



CircBrief

Electronics and circular economy

Jáchym Judl, Susanna Horn and Kaarina Kaminen
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circwaste.fi/en-us



@judlj

Jáchym Judl, SYKE 1.10.2021

Structure of a CircBrief

Environmental impacts and consumption of primary raw materials can be reduced by extending products' lifespans and decreasing consumption.

Electronics and circular economy

- Approximately 2 million smartphones, 400,000 smart TV sets, over 300,000 personal computers and hundreds of thousands of other electronic devices are being sold annually in Finland. Their active lifetimes are short.
- Electronic products contain a wide variety of materials, incl. specialty metals, critical materials, and conflict minerals. Their value chains are global, complex and cause a wide range of impacts.
- The material composition, their origins and the overall environmental impacts of electronic products remain largely unknown. Transparency must increase to improve value chain sustainability.
- The material complexity of electronics causes challenges in recycling. For more efficient recycling, a stable flow of electronic waste is necessary.
- Organisational layers, such as companies, public agencies or municipalities are a strong purchasing power. Through purchasing criteria, they can promote more sustainable practices.

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Life cycle of an electronic product

Common electronics are mobile phones, computers and televisions. They are typically used for communications and entertainment purposes, as well as for work. New products are more affordable than ever before, and new features are introduced at a high pace. Rising market demands and short life cycles increase the sales volume steadily. Growing consumption of products of high material complexity increases the demand for primary raw materials, as recycling remains underdeveloped.

Product development and design
Environmental impacts are determined already during the design phase. Besides aesthetic, design defines functionality, technical specifications, selection of materials and components, its use energy consumption, durability, reparability, and recyclability. Design determines the software support and usability. Design decisions are driven by consumer preferences, business strategy, value chains as well as for regulations and legislations.

Raw materials
Electronics contain a wide variety of materials, especially metals, some classified as rare earth metals or conflict minerals. Their mining is associated with social issues and environmental degradation. Geological deposits of some of the key primary raw materials in electronics are very local, causing supply security risks. The transparency of supply chains and due diligence need to improve to support informed decision making.

Manufacturing
Knowledge about environmental impact of manufacturing is limited. Rapid technological development and short product cycles make any assessment, from identical. Unfavourable working conditions, insufficient environmental protection and a lack of transparency have raised concerns in countries where electronic products are made. Energy use in manufacturing processes remains carbon intensive. This, together with increasing consumption, compicates for manufacturers to achieve sufficient efficiency.

Use phase
Electronic products are powerful and sophisticated devices that require electricity to operate. Growing screen sizes and computation power increase energy consumption of devices.
Despite their sophistication, the lifespan of electronic products is often short. Limited reparability and availability of spare parts are issues leading to repair. Products, as software obsolescence. Modern electronic products are often connected devices and generally use software algorithms. Functioning devices may become quickly obsolete once software support is discontinued.

Networks and data
Connected devices serve as a gateway to online services and rely on telecommunication networks, core network and on data centres. The infrastructure is complex and mostly invisible to users. Its material and energy flows, and consequently environmental impacts, can be only roughly estimated. Depending on the user profile, environmental impacts of the infrastructures can be greater than those of a device itself. For example, streaming high-definition video content is energy intensive and requires reliable online storage.

Product life extension
A short lifespan of most electronics can be extended through design, responsible use, to reuse and repair. Products that are designed as modular, upgradeable, adaptable, and disassemblable are likely to reach longer lifespans. Yet, a common practice is to form and fixate an ecosystem over reparability and recyclability.
To keep existing devices in use for longer, consumers need to be better informed about their rights to repair and about the expected life span of products they buy.
Coupled with a longer warranty, refurbished used devices, products-as-a-service and third-party repairs are examples of consumer-friendly services effectively extending the lifespan of products.

Recycling
Increasing uptake of recycled raw materials minimises the need for primary raw materials. Generic metals are endlessly recyclable. However, the material complexity of electronic products is one of the reasons why recycling is challenging. With currently existing recycling technologies it is difficult, even impossible, to achieve a full recovery of all metals. The lack of information about material composition of used products hinders efficient recycling processes for that.
A recycling system requires a stable flow of end-of-life devices to be as efficient and economically viable. This, due to a high personnel and logistical value, and because of a small amount, some electronic products reach recycling with a significant delay.

