and linked to a specific shipment.

- Benefits**
- Shared packaging across e-tailers and outsourcing of the reverse logistics lowers costs and limits hassle for online shop owners.
  - Increase customers with products that come in high-quality, waterproof, durable packaging that enables sale delivery and minimises the chance of damage.
  - Customer bonding as customers receive discount vouchers for a selection of participating stores when shipping back the RePack. The indirect deposits structure creates brand loyalty and increases customer retention.
  - Traceability as each shipper has a unique barcode to track cycles and control deposit accounting.

- Challenges:**
- Return rates: RePack is generally returned in 60-90% of the cases. Especially at low return rates, the financial and environmental impact is hard to break-even.
  - Durability: as the logistic system tends to be rough and unforgiving, there is a risk that the shopper becomes crooked too quickly. The perfect ratio between material durability, production quality and price is a challenge for RePack.



2.5 Key insights & conclusions

After researching the history, values and future of KPN and better understanding the circular economy and how packaging can play a role in this, a number of essential insights were concluded. These insights will be used in further research and design of the reusable packaging.

In KPN's mission of sustainability, a reusable packaging would be a strategically smart product to introduce. Where KPN used to have a strong influence in design culture with numerous industrial products, they are now more famous for an intangible product; cloud services, ICT and internet- and mobile connections. Even though these operations are already made climate neutral, intangible products are not very suited to create a public image of sustainability, as it is not directly visible. Packaging, on the other hand, is a very visual product, which KPN uses fairly often. Packaging, which is currently all single-use, is a product that gets in direct contact with the client. As reusable packaging has a truly sustainable, 'waste-less' function, this unique selling point can be made very visible to the client to directly improve KPN's sustainable image. This feature can be even highlighted in the design by adding text or the amount of CO2 it reduces, for example.

Apart from this 'sustainable business card', a reusable packaging has a serious potential to reduce waste, costs, operational lead time and lower the dependency on suppliers. The latter can be important for the future as resource scarcity and prices are rising quickly. On the other hand, KPN could improve the relationships with suppliers, like Company A, by co-developing and sharing such a solution.

For a successful implementation of a reusable packaging, the right circumstances are important. In the next chapter, KPN's business-to-business market is unravelled to find a starting point for a pilot with a reusable packaging. With the knowledge derived from this chapter, these 5 principles will be the guidelines in finding this circular opportunity:

The 5 principles for reusable packaging

Logistics

Functioning forward and return logistics are essential for reusable packaging. Preferably, the logistic lines are kept as short as possible. You can imagine that returning an empty reusable packaging to China can be complex and expensive

Volume

Just as with many products, reusable packaging will be most impactful and profitable when the volumes are high. Generally, an order volume between 5000 - 10.000 units is preferred. However, as this project rather functions as a 'proof of concept', such high volumes are not a necessity. A lower volume is actually preferred as it decreases complexity and impact of mistakes.

Consistency

Not only in outgoing orders, but also in product dimensions. Preferably, one product category (for example routers) is covered using only one type of packaging. When the product dimensions deviate too much, this is not possible.

Packaging waste

To make as much impact as possible, it's preferred to improve a process where the most amount of (unsustainable) packaging waste is generated

Product damage

Sometimes products get damaged due to incorrect use of packaging. By finding these issues, the impact of reusable packaging can be increased.



# 3.

# under-stand

KPN processes,  
stakeholders &  
the role of packaging

In the ‘understand’ phase of this project, four services in KPN’s business-to-business market are analysed to find a potential fit for implementation of a reusable packaging solution. In this search, the 5 considerations that were concluded in the previous chapter are central. The analysis starts with a general understanding of these four services by finding out their purpose and operational processes. This is done by interviewing and visiting all the involved companies and managers responsible for that specific service. To deeper understand the preference per stakeholder, role of packaging and any bottlenecks between the two, a packaging journey is mapped out per service. This shows the forward and return journey of every device, including the function of packaging . To further quantify the analysis, the product types, their volume and order consistency per service are determined. This all results in a substantiated decision on where, why and how the first pilot of reusable packaging must take place.



# 3.1 The initial scope

To make the implementation of a reusable packaging successful within the large and sometimes complex business premises of KPN, a clearly defined and selected scope is important. As already described, this project will focus on the B2B segment of KPN. Within this business segment, KPN currently offers around 180 different services and products. To reduce the complexity, two steps of rationalisation were made to narrow the scope down for further research.

## 4.1.1 Focus on four services

Because the business segment of KPN consists of many services with all different processes, a selection was made to narrow the scope down. Three of them, VPN, SDLAN/SDWAN and Premium Wifi, were chosen because KPN is currently improving their circularity by product development and return policy. Any additional circular research and development around these services fits well in the timeline and will get more direct attention. The fourth service is ‘KPN EEN’ because this service offers the Experia Box, which is the product with the highest volumes in the B2B market. More detailed information about these four services in the next chapter.

## 4.1.2 Focus on internet routers

In KPN’s business market numerous types of products are provided; from small access points to enormous servers. However, internet routers are the most popular product type, which evidently results in the largest volumes. High volumes (often) lead to a higher feasibility of reusable packaging. The majority of the routers used in KPN’s business market are made by Company A. This is a company that produces high-end networking gear and has high-end sustainability ambitions. The other majority of routers is the Experia Box. This is a device that KPN co-created with French Sagemcom. This router is a lot cheaper and has lower quality but is designed with circular principles. This router is also used in the consumer market.

This results in an updated design challenge;

“Design a reusable packaging solution for internet routers used in one of KPN’s VPN, SDLAN/SDWAN, Premium Wifi and KPN EEN business-to-business services.

# 3.2 Proces Analysis

To understand the global working principles per service, the forward and return flow of products is visualised in a process map. These four maps solely focus on understanding the general logistics from stakeholder to stakeholder. More in-depth information about logistics and volumes can be found in respectively chapter 4.3 and 4.4. Every process map is developed and verified with the product and operational manager of that particular service. The four service that are in scope:

## VPN

stands for “Virtual Private Network” and is a protected network connection fully dedicated to one specific company. VPNs encrypt your internet traffic and disguise your online identity. This makes it more difficult for third parties to track your activities online and steal data. KPN currently covers multiple 1000’s of middle/large companies with this service.

## Main Insights

- VPN uses NaaS; Network as a Service. This means that all devices stay in ownership of KPN. The client pays a monthly amount for internet connection with all necessary supplies, maintenance and updates.
- All logistics and orders revolve around KPN’s logistic partner; Company B.
- Delivery is done by Company C. This is a night service that delivers directly to the car/bus of the mechanic.
- Company C also has a return service that is directly sent to the logistics hub of Company B.
- Instead of the other services, VPN does not make use of Company A Meraki; which is the high-end product line of Company A. VPN currently still makes use of older and less high-end Company A products.
- Instead of the other services, VPN does not have so-called ‘RMA contracts’ with Company A. An RMA contract allows you to return a defective device directly to Company A, who will then refurbish/ recycle it.
- Company D, the refurbishment partner, does not have direct access to Company A spare parts or refurbish manuals. Because of this, they are only able to do low-tier refurbishment. In case of internal or cosmetic damage, the device is directly recycled.

## SDLAN/SDWAN

stands for ‘Software Defined Local-Area Network’ and ‘Software Defined Wide-Area Network’. SDLAN, as it’s a ‘local area network’, connects multiple devices in a house or office together to form a network. SDWAN (as its ‘wide-area’) is not tied to a single location, but rather connects devices or locations all around the world. A LAN/WAN combination can be seen as a ‘traditional’ internet connection. Every household has one.

## Main Insights

- LAN/WAN also makes use of NaaS. Instead of VPN, this service uses Meraki; a high-end, more expensive product line of Company A. All products stay in ownership of KPN.
- Company E (Company E) is dominant in this service, as they are responsible for installation, grading, refurbishment and logistics from their warehouse to the client.
- A Company E mechanic only visits the warehouse once or twice a week. Here he picks up all the gear he needs for that week and returns everything he collected.
- VolkerWessels hardly does any refurbishment, apart from some light cleaning. When a device is damaged, it’s directly returned as RMA to Company A.
- There is a return process from the Company E warehouse to Company B in place, but this is never used.

## Premium Wifi

is a service where a company is provided with an extra strong and stable internet network covering the complete premise (also parking lots for example).

## Main Insights

- This service also uses NaaS with Company A
- The relation between KPN and the installation partner is not as close as the previous two services. Private Dealers are independent ICT/Telecom companies, which are not subcontracted by KPN. In the other services, the installation is done by a direct or indirect employee.
- Delivery and pick-up is done with the regular process of PostNL.
- Refurbishment by Reconnext, formerly Teleplan. Reconnext has, instead of Company D and Company E, direct ties to Company A. They do have access to original spare parts and the latest software updates.

## Experia Box

The Experia Box is the go-to modem/router for KPN’s SME market. It’s offered in the ‘KPN EEN’ service, which is a basic offering of internet, TV and/or telephone. The Experia box is a KPN branded product, which is designed and manufactured by the French Sagemcom. The modem is also used in the consumer market.

## Main Insights

- This service does not use NaaS. The client will own the device, which is a lot cheaper than in the other three services.
- The modem is sent straight to the client with PostNL. The mechanic collects the device at the location of the client and installs it directly.
- At replacement, the mechanic de-installs the old device and sends it to the refurbishment partner with Company C.
- At cancellation, the client does the de-installation and returns themselves. The client repacks in a specially sent return box & drops off at a PostNL drop-off point.
- Refurbishment is done by Company F. They are located in the distribution centre of Company B Logistics. As the Experia box is used in the consumer & business market, Company F is a central collection point for all returned modems. After refurbishment, they do part of the forward logistics as well.
- Recycling is done in Romania.



# 4.

# Define

Outline  
and detailing of  
the design scope

In the 'define' phase of this project, the conclusions and main insights from the previous two chapters are formed into an opportunity that shows the most potential on where to start testing with a reusable packaging. This starts by stating an updated project scope, which is the result of weighing the four services against the 5 general principles of reusability. This new scope will be used for the remaining research, the design process and finally; the pilot. To further detail this direction, more information on logistics, the product types and their volumes is gathered. To conclude this all, a list of requirements is developed. This list of 'must-haves' and 'nice-to-haves' will be the framework for the next part of this project; the ideation and prototyping phase.

# 4.1 Updated scope

The conclusions from the previous two chapters results in an updated design scope;

“Design a reusable packaging solution for the redeployment of refurbished Company A routers used in the VPN service”

Updated scope explained:

- **Focus on redeployment.** Firstly, the logistics and packaging of refurbished devices stay inside the Netherlands. New devices often come from Asian countries, where it’s hard to intervene with new packaging concepts. Secondly, because the return process shows some bumps that potentially can be fixed with reusable packaging.

- **Focus on VPN service.** Firstly, because the order volumes and consistency are big enough for relevant impact, but moderate enough to experiment in. Secondly, because the packaging footprint is relatively big due to use of plastic foam. Thirdly, because the logistic processes are more internalised and revolve around either KPN employees or very close partners (Company B). Lastly, because the current return process used in VPN leads to proven product damage, which potentially can be solved with packaging.
- **Focus on Company A routers.** Firstly, because this is the only device used in VPN. Secondly, because Company A gear is often expensive and high-end, proper packaging (especially during return) is more important.

# 4.2 Detailing of scope

With a more narrow scope, more detailed information regarding products, logistics and volumes can be examined.

## 4.2.1 Product types

As described in the previous chapter, the VPN service provides five types of Company A routers. As it happens, four of the five devices have (almost) the exact same dimensions (see image 16), which means this group can be covered with one type of packaaing.

The X-series are slowly being phased out by KPN, but will be taken into account for the remaining project as they are still part of the operation. This explains the low order quantity of the X and the rise of the type X and X.

## 4.2.2 Gross packaging waste

About 70% of the refurbished Company A devices that are in the scope of this project need a new single-use box and two pads of PU foam. The other 30% are packaged in the reused, original packaging. With this data, which was retrieved from Company D (appendix 4), the amount of yearly gross packaging waste and environmental footprint can be calculated. The data about environmental impact was sourced from Ecoinvent.

Figure 16 The Company A X-series & X-series

The outgoing volumes that we analysed in the previous chapter were a combination of new and refurbished devices. As the new scope is focused on refurbished devices, the actual volumes of reuse are important. With data from Company D (the refurbishment partner), the redeployment rate of 2021 was calculated.

What’s important to know: the Company A X is already end-of-sale and end-of-life. This means that it’s not sold, nor updated anymore. The only reason why KPN is still using them is because of the unavailability of newer models due to a chip shortage.

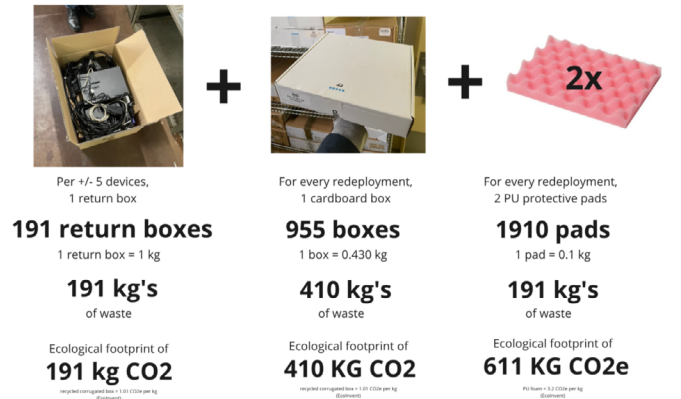


Figure 17 Amount of packagng that's used and discarded for refurbished devices from VPN service.

# 4.3 Stock movements

To give an overview of the volumes that ‘flow’ in and out of the logistic system, the monthly stock movements are calculated. With the stock movements, an estimation can be made on how much reusable packaging is actually needed to cover monthly peaks. The visuals below revolve around the logistic hub, where the stock is kept, and shows the monthly incoming (new & re-used) and outgoing amounts in detail. The numbers are a based on data from Company G and Company B from 2021.

**Company A X-series**  
In figure 19, the monthly stock movements of a Company A X-series are described. As described in the previous chapter, the Company A X-series are

already end-of-sales & end-of-life since 2019. This means no new devices can and will be ordered. Where in 2021, the reuse volumes were still significant due to shortages, in 2022 all X will slowly be phased out to recycling. The responsibility will be taken over by it’s brother; the X-series.

**Company A X-series**  
In figure 20, the monthly stock movements of a Company A X-series are described. The retirement of the X-series will inevitably lead to a rise in orders of its successor; the X-series. As you can see in image 20, KPN is currently building a big stockpile of this type of device, to cover any unexpected delivery issues due to shortage. Because the X-series is the ‘to-go’ routers used in the VPN service, the return volumes are also bigger.

## Montly Stock movements

Figure 19: Montly stock movements of Company A X-series

## Montly Stock movements

Figure 20: Montly stock movements of Company A X-series



# 4.3 Main Requirements

All the insights and conclusions from this previous research result in a list of requirements, which are used as guidance and measurements throughout the design process. The guidelines are divided into three topics; logistics (focused on the system), workflow (focused on the stakeholder) and product design (focused on the packaging). Within every topic there is a list of must-haves, which are essential, and nice-to-haves.

A previous version of the requirements from early stage development can be found in appendix 2.

## 4.3.1 Logistics

Must have:

- A refurbished device must reach the client using a reusable packaging without any changes to the current forwarding process.
- An empty reusable packaging must be returned from the client without any changes to the current return process.
- A replacement device must be returned from the client using reusable packaging without any changes to the current return process.
- The cycle time (to the client and back) must not be longer than 2 weeks.
- The reusable packaging must be registered in the stock program of Company B.
- The reusable packaging must be registrable in the sorting system of Company C.

Nice-to-have:

- The location status of the order should be traceable.
- The return process of replaced devices should be improved by the implementation of reusable packaging.
- The return time of replaced devices should be decreased by 20%.

The return rate of the packaging should not be lower than 90%

## 4.3.2 Interaction

Must have:

- The packaging must be easy to pick up with two hands.
- The packaging must be impossible to open when processed by the automatic sorting system.
- The opening mechanics of the packaging must be obvious and easy to open by the packaging employees and mechanics
- The opening mechanics of the packaging must not be obvious and easy to open by order picking employees or delivery drivers.
- The packaging time must be shorter compared to the current single-use options.
- The installation process must not be obstructed or delayed by the reusable packaging.
- An empty or filled packaging must be easy to put in storage.
- The packaging must be easy to stack, and be stacked on, when placed on a pallet.
- The packaging must be easy to recognize by night.
- The packaging must improve the mechanic's workflow to initiate a return order.

Nice-to-have:

- The packaging should be easy to pick up with one hand.
- The packaging time should be improved by at least 20%
- The installation process should be more organised and comfortable for the mechanic.

## 4.3.3 Product Design

Must have:

- The packaging must fit one Company A X-, X- or X-series.
- The packaging must ensure no damage to the device during the forward and/or return transport.
- The packaging must be sealed from splash water and dust.
- The packaging must have a confined space for stickers.
- Stickers must be easy to apply and must not get loose during transport.
- Stickers must be easy to remove and/or pasted over.
- The reusable packaging must have a permanent label with article number and barcode that's easy and obvious to read and scan.
- The packaging must be stable when stacked.
- The packaging must have at least two sides that are very stable when put down.
- The packaging must be reused at least 20 cycles.
- The packaging must have a lower environmental footprint than the current single-use packaging approach.
- The packaging must be made from mono-material.
- The packaging must be 100% recyclable.
- The packaging must contain KPN branding.
- The product price must not be over €20

Nice-to-have:

- The packaging should fit other types of routers as well.
- The packaging should be water tight.
- The complete surface of the packaging should be suited to stickers.
- The packaging should not have any sticking out features.
- The packaging should have handles.
- The packaging should be as lightweight as possible.
- The packaging should be optimised for repairability.
- The packaging should have a RFID tracking system.
- The packaging should be suitable for periodic cleaning.

# 5. Make

## The design of the reusable packaging solution

In the ‘make’ phase, the design process of the reusable packaging is described. All concepts and prototypes are a result of the insights and conclusions from previous chapters. This starts with a short ideation, which basically is a brain dump of all ideas and fantasies throughout this project. After this, three concepts were further elaborated, of which all three were developed into physical packaging models. These prototypes were assessed on all-round functionality, which resulted in one, final choice. The concept choice is improved into a final prototype, which will be used during the pilot. In a reusable packaging solution, the product goes hand in hand with the logistics system. That’s why a concept for the ‘system architecture’ was developed, which shows a possible approach on how, when, and where the packaging must flow through the system. The combination between the physical prototype and this theoretical system architecture is the stepping stone towards the pilot plan, which is developed in the next chapter.



