Foxway

Report

Giving new life to old laptops:

Estimating the positive impact of Foxway using the handprint approach

January 2021

Key terms and definitions

Carbon footprint	The total amount of greenhouse gas emissions (expressed in carbon dioxide equivalents) that are generated by an individual, event, organization, service, or product.
Carbon handprint	Beneficial environmental impacts that organizations can achieve and communicate by providing products that help their customer avoid carbon emissions.
CO_2**-eq**	Carbon dioxide equivalent is used to compare the emissions from various greenhouse gases on the basis of their global warming potential by converting amounts of other gases to the equivalent amount of carbon dioxide with the same global warming potential.
EOL	End-of-life. In the context of product life-cycles, EOL is the final stage of a product's existence.
GHG	Greenhouse gas. The primary greenhouse gases in Earth's atmosphere are water vapor (H_2O), carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and ozone (O_3). Water vapor and ozone are not quantifiable with global warming potential (as they are short lived gases) and are not included in the carbon footprint calculations .
ICT	Information and communication technologies.
ISO	International Organization for Standardization is the world's largest developer of voluntary international standards and it facilitates world trade by providing common standards among nations.
LCA	Life-cycle assessment. A methodology to quantify and assess the inputs, outputs and potential environmental impacts of a product system throughout its life-cycle (ISO 14040; ISO 14067:2018).
WEE	Waste electrical and electronic equipment, i.e., e-waste.

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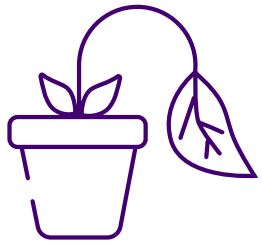
01. Background

Increasing amounts of e-waste coupled with low collection and recycling rates...

+ In 2019, approximately **53.6 million tons (Mt) of e-waste was generated globally** (which brings to an average of 7.3 kg per capita), fuelled by increasing consumption rates of electrical and electronic equipment, dropping price of ICT products, their short life cycles, and relatively few repair options. With an annual growth of almost 2 Mt since 2014, this waste stream is expected to exceed 74 Mt in 2030 (Forti et al., 2020).
+ At the same time, **only 17.4% of that waste was formally collected and recycled** – the fate of the rest is uncertain, but majority is probably mixed with other waste streams, like plastic and metal, and even if it is (partly) recycled, it is often done under inferior conditions.
+ Europe has the highest collection and recycling rate compared to other continents (42.5% in 2019), but nevertheless, **recycling activities are not keeping pace with the global growth of e-waste** (Forti et al., 2020).

WEEE is the fastest growing waste stream in the world. The amount of e-waste generated in 2019 equals the weight of almost 4,500 Eiffel towers.

...have led to negative environmental impacts, loss of valuable finite resources, and growing pressure on the planet



+ Repairing old devices, on the other hand, saves energy and finite resources that would otherwise be consumed in the manufacturing of new products, which carries considerable negative impacts on the environment.
+ Especially from a global warming point of view and **when talking about notebooks, it never makes sense to replace an old device with a new one**, because not only will the manufacturing of a new device require new resources, but newer laptop generations are generally more energy consuming than the previous ones as the market is moving towards products with higher processing capacity (EEB, 2019).

Foxway's recommerce business helps to alleviate this issue by extending the total service life of ICT products

Foxway's asset recovery services give laptops a longer life – they buy used or damaged laptops and WEEE (computer components), screen, sort, and test them, perform a regulation-compliant full data wipe, and repair as much as possible. In fact, most devices can be redeemed and are then sold through a network of resellers, thus being gifted a second lifetime.

This potentially brings significant environmental benefits. Indeed, the **extension of the service life of ICT products has been identified as the key strategy to minimize the total environmental impact of ICT products** (Prakash et al., 2012, Bakker et al., 2014).

According to a 2019 report by the European Environmental Bureau, a **1-year lifetime extension of all notebooks in the EU would save 1.6 Mt CO_2 per year by 2030**, the equivalent of taking 870 000 cars off the roads.

Fortunately, there's a market demand for sustainable products and services and at least European consumers are becoming more open to buying used electronics, especially as home offices and e-schooling have become more prominent (DW, 2020). According to the Transparency Market Research report (2019), the **refurbished computers and laptops market in Europe is anticipated to grow at a compound annual growth rate of ca 12% from 2019 to 2027**.

Foxway's ambition

The Foxway of doing things, sustainably

+ Foxway's ambition is to be the top company in Europe for sustainable IT services and recycling, leading the way with **circular solutions** that go beyond the industry's traditional linear consumption models.
+ Extending ICT products' service life undoubtedly brings environmental benefits, but Foxway hasn't so far quantified their exact impact. However, in order to build a stronger foundation for their sustainability efforts (as well as for doing corresponding communication), calculating their positive impact on the environment is a necessary step.
+ In line with the above, the current study was set out to quantify the positive impact of refurbishing laptops.
+ Foxway's longer term goal is to cover all product lines that go through refurbishment processes (smartphones, tablets, etc) in a similar fashion so the company's asset recovery services total positive impact can be quantified on a yearly or quarterly basis.