With unpaper design decisions, the recyclability of the devices can be significantly improved.

Increasing uptake of recycled raw materials eliminates the need for primary raw materials.

Organisational layers, such as companies, public agencies, or municipalities, play an important role through their strong purchasing power.

Consumers need to be better informed about their rights to repair and about the expected life span of products they buy.

The life cycle of electronics is global and consists of several stages, all having their distinct impacts that need to be considered.

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Recycled laptops for high school students in Forssa

The City of Forssa, Finland has purchased second-hand laptops for high school students since 2017. Students have access to refurbished devices in excellent condition with a three-year warranty.

The procurement is made for three years at a time, the most recent one being from 2020. The procurement has resulted in annual savings of 100,000-200,000 euros bought for a unit price of 235 €. In 2020, 500 devices were acquired for the same unit price. The reference price for a new device was 425 €.

Net cost savings over 100,000 €

Estimated avoided emissions of 84 t CO₂

Estimated savings of primary raw materials of up to 180 t

Students gain hands-on experience on benefits of responsible consumption.

Product life extension achieved

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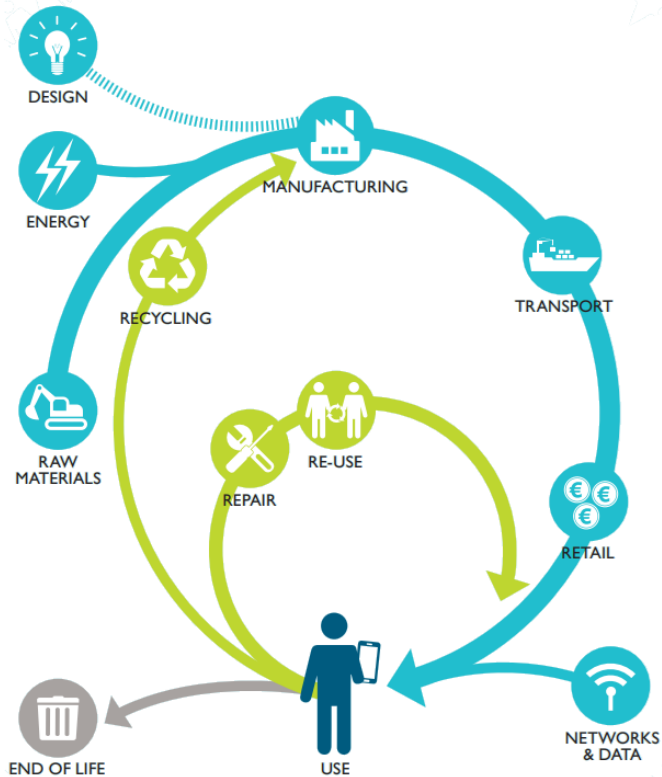
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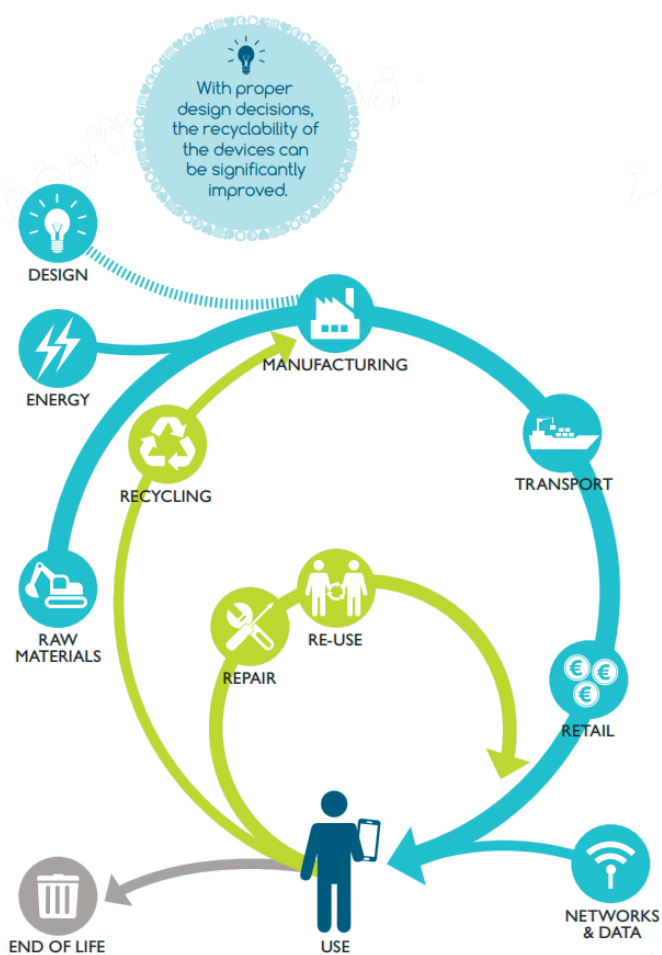
A life cycle of an electronic product