# 5.1 Ideation

*Pack Aging HUB on wheels*

Foldable & transparant boxes to package & transport devices

The complete hub can be taken back with the delivery partner

Packaging for delicate products

Elastic

EPP

Repurposing telephone books

Modern coat

Use corporate fashion as packaging

Pouch erects as product is packaged

Device clamps in

Old PTT bags

Reusable packaging pouch

Repurposing waste of KPN

Glass Fibre cables

Woven packaging

Old KPN jackets

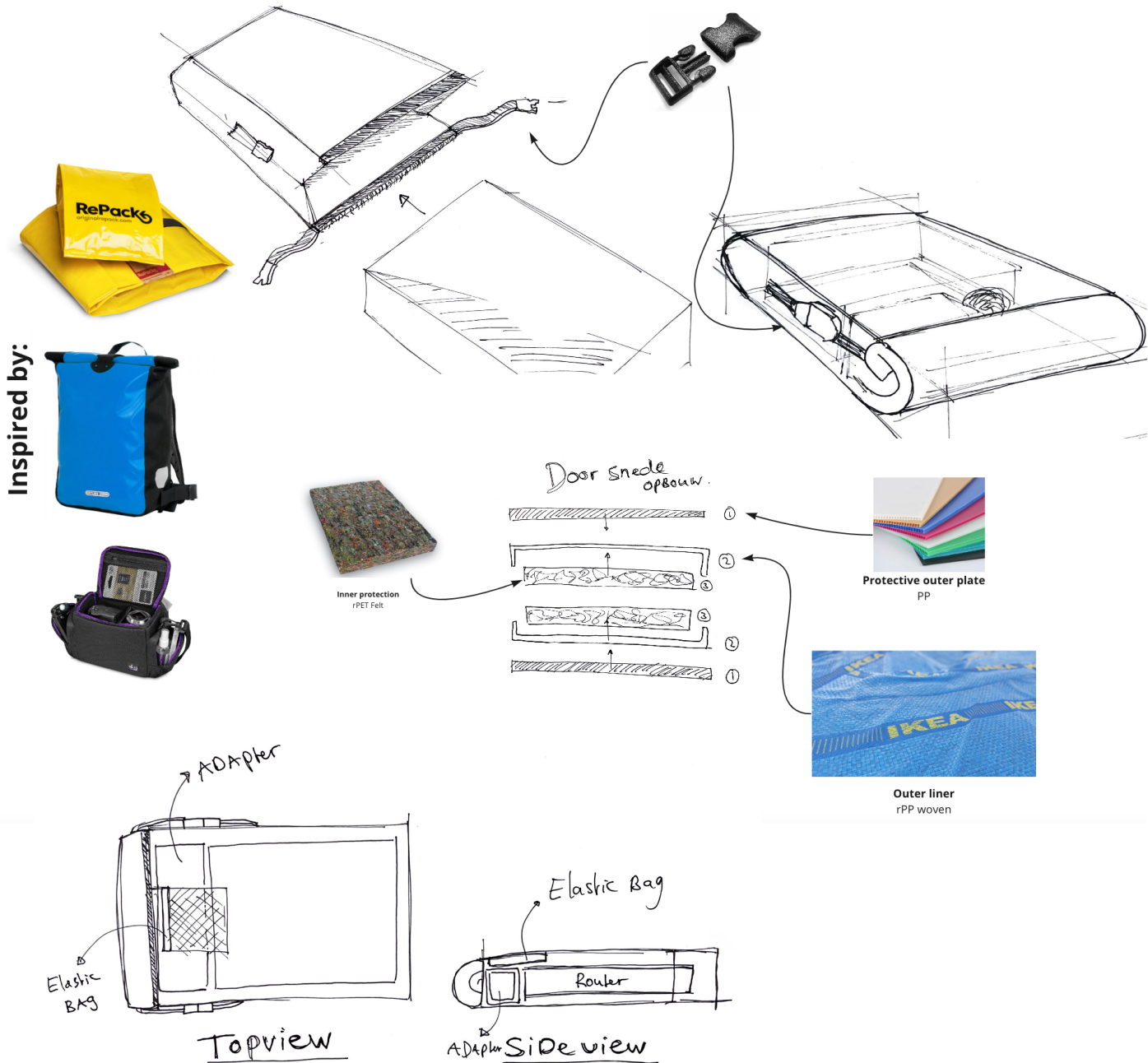


# 5.2 Concepts

Below, three concepts of reusable packaging are elaborated.

**Concept 1: Reusable messenger**

During talks with mechanics, the delivery partner and the refurbishment partner, the reusable bag came by multiple times. Especially the mechanics speak highly of this idea. The concept is inspired by the design of RePack and messenger bags. The main advantage about this design is it's durability (as a bag is a tough product that will not break easily) and ease of use (as you don't have to unfold or set-up a box). Two potential disadvantages could be the price (as they must be handmade) and protection (as the bag is soft and flexible).

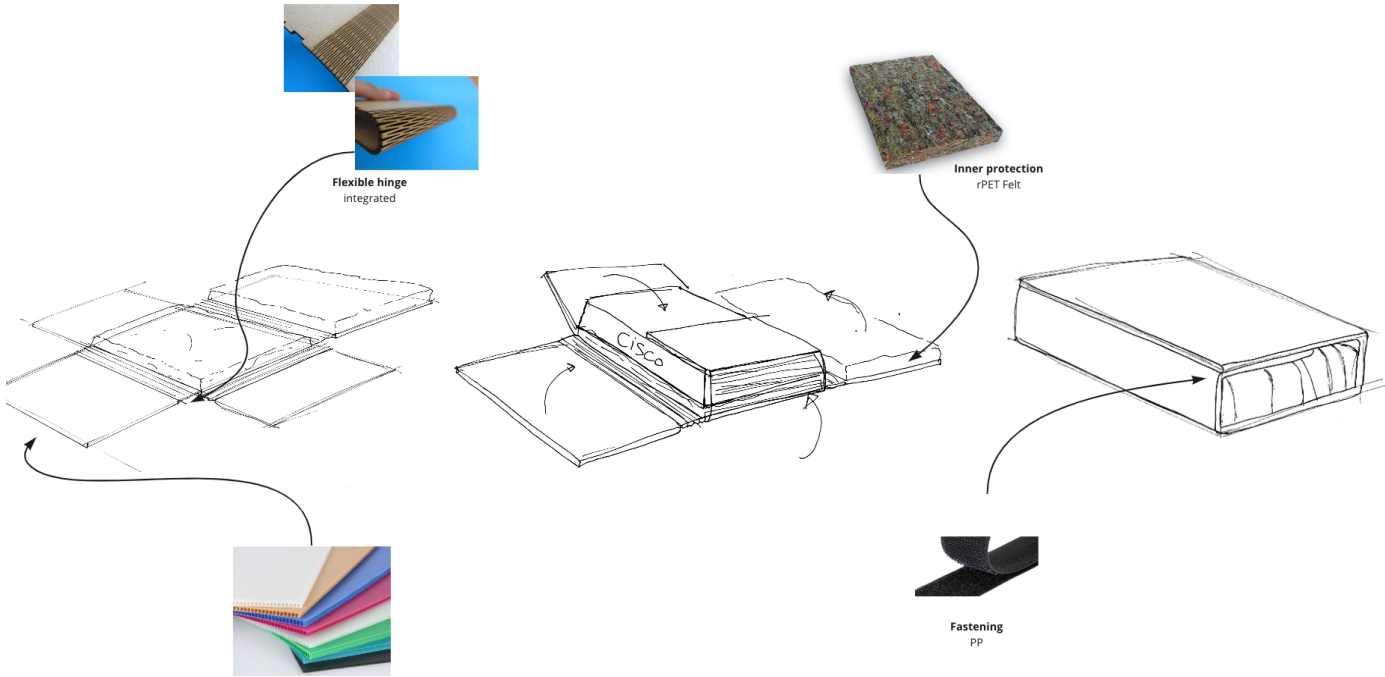


**Figuur 21**  
Concept sketches of the reusable messenger.

**Concept 2: Reusable Wrapper**

Inspired by packaging used for books. The product is placed in the middle, after which the four sides are wrapped around the device. On the inside there is soft protection. The main advantage about this product is it's

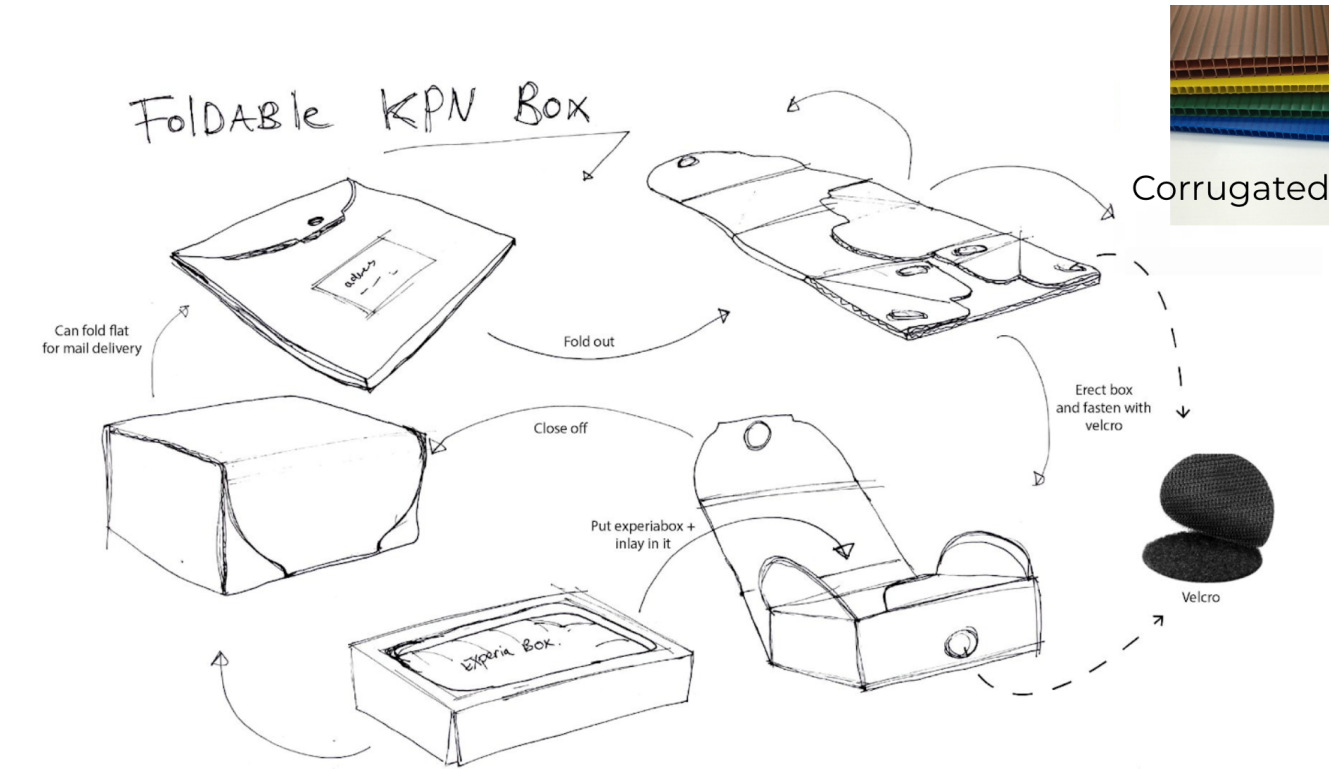
modularity (as multiple sizes and thicknesses can be covered with one packaging) and price. The main disadvantages are protection and ease of use (as it's quite large when it's unfolded).



**Figuur 22**  
Concept sketches of the reusable wrapper

**Concept 3: Normal box, but then reusable**

Very straightforward idea; the design of a normal 'erectable' box, but with a more durable material (corrugated plastic). The main advantage of this concept is the low price and efficiency during storage and return transport. The main disadvantage is the durability (as it might decay after only a few use cycles) and protection (it's hard to add an inlay).



**Figuur 23**  
Concept sketches of 'the normal box, but made reusable'.



# 5.3 Prototyping

To get a better physical understanding of the three concepts, the sketches are translated into prototypes. These first round prototypes are still preliminary and used to test the main functionalities of the packaging. With insights from these three models and feedback from stakeholders, one concept direction is determined, redesigned and made into the final prototype. The final prototype will be used during the pilot tests.

## 5.3.1 Turning three concepts into prototypes

### Concept 1: Reusable messenger

The reusable bag is made from a supermarket shopper, which is modified and resized with a sewing machine. The inside protection is made with a polyethylene foam. A plastic sheet on top and bottom gives extra stiffness and protection. The bag can be closed off with a rolling top, velcro and two buckles to secure the whole bunch.

#### Main insights:

- Relatively hard and expensive to manufacture.
- The roll top with velcro and buckles works well as a closing mechanism. A zipper could also be an option, but is more fragile and expensive to manufacture and/or replace. This approach is basic, cheap, durable, allows a good workflow and is dust/splash water resistant.
- The product slides in comfortably and fits well in between the foam sheets. Yet, this only applies for one size. If a device is a little smaller, it fits too loose and does not offer protection; if a device is a little bigger, it will not fit.
- It can be folded smaller for 20-30%. This is not so much and might cause problems with return/storage efficiency.

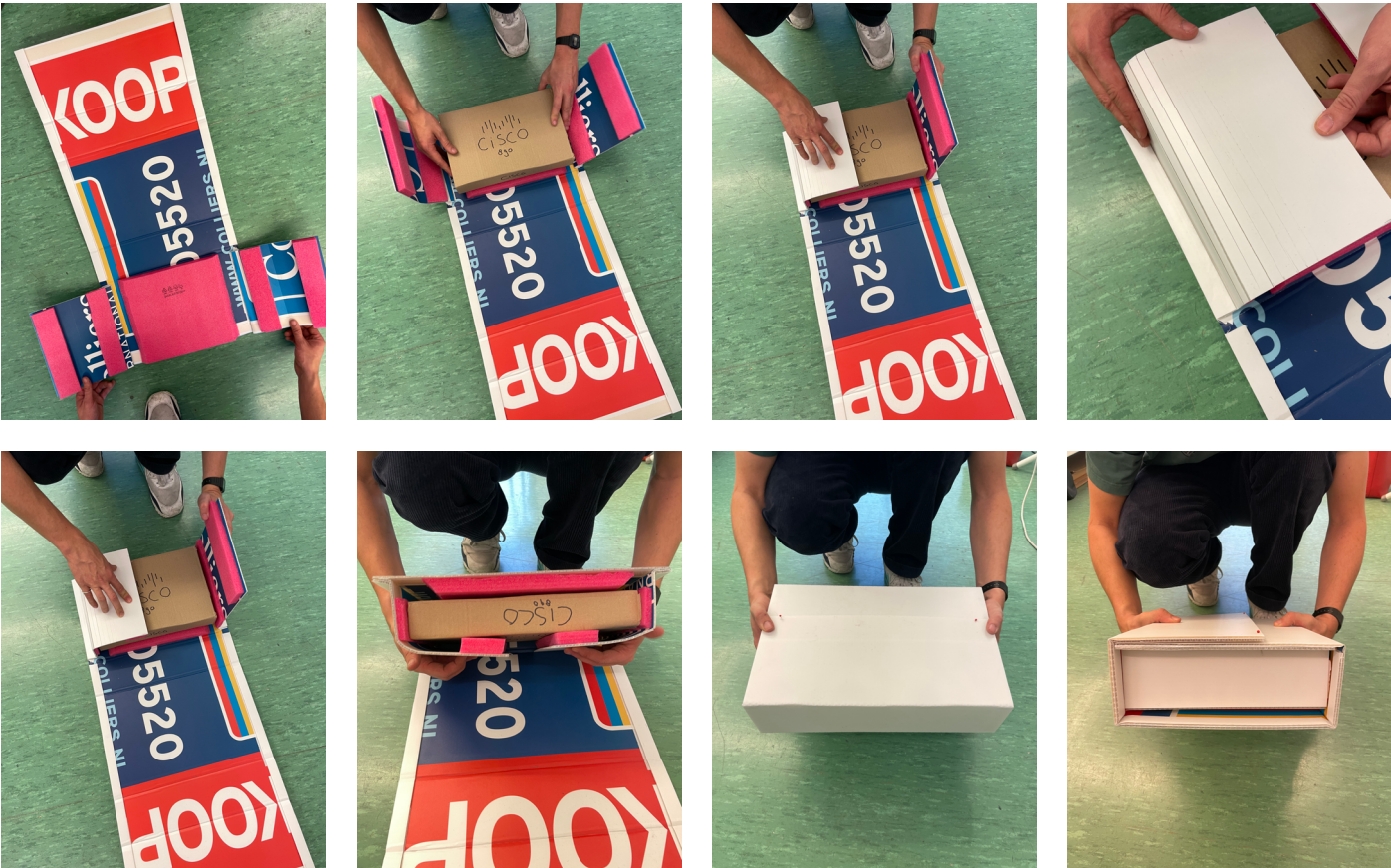
- Even though it's a soft product, the stiff outer plate gives the packaging enough structure to be stacked.
- The current design is not big enough. A router inc. adapters and cables do not fit comfortably.

#### Feedback from stakeholders

- The mechanics are especially enthusiastic about this concept. Mainly because it's a tough and durable product, which they can easily 'throw in the back of their bus'.
- Feedback from KPN was especially about the protection. A safe and undamaged delivery should be the main requirement. In the prototype, the sides of the packaging are not protected by foam, which leaves the device partially unprotected.
- The packaging expert (KIDV) likes this idea as the use cycles can be relatively high, which makes the product sustainably and economically attractive. He did show his concerns about the return rate, as people tend to steal products that look too nice.



Figuur 24  
Prototyping the reusable messenger bag



Figuur 25  
Prototyping the reusable wrapper

### Concept 2: Reusable wrapper

Inspired by packaging for books. The device is placed in the centre, after which the three sides are wrapped around it. The exterior is made from corrugated polypropylene (also used for realtor signs), which has a similar character as flute cardboard but is more durable. The inside is protected with PE foam. The packaging is closed off with velcro.

#### Main insights:

- Very easy and cheap to produce.
- Give enough protection, as a boxy structure is applied around the device.
- It does offer some modularity in sizes, but not insantly much. For product's that are a lot smaller, the packaging does not work as the structure becomes unstable and weak.
- It's not very efficient when empty. In the first instance, this type of packaging can be small and efficient, as it can be folded completely flat. However, the inside foam protection is in the way, which still leaves the empty packaging quite bulky.

#### Feedback from stakeholders

- Mechanics and refurbishment partners do not really like this idea. Especially because it's large and clumsy when unfolded. You really need two hands and a flat, large surface to pack and unpack this concept.
- The packaging expert (KIDV) does promote the use of PP corrugated board, because it's durable and easy to recycle.





**Figuur 26**  
Prototyping the normal box, made reusable.

**Concept 3: Normal box, made reusable**

This concept is meant as a 'base-line' product and is inspired by the principle of an existing, 'autolock' or 'speedlock' box. An autolock box is self-erectable and can be folded completely flat. The prototype is made with single-wall cardboard and modified by adding bubble wrap protection and velcro to close off without using tape.

**Main insights:**

- Relatively easy and cheap to produce.
- Not very durable, nor strong.
- Folds very flat, improving storage and return logistics. Does need velcro to fasten the flat 'package', because cardboard tends to jump back into its original shape.
- Can only be made with single-walled cardboard. Double/corrugated cardboard is too stiff and inflexible to be folded in and out.
- Suitable for multiple sizes of products.
- The closing mechanism is not strong enough and tends to rip open easily.

**Feedback from stakeholders**

- The refurbishment partner is a fan of this concept, as it is very easy to set-up but also very efficient in storage.
- The mechanics are not a big fan of this concept. They do not understand why you would send back or store a low value cardboard box, when you can also put it in the recycle bin.
- KPN already uses these types of packaging in their B2C market.

# 5.4 Concept choice

To choose a design to continue this project with, the three concepts are graded on the three topics of requirements: logistics, interaction and product. For every concept, the pro's and con's are described and weighed with one another. This resulted in the first concept, the reusable messenger bag, which will be used for further development and testing.

**Final Verdict**

|           | Logistics | Interaction | Product | Explanation                                                                                                                                                                                                                                                                               |
|-----------|-----------|-------------|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Concept 1 | +         | ++          | +/-     | <b>Logistics:</b> Storage efficiency (+) return efficiency (+) lower return rates? (-)<br><b>Interaction:</b> resistant to rough handling (+), easy to pack/unpack (+), Leaves first impression (+)<br><b>Product:</b> very durable and tough (+), high price (-), average protection (-) |
| Concept 2 | -         | -           | +       | <b>Logistics:</b> no storage efficiency nor handiness (-)<br><b>Interaction:</b> difficult and inconvenient to pack (-),<br><b>Product:</b> Offers real protection (+), cheap (+), not very durable (-)                                                                                   |
| Concept 3 | ++        | +/-         | +/-     | <b>Logistics:</b> very efficient during storage (+), return efficiency(+)<br><b>Interaction:</b> Easy to pack and unpack (+) bad perception among mechanics (-)<br><b>Product:</b> cheap (+), not durable (-)                                                                             |



# 5.3 Final prototype

With the design requirements, feedback from stakeholders, but also the enthusiasm and support for the three concepts, the reusable bag came best out of the test. This concept will be elaborated into a final prototype that will be used for the pilot.