Purpose of this study

Is to estimate the climate impact and advantage (compared to buying a new device) of a typical* Foxway's refurbished laptop

+ For this reason, a **partial life cycle assessment** (LCA) was conducted to quantify the GHG avoidance of refurbishing laptops, following the **Carbon Handprint methodology** (see next page for more details.

** By typical we mean an average refurbishment scenario for a Foxway laptop. For this, the climate impact of all the different refurbishment scenarios was evaluated and an average scenario was then calculated by using weighted average mean. Please see Appendix B for more details.*

Estimating Foxway's positive impact using the Carbon Handprint methodology

+ In contrast to *carbon footprint*, which refers to the *negative* environmental impact throughout the life cycle of a product, the term *handprint* refers to the *positive* environmental impact of a product throughout its life cycle.
+ The purpose of carbon handprint assessment is to calculate the beneficial greenhouse gas impacts of a product compared to an alternative solution (i.e., the baseline solution).
+ This fits well with Foxway's goal of being an ESG enabler since Foxway's asset recovery services help Foxway's clients improve their sustainability performance by avoiding unnecessary carbon emissions. Therefore, the handprint methodology allows Foxway to clearly communicate the climate benefits of their products and services.

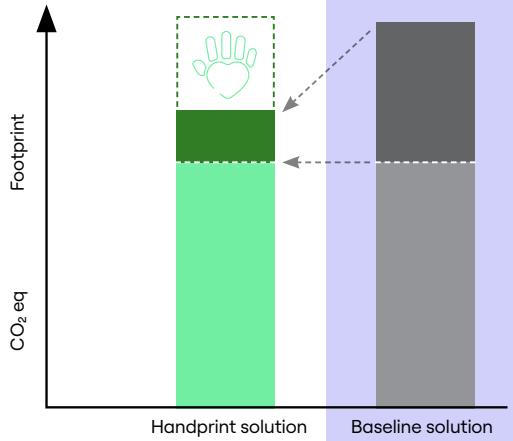


Figure 1. Example: handprint solution has a lower total CO_2-eq footprint compared to baseline solution.

Source: Pajula et al., 2018. Carbon Handprint Guide.

Handprint calculation itself is a simple equation that is based on carbon footprint calculations following **ISO 14040-44** and **ISO 14067** standards, which specify principles, requirements and guidelines for life cycle assessments (see next page for more details).

$$\text{Carbon handprint}_{\text{product}} = \text{Carbon footprint}_{\text{Baseline solution}} - \text{Carbon footprint}_{\text{Handprint solution}}$$

Where:
Baseline solution = production of a new laptop and its transport to customer
Handprint solution = refurbishing an old laptop and its transport to customer (aka the „Foxway solution")

Foxway's Handprint is based on a partial life-cycle assessment

+ Life-cycle assessment is a quantitative analysis of the environmental aspects of a product over its entire life cycle, from raw material extraction (cradle) to end-of-life (grave). Accordingly, a full life-cycle assessment is called cradle-to-grave.
+ For estimating Foxway's positive handprint, a **partial life-cycle assessment** was conducted to determine the climate impact of refurbished laptops. Specifically, processes **from raw material extraction until (and including) distribution to customers** were considered, leaving out the climate impact of the use phase and end-of-life stage.
+ This is in line with the ISO standards* for life-cycle assessment, which allow excluding phases that are considered to be equivalent when comparing the life-cycle impact of two (or more) alternative solutions. In other words, since the use phase and disposal/recycling for baseline solution and Foxway solution can be assumed to have equal climate impact, including them in the calculation would not influence the final outcome of the handprint calculation.