Product development and design



Environmental impacts are determined already during the design phase. Besides aesthetics, design defines functionality, technical specifications, selection of materials and components, in-use energy consumption, durability, reparability, and recyclability. Design determines the software support and updatability. Design decisions are driven by consumers' preferences, business strategy, value chain as well as by regulations and legislations.



Product development and design

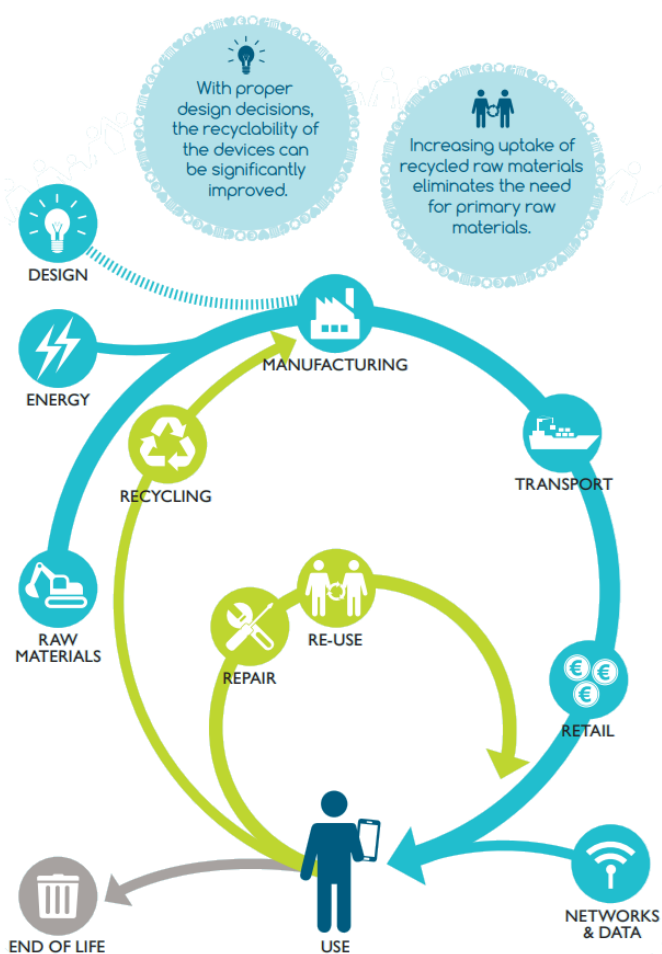


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Raw materials



Electronics contain a wide variety of materials, especially metals, some classified as rare earth metals or conflict minerals. Their mining is associated with social issues and environmental degradation. Geological deposits of some of the key primary raw materials in electronics are very local, causing supply security risks. The transparency of supply chains and due diligence need to improve to support informed decision making.