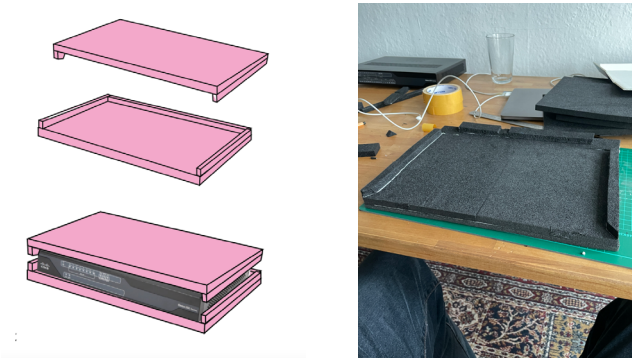


Figuur 26 The final prototype

## 5.3.1 Main improvements

**Size**  
The bag is made ±20% bigger, so that the router and all accessories fit more easily.

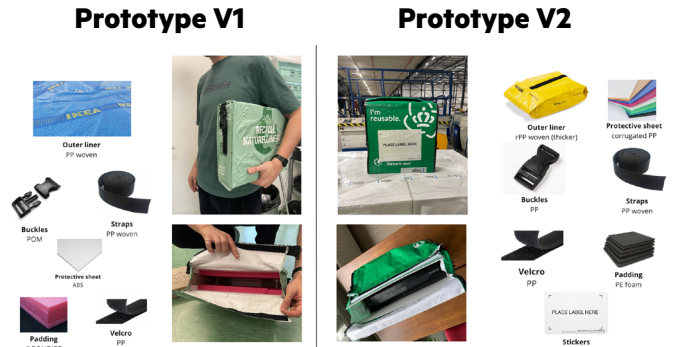
**Better protection**  
In the first version of the prototype, there were concerns about the protection of the packaging, as only the top and bottom were covered. In the redesign, the foam protects all sides as a 'clam shell', while retaining some of its flexibility.



Figuur 27 Clamshell protection.

**Towards mono-material**  
To allow 100% recyclability, it is convenient that the product is made from one material that is well suited to be recycled. Polypropylene is a plastic that comes in many forms at a relatively low cost and is recyclable. In the second version, 5 of the 7 components are made of PP.

The inside protection is now made from a polyethylene foam, but can be replaced with expanded PP. This is an impact resistant foam, which is well suited for packaging and recycling. However, the delivery time is 3-4 months, which takes too long for this project. The stickers are made from PVC. This needs some more thought in the final design of the product.

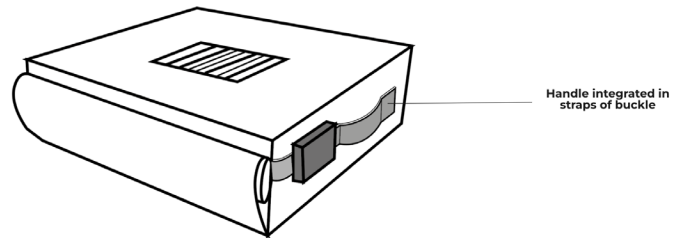


Figuur 28 Material improvements

**Article number**  
As the packaging is not considered as waste, but as an actual product, it must be registrable in KPN's inventory system. This is done with article numbers, which allow them to keep track of stock, orders and location status. The reusable packaging has its own article number (843371) and barcode, which can be scanned and registered by the logistic partner. The barcode is located on the side of the packaging, which allows scanning as easy as possible when the packaging is stacked.

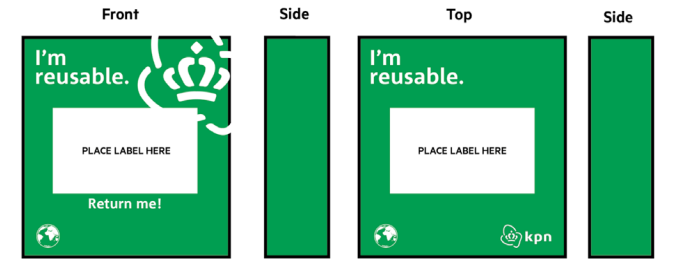
**Extra pouch**  
An extra pouch is added to store the necessary adapters and cables separately. This also adds better overview and workflow for the mechanic during installation.

**Handles**  
To improve the workflow of the mechanic, handles are added on both sides of the packaging. These handles are integrated in the straps and buckles that were already used for the closing mechanism.



Figuur 29 Integrated Handles

**Branding**  
To make the packaging more recognizable, the KPN colours and logos are added. The style is inspired by the full-colour packaging KPN currently uses in the consumer market. Use-cues of reusability are also added to minimise any misunderstanding throughout the logistics. These quotes underline the sustainable character of the product, which can improve the presentation at the client. This will also be tested during the pilot.



Figuur 30 Recognizable and engaging branding

**'Place here' stickers**  
Throughout one logistic trip, multiple address and barcode stickers are applied to the packaging. For the packaging to be reused in a proper way, all these stickers must be removed after the trip. This can be difficult, as stickers tend to tear or leave glue residue.

To prevent this, a 'sticker holder label' is tested in the final prototype. This label allows stickers to stick very well, but also allows very easy removal without tearing or glue residue.



Figuur 31 Sticker Holder or Swaplabel



# 5.4 System Architecture

Just as important as the product, is the system on which it operates. The distribution of the reusable packaging must be designed for optimal forward- and return movements.. Different theoretical concepts were explored on logistic feasibility, functionality and costs (appendix 5), which resulted in an optimal strategy for the distribution of the reusable packaging in the VPN service.

## 6.4.1 System revolving around the mechanic

As described in previous research, the return logistics of electronics showed some issues that were potentially caused by a lack of proper packaging. This could be solved by properly distributing the right packaging, to the right location, at the right moment. To do so, a logistic concept is proposed, in which the distribution of the packaging is built around the initiator of the return process; the mechanic or a ‘mechanic centred’ system architecture.

In this system, the mechanic plays a central role in the receiving, dispatching, but also keeping and managing stock. The mechanic always has a stockpile of reusable packaging stored in his working vehicle. Every mechanic has an automatic restocking system that’s linked to his car and monitors the inventory of essential products like screws, cables, sockets etc. The reusable packaging can be added to this restocking system to allow automatic supply.

In case of a return order, the mechanic can grab one of the empty reusables from his stockpile and directly return the device. Everytime he receives a device with reusable packaging, he retains and stores the empty packaging back in his car after installation, instead of directly returning it. This way, the supply and stock of packaging balances itself out, saving trips to provide or pick up empty packaging to and from the mechanic. Be-

side that, it always offers the right return packaging, which could reduce product damage (as devices are not combined in a big box) and reduce return time (as the packaging makes returning easier). Every mechanic has a minimum and maximum amount of packaging in his car. In case of a shortage, the restocking system automatically orders new reusables at Company B. In the case of empty packaging piling up, the mechanic can send the surplus back to Company B using the existing return process.

The same ‘supply balancing’ idea works for the refurbisher. They always have a certain amount in stock, based on the supply. When they receive a returned device in a reusable packaging, they unpack the device and store the empty packaging until it can be used again. In case of shortage, they order new packaging at Company B. In case of surplus, they send it back to Company B.

Company B is used as a packaging hub; they store the reusable packaging, transfer orders to and from the client and restock in case of shortage or disappearance.

## 6.4.2 The three scenario’s

In the visual, three different supply scenarios are displayed, all by different colour arrows.

→ In case of an installation: a refurbished device is sent to the mechanic. The refurbishment partner has a stockpile of reusable packaging which they use to package a refurbished device. With the existing processes, this installation order is sent to the mechanic. After installation, the mechanic stored the reusable packaging in his car, waiting to be reused.

→ In case of a return order: a replaced or cancelled device is returned from the mechanic. The mechanic has a stockpile of reusable packaging which he uses to package a returned device. With the existing processes, this return order is sent to the refurbishment partner. Here the device is unpacked, refurbished and repacked in the reusable packaging, waiting to be installed again.

↔ In case of a surplus or shortage of reusable packaging; empty packaging is provided to, or taken from the mechanic or refurbishment partner. The delivery of this empty packaging uses the existing forward and return logistics of that particular service. There’s only one exception; the mechanic sometimes returns stuff from their local ‘rayon’ warehouse, which they visit twice a week. Here they can leave behind everything that has to be returned.

## 6.4.3 Determining the required packaging

With the knowledge about order volumes (chapter 6.2) and a strategy for the distribution, the total amount of reusable packaging that’s needed can be determined. The amount of packaging is formed by the weekly stock movements (figure X) and three other stock factors:

- **Packaging that’s actively used:** There’s also an amount of packaging that’s actively ‘on the move’ through the system. This amount is influenced by the stock movements and return time, which is assumed at 2 weeks in this case.
- **Stock at mechanic:** Every mechanic must have a certain amount of empty packaging in his car to cover weekly return orders.
- **Stock at manufacturer:** The devices are being packed at the manufacturer, which in this case is the refurbishment partner. The refurbishment partner must have a constant stockpile of empty packaging to cover forecasted peaks of orders. When the packaging-

stock goes below this peak, they order new packaging at the central hub of the logistic partner. At a maximum of 80 (which is a full roll container), they send this surplus back to Company B.

- **Stock for compensation:** The central logistic hub, in this case Company B, is used to store and supply the system of empty packaging at surplus or shortage. To compensate for disappearance, theft or damage of the packaging, Company B has a back-up. On average, it is estimated that 10% of the packaging does not return on a yearly base.

## 6.4.4 Quantity for VPN service

With the four factors, the total amount of packaging that’s needed to cover the VPN service can be calculated. Considering a return time of two weeks and a return ratio of 90%, KPN needs to invest in 260 reusable packaging to provide for all refurbished devices and return orders in the VPN service for at least 4 year. At first glance, this seems like a lot, but there’s an explanation for this number.

This number consists of 35 packages being actively used, based on the weekly stock movements. To provide all mechanics in the VPN service of at least one package, 111 units are needed. The manufacturer and logistic partner both need at least 25 units to cover for any weekly order peaks. To compensate for the 10% disappearance over 4 years, another 65 units are needed.

This results in 260 reusable packaging.



# 5.5 Key insights & conclusions

By developing three prototypes and a distribution concept for reusable packaging solution, the following insights and conclusions were found.

The final prototype

Through ideation, conceptualization and prototyping, three different concepts were developed. By weighing them against the three topics of requirements, the reusable messenger bag was chosen to develop in a final prototype. This choice was made because it's a durable, tough product (leading to more use cycles) and it allowed a smooth workflow during packing. Additionally, this idea was already supported by the mechanics and the refurbishment partner which will create a better participation in the testing phase and perhaps more support when scaled up.

With insights and feedback from the first round of testing, the final prototype was made. This reusable bag is tailor-made for a Company A type X and 1110 and offers protection during rough transport using soft foam on the inside. The bag is opened and closed using a roll top with additional velcro and buckles, making the design dust and splash water resistant. To optimise recyclability, the design is mono material (polypropylene), except for the inside protection. In practice, it is possible to make it 100% PP, but the delivery of the protective foam took too long. A 'sticker area' is added, which is a special label that allows stickers to stick very well, but also allows very easy removal without tearing or glue residue. Lastly, to make the packaging more recognizable and underline it's sustainability, the KPN colours, logos and additional quotes were added to the exterior.

System architecture

Just as important as the product, is the distribution system on which the reusable packaging moves forwards and backwards to and from the client. From previous research, it was shown that the current return process shows some difficulties that are potentially caused by packaging. By introducing a 'system architecture' that revolves around the mechanic (the initiator of the return process), these issues could be solved.

In this system, the mechanic plays a central role in the receiving, dispatching, but also keeping and managing packaging stock. The mechanic always has a stockpile of reusable packaging stored in his car, so he always has the right return packaging for grabs. Every mechanic has an automatic restocking system that's linked to his car and monitors the inventory of essential products like screws, cables, sockets etc. The reusable packaging can be added to this restocking system to allow automatic supply. Short-

ages or surplus can be regulated by this automatic stock system. When receiving a device with a reusable packaging, the mechanic retains and stores the empty packaging in his car. Everytime he has to return something, he simply grabs a reusable from his stockpile. This way, the inventory and supply of packaging balances itself out, while allowing smooth and clear return guidelines.

The amount of reusable packaging that's needed to provide for a certain service or business depends on four factors: the packaging that's actively used, mechanic stock, manufacturer stock and compensation stock. To provide all refurbished devices and return order in the VPN service of reusable packaging for at least 4 year, KPN needs to invest in 260 reusable packaging. This number consists of 35 units that're actively used, 111 units for mechanic stock, 50 for manufacturing and logistic stock and 65 for compensation stock.



Figuur 34 The prototype that will be used during the pilot





**Outer liner**  
rPP woven (thicker)



**Protective sheet**  
corrugated PP



**Buckles**  
PP



**Straps**  
PP woven



**Velcro**  
PP



**Padding**  
PE foam



**Stickers**  
PVC





# Release

## Evaluation & Testing

In the ‘release’ phase of this project, the final prototype and its distribution concept are tested in real life. To do so, an actual installation order of the VPN service is used for a small scale pilot. This means; a refurbished device is packed in the prototype packaging, sent to an actual client on the planned logistic system, and is being installed, after which the empty packaging is returned for reuse. This chapter described the pilot plan and its results. Secondly, a business case is developed, where the costs and other direct and indirect values of the reusable packaging are compared to the current single-use packaging. This is followed by a fast-track life-cycle assessment, where the footprint of the reusable packaging is compared to that of the current single-use approach. The main insights and feedback from this ‘release’ leads to the validation of the concept, an improved design and recommendations, which are described in the next chapter.



Release

# 6.1 Pilot

During the first, small-scale pilot, the reusable packaging is tested to see if the logistics processes and stakeholders are resistant to such a concept. The pilot is done with an actual order in the VPN service.

### 6.1.1 Pilot Plan

The extensive pilot plan can be found in appendix 7.

#### Main objective of pilot

Test how the logistic system, workflow of involved stakeholders and the packaged product react to the concept of a reusable packaging in KPN's VPN service.

#### Three criteria topics throughout pilot

The main objective of the pilot is subdivided into the three essential topics for successful implementation; the same structure was used in the list of requirements. Throughout every stage of this pilot, these essential topics are the focus points of the research questions.

- Logistics:** Test if the logistics of the VPN service are capable of adapting to a reusable packaging solution and observe how this system responds to such implementation.
- Interaction:** Test if employees within VPN operation are capable of adapting to a reusable packaging solution and observe how this influences their workflow.
- Product:** Test if the prototype design offers enough protection, durability and functionality during use.

#### Pilot set-up

This pilot will consist of following an actual order of a refurbished router, where the current single-use packaging is replaced with a reusable packaging. The reusable packaging will circulate one full cycle through the logistic chain of the VPN service; from warehouse to client and back.

#### Three different scenarios

An order can run through three different scenarios; an installation order, a cancellation order and a service order. This pilot will be focussed on an installation order, as this type of order is most common. Additionally, an installation order has a wider variety of actions which leads to a more complete set of results. Unlike what was determined in the system archi-

ture (chapter 7.3), the empty packaging will be sent back directly after installation. This is done to test and verify the return logistics of an empty packaging that does not contain a product.

#### Packaging journey

The forward and return logistics of an installation order is based on the existing logistic chain and processes of the VPN service. A detailed, step-by-step product journey of the pilot is thought out and visualised below. This is mainly done to predict attention points throughout the pilot. The order consists of 6 moments of transference from one stakeholder to the other. At every moment of transference, the related location is visited to observe and interview the stakeholders. For every stage, a list of research questions The detailed product journey of all three different scenarios can be found in appendix 6

#### When is the pilot considered successful?

The packaging makes a successful forward and return trip by using only existing logistic processes.

The reusable packaging is received positively by all the involved stakeholders, without making drastic changes to their daily work. By feedback and insight from interviewing all the involved stakeholders, a clear framework for an iteration can be made.

The Company A device is delivered safe and undamaged.

#### Observation methods

For every stage, a list of research questions is drafted (see next chapter) which can be answered in a short interview with the relevant participant. By being physically present at each stage (where possible), this interview can be conducted on site and the actual interaction with the product can be observed. The results are transcribed and recorded with photographs.

#### Limitations

The sample group is one (N=1). Therefore, this small-scale pilot will only be an indication on functionality and impact of reusable packaging. For more valid conclusions the sample size must be increased.

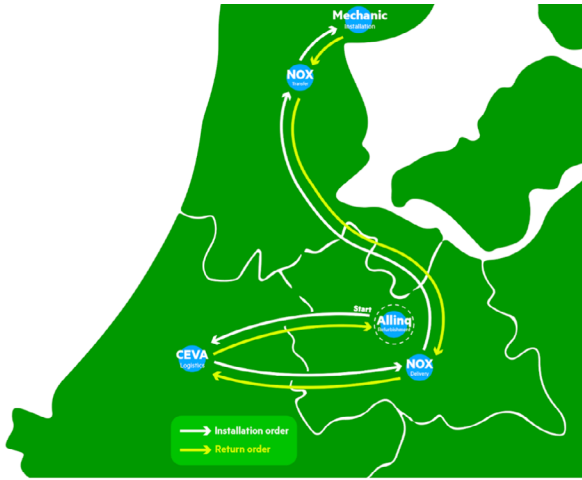
#### Legal

KPN is committed to be fully responsible for any damage during this pilot. The consent for interviewing and photographing participants was confirmed verbally or in writing (by mail).

### The order

With help of KPN planners and Company B, a suitable order for the pilot was found. This involved an installation order of a Company A X in Hoorn, Noord Holland. The logistic journey of the packaging is visualised in figure 37.

The order consists of 8 moments of transference from one stakeholder to the other. At every moment of transference, the related location is visited to observe and interview the stakeholders. One of the transfers happens internally (between Company C and mechanic), which is combined into one stage. Therefore the pilot is divided into 6 stages, with relevant research questions (based on the three pillars) and description about stakeholders, actions and uncertainties.



Figuur 37 The installation order that's used in the pilot.

### The 6 pilot stages & corresponding research questions.

One cycle of redeployment order typically consists of 6 stages (see image 1). In the following part, every stage is described shortly with its dedicated stakeholders, employees, research questions and possible uncertainties.

#### Stage 1: Company D - 'refurb & packing stage'

Responsible; Company representative X

Person who performs actions; Company representative X

#### Actions

The first stage takes place at the refurbisher; Company D. Here the reusable packaging is first temporarily stored, until an order is placed. Then a product is refurbished by one of Company D's employees, packed in the reusable packaging and sent out to the next stage.

#### Research questions

##### Logistics:

- Where is the package during temporary storage? Is the current design efficient enough for temporary storage?
- Is the packaging stable during stacked transport?
- Is the packaging suited for transport on a pallet AND in a trolley?

##### Interaction

- How much time does the employee win/lose compared to the single-use packaging?
- Is the packaging opened in a smooth and comfortable manner?
- Is the packaging closed in a smooth and comfortable manner?
- Is the packaging sequence clear? (Device first, accoires last)

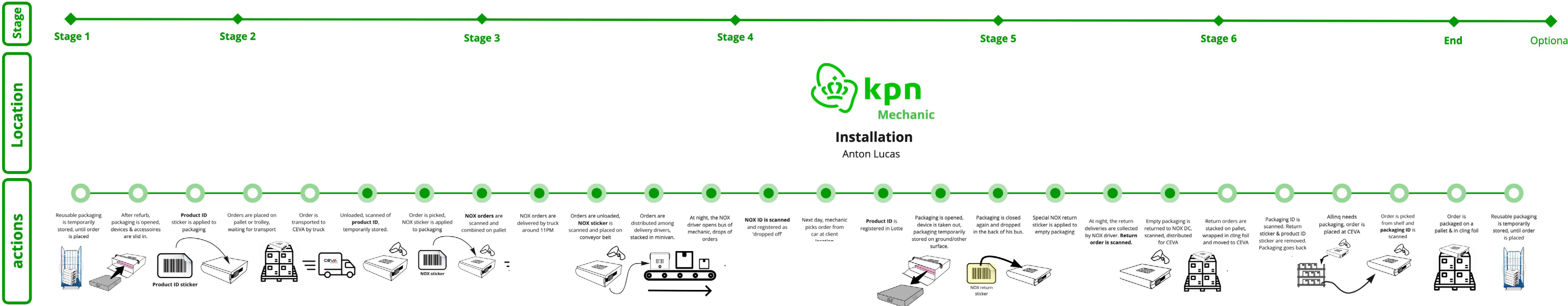
- Does the device slide in smoothly?
- Are the accessoires packaged smoothly in the dedicated pouch?