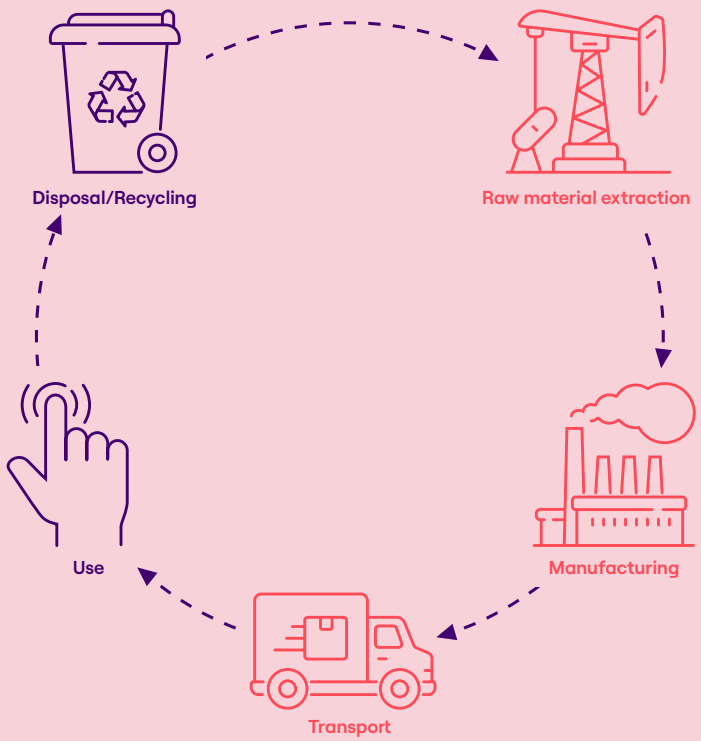


Figure 2. Product's life-cycle. Phases included in the calculations of the current study are depicted in red.

** ISO 14044 and ISO 14067. The former specifies requirements and provides guidelines for life cycle assessment, whereas ISO 14067 specifies principles, requirements and guidelines for the quantification and reporting of the carbon footprint of a product in a manner consistent with ISO 14044.*

02. Methodology

Identification of the operating environment

Carbon handprint is always quantified for a specific situation and a specific type of user. Without a user applying the examined product, no handprint can be created.

Identifying customers of the refurbished laptop

The purpose of carbon handprint assessment is to calculate the avoidance of greenhouse gas impacts of a product when used by a (potential) customer.

+ The buyers of a refurbished laptop are environmentally aware consumers or companies that value sustainability and are concerned about the environmental impact of their purchasing decisions. When buying laptops, they are interested in the performance of the device, not so much in necessarily aquiring the latest model.

Identifying potential carbon handprint contributors

Contrary to carbon footprint, which represents the absolute sum of GHG emissions and removals in a product system, carbon handprint refers to a change that will result in a beneficial climate impact.

+ Carbon emissions reduction in this study comes from the decrease in energy and resource demand which would have been needed to manufacture and transport a new laptop.

Defining the baseline

Baseline is an alternative solution to buying a refurbished laptop. Defining the baseline is necessary to compare the handprint solution to business as usual, i.e. “common” practice.

+ Current baseline description: customer buys a brand-new laptop.

LCA technical details

Functional Unit

A functional unit provides a reference to which greenhouse gas emissions are related. The functional unit is the same both for the baseline solution and the handprint solution to ensure comparability of the two scenarios.

+ **The functional unit for this study is: one laptop with expected use phase of 3 years.**

System boundaries

System boundary defines the processes included in the life-cycle assessment. Not all stages of the life-cycle need to be assessed and some stages/processes can be excluded if they do not change the overall conclusions of the study.

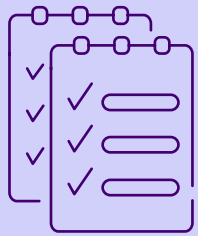
+ **A partial LCA was done for this study (see Figure 3 on the next page) – life stages starting from (re)manufacturing and ending with transport to the customer. Considering the assumed functional equivalence of laptops in both scenarios, the use phase, transport to EOL and EOL processing are considered identical in both solutions and thus can be left out of the equation as they do not affect the comparison.**

Data needs and sources

+ Data to calculate carbon footprint of the handprint solution was gathered **from Foxway** (such as energy and heat use, laptops' and repair parts' import and export information, handled devices and parts amounts). In addition, some information was obtained from different **web-based databases** (such as distance values, Estonian electricity mix). Impact assessment data was obtained from the **Ecoinvent v3.7.1 database, various electronics companies' products' environmental reports and declarations and from relevant scientific literature**.

+ Secondary data for the baseline solution was gathered from **various product environmental reports and declarations published online**.

More exact overview of the data can be found in the Appendices.



The selection of the functional unit and system boundary must be consistent with the goal of the study and equal in baseline and handprint solutions.