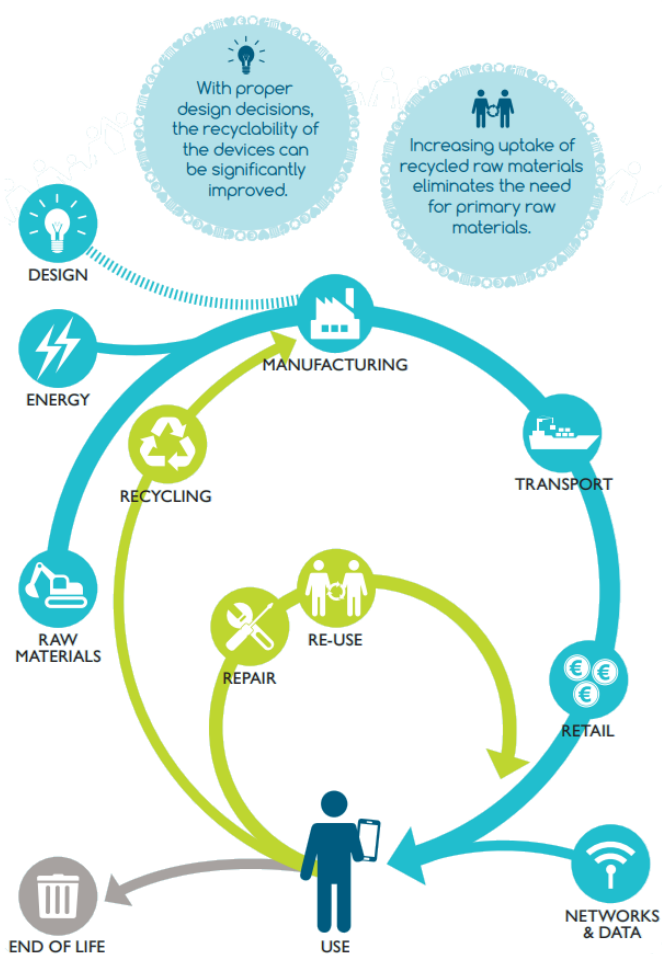


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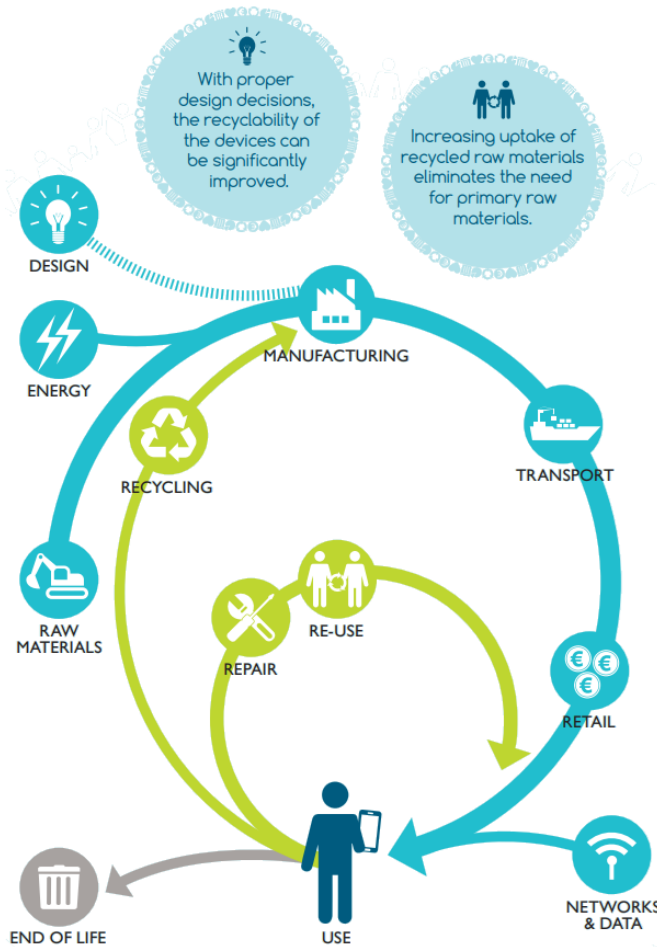
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Manufacturing

Knowledge about environmental impacts of manufacturing is limited. Rapid technological development and short product cycles make any assessment soon outdated. Unfavourable working conditions, insufficient environmental protection and a lack of transparency have risen concerns in countries where electronic products are made. Energy mix in manufacturing countries remains carbon intensive. That, together with increasing consumption, compensates for improvements in manufacturing efficiency.