#### Product:

- Is it clear how the packaging is opened and closed?
- Is it clear how the device slides into the packaging?
- Is it clear where the cables and adapters are stored?
- What's the most logical and efficient location for a product ID sticker?
- What's the most logical and efficient location for a packaging ID sticker?
- Is it clear where the sticker is placed? Does the product ID sticker attach in a solid way?
- Are any remaining stickers removed easily?
- Does the packaging offer enough protection at first sight?

#### Limitations

The sample group is one (N=1). Therefore, this small-scale pilot will only be an indication on functionality and impact of reusable packaging. For more valid conclusions the sample size must be increased.



Figuur 36 The detailed packaging journey of a redeployment order in the VPN service.



Release

Stage 2: Company B - ‘transit stage’

Responsible; Company representative X  
Person who performs actions; Company representative X

Actions

The second stage is a so-called ‘transit stage’, where the order is merely forwarded to the delivery partner. The packaging is collected, unloaded, temporarily stored and prepared for dispatching again.

Research questions

Logistics:

- Where is the package during temporary storage? Is the current design efficient enough for temporary storage?
- Is the packaging suited for short, internal transport on a trolley?
- Is the packaging stable during stacked transport?
- Is the packaging suited for transport on a pallet?

Interaction:

- Is the Company C sticker applied in a smooth and convenient way?
- Are the product ID and Company C stickers scanned in a convenient way?
- Is the packaging easy to carry?

Product:

- Is it clear where the sticker is placed? Does the sticker slide into the transparent window in a convenient way?

Does the packaging offer enough protection?

Stage 3: Company C - 'Delivery stage'

Responsible; Company representative X  
Person who performs actions; Company C employee

Actions

The third stage is the ‘delivery’ stage. At night, the KPN orders are received and sorted in their distribution centre of Company C using automatic and manual sorting systems. After this, the parcels are distributed over KPN mechanics.

Research questions

Logistics:

- Is the packaging accepted and handled well and correctly throughout the conveyor belt sorting system of Company C?
- Is the packaging stable during stacked transport?

Interaction:

- Is the Company C sticker scanned by the automated scanning system of Company C?
- Is the packaging easy to store in the back of the delivery van?
- Is the packaging easy to recognize at night?
- Is the Company C barcode easily scanned?

Product:

- Is the packaging durable enough for the (rough) conveyor belt sorting?
- Does the packaging offer enough protection to the product during conveyor belt sorting?

Stage 4: Mechanic - 'installation stage'

Responsible; Company representative X  
Person who performs actions; Company representative X

Actions

The fourth stage is the ‘installation’ stage, which is an important stage for the functionality of the packaging as it is opened and unpacked, sometimes in challenging circumstances. In this stage, the mechanic receives, unpacks and initiates the return of the reusable packaging.

Research questions

Logistics:

- Is the order received well?
- What is the optimal return process for the mechanic?

Interaction:

- How much time does the mechanic win/lose compared to the sin-

- gle-use packaging? Focus on trip to (cardboard) bin.
- Is the packaging opened in a smooth and comfortable manner? Also in challenging positions?
- Is the packaging opened in a smooth and comfortable manner? Also in challenging positions?
- Is the method of opening/closure (buckles and velcro) approved by the mechanic?
- Is the device removed from the packaging in a convenient way? Does the mechanic approve the design?
- Are the cables and adapters removed from their pouch in a convenient way?
- Where is the empty packaging placed when installation is being done?

Product:

- Is the packaging durable enough for rough handling? Think of being carelessly thrown in back of the van, dirt, dust etc.
- Does the packaging offer enough protection?
- Is the cable/adaptor pouch durable enough?
- Is the method of opening/closure (buckles and velcro) effective?

Stage 5: Company C - 'Return stage'

Responsible; Company representative X  
Person who performs actions; Company C employee

Actions

In the 6th stage, the empty packaging is returned to be reused. At night, the Company C rider picks up return orders and returns them to a Company C distribution centre. After this, the return orders are sorted again, automatically and manually.

Research questions

Logistics:

- Is the return order actually picked up by the Company C driver?
- Is the empty packaging too bulky for return delivery?
- Is the packaging accepted and handled well and correctly throughout the conveyor belt sorting system of Company C?
- Is the packaging stable during stacked transport?

Interaction:

- Is the Company C sticker scanned by the automated scanning system of Company C?
- Is the packaging easy to recognize at night?
- Is the Company C return sticker easy to read by the scanner?

Product:

- Is the Company C sticker easy to apply to the packaging?
- Is the packaging durable enough for the (rough) conveyor belt sorting?

Stage 6: Company C - 'Storage stage'

Responsible; Company representative X  
Person who performs actions; Company representative X

Actions

After the (empty) reusable packaging is handled by Company C’ distribution, it enters the 6th stage; the storage stage. The return orders of Company C are received by Company B, after which they unload the parcels and store them at a designated location in their warehouse.

Research questions

Logistics:

- Is the packaging stable during stacked transport?

Interaction:

- Are all stickers removed in an effective way?

Product:

- Is the packaging durable enough for storage in a pallet container? The packaging is thrown in and thus stacked in a random order.
- Are the stickers removed easily?
- What is the best location for the packaging ID?

6.1.2 Pilot results

The results of the pilot are subdivided according to the six different trips the packaging makes, described in figure X. At every one of these stages, the related location is visited to observe and interview the relevant stakeholder. The detailed description of all the results can be found in appendix 7.

Stage 1: Company D - Refurb & Packaging stage

On Thursday 28th of January the device was packed.  
On Friday 29th of January the pallet with orders was sent out.



Figuur 38

On the left; the critical Company D men inspecting the ‘new kid in town’  
On the right; They seem convinced and the order is ready for transit.

The main insights that were found during this stage are:

- + By using the reusable packaging, the packaging time goes down by ±15%
- + According to the Company D men, the packaging offers more than enough protection. Even more than the current single-use packaging.
- + After one or two seconds of thought, the roll-top opening of the packaging was understood. After that, the opening and closing was done very smoothly. The device was also packaged in a smooth way. The adapter pouch was also opened, filled and closed as intended.
- The article sticker must be visible when stacked (see figure 40). Therefore, these stickers must be placed on the side of the packaging. In the current design, the sticker does not stick very well to the side as the material is too smooth and flexible.
- The Company D guys raise some concern about the fact that the storage of empty packaging takes more space than normal, which can be a problem with higher volumes.



Figuur 39 Packaging is being packaged.



Figuur 40 Stickers that do not stick



Stage 2: Company B - Transit stage

On Friday 28 January, the shipment was received at Company B.  
On Monday 31 January, the shipment was unloaded and stored.  
On Wednesday 2 February, the order was picked from Company B’s warehouse and sent to Company C.

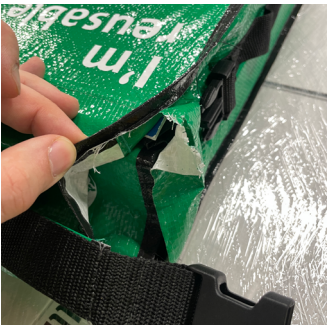


Figuur 41

On the left; a full shipment of Company A X’s, including the one with reusable packaging.  
On the right; Adil and colleague inspecting the reusable packaging.

The main insights that were found during this stage are:

- + Slippery or not-so stable surface does not matter for stackability. The whole pallet is generally wrapped in cling foil. At Company B they are working with boxes that are way more slippery.
- + The article stickers are well visible and scanned successfully.
- + Clear where to place stickers. ‘Place here’ label works very well.
- People tend to grab the packaging by it’s roll top. This is a fragile part and led to the packaging already tearing in one of the corners.
- An unexpected, relatively large sticker is placed on the packaging.



Figuur 42

On the left; First damage  
On the right; a big unexpected sticker is added.

Stage 3: Company C - Delivery stage

On Wednesday evening 2 February, the shipment was received by Company C and sorted for the right receiver.  
On Thursday 3 February, between 1:00 and 3:00, the order was sorted a second time in Zaandam.  
On Thursday 3 February, between 3:00 and 4:00, the order was delivered successfully at the mechanic.



Figuur 42

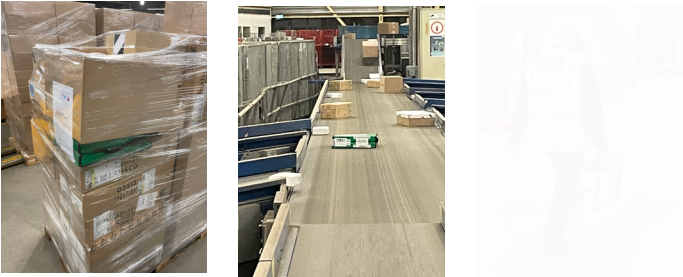
On the left; a full shipment of Company A X’s, including the one with reusable packaging.  
On the right; Adil and colleague inspecting the reusable packaging.



Release

The main insights that were found during this stage are:

- + Order is sorted and accepted twice by the automatic sorting system. This is quite an essential insight, as this means that all barcodes and non-manual processes are suited for a reusable packaging approach.
- + All stickers are correctly placed and scanned.
- + The order was correctly delivered at the mechanic.
- The design seems not stable enough to be stacked on a pallet, as seen on the picture. Seems like the packaging does not offer enough protection when larger or heavier boxes are placed on top.
- The buckles and handgrip can potentially lead to clogging up the conveyor belt system.



**Figuur 43**  
On the left; the reusable packaging seems to have a hard time when something is stacked on top.  
In the middle; the reusable packaging is accepted by the scanning system and correctly sorted by the automatic system.  
On the right: Even Though Hans seems to like the handles, they are a potential danger in clogging up the

Stage 4: KPN - Installation stage

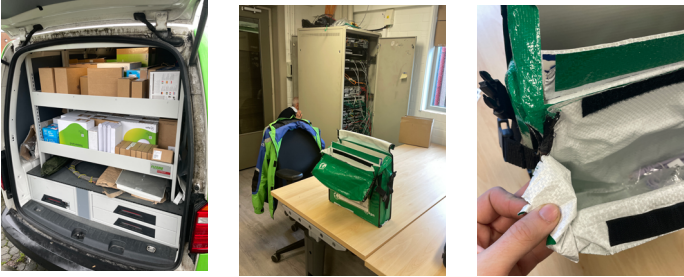
On Friday 4 February , the mechanic installed the device.  
On Monday 7 February, the mechanic initiated the return process.



**Figuur 44**  
On the left; Reusable packaging is successfully delivered  
On the right; Vincent unpacked and installed the very undamaged device!

The main insights that were found during this stage are:

- + The device is undamaged, which means the packaging offers enough protection.
- + Opening, closing and unpacking the device all went very smoothly. The mechanic understood everything right away.
- + The mechanic was a big fan of the handles, because it leaves one hand to hold other stuff.
- + Again, found damage on devices that was potentially caused by lack of packaging
- + Mechanic normally takes a 20 minute trip to get rid of packaging waste. With reusable packaging this is not necessary anymore.
- Adapter pouch functions well, but is not strong enough as it is partially torn in of the seams.
- Doubtful if the bus of mechanic has enough room to store multiple reusable packaging. On the other side; KPN mechanics will receive larger vans as of March '22.
- The mechanic does not really seem to understand or support the concept around the whole reusable packaging. He seems fine with the return process and single-use packaging he currently uses.



**Figuur 45**  
On the left; storage racks in mechanic's bus  
In the middle: the reusable packaging on sight  
On the right: the adapter pouch also torn

Stage 5: Company C - Return stage with Vincent van der Wekken & Hans Hattink

On Tuesday 8 February, the first pick-up attempt failed.  
On Wednesday 9 February, the second pick-up attempt was successful.  
On Wednesday 9 February, around 6am, the order was automatically sorted by Company C in Zaandam.  
On Wednesday 9 February, the order was automatically sorted a second time by Company C in Utrecht.  
On Thursday 10 February, the order was delivered at the wrong address.



**Figuur 46**  
On the left; Ready for return  
On the right; The wrong return sticker...

The main insights that were found during this stage are:

- + The empty packaging is successfully scanned and sorted twice by the automatic sorting system of Company C. This round was especially important, as I was not physically present to intervene when a problem occurred.
- + The empty packaging was delivered and received at the address that was specified on the return sticker.
- The empty packaging was delivered at the wrong address, as the wrong return sticker was applied. Apparently there are two return stickers; a white one, which is bound for Company B, and a yellow one, which is bound for Company F; another refurbishment partner of KPN. In the first pick-up attempt, the correct, white sticker was applied to the packaging. However, because the delivery driver took another box (with a yellow sticker) for return, the mechanic also applied a yellow sticker on the reusable for a second attempt. This time the order was picked up, only bound for the wrong address.

Stage 6: Company B - Storage Stage with

On Tuesday 15 February, the packaging appeared again after being lost for a couple of days.

That same day it's delivered back to Company B, where it's unloaded and stored.

The main insights that were found during this stage are:

- + The reusable packaging design is striking, which made it easy to recognize. In the end, this was the reason why it was found back.
- + The packaging actually wasn't sent to the wrong address, but the wrong sticker was applied.
- + If the volumes are not enormous (which is the case, also when scaled up) the size efficiency is not a vital requirement for the functionality of the product, as there's more than enough space for storage. Aziz even said it's not efficient when the packaging can be folded in, as this is another action that's added.
- + The best location of the packaging ID is on the side, at the same place where the product ID is applied.
- Not all stickers can be removed easily, as not all stickers are applied to a Swaplabel. Removing these 'extra' stickers is a very time-consuming and frustrating task.



**Figuur 48**  
Packaging made it's round trip!



# 6.2 Business case

The direct and indirect value of the reusable packaging is formulated in the business case. The business case is divided into three parts. Firstly; the cost structure, in which the direct packaging expenses (materials & logistics) of the current single-use approach are compared to the reusable option. Secondly; an estimation of the costs savings through reduction of product damage and turnaround time. Lastly; the value proposition, in which other (indirect) advantages of the reusable packaging are discussed.

## 6.2.1 Direct packaging costs

The cost structure is based on the yearly amount of refurbished Company A routers that's being redeployed in the VPN service. The costs are spread over four year, which is the estimated life-time of the reusable packaging. As previously described, only 70% of refurbished routers actually need new packaging, which results in a yearly amount of 820 units. This cost structure does not contain the potential costs savings due to improved return logistics, but solely focuses on material costs, transport and storage costs and labour. The indirect costs savings are described in the next chapter.

### Costs of single-use packaging

|                                      | 2022    | 2023    | 2024    | 2025    |                                                             |
|--------------------------------------|---------|---------|---------|---------|-------------------------------------------------------------|
| Current packaging                    |         |         |         |         |                                                             |
| Cost of packaging material           | 1320,2  | 1320,2  | 1320,2  | 1320,2  | Consulted by RAJA, packaging wholesalers                    |
| Cardboard box (60x30cm)              | 1148    | 1148    | 1148    | 1148    |                                                             |
| PU foam                              | 98,4    | 98,4    | 98,4    | 98,4    |                                                             |
| Tape                                 | 73,8    | 73,8    | 73,8    | 73,8    |                                                             |
| Cost of transport (Wholesaler to DC) | 0       | 0       | 0       | 0       | Consulted by RAJA, packaging wholesalers                    |
| Cost of storage                      | 0       | 0       | 0       | 0       |                                                             |
| Cost of return transport             | 0       | 0       | 0       | 0       | No return costs, as single-use packaging                    |
| Disposal costs                       | 75,95   | 75,95   | 75,95   | 75,95   |                                                             |
| Labour                               | 805     | 805     | 805     | 805     |                                                             |
|                                      | 2201,15 | 2201,15 | 2201,15 | 2201,15 | Average Dutch disposal costs - €155 per ton                 |
|                                      |         |         |         |         | Packaging costs; €35/h; Average packaging time is 2 minutes |

### Costs of reusable packaging

|                           | 2022  | 2023  | 2024  | 2025  |                                                                                    |
|---------------------------|-------|-------|-------|-------|------------------------------------------------------------------------------------|
| Reusable Packaging        |       |       |       |       |                                                                                    |
| Depreciation investment   | 1377  | 1377  | 1377  | 1377  | Packaging investment                                                               |
| Cost of transport         | 429   | 429   | 429   | 429   |                                                                                    |
| Cost of storage           | 210   | 210   | 210   | 210   | Restocking: Consulted by CEVA, KPN's logistic partner                              |
| Cost of forward transport | 423,8 | 135,2 | 135,2 | 135,2 | Yearly storage price of a pallet; €105, 75 per pallet; (daily storage price; 0,29) |
| Cost of return transport  | 114,4 | 114,4 | 114,4 | 114,4 | NOX return price per unit; €2,60; Every week there is one mechanic with shortage.  |
| Cost of disposal          | 0     | 0     | 0     | 62    | NOX return price per unit; €2,20; Every week there is one mechanic with surplus.   |
| Labour                    | 980   | 980   | 980   | 980   | Average Dutch disposal costs - €155 per ton                                        |
|                           | 3.534 | 3.246 | 3.246 | 3.308 | Packaging costs; €35/h; Reusable packaging is 15% quicker                          |

| Total Costs to produce 270 reusables |       |      |      |      |                                                         |
|--------------------------------------|-------|------|------|------|---------------------------------------------------------|
| Investment of €5.500 based on:       | 2022  | 2023 | 2024 | 2025 |                                                         |
| Cost of packaging material           | 2268  | 0    | 0    | 0    | Consulted by Saskia Markx, production & material expert |
| Outer PP                             | 486   | 0    | 0    | 0    |                                                         |
| Protective plate PP                  | 216   | 0    | 0    | 0    |                                                         |
| Inner protection PP                  | 756   | 0    | 0    | 0    |                                                         |
| Other (buckles, velcro, belts)       | 810   | 0    | 0    | 0    | Consulted by Momapack, foam specialists                 |
| Manufacturing                        | 3240  | 0    | 0    | 0    |                                                         |
| Total investment:                    | 5.508 | 0    | 0    | 0    | Consulted by Saskia Markx, production & material expert |

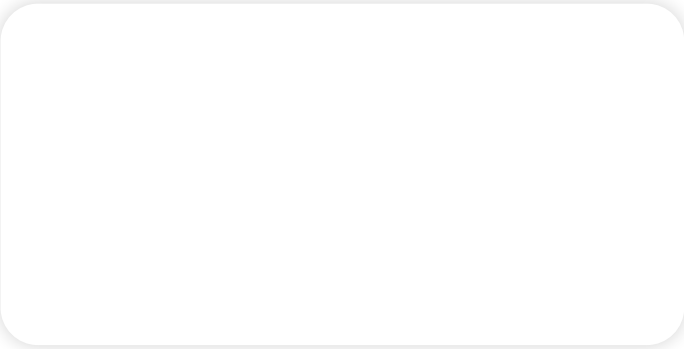
## 6.2.2 Indirect cost savings

However, it's not all about material and transport costs. As was found in the research, applying reusable packaging correctly could lead to a decrease in product damage and return times. As more capital is in the electronics than in its packaging, this could lead to a serious cost saving in the operation of KPN. How much this could be is estimated below.

Last year, the VPN service returned a total of ±1500 Company A devices to Company D. The average cost of a Company A device is €760. The data from Company D (the refurbishment partner) shows that ±5% cannot be reused due to damage, and will therefore be recycled. This totals to an amount of ±80 devices. The research also showed that the incorrect use of packaging could be a legitimate cause of this damage. It is estimated that a modest ±5% of this amount could be prevented by applying the right packaging.

This shows that reusable packaging could potentially prevent 4 devic-

## 6.2.3 Total costs structure



## 6.2.4 Value proposition

But, it's not only about the direct expenses. Reusable packaging brings other cost savings and indirect values to the table.

### A 'sustainable business card'

Just as the sim cards made from recycled fridges, a reusable packaging can be a 'sustainable business card' for KPN. As it's a visible and tangible product that makes circularity easy to understand, it can improve KPN's sustainable image with the client. With quotes of CO2 savings for example, the client will get a direct impression when he or she gets in contact with packaging.

Besides making an impact on the client, it could also build stronger relations with partners and suppliers as it can be shared and co-developed. Besides that, it's in line with the ambition to introduce 10-20 circular products by 2025.

### Increase independency

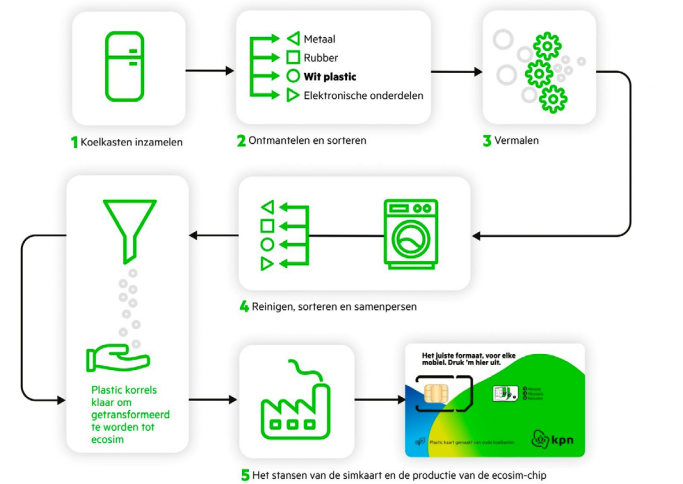
In the last year, cardboard prices and delivery times have doubled. It is not unthinkable that in the future, resources will be so scarce and expensive, the suppliers cannot provide any single-use packaging anymore. This could lead to a halt of KPN's operation, which directly leads to serious losses. With reusable packaging, KPN becomes more independent of suppliers, reducing the risk of shortages.

### Costs will only rise

Due to rising resource prices, rising waste tax and changing regulation, it will only become more expensive and difficult to generate waste in the future. It's time to change.

### Rising morale

As a big, leading company in our country, we must give an example. We simply cannot keep polluting our country and say that 'it's ok'.



Figuur 49 Another circular KPN product that has a great story



# 6.3 Life-cycle assessment

In an LCA estimation, the CO2 footprint of the reusable packaging is compared to that of the single-use box that's currently used. For these calculations, the most recent IDEMAT LCA calculator was used. Ecolnvent was used as the main source for data on eco-intensity. The extensive calculation can be found in appendix 9.

- The following assumptions were made regarding these calculations:
- A return rate of 90%, which means a packaging would disappear after 10 use-cycles. This is an average number, looking at other examples from the industry. The functional unit in the LCA is therefore; "Protecting and transporting 10 Company A devices".
  - Sourcing, production, transport, use and end-of-life were taken into consideration.
  - Manufacturing of both products is done in China.
  - An average uncertainty of 30%

In appendix 9, the comprehensive version of the calculation can be found. What's important to note is that these calculations are rather a detailed estimation, than cold-hard facts.

## 6.3.1 Results

When the reusable packaging is compared to single-use packaging at a 90% return rate, the following footprints were calculated. To package 10 Company A routers with single-use packaging, the total impact would be around 12.4 kg of CO2 (figure 50). However, packaging 10 Company A routers with reusable packaging would result in 4.84 kg of CO2. (figure 51) This means that the reusable packaging could potentially save around 60% of CO2 emissions.

With the LCA charts, it is clearly shown that the impact lays at the materials & manufacturing. The end-of-life also shows to have some impact on the footprint. Transport is almost negligible.

## 6.3.2 Break-even

When their total impact is compared, a break-even point is reached between 4 and 7 use-cycles. This means that the product should (at least) last 7 use cycles to make an impact.

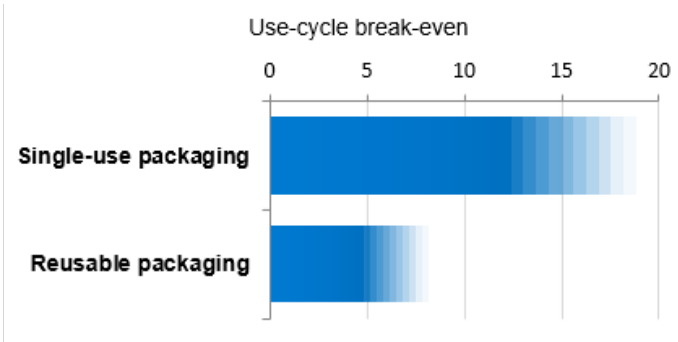


Figure 49 Break-even point of reusable packaging

## Impact of single-use packaging

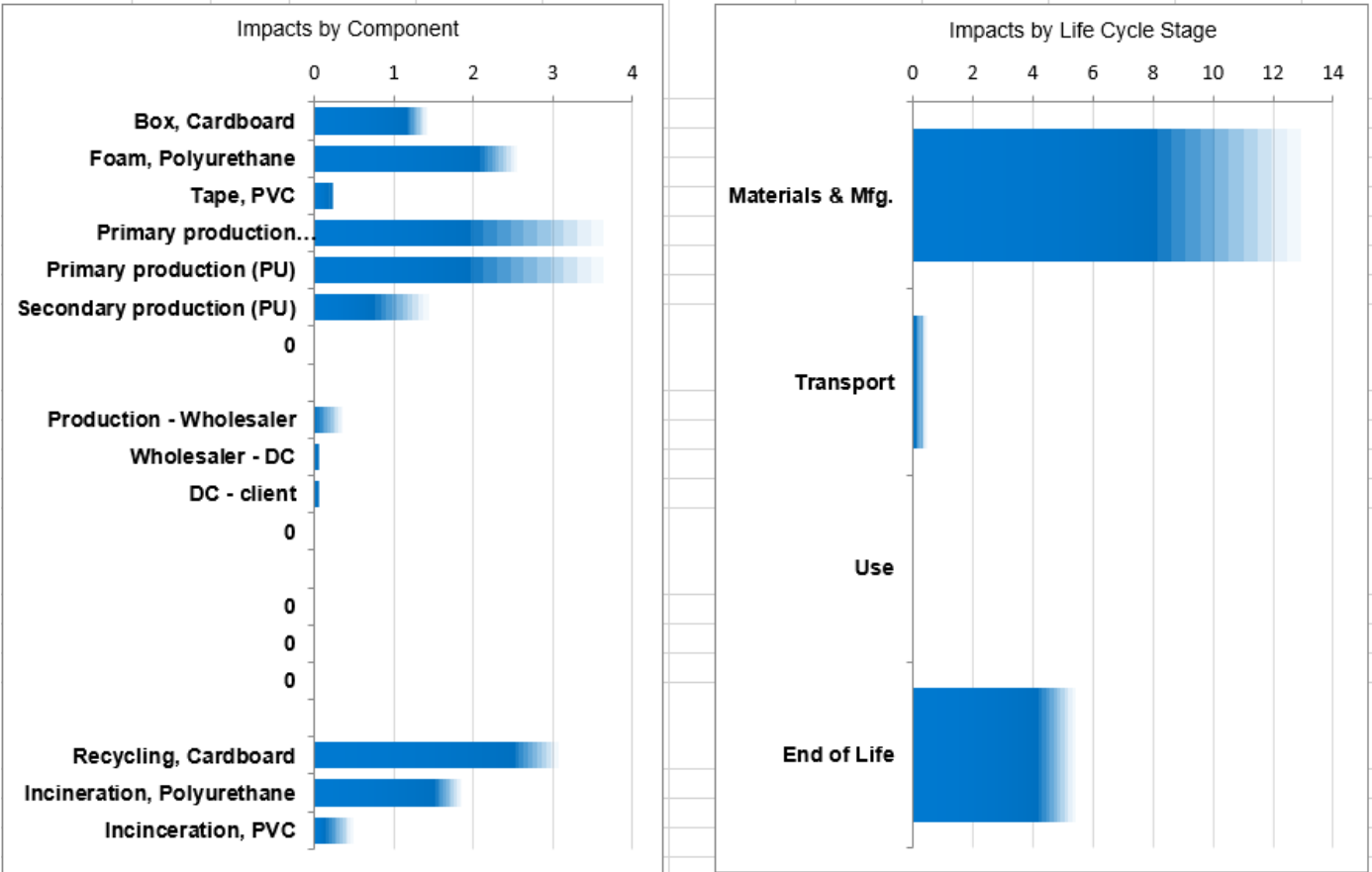


Figure 50 Environmental footprint of the current, single-use packaging approach.

## Impact of reusable packaging

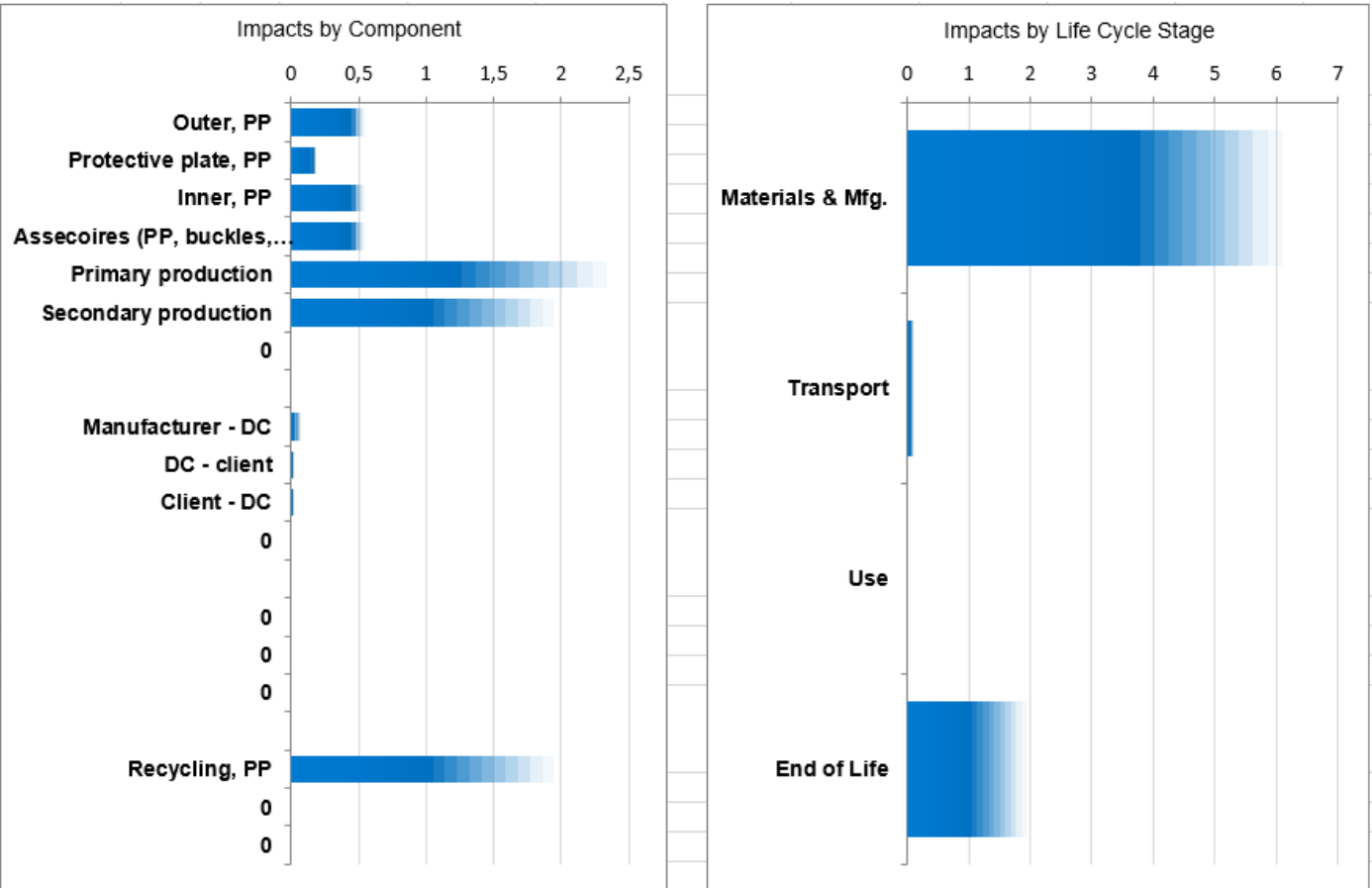


Figure 51 Environmental footprint of the reusable packaging approach.



# 6.4 Key insights & conclusions

By ‘releasing’ the concept in KPN’s VPN service, the following insights and conclusions were found. These results are a validation of the reusable packaging concept and a stepping stone towards a redesign and recommendation for next steps

### 7.4.1 Testing the logistic system in real life

One of the main goals of the pilot was to test and verify the existing logistic processes on their resistance and suitability for a returnable packaging concept. Apart from a few flaws, it can be concluded that the logistic system passed the test. The reusable packaging successfully made a trip to the client and back using all existing processes. Along the way, the packaging was registered in the inventory system of KPN, it was successfully scanned and sorted by multiple automatic and manual sorting systems, it was transported by automatic conveyor belt systems and delivered to the right addresses in a total of six shipments.

A flaw that occurred along the way was the application of an incorrect return sticker. The mechanic has the choice between two different return addresses, accompanied with two different return stickers (white and yellow). Normally, the mechanic sticks one of the two at random on the return consignment. In the pilot plan, the empty packaging must be returned to Company B using the white sticker. Unawarely, the mechanic applied the yellow sticker, which was bound for a different partner of KPN. This led to the packaging being sent to the wrong end station. Eventually, the reusable packaging was found back and returned to the right address.

This error does not mean the whole system doesn’t work. Quite the opposite in fact; it still showed the empty reusable packaging was delivered to the right adres, it was only the wrongly indicated. This flaw could be solved by better informing the mechanic on which stickers he must apply to the packaging. Another solution is to involve the other recipient address, which is refurbishment partner Drake & Farrell, to also start using the reusable packaging.

### 7.4.2 Testing the workflow in real life

From the observation during the pilot, the workflow is improved in two ways. Firstly, the packaging time is reduced by an average of 15%. When conducting the pilot with a larger batch size, this number could be different, but the packaging employees agreed on this improvement. Secondly, the mechanic does not have to get rid of packaging waste anymore. In a normal situation, he collects packaging waste over the week and disposes of it at a KPN warehouse. This trip takes 10 to 15 minutes on average. With a reusable packaging, a bulk of ‘waste’ in the mechanic’s car and the weekly trip to the recycling site could be avoided, saving time, space and frustration.

On the flip side, the mechanic sometimes found it hard to grasp and understand the concept of the reusable packaging. Especially the idea to keep multiple reusables stored in his bus to be directly used for the return of devices. His bus is often packed and unorganised, so there’s no room for reusable packaging. In his opinion, the current forward and return process is working relatively fine, so why change it? This shows that at further implementation, the mechanic needs more attention and participation in the design process, as he goes through the biggest behaviour change.

### 7.4.3 Testing the product in real life

As a result of the pilot, the main flaws of the prototype are; it’s durability, instability, a lack of adherence for stickers and the risk of clogging up the automatic sorting system. Already after the first stage, the seams of the reusable packaging started to tear. This is an obvious production mistake, which is caused by the inexperience of the manufacturer (me). To ensure the requirement of 20 use-cycles, the production and material quality must therefore be higher. Secondly, due to the soft foam protection on the inside, the packaging becomes wobbly when heavy objects are stacked on top. To ensure stability during transport, the overall stiffness of the packaging must be higher without losing it’s protection. Thirdly, during the pilot a total of 7 different stickers were applied to the packaging, which were all essential throughout the logistic process. The current exterior of the packaging is too slippery and flexible for the stickers to stick well. To solve this, a special ‘sticker area’ was added to one side of the packaging. This worked well, as stickers stayed on well and it functioned as a usecue. Yet, this was only on one side, which was not enough to cover all 7 stickers. To provide enough sticker space, the ‘sticker area’ must be extended to all sides of the packaging. Lastly, the handles that are applied to the packaging stick out too much and cause a risk of clogging up the automatic sorting system. As the mechanic did really like the handles, they mustn’t be removed, but rather redesigned or reduced in size.



Figuur 52 F.I.t.r. the flaws with protection, stackability, stickers coming off and the risk of getting stuck behind something.

### 7.4.5 The business case

The overall business case of the reusable packaging shows to be profitable and positive. This business case consists of three parts; the direct packaging costs, the indirects costs savings due potential reduction in product damage and lastly, the more intangible benefits like public image.

As predicted, the direct packaging costs will not be profitable. In the current calculations, the yearly costs of a reusable packaging lay ±€1300 higher compared to single-use packaging. The current volumes are simply too low, which is mainly reflected in the logistic cost of reusable packaging. However, the cost of the packaging is compensated by the reduction in product damage the reusable packaging could enable. With consultation from KPN, it is predicted that the introduction of the reusable packaging can prevent 5% of the current product damage. In the VPN service, this could result in 4 devices a year, or €3040.

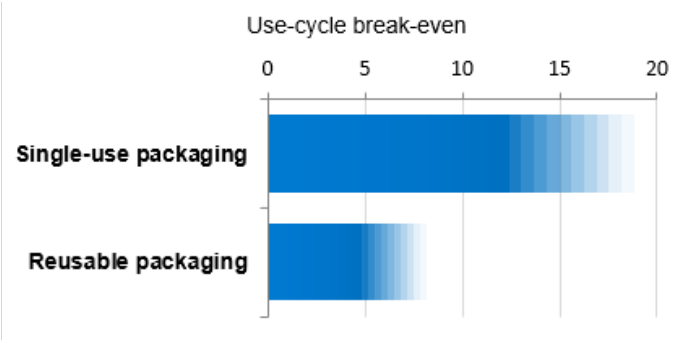
This would mean that KPN could save a potential ±€1700 euro by introduction reusable packaging.

- But, it’s not only about the direct expenses. Reusable packaging also brings other indirect values to the table.
- Packaging is an excellent ‘sustainable business card’ for KPN. As it’s a visible and tangible product that makes circularity easy to understand, it can improve KPN’s sustainable image with the client. Besides making an impact on the client, it could also build stronger relations with partners and suppliers as it can be shared and co-developed. Besides that, it’s in line with the ambition to introduce 10-20 circular products by 2025.
  - The packaging not only increases public visibility, but also visibility in the supply chain. As distribution centres process enormous amounts of anonymous, monotone brown boxes, once in a while one gets lost. This can lead to delay or even total disappearance. By making the packaging more recognizable, among all the cardboard, the risk of delay or disappearance can be reduced.
  - Lastly; increasing independence of suppliers. In the last year, the cardboard price and delivery times have doubled. In the future, this will only get worse, with a rising risk of a halt in production due to a shortage of packaging. With a reusable solution, this dependency could be decreased.

### 7.4.5 The environmental impact

With a life-cycle assessment, it was calculated that at a return rate of 90%, a reusable packaging could save around 60% of CO2 compared to the current single-use packaging. In a lifetime this would save around 7.6KG of CO2 per reusable packaging, with a break-even point between 4 to 7 trips.

Therefore, it’s important that the packaging is durable enough to last (at least) 7 use-cycles, otherwise it will not be environmentally profitable. A big challenge in this is the return rate. It is estimated that the current return rate will be around 90%, which would mean the packaging will last for ±10 use-cycles. Looking at examples from the industry, it is possible that this return rate will drop below 85%. This would mean the minimum of 7 use-cycles will not be reached and the product will not compensate in terms of CO2. It is important for KPN to oversee this return rate, or even find ways to actively monitor this with IoT for example.