Use phase



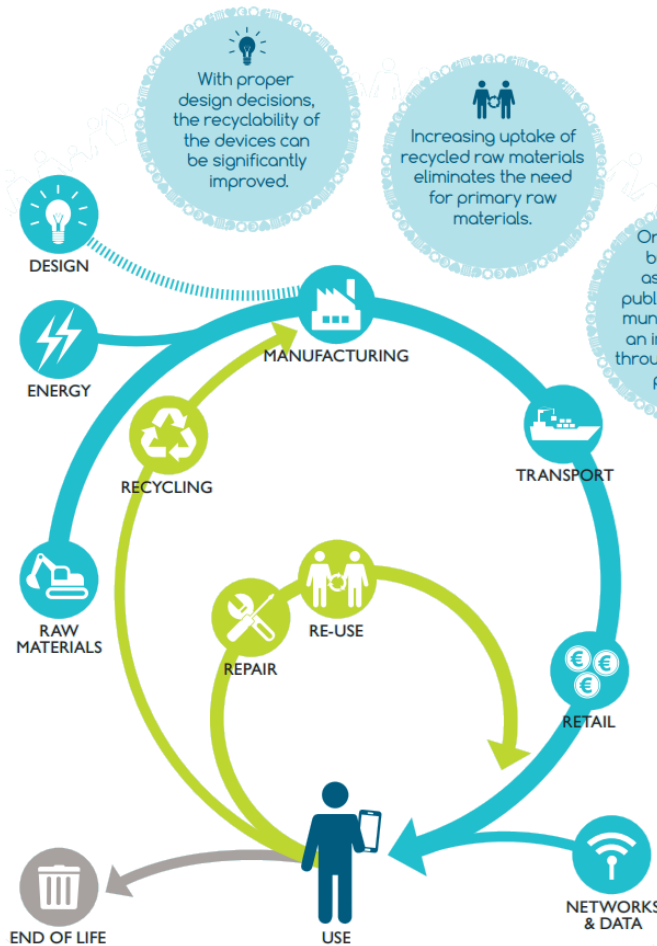
Electronic products are powerful and sophisticated devices that require electricity to operate. Growing screen sizes and computational power increases energy consumption of devices.

Despite their sophistication, the lifespan of electronic products is often short. Limited repairability and availability of spare parts are issues hindering longer lifespans, as is software obsolescence. Modern electronic products are often connected devices and generally are software dependent. Functioning devices may become quickly obsolete once software support is discontinued.

Networks and data



Connected devices serve as a gateway to online services and rely on telecommunication networks, core network and on data centres. The infrastructure is complex and mostly invisible to users. Its material and energy inputs, and consequently environmental impacts, can be only roughly estimated. Depending on the user profile, environmental impacts of the infrastructure can likely be greater than those of a device itself. For example, streaming high-definition video content is energy intensive and requires sizeable online storage.



Product life extension

A short lifespan of most electronics can be extended through design, responsible use, re-use and repair. Products that are designed as modular, upgradeable, updateable, and affordably repairable are likely to reach longer lifespans. Yet, a common practice is that form and function are prioritized over reparability and recyclability.