Figuur 54 Break-even point of reusable packaging

|                             | 2022  | 2023  | 2024  | 2025  |
|-----------------------------|-------|-------|-------|-------|
| Netto packaging costs       | -1300 | -1300 | -1300 | -1300 |
| Reduction in product damage | +3040 | +3040 | +3040 | +3040 |
| Total                       | +1740 | +1740 | +1740 | +1740 |

Figuur 53 Total cost savings of reusable packaging in VPN service



# 7.

# Concluding

The final  
verdict

In this chapter, the findings from the research and pilot are reflected upon. In the discussion, the key findings are summarised where the successes and shortcomings are evaluated. These evaluated findings resulted in a list of recommendations for KPN when it comes to reusable packaging and its logistics. The recommendations regarding the product are physically implemented by developing a final showcase product. This is followed by the next steps, in which two potential and realistic scenarios are proposed for further scaling up the concept. To officially finish this report, a reflection is written in which I look back at my personal development and struggles as a designer and a person.



# 7.1 Discussion

**This project shows a successful proof of concept and a first stepping stone towards the implementation of a zero-waste, reusable packaging approach for KPN. With a small-scale, technical implementation of this concept, it was shown that reusable packaging has the potential to not only reduce packaging waste, but also increase the workflow of involved stakeholders, improve the return logistics of electronics and therefore also reduce costs. This resulted in a positive and profitable business case for further development of this concept.**

However, as the concept of reusable packaging was completely new to KPN, this project was only validated on a small scale, in only one of KPN's business-to-business services. Even though this is a logical and important step towards further implementation of the concept, the results of this small-scale pilot are only an indication of the functionality and impact of the reusable packaging.

### Logistics

One the main aims of the project was to test if KPN's logistic system is capable of distributing reusable packaging. By testing the forward and re-turn distribution during a pilot, it was successfully demonstrated that one of KPN's business services (VPN) is logistically suited for the implementation of a reusable packaging approach. For now, it was also found that it's most effective for KPN to focus on the redeployment of refurbished electronics, as the logistics show a better fit for reusable packaging. In contrast to the supply of new equipment (often coming from Asia), KPN's operation of refurbished devices have short, internal logistic lines, well established communication with partners and an existing return process, which all benefit the implementation of reusable packaging. However, this validation was only done in one service of KPN, which has relatively low volumes and therefore does not reach full potential. The other business services of KPN show similarities in logistics, but it is difficult to make a validation statement as nothing was tested in real life.

The pilot also showed that the current return logistics of KPN show some difficulties due to the unavailability or improper use of packaging. In turn, this leads to product damage, an increased turnaround time of electronics and unclarity in the return process. An unexpected result is that providing the proper reusable packaging solution could potentially solve these problems. Only in the VPN service, it was estimated that approximately €3000 of yearly product damage could be prevented by introducing reusable packaging. This rather indirect result also brings the most valuable benefit of the reusable packaging to the table; enabling a better circularity for electronics.

To improve the hindered return process, the proper packaging must be supplied at the right time and location. A proposal on how this can be achieved is with a distribution concept that revolves around the mechanic, as he is the initiator of the return process (the mechanic-centred system architecture). In this system, the mechanic will act as the orchestrator of the packaging, as he receives, stores and returns the supply from his working vehicle. By ensuring a stockpile of empty packaging at mechanics' premises at all times, he can always return his electronics with proper packaging that communicates and encourages the desired return guidelines. The supply of reusable packaging can be managed with the existing, automatic stock system the mechanics currently use. Because logistics manifest themselves at scale, it was not yet possible to actually test this system in real life, which leaves it at a conceptual level.

### Interaction

The biggest challenge in this distribution concept is the adaption of the mechanic, as he is the centre of distribution. The research has shown that mechanics aren't a fan of storing an extra product in their often packed and cramped working vehicle. Size of the packaging plays a big role in

this consideration. However, the reusable packaging has also shown to improve the mechanic's daily workflow, as it reduces his weekly trip to a disposal location and prevents de-installed electronics to pile up in his bus, creating more space. These two known frustrations could be used to nudge the acceptance of the mechanics.

Another challenge is the manufacturer, or the refurbishment partner. From their perspective, two features are important; packaging efficiency and storage efficiency. The research has shown that the packaging time could be decreased by 15%. Especially at a larger scale, this impact is significant. With the design that was used in the pilot, the desired storage efficiency was not achieved. The size of the empty packaging was simply too big, and the storage facility at the manufacturer too small to store larger amounts of packaging.

### Product

With insight from analysing KPN's operation and stakeholders, a physical prototype packaging was developed to be tested in the pilot. For the design, a 'messenger bag' packaging was chosen, as it is durable, relatively cheap, size efficient and an already known, and valued concept among mechanics and the refurbishment partner. The pilot turned out that the soft, foldable bag does not offer enough protection for the rough delivery process. Even though the design is durable and the device arrived safely and undamaged, the flexible bag does not absorb enough impact and leaves too much risk for damage. Additionally, because the flexible bag can be easily pushed in, it is not stable and protective enough when being stacked during transport.

A functionality of reusable packaging that did turn out positive was the reduction of packaging waste. Introducing a reusable packaging solution only to the VPN service could already reduce a potential 600kg of single-use cardboard and plastic. Apart from the waste tax and legislation, this could further decrease dependency on packaging suppliers who are also facing rising shortages in resources.

Important in retaining the environmental impact of this waste reduction is to follow the circular principles during the design. An approach in this was to make the packaging mono-material (polypropylene) to allow 100% recyclability. This turned out to be more difficult as the inside protection and SwapLabels could not comply with this requirement, as the mono-material version did not exist or did not perform well. Still, with an LCA, it was found that after 4 to 7 use-cycles, the reusable packaging finds a CO2 break-even compared to single-use packaging. One of the goals of this project was to design a 'fully circular' product, which was only partially achieved. It is not only about a positive CO2 impact, but also about allowing a better end-of-life and repairability for example. These topics need more care in further development.

Overall, the reusable packaging solution results in a positive and profitable business case for further development of this concept. Netto, KPN, needs to spend ±€1300 more on packaging materials and logistics. However, this amount is easily compensated by the potential reduction in product damage. This results in KPN saving a potential €1700 yearly with reusable packaging in the VPN service. Next to that, the packaging also brings other, non-monetary values to the table as it can act as a tangible and visible communicator of KPN's circular ambitions and act as a 'sustainable business card' to their clients and partners.

The LCA and business case is based on an assumption that's a known bottle-neck for reusable packaging; return rates. For now, a return rate of 90% was estimated (which is a B2B industry average), but this could turn out very different in practice. When these return rates go down by more than 15-20% (due to disappearance, theft, damage), it is difficult to still find environmental, and financial break-even.

# 7.2 Recommendations

**All the insights that were gained during the pilot led to a redesign of the product and its accompanying system. Besides the general recommendation, this section covers the three levels this project was subdivided in; logistics, interaction and product. A big part of the recommendations are incorporated in the final design, which can be found at the very begin of this report**

### General recommendation

Increase scale. As was already described, this project was only validated on a small scale, which is not representative for the large scale that KPN operates on. This leaves essential topics, like the logistic concept, still largely based on assumptions. By adding scale, this concept could react very differently and lead to a different design. In the next chapter, a large-scale pilot plan is described, in which this logistic concept and other features can be validated.

A limitation in scalability is that the logistic processes in B2B markets and B2C markets differ quite a bit. The logistic lines in the B2B market are often more robust and better controllable because they are built on regulations between companies and/or employees. In the B2C market, you can only ask or stimulate the return of the packaging, which often fails. So even though the impact might be in the B2C, from a logistic point of view, it is recommended to focus on the business market for now.

### Logistics

In this project, a logistic concept for reusable packaging is proposed, in which the distribution is built around the mechanic. This concept was not yet officially validated, as it manifests itself at large-scale. However, by analysing the current logistics of KPN, and conducting a small-scale pilot, the following two, more general recommendations are proposed:

- Create more clarity in current return process  
For a more efficient return time, the return address should either be centralised to one location (Company B) or the mechanic should be briefed better about which sticker goes one which parcel. Currently, there are two different return addresses and the mechanic is not informed well enough what the function of each sticker is. The reusable packaging could be an enabler for more clear return guidelines.

This problem came to light during the pilot. When the return orders wasn't picked up the first time (left on image 53), he applied the second, yellow return sticker (right on image 53). This lead the packaging to be send to the wrong address.



**Figuur 53** Unclearly with two different return addresses for one return shipment.

- Revise the 'mechanic-centred distribution system'  
A bottleneck of the concept is that the mechanic has to store and manage the packaging from his working vehicle. KPN's mechanics organisation recently introduced a logistic procedure where a cardboard box is automatically sent to the mechanic every time a de-installation order is booked in. This procedure can overlap with

the reusable packaging approach, and could solve this bottleneck.

- Introducing processes like this is more complex and time consuming than previously anticipated and therefore it could be smart to simultaneously integrate this in the distribution of the reusable packaging concept. This does not immediately mean that the mechanic-centred approach is dismissed, but it's an interesting option to look into for further developing and testing.

### Interaction

- Get rid of return stickers  
As previously described, there is a lack of clarity regarding the return stickers. Not only because it hinders the return process, but also the availability leads to frustration for the mechanic.

It seems like this problem could be solved fairly easily. As all Company A devices have to be returned to the same address, the return sticker could be added permanently to the reusable packaging. In the redesign, it's suggested to print these return credentials on the sticker area (see image FIXME). As a forward address sticker is applied to this sticker area, it covers the return sticker, which will then be invisible. When the packaging has to be initiated for return, the forward address sticker is simply removed, which makes the return sticker visible again

- Don't get rid of small functionalities  
They seem so trivial, but what was found during the pilot is that the mechanic loves small functionalities of the packaging, for example the two handles on both sides of the packaging. At first, this feature was dismissed by the delivery partner, because the risk of clogging up the system was too big. However, because it worked so well as a 'nudging mechanism' for the mechanic, it was redesigned and left on. With knowledge from Company C and Company B the handle is designed smaller and less sticking out, which minimises the risk of clogging up the distribution centres. Another unexpected feature that made the mechanic enthusiastic was the 'hip' and eye-catching appearance of the packaging. That's why in the redesign of the packaging, the graphics got extra attention to be spot on.



**Figuur 54** Don't underestimate small functionalities

### Product

During the pilot a prototype was tested on its functionality and suitability in the logistic system. With the insight from this testing round, these are the recommendations that lead to the final product. These improvements were all implemented in the final prototype, which is displayed in chapter 2.

- Protection  
One of the main findings of the pilot was the realisation that the prototype did not offer enough protection and stability as it's partially soft and flexible. In a redesign, it is recommended to add a more traditional, stiff container to ensure protection and safety. For further



Concluding

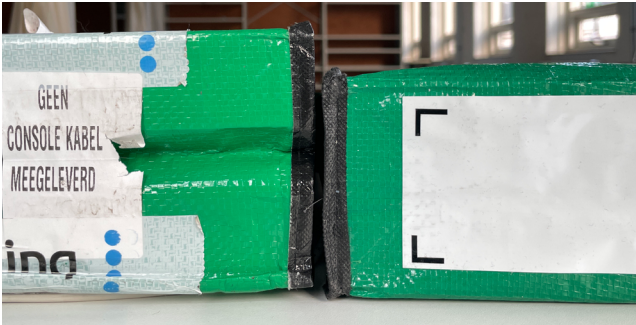
development, it is recommended to look into off-the-shelf packaging solutions that provide this boxy protection (more like a suitcase). In the next chapter, two examples are given.

In this project, the messenger bag will be continued and improved into a final product, as it remains very suitable to communicate the concept and explain the requirements.



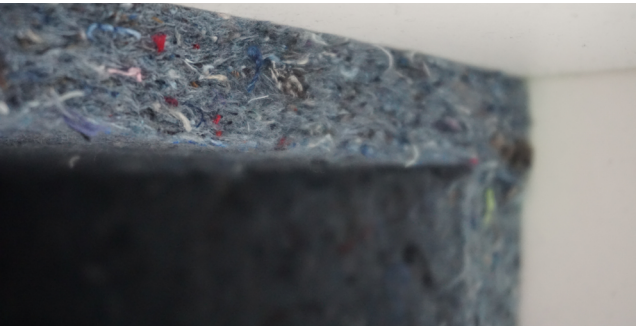
Figuur 55 The stiff, container that's applied to ensure protection.

- **Size**  
A second reason why the messenger bag was chosen was because it can be folded in slightly. With the final prototype design, it was found that this feature only increases a little bit of volume efficiency (10%), which is not significant enough to really make an impact. By adding the boxy structure to increase safety, this 'folding in' feature is abandoned. Instead, the packaging can be made 10% smaller, because less protective padding is needed.



Figuur 56 On the left the final prototype. On the right, the smaller improved product.

- **Materialisation**  
One of the goals of the project was to design a packaging with a fully circular approach. In materialisation this would mean a mono-material approach to ensure 100% recyclability. Therefore, most parts of the packaging are made of polypropylene, a cheap and widely available plastic. The biggest challenge in this approach was to find protective padding made of polypropylene. This turned out to be either too expensive, or not available, which led to an alternative material that does not comply with the mono-material approach  
  
In the redesign the inside padding is made from felt, produced with 80% recycled garments. The felt is not glued to the packaging, which makes it easy to disassemble before recycling. This felt has good enough properties to absorb the smaller impacts and prevent the device from scratching, while staying at a relatively low price point.



Figuur 57 The alternative padding

- **Durability**  
During the pilot, the prototype clearly showed the weak points of the packaging as certain parts, like seams and corners, already started to tear and wear. Durability is important as it ensures more use-cycles, but it also increases the acceptance of the concept as people tend to reject products that look beaten earlier. With help of a fashion and manufacturing expert, these weak points were reinforced in the final product.

Another reason for the damage was the low quality polypropylene liner that was used in the prototype. In the final design, a more heavy liner is used, with an additional coating which decreases the risk of tearing.

- **Sticker area's**  
In a forward and return trip, the packaging receives 5 to 7 stickers. After use, all these stickers must be removed properly to ensure a reuse. The prototype design did not offer enough sticker areas (SwapLabels) to provide for all these stickers. In the redesign, the packaging is provided with enough sticker areas, on the right locations, to offer space for all the needed stickers.



Figuur 57 Additional sticker areas on the most convenient places

- **Communication and recognizability.**  
In the redesign of the packaging the recognizability and brand communication should be improved. This is important for two reasons. Firstly, the packaging must be recognizable in the distribution centres and delivery processes to reduce the risk of losing it. Secondly, the packaging must act as a 'sustainable business card' for the client. In the final design, this is done by emphasising its reusable function, CO2 footprint and by clearly linking it to KPN.



Figuur 58 Communicating the circular ambitions of KPN



# 8.4 Personal Reflection

Not to become spiritual all of a sudden, but I think I found ‘my calling’ in life. At least for now. When I was a kid, I never could stick to toys, games, sports for a longer period of time. Also when growing up, I often dodged the question ‘what my hobbies were’, because I simply didn’t have an answer. I think finally I have the answer and it sounds very foolish; the design of packaging. I see a great challenge and noble mission in truly changing the way we produce, use, reuse and recycle our packaging. I think that’s what we desperately need; systems aren’t less bad, but truly different. I hope this project was the first of many to come.

But enough with the moral speeches. In the last six months, there was hardly a moment where I lost interest, motivation or confidence, which made this project feel like a hobby. This all makes sense, because this idea of reusable packaging had been in my head for a long time and what’s better than a chance to implement it in real life. Inevitably, these six months have changed me as a designer and a person. On four of these learnings, I would like to reflect.

## Reusable packaging in practice

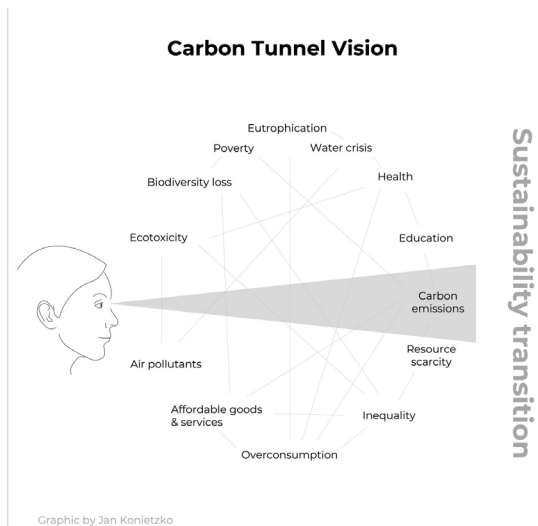
When starting, I was a little afraid that I would get stuck in between the complex logistic machine of a big corporate, people that wouldn’t believe in or understand this idea. Why would you do so much effort to reuse something so cheap? To my surprise, I found out quite the opposite. The people I talked to, ranging from mechanics to KPN executives, were very open minded towards ideas like this. I also found out that, at least at B2B companies, logistics are not as complex as people think. It’s just literally moving boxes back and forth, where often automated systems and existing return logistics are in place. Of course, there are some circumstances (like distance, product value, scale) that are heavily dependent for success, but I do see a bright future for reusable packaging. In the business segment, I don’t think it’s a lack of potential or mindset or resources that’s holding back these ideas but rather someone who is able to push them through. How badly do you want it?

I also learned that my positivity might be a little premature (maybe even close to naive?). The scale of this project was so small that the results sometimes feel like a miniscule tip of the iceberg. This also became the biggest challenge I came across as a designer: the impact of scale. Of course, you have to start small to ensure first validation and build a business case to convince managers. But scaling these ideas to realistic numbers is a completely different game. I learned that you constantly have to keep in mind where you want to go in 3, 4, 5 year and adapt your design strategy to this. This might also be a point of improvement for the IDE faculty; learn about the impact and strategy of scaling a product. In the end, the ‘industrial’ in industrial designer means scale. The level of thinking when it comes to 100 products is quite rational, as you can basically do what you like. But I ran into the step you have to make to reach 100.000, or even 1 million products. When you don’t keep the scalability in mind from the first moment you start designing, this step becomes complex, sometimes even impossible, because different concepts of manufacturing, logistics, finance, politics come into play. I think it would be good to teach our students how to do this in a more sustainable way.

Another thing that confronted me was the complexity of actually designing a ‘fully’ circular product. In theory, a lot is possible. But in practice, almost everything seems not manufacturable, affordable nor available at a larger scale. That’s why I think ‘fully circular’ is a term that is currently too ambitious to achieve in practice at a large scale. Circularity is such a layered concept, that you have to prioritise on which impact you want to make. And while we’re at it; why do we always prioritise CO2 impact? Of course it is a measurement that’s easy to understand, but I think every product has a different function and should therefore be focussed on

the footprint it leaves. This made me think of the story of Jan Konietzko about ‘Carbon Tunnel Vision’, which is well visualised below.

When developing the reusable packaging I had a tendency to focus too much on the actual principle of reuse, which embezzled the fact that the product also has a beginning (sourcing) and an end-of-life. To retain the impact of reuse, taking care of these aspects is essential.



Figuur 64 The Carbon Tunnel Vision by Jan Konietzko

## The game of the corporate world

This project was my first experience in a big corporate environment. What I started to learn here was the strategic (or political?) ‘game’ you have to play to push your ideas forward. I vividly remember a quote from Jeroen (my company mentor) who told me; ‘A good idea is worthless. It’s the people you gather around it that makes it valuable’. He was talking about my idea of course. In a large company like KPN, with so many people and so much stratification (read bureaucracy), you need to have a serious game plan. Who will make the final decision? How will you reach them? Who is going to be in your loyal ‘team’? Who will advocate your ideas? This is something you should literally write out in a timeline or roadmap or whatever. This ‘game plan’ is also a vital part in the scalability of a project (see chapter above). Having a truly circular design is cute, but if you’re not able to give it weight, it’s worthless. I now also realise that I was 2 or 3 months late in understanding this game. At first I did not like this at all, because it felt like nepotism and it was holding back my creativity as I constantly had to adapt to a business-oriented person. But now I understand this is an essential part in making a change. I actually started to enjoy it, as you literally feel your ideas become more valuable. At the end of the day, the impact is in the industry, and that’s what I want to do: ‘make an impact’, so I better have a good game plan ready.

I also realise that if you want to play this game, your design process will be different. Less autonome and more numbers. I experienced a serious shift from Adobe Illustrator, to Microsoft Excel. Sometimes it felt like I was mostly busy meeting people and making slides to convince them of my story, rather than putting more effort in making a very high-end design. This made me an efficient designer, who now thinks from a more business-oriented perspective.

## The way I work

As a designer, I am a ‘do-er’, and quite a practical one as well. On the contrary, this makes thinking on a very abstract level not my thing. However, this project really suited my designer traits, as it gave me the chance to

get away from my computer, do things with my hands and visit the more practical, ground jobs of KPN. In a previous meeting, this working style was briefly discussed, after which I promised to reflect on its origin and implications.

I think a ‘do-er’ mentality is mostly built by the practical experience you gain in the field, not at the faculty. When you start a (design) study, your comfort zone is small and safe. I think a practical education (like IDE) should stretch this comfort zone, by forcing you to get away from your computer and visit that farm where it smells like cow dung. Come one design student, that’s where it’s happening!!! I think it’s mad that you can graduate as a designer, which is a very practical job, with hardly gaining any practical experience. This excludes the aspiring design researchers of course, but that’s only a small part. Around me, I see a lot of fellow students who are constantly doubting about choices, not daring to fail etc. I think that’s caused by a lack of real world experience. Of course, an internship is good, but I don’t think that’s enough. It’s a curious mentality that’s built by doing and enjoying the things you find scary. I’d rather fail ten times, get two people angry and get a lot of feedback, then safely work out a product in detail from my student room and fail once. I’ve learned that the emotion of failure is intense, but short. The emotion of regret however is nagging and irritating, like a headache. That’s why you should always choose failure over regret. That’s what’s at the foundation of every do-er mentality; not failing to do anything wrong.

What’s harder to grasp is my personality, that also facilitates the ‘do-er’ mentality. I’ve always been an optimistic and energised person (perhaps close to naive) that does not see many obstacles. I am an easy talker, which makes connecting to people easy. The combination of these things make me quite confident and sure about my ideas. In turn, this confidence leads you to pick up the phone and start calling!!

This determination also made me realise something else. Sometimes you believe so much in a certain idea, you almost create your own new, mental world where this idea is real, regardless if it is correct or not. Maybe this is called ‘a vision’, but in Star Trek they called this a ‘Reality Distortion Field’. This happened a couple of times, where I assumed a little too easy and ignored the ‘cold hard validation’. I would not say this a bad thing to sometimes, because, especially in a complex corporate environment with a lot of people having their own agendas, this strategy keeps the direction and pace. But especially in the final stage, when the development of the Company A competition started, this became difficult, as the very sharp and business savvy consultants started to review the concept. Here you can’t get away with an anecdotal picture of an unpackaged Company A device, and claim it leads to product damage without being supported with hard quantitative facts. This criticism forced me to step outside of my reality distortion field and still validate the concept more in depth. I must say this added a lot of complexity (and some stress) to the final stage of this project, but eventually powered on the viability of this project.

I’ve also learned that this energy makes me more stubborn than I initially thought. When I have an idea, I rather not have too much interference from managers or colleagues, because it can obstruct my ideas. Of course, this is not a smart move, as you need other people to sharpen and validate the ideas, especially in a big corporate company. It is not that I have extremely avoided contact with colleagues because of this, but it sometimes felt like my communication towards my managers lacked or was inconsistent, leading them to lose interest. When reflecting on this with my managers, they did not feel the same though. However, this point directly refers to how you play ‘the game’ of the corporate world. Who do you have to keep satisfied, and how do you communicate this?

## The future

So what’s next? I’ve realised that I rather cope with the complexity of a big company so that I can ultimately make a big impact, then keeping it simple in a small-scale design environment. At least, for now. My optimistic character sees that we’re not too late to save the world, we just need the right people to work their ass off for this transition. I hope this does not sound arrogant, but I think the industry needs people like me who have the power and skills to do so. So that’s what I will do.

Like I said, I would like to continue to change the way we use and produce packaging. Luckily, by playing the right ‘game’, we’ve had the chance to show my reusable packaging ideas to multiple high-level managers at Company A. This gave the concept some weight and exposure to the decision makers. This led KPN to decide to hand in this project for a sustainability contest at Company A. In the coming months, I will stay at KPN to further develop the concept. Hopefully, the high-level meetings and/or award will expose the opportunity for me to scale-up this idea, because I am far from done with it!



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# Appen- dices

## IDE Master Graduation

### Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

#### ! USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT

Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

#### STUDENT DATA & MASTER PROGRAMME

Save this form according the format "IDE Master Graduation Project Brief\_familyname\_firstname\_studentnumber\_dd-mm-yyyy". Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !



family name van Alfen 5397  
initials C.M. given name Casper  
student number  
street & no.  
zipcode & city  
country  
phone  
email

Your master programme (only select the options that apply to you):

IDE master(s): ☒ IPD ☐ DFI ☐ SPD

2<sup>nd</sup> non-IDE master: \_\_\_\_\_

individual programme: - - (give date of approval)

honours programme: ☐ Honours Programme Master

specialisation / annotation: ☐ Medisign

☐ Tech. in Sustainable Design

☐ Entrepreneurship

#### SUPERVISORY TEAM \*\*

Fill in the required data for the supervisory team members. Please check the instructions on the right !

\*\* chair Conny Bakker dept. / section: SDE  
\*\* mentor Maurits Willemen dept. / section: DOS  
2<sup>nd</sup> mentor Jeroen Cox  
organisation: KPN  
city: Rotterdam country: Netherlands

comments  
(optional)

---

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v..



Second mentor only applies in case the assignment is hosted by an external organisation.



Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.

**APPROVAL PROJECT BRIEF**

To be filled in by the chair of the supervisory team.

chair Conny Bakkerdate 05 - 10 - 2021

signature

Digitally signed by  
Conny Bakker  
Date:  
2021.10.05  
11:16:54  
+02'00'

**CHECK STUDY PROGRESS**

To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair. The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: 30 ECOf which, taking the conditional requirements into account, can be part of the exam programme 30 EC

List of electives obtained before the third semester without approval of the BoE

☒ YES all 1<sup>st</sup> year master courses passed

☐ NO missing 1<sup>st</sup> year master courses are:
name J. J. de Bruindate 02 - 12 - 2021

signature

Digitally signed by J. J. de Bruin, SPA  
Date:  
2021.12.02  
10:20:11  
+01'00'

**FORMAL APPROVAL GRADUATION PROJECT**

To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked \*\*. Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

- Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?
- Is the level of the project challenging enough for a MSc IDE graduating student?
- Is the project expected to be doable within 100 working days/20 weeks?
- Does the composition of the supervisory team comply with the regulations and fit the assignment?

Content: ☒ APPROVED ☐ NOT APPROVEDProcedure: ☒ APPROVED ☐ NOT APPROVED

- the projectbrief has been submitted late (stayed with the secretariat accidentally)

comments

name Monique von Morgendate 06 - 12 - 2021

signature

Designing a circular packaging solution for KPN's business market

project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 14 - 09 - 202107 - 03 - 2022

end date

**INTRODUCTION \*\***

Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

KPN wants to accelerate their journey to become near 100% circular by 2025 and net zero emission by 2040. In the efforts to reduce their environmental impact, KPN wants to make use of as little packaging material as possible. The aim of this project is to reduce as much packaging waste as possible by designing a reusable packaging solution for Cisco network equipment used in the business market segment of KPN.

Packaging, in all its many forms, accounts for a big portion of all virgin paper and plastic material that is used globally. Worldwide, 50% of paper and 40% of all plastic produced annually is used for packaging, while packaging generally represents 36% of municipal solid waste[1,2]. In 2020, the Netherlands produced about 250.000 tons of packaging waste, of which around 78% was recycled [3,4]. While these rates are high compared to other EU countries, still a big portion of resources is discarded. Oftentimes, material recycling results in a product that has a lower quality or that's still partially discarded. The problem particularly lays with plastics. Only 40% of plastic packaging is recycled, and only a small portion of that ( $\pm 10\%$  of all plastic packaging) is recycled in a closed-loop, with the remainder being downcycled [4]. These problems, along with increased consumer awareness around (plastic) pollution on beaches and in oceans, have led to a gradual increase in a focus on new ways of packaging that prevent unnecessary resource extraction. Reusable packaging is one of them.

KPN, one of Netherlands leading telecom and internet providers, established a 'Circular Manifest' with their most important suppliers to work towards a fully circular chain. The manifesto aims at a 100% reusability and/or recyclability of all parts and raw materials used in their equipment. Cisco Systems, the manufacturer of their network equipment, is also part of the agreement. Additionally, Cisco itself formulated a list of goals for sustainable, zero waste packaging to work towards 100% circularity.

The reusable packaging solution will be made for the B2B market of KPN. Apart from consumer products, KPN also provides internet and telecom for medium- and large-sized companies in their business market segment. KPN offers three different services to their business customers (VPN, Premium Wifi and Secure Networking), which are all optional as a 'Network as a Service (NaaS)'. This means that KPN leases the equipment, software, installation and maintenance for a monthly fee to their client. The installation and maintenance is done by a subcontractor (VolkerWesselsTelecom or Allinq). When equipment is broken or obsolete, it is refurbished by Reconnext. In this process, the biggest part of the logistics and warehousing is outsourced to CEVA, a supply chain management specialist.

Sources:

[1] Ec.europa.eu. Municipal Waste Statistics - Statistics Explained.

[https://ec.europa.eu/eurostat/statistics-explained/index.php/Municipal\\_waste\\_statistics](https://ec.europa.eu/eurostat/statistics-explained/index.php/Municipal_waste_statistics)[2] Plasticseurope.org, 2018. Plastics – The Facts 2018 An Analysis Of European Plastics Production, Demand And Waste Data. [https://www.plasticseurope.org/application/files/6315/4510/9658/Plastics\\_the\\_facts\\_2018\\_AF\\_web.pdf](https://www.plasticseurope.org/application/files/6315/4510/9658/Plastics_the_facts_2018_AF_web.pdf)[3] Nedvang b.v., 2020. Recycling in Nederland, <https://www.nedvang.nl/recycling-nederland/>

[4] Rijksoverheid, 2021. Verpakkingen en Verpakkingsafval

<https://www.rijksoverheid.nl/onderwerpen/afval/verpakkingen-en-verpakkingsafval>

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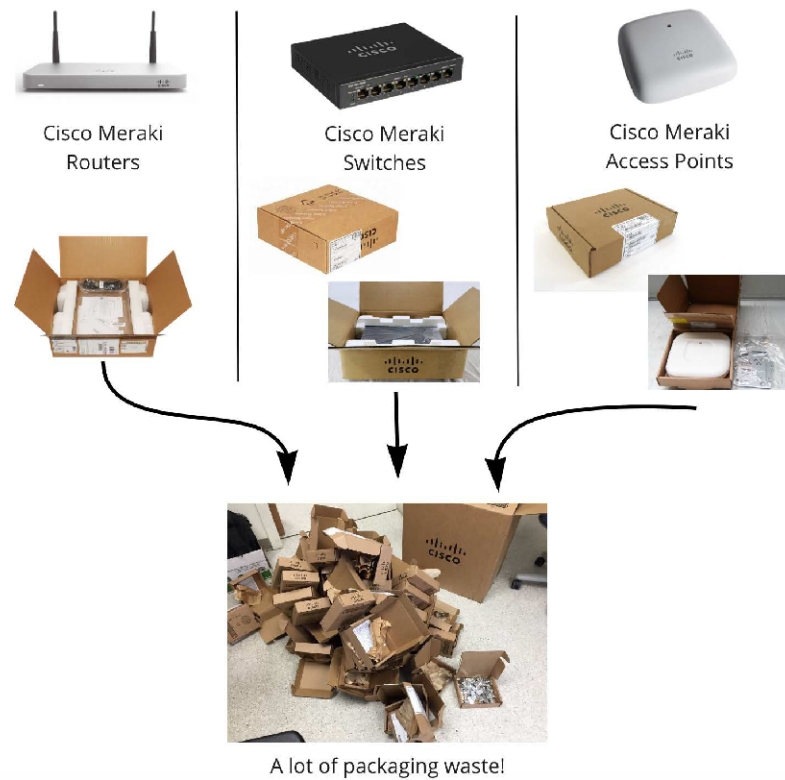


image / figure 1: Three common product categories in KPN's b2b market, including the corresponding packaging.

## PROBLEM DEFINITION \*\*

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

KPN wants to become a near 100% circular company by 2025, yet their products are still packaged in materials that are discarded after use. That's why KPN wants to look into options on how their equipment can be packaged in a fully circular way, focused on reusability.

A big challenge in this project is the logistics behind the packaging. KPN works with suppliers that all have a different, existing and optimized supply chain totally dedicated to the current single-use packaging. This refers to their mechanical packing process, but also the manual labour done by employees. Secondly, the current logistics and packaging are optimized for a linear delivery process, where the packaging is thrown away after use. With re-use, the packaging (with or without product) has to be returned to a distribution centre after installation. From there it's sent back to the supplier to be filled again or stored in a warehouse, waiting to be reused. Every step in this chain has a different stakeholder with different procedures and preferences. The packaging should balance in all these different systems, without compromising the operations of the supplier.

Apart from the logistic challenge, other sub-challenges are:

- Fit for different product types
- Financial viability of reusable packaging
- Acceptance among mechanics and other employees in the chain
- Usage of circular and/or recycled materials in packaging
- An easy to repair approach
- Ownership of the packaging

## ASSIGNMENT \*\*

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... . In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

I aim to deliver a durable and reusable packaging solution to replace the current single-use packaging that's used for networking equipment in one of KPN's services in the business market.

Since the concept of reusable packaging is new to KPN, this project should not only show what can be done within one product category, but also show the opportunities on what's possible in the future. The product should spark and inspire further development of reusable packaging within KPN. To make this more tangible, a physical pilot case with the packaging of internet routers will be conducted to test the functionality and feasibility of this packaging approach.

This packaging solution will be designed in a participatory way, constantly consulting and involving the suppliers and mechanics during the design process. The packaging solution should be designed in such a way that it fits in the distribution of suppliers and is optimized for a smooth return process. For the final product I aim to produce a 1:1 physical prototype that can be tested in the distribution of the supplier.

Apart from preventing the rejection of material, the aim is to design the packaging in a fully circular way as well. This means; the use of recycled materials, use of easy to recycle materials, a design that is easy to disassemble and repair

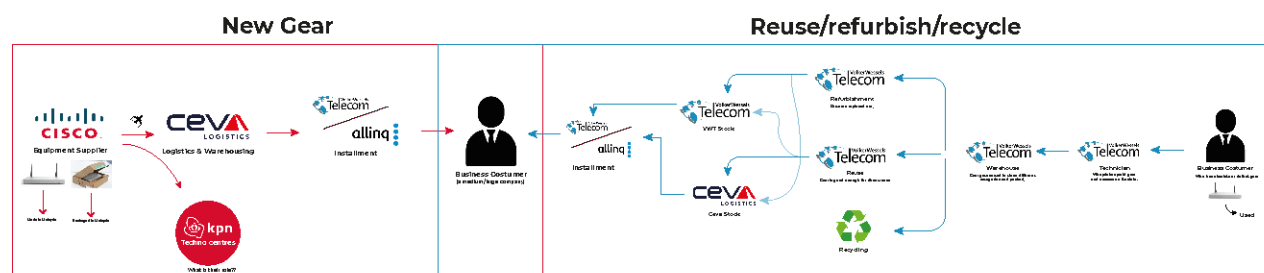
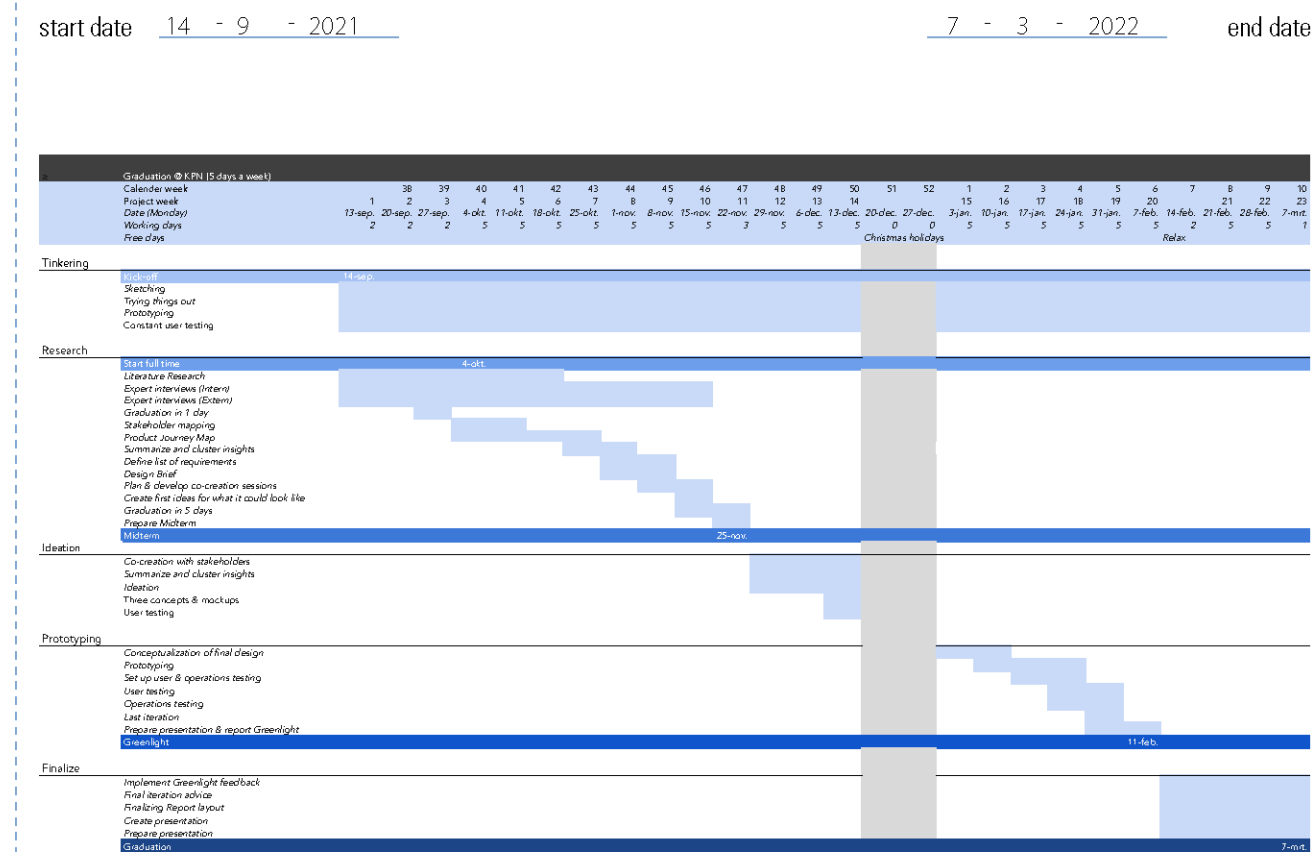


image / figure 2: The logistic journey of networking equipment in KPN's business market

## PLANNING AND APPROACH \*\*

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.



To build a structure around this project, the planning is made into a 'Gant chart'. This waterfall structure is only an indication of how the design process could look like.

As I know myself as a practical and experimental designer, the research and design is constantly intertwined. From the start, I like to start designing; put my ideas on paper, try out things or make small mockups. This way the research arises from designing and vice versa. I call this the 'Tinkering' fase, which will be spread out over the entire project.

A suggestion by one of the project coaches was the '1-10-100' method. With this method, I will run through the whole project in 1 day, 10 days and 100 days. The '1 day session' is a very rough pressure cooker, which will be done early on in the process. The '10 day session' is a more extended design cycle, where a brainstorm with stakeholders already is integrated. The '100 day session' obviously refers to the result at the end of the project term. I really like to work with pressure cooker sessions, so I will build this approach into the project.

To get a better understanding of how the packaging is currently used by all stakeholders, I planned to make a complete 'product journey map'. This will be done in the first part of the project, before the midterm. To get knowledge on the product journey, I will physically participate in the working day of a mechanic, but also visit a factory of Cisco and a distribution centre. With all this knowledge, I will not only get insight on the product, but also what the preferences of the stakeholders are.