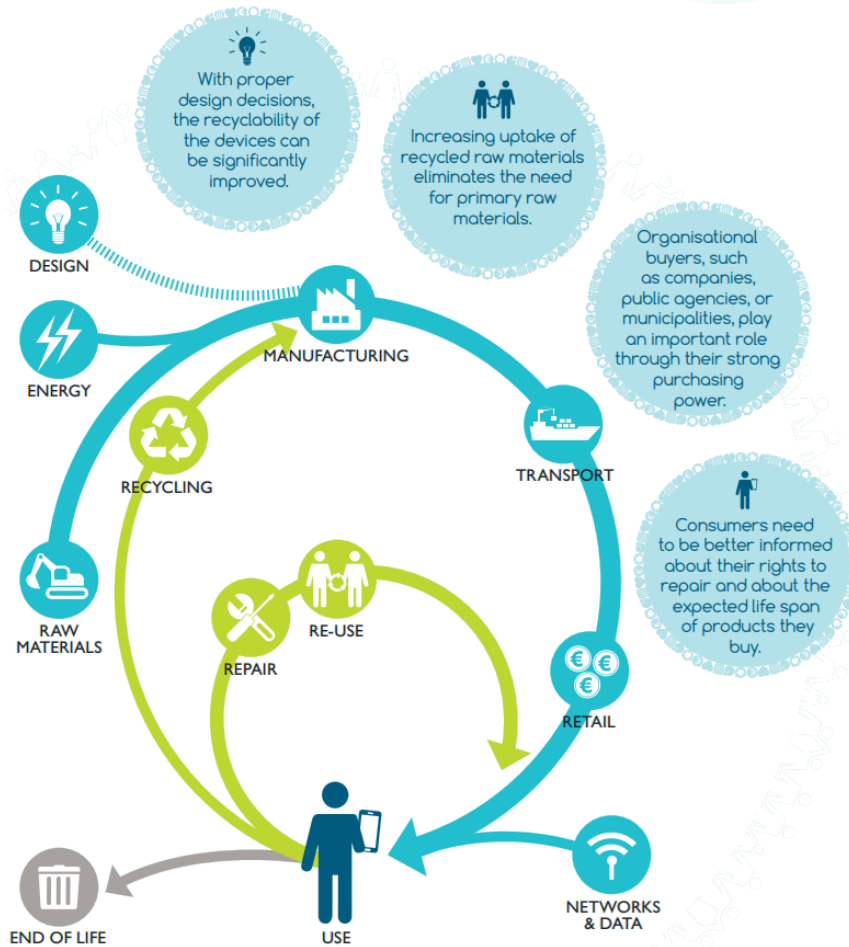
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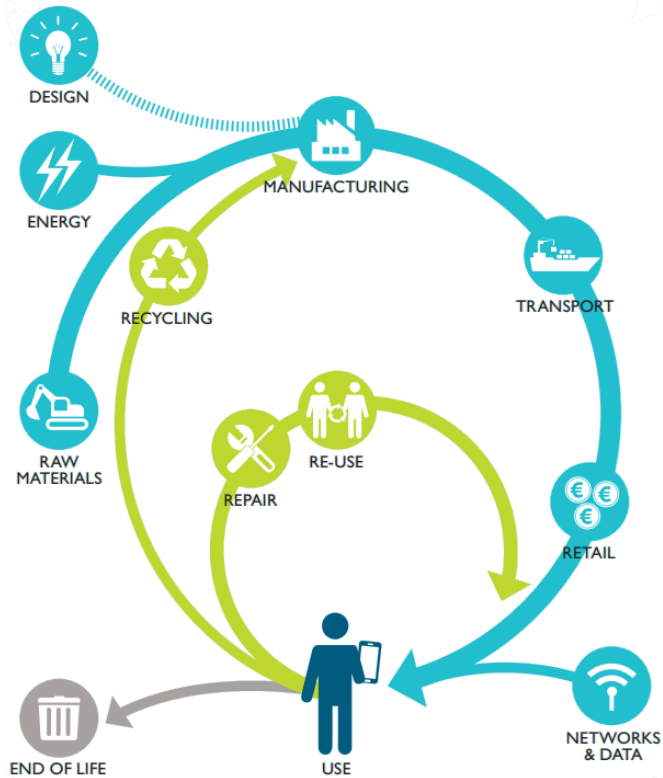
Coupled with a longer warranty, refurbished used devices, products-as-a-service and third-party repairs are examples of consumer-friendly services effectively extending the lifespan of products.

Recycling

Increasing uptake of recycled raw materials eliminates the need for primary raw materials. In general, metals are endlessly recyclable. However, the material complexity of electronic products is one of the reasons why recycling is challenging. With currently existing recycling technologies it is difficult, even impossible, to achieve a full recovery of all metals. The lack of information about material composition of used products hinders efficient recycling processes further.

A recycling system requires a stable flow of end-of-life devices to be efficient and economically feasible. Yet, due to a high perceived and emotional value, and because of a small size, some electronic products reach recycling with a significant delay.





Best practice example

750 refurbished laptops for high school students in Forssa

- Net savings of 130 000+ €
- Domestic employment in the repair industry
- Students' hands-on experience on responsible consumption and on a circular business model
- Estimated avoided emissions of 84 t CO₂ *
- Estimated savings of primary raw materials of up to 180 t *





Thank you!



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