I will work full-time throughout this project. To get some rest and set my mind straight in between, I will take two weeks off during Christmas and some additional days after big deadlines.

## MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... . Stick to no more than five ambitions.

The last couple of years, packaging design is something that grew into a fascination of mine. Especially the use and sustainability behind packaging is something that really grabbed me; two components that do not seem to live in harmony. Why does 95% of packaging turns into waste right after use? Why does it seem like sustainability is innovating in all other fields, but packaging stays behind? I started following initiatives that found ways to retain the value of packaging (like Pieter Pot) years before I actually found this graduation project. During that time, I worked as a student and freelance designer on packaging projects, exploring how this industry works and how sustainability (mostly regarding materials) is implemented. The question was still; how to make use and sustainability of packaging click? Sounds like a good case for a graduation project, I thought, so I contacted Picnic, Albert Heijn and some other companies. At that exact same time, this project became available at KPN. That could not be a coincidence, so I applied and got hired. To summarize; I feel very lucky and motivated to do a project that stands so close to my interest. How cool is it to realize an idea that's been in your head for years?

Another part that I find interesting about this project is the effort and importance KPN puts into the circular transition of their company, making them one of the sustainability pioneers in worldwides telecom. As one of Netherlands biggest companies, the impact they make is big. As I want to learn more about how circular product design works on a corporate level, this project is a perfect fit.

Thirdly, the project needs a hands-on and social approach, as the stakeholders play a vital role in the design decisions. To make a reusable packaging fit in all the existing systems of all parties involved, it requires high involvement and good communication from all sides. This social and connecting role is something that I feel comfortable in and something that I enjoy doing.

## FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.



## Appendix 2: article for CDL on '1-10-100' method.

Link to article:

<https://delftdesignlabs.org/news/almost-graduating-in-one-day-how-to-kick-start-your-graduation-project/>

### (Almost) Graduating in one day; how to kick-start your graduation project.

*by Casper van Alfen*

Starting your graduation project (or any project) can be fuzzy. You're often new to the context, to the people or even the complete topic. Ideally, you want to somehow upload this information as quickly to your brain as possible, so you can jump right into the project. Unfortunately, the human race is not (yet) advanced enough, so you need to find other ways to kick-start your project. Let me tell you about how I did it.

In October of this year, I started on the finale of my studying career. As I've always been into packaging design and sustainability, I went looking for something in this direction. Luckily, I found a great graduation project at KPN, where I got to design a reusable packaging solution for their business market. Both at KPN and the Circular Design Lab I was welcomed with open hands. But then... Where to start?

In one of the first meetings I had with my graduation chair Conny Bakker, the '1-10-100' method came up. A pressure cooker approach where you run through your graduation project in 1 day, 10 days and 100 days (which obviously is the completed project).

I decided to try it. I've always had good experience with pressure cooker sessions as you force yourself to be productive and decisive, while partially being unplugged from certainty, feasibility or prejudice. This creates a great environment for creativity and imagination.

So I invited the supervisory team (TU & KPN) over for the so-called 'project kick-off' on Tuesday. The day before would be the day of justice; graduating in one day. I booked a room with big whiteboards on all the walls (super important!), got a few good markers and paper to sketch on. I made a rough structure of how a design process looks like; start with framing the problem, write down the design challenge, go through some research, ideation, conceptualization and top it off with a prototype. I set a timer for every part ( $\pm 1$  hour) and took off.

As you start working, you get into a certain flow where you let loose of uncertainties and just write everything down how you interpret it at that moment. Slowly you fill all the whiteboards with an integral design process, drenched with assumptions. But that does not matter, because it's your first day ;)

The next day, the supervisory team came into a room that looked like it belonged to a crazy detective that was on the verge of solving a murder. Together we could literally walk past the whiteboard and through the design process. Because I showed my reasoning and perspective, we created a full understanding between each other and the project context within an hour. The ability to walk through a room, point things out and spontaneously dropping ideas, created a great energetic atmosphere that in turn led to a momentum in the project. There it was; the kick-start I was looking for.

Within a week, my manager at KPN arranged physical meetings with all the stakeholders in the project (and they were not few), which normally would already take one month to arrange yourself. All the assumptions that I took are simply questions to answer and all the concepts were interesting, but not something to fixate on.

Now, two months later, I am still turning assumptions into certainties, but my project is going very well. I am actually planning to do another 'one-day graduation' next week, which will be obviously completely different but just as valuable.

Appendix 10: Cost structure of 3 services.  
(scenario 1)

Single-use packaging

|                                      | 2022 | 2023 | 2024 | 2025 |                                          |
|--------------------------------------|------|------|------|------|------------------------------------------|
| Current packaging                    |      |      |      |      |                                          |
| Cost of packaging material           | 2898 | 2898 | 2898 | 2898 | Consulted by RAJA, packaging wholesalers |
| Cardboard box (60x30cm)              | 2520 | 2520 | 2520 | 2520 |                                          |
| PU foam                              | 216  | 216  | 216  | 216  |                                          |
| Tape                                 | 162  | 162  | 162  | 162  |                                          |
| Cost of transport (Wholesaler to DC) | 0    | 0    | 0    | 0    | Consulted by RAJA, packaging wholesalers |
| Cost of storage                      | 0    | 0    | 0    | 0    |                                          |
| Cost of return transport             | 0    | 0    | 0    | 0    | No return costs, as single-use packaging |
| Disposal costs                       | 186  | 186  | 186  | 186  |                                          |
| Labour                               | 1715 | 1715 | 1715 | 1715 | Average Dutch disposal costs per ton     |
|                                      | 4799 | 4799 | 4799 | 4799 |                                          |

Reusable packaging

|                           | 2022  | 2023  | 2024  | 2025  |                                                          |
|---------------------------|-------|-------|-------|-------|----------------------------------------------------------|
| Reusable Packaging        |       |       |       |       |                                                          |
| Depreciation investment   | 2142  | 2142  | 2142  | 2142  | Packaging investment, EoL packaging is depreciation time |
| Cost of transport         | 858   | 858   | 858   | 858   |                                                          |
| Cost of storage           | 420   | 420   | 420   | 420   | Consulted by CEVA, KPN's logistic partner                |
| Cost of forward transport | 572   | 286   | 286   | 286   | Consulted by NOX, KPN's delivery partner                 |
| Cost of return transport  | 242   | 242   | 242   | 242   | Consulted by NOX, KPN's delivery partner                 |
| Cost of disposal          | 0     | 0     | 0     | 155   | Consulted by NOX, KPN's delivery partner                 |
| Labour                    | 1.470 | 1.470 | 1.470 | 1.470 | Labour                                                   |
|                           | 5.704 | 5.418 | 5.418 | 5.573 |                                                          |

|                                |             |      |      |      |                                                         |
|--------------------------------|-------------|------|------|------|---------------------------------------------------------|
| Investment of €8600 based on:  | Total Costs |      |      |      |                                                         |
|                                | 2022        | 2023 | 2024 | 2025 |                                                         |
| Cost of packaging material     | 3528        | 0    | 0    | 0    | Consulted by Saskia Markx, production & material expert |
| Outer PP                       | 756         | 0    | 0    | 0    |                                                         |
| Protective plate PP            | 336         | 0    | 0    | 0    |                                                         |
| Inner protection PP            | 1176        | 0    | 0    | 0    |                                                         |
| Other (buckles, velcro, belts) | 1260        | 0    | 0    | 0    | Consulted by Momapack, foam specialists                 |
| Manufacturing                  | 5040        | 0    | 0    | 0    |                                                         |
| Total investment:              | 8.568       | 0    | 0    | 0    | Consulted by Saskia Markx, production & material expert |

Appendix 11: Cost structure of global approach  
(scenario 2)

|                                              | 2022   | 2023   | 2024   | 2025   |                                                                                                                                                                            | 2022   | 2023   | 2024   | 2025   |
|----------------------------------------------|--------|--------|--------|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|
| Current packaging                            |        |        |        |        |                                                                                                                                                                            |        |        |        |        |
| Cost of packaging material                   | 3739.4 | 3739.4 | 3739.4 | 3739.4 | Consulted by Cisco, packaging department<br>Consulted by RAJA, packaging wholesalers<br>Consulted by RAJA, packaging wholesalers                                           | 11.287 | 11.287 | 11.287 | 11.287 |
| Cardboard box (Cisco, custom high-end)       | 33861  | 33861  | 33861  | 33861  |                                                                                                                                                                            | 11.287 | 11.287 | 11.287 | 11.287 |
| Transport packaging (cardboard sleeve)       | 2257   | 2257   | 2257   | 2257   |                                                                                                                                                                            | 11.287 | 11.287 | 11.287 | 11.287 |
| Wooden pallet                                | 1275   | 1275   | 1275   | 1275   |                                                                                                                                                                            | 11.287 | 11.287 | 11.287 | 11.287 |
| Cost of transoceanic transport (China to NL) | 39730  | 39730  | 39730  | 39730  | Consulted by CEVA, KPN's logistic partner<br>Consulted by CEVA, KPN's logistic partner<br>No return costs, as single-use packaging<br>Average Dutch disposal costs per ton | 11.287 | 11.287 | 11.287 | 11.287 |
| Cost of inland transport                     | 686.4  | 686.4  | 6.44   | 3146   |                                                                                                                                                                            | 96     | 96     | 9      | 44     |
| Cost of storage                              | 840    | 840    | 840    | 840    |                                                                                                                                                                            | 8      | 8      | 8      | 8      |
| Cost of return transport                     | 0      | 0      | 0      | 0      |                                                                                                                                                                            | 0      | 0      | 0      | 0      |
| Disposal costs                               | 697.5  | 697.5  | 697.5  | 697.5  |                                                                                                                                                                            | 4.5    | 4.5    | 4.5    | 4.5    |
| Labour                                       | 3000   | 3000   | 3000   | 3000   |                                                                                                                                                                            | 40     | 40     | 40     | 40     |
| Total                                        | 81662  | 81662  | 81662  | 81662  |                                                                                                                                                                            |        |        |        |        |

|                                | 2022   | 2023   | 2024   | 2025   |                                                                                                                                                                                                                                   | 2022   | 2023   | 2024   | 2025   |
|--------------------------------|--------|--------|--------|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|
| Investment                     |        |        |        |        |                                                                                                                                                                                                                                   |        |        |        |        |
| Total investment               | 16.395 | 16.395 | 16.395 | 16.395 | Packaging investment, EoL packaging is depreciation time                                                                                                                                                                          | 1      | 1      | 1      | 1      |
| Bulk crate                     |        |        |        |        |                                                                                                                                                                                                                                   |        |        |        |        |
| Cost of storage                | 2100   | 2100   | 2100   | 2100   | Consulted by CEVA, KPN's logistic partner<br>Consulted by CEVA, KPN's logistic partner<br>Consulted by CEVA, KPN's logistic partner<br>Consulted by NOX, KPN's delivery partner<br>Average Dutch disposal costs per ton<br>Labour | 20     | 20     | 20     | 20     |
| Cost of transoceanic transport | 22461  | 22461  | 22461  | 22461  |                                                                                                                                                                                                                                   | 11.287 | 11.287 | 11.287 | 11.287 |
| Cost of inland transport       | 3146   | 3146   | 3146   | 3146   |                                                                                                                                                                                                                                   | 44     | 44     | 44     | 44     |
| Cost of return transport       | 4858   | 4858   | 4858   | 4858   |                                                                                                                                                                                                                                   | 480    | 480    | 480    | 480    |
| Cost of disposal               | 0      | 0      | 0      | 81     |                                                                                                                                                                                                                                   | 0      | 0      | 0      | 0.52   |
| Labour                         | 0      | 0      | 0      | 0      |                                                                                                                                                                                                                                   | 103    | 103    | 103    | 103    |
|                                | 32565  | 32565  | 32565  | 32645  |                                                                                                                                                                                                                                   |        |        |        |        |
| Primary packaging              |        |        |        |        |                                                                                                                                                                                                                                   |        |        |        |        |
| Cost of storage                | 420    | 420    | 420    | 420    | Consulted by CEVA, KPN's logistic partner<br>Consulted by NOX, KPN's delivery partner<br>Consulted by NOX, KPN's delivery partner<br>Average Dutch disposal costs per ton<br>Labour                                               | 4      | 4      | 4      | 4      |
| Cost of forward transport      | 0      | 0      | 0      | 0      |                                                                                                                                                                                                                                   | 0      | 0      | 0      | 0      |
| Cost of return transport       | 7365   | 7365   | 7365   | 7365   |                                                                                                                                                                                                                                   | 103    | 103    | 103    | 103    |
| Cost of disposal               | 0      | 0      | 0      | 263.5  |                                                                                                                                                                                                                                   | 0      | 0      | 0      | 1.7    |
| Labour                         | 13055  | 13055  | 13055  | 13055  |                                                                                                                                                                                                                                   | 373    | 373    | 373    | 373    |
|                                | 20840  | 20840  | 20840  | 21103  |                                                                                                                                                                                                                                   |        |        |        |        |

| 2022   | 2023   | 2024   | 2025   | 2022 | 2023 | 2024 | 2025 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------|--------|--------|--------|------|------|------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11.287 | 11.287 | 11.287 | 11.287 | 3    | 3    | 3    | 3    | Consulted by Chris Tindler, packaging designer @ Cisco<br>Cardboard cap and sleeve loading cases; 23.2 per full pallet; 115 devices per pallet<br>Used Europallet is 13 euro; 115 devices per pallet<br>Average shipping price of pallet from Shanghai to Rotterdam is 1405; 115 devices per pallet; On average 8 pallets per month<br>Pallet transport price from Rotterdam to CEVA: 71.50; 8 pallets per month<br>Yearly storage price of a pallet; 1105, daily storage price; 0,29 |
| 11.287 | 11.287 | 11.287 | 11.287 | 3    | 3    | 3    | 3    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 11.287 | 11.287 | 11.287 | 11.287 | 0.2  | 0.2  | 0.2  | 0.2  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 11.287 | 11.287 | 11.287 | 11.287 | 0.11 | 0.11 | 0.11 | 0.11 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 11.287 | 11.287 | 11.287 | 11.287 | 3.52 | 3.52 | 3.52 | 3.52 | Yearly storage price of a pallet; 1105, (daily storage price; 0,29)<br>Average shipping price of pallet from Shanghai to Rotterdam is 1405; 230 devices per pallet; On average 4 pallets per month<br>Pallet transport price from Rotterdam to CEVA: 71.50; 4 pallets per month<br>Average shipping price of pallet from Rotterdam to Shanghai is 1405; 40 boxes per pallet; one pallet shipment per month                                                                            |
| 96     | 96     | 9      | 44     | 71.5 | 71.5 | 71.5 | 71.5 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 8      | 8      | 8      | 8      | 105  | 105  | 105  | 105  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 0      | 0      | 0      | 0      | 0    | 0    | 0    | 0    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 4.5    | 4.5    | 4.5    | 4.5    | 155  | 155  | 155  | 155  | Packaging designer: 1751h;                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 40     | 40     | 40     | 40     | 75   | 75   | 75   | 75   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

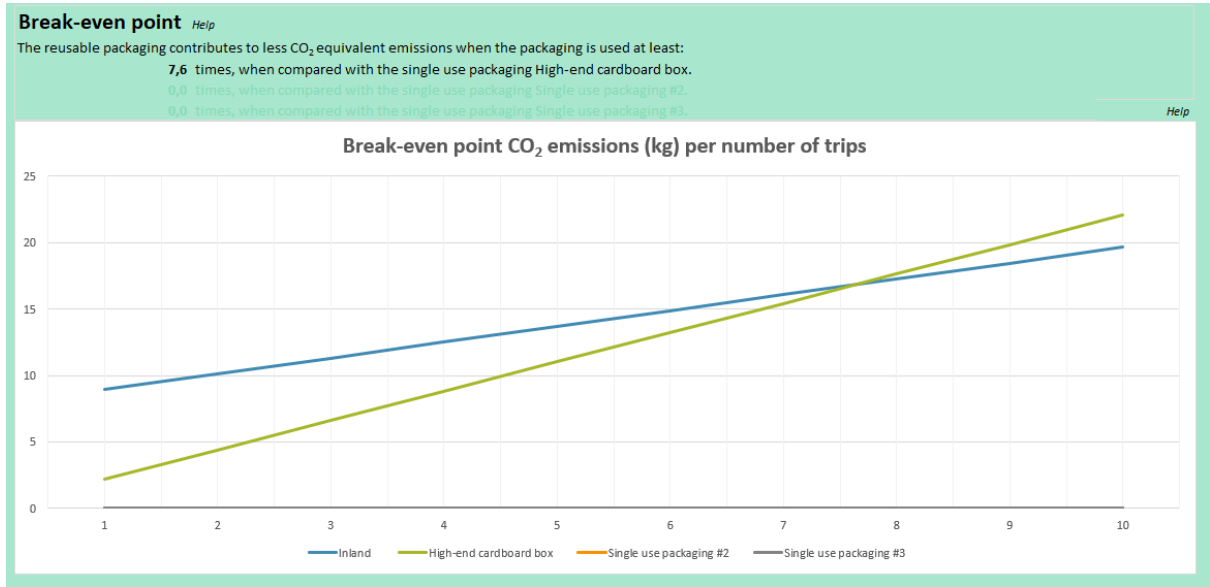
| 2022   | 2023   | 2024   | 2025   | 2022  | 2023  | 2024  | 2025  |                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------|--------|--------|--------|-------|-------|-------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | 1      | 1      | 1      | 1     | 1     | 1     | 1     |                                                                                                                                                                                                                                                                                                                                                                                                            |
| 20     | 20     | 20     | 20     | 105   | 105   | 105   | 105   | Yearly storage price of a pallet; 1105; (daily storage price; 0,29)<br>Average shipping price of pallet from Shanghai to Rotterdam is 1405; 230 devices per pallet; On average 4 pallets per month<br>Pallet transport price from Rotterdam to CEVA: 71.50; 4 pallets per month<br>Average shipping price of pallet from Rotterdam to Shanghai is 1405; 40 boxes per pallet; one pallet shipment per month |
| 11.287 | 11.287 | 11.287 | 11.287 | 199   | 199   | 199   | 199   |                                                                                                                                                                                                                                                                                                                                                                                                            |
| 44     | 44     | 44     | 44     | 71.5  | 71.5  | 71.5  | 71.5  |                                                                                                                                                                                                                                                                                                                                                                                                            |
| 480    | 480    | 480    | 480    | 10.12 | 10.12 | 10.12 | 10.12 |                                                                                                                                                                                                                                                                                                                                                                                                            |
| 0      | 0      | 0      | 0.52   | 155   | 155   | 155   | 155   |                                                                                                                                                                                                                                                                                                                                                                                                            |
| 103    | 103    | 103    | 103    |       |       |       |       |                                                                                                                                                                                                                                                                                                                                                                                                            |

|     |     |     |     |      |      |      |      |                                                                                                                                                                                                                                                                                                                                                                                      |
|-----|-----|-----|-----|------|------|------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4   | 4   | 4   | 4   | 105  | 105  | 105  | 105  | Yearly storage price of a pallet; 1105, 100 per pallet; (daily storage price; 0,29)<br>No forward transport costs, as subcontractors work from their own warehouse.<br>Collected in warehouse of sub-contractor; Returned in bulk, every two weeks; 430 every two weeks; 100 per pallet<br>Packaging costs; 1351h; transfer from bulk crate to primary packaging; 2 minutes per unit |
| 0   | 0   | 0   | 0   | 0    | 0    | 0    | 0    |                                                                                                                                                                                                                                                                                                                                                                                      |
| 103 | 103 | 103 | 103 | 71.5 | 71.5 | 71.5 | 71.5 |                                                                                                                                                                                                                                                                                                                                                                                      |
| 0   | 0   | 0   | 1.7 | 155  | 155  | 155  | 155  |                                                                                                                                                                                                                                                                                                                                                                                      |
| 373 | 373 | 373 | 373 | 35   | 35   | 35   | 35   |                                                                                                                                                                                                                                                                                                                                                                                      |



# Appendix 12: LCA of global approach

## Overseas bulk-crate



## Inland box