System boundaries of the life-cycle assessment

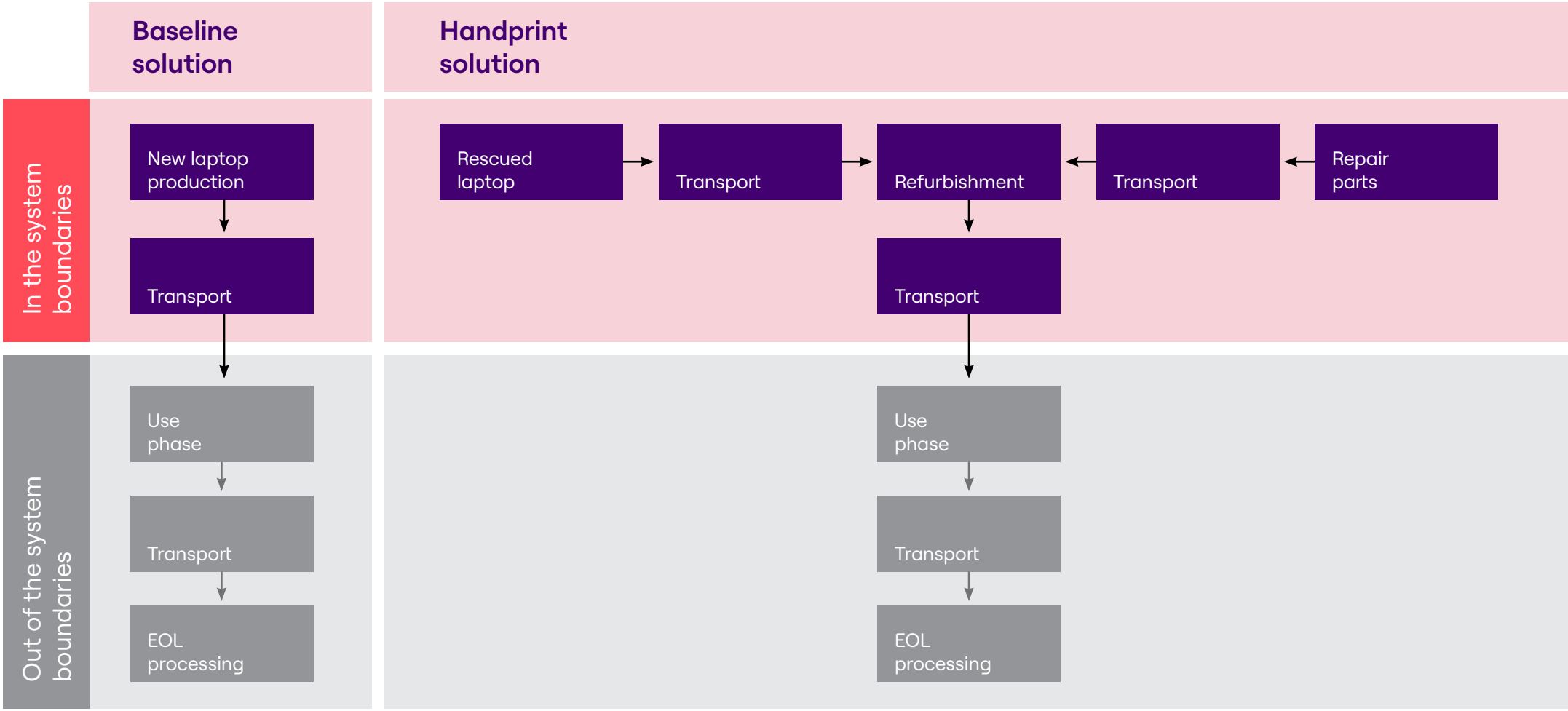
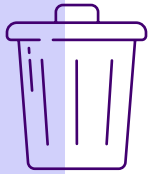


Figure 3. Life-cycle system boundary

Important presumptions behind the calculation

The rescued laptop is considered waste, because:



+ **Nearly all laptops that Foxway handles are at least 4 years old** (86% are 4 years or older; average laptop is 7 years old), but since 4,5 years is considered the average lifetime of a laptop (based on several scientific articles and reports*), the assumption has been made to regard the rescued laptops as saved from disposal.
+ Furthermore, it has been reported and shown that the lifetime of laptops is becoming shorter (Bakker and Schuit, 2017; Prakash et al., 2020). During the refurbishment, the laptop's performance is enhanced to extend its lifespan. Without the refurbishment, the laptop would most probably be disposed after first use, as consumers generally assume products, especially electronics, will only last for short periods (Wieser et al., 2015). This supports the presumption that if Foxway would not collect the used laptops, they would reach EOL.

The refurbished laptop is assumed to be functionally approximately equivalent to a new laptop and is assumed to be used for another 3 years.

+ Refurbished laptop is assumed to be functionally equivalent to a new laptop. Products are functionally equivalent or approximately equivalent if they share a set of obligatory properties including the main function (Andre et al, 2018).
+ It is assumed that both laptops can be used for the same purpose (e.g., either for working, studying, or entertainment) and for the same time period as their technical specifications are presumed to cover a similar performance.

The use and EOL phases of the baseline and handprint solutions are considered to be equivalent, because:

+ Considering the assumed functional equivalence of laptops, the use phases and disposal are identical in both alternatives and do not affect the comparison, therefore eliminating the need to be assessed during this study. To highlight the differences between the alternatives, the results are presented without the contribution of the use phase.
+ Real-life climate impacts of the use phase, transport to EOL and disposal are consumer specific and depend on several factors (for instance, the source of electricity used when the device is charged), and these can be considered the same across both the baseline and handprint scenarios.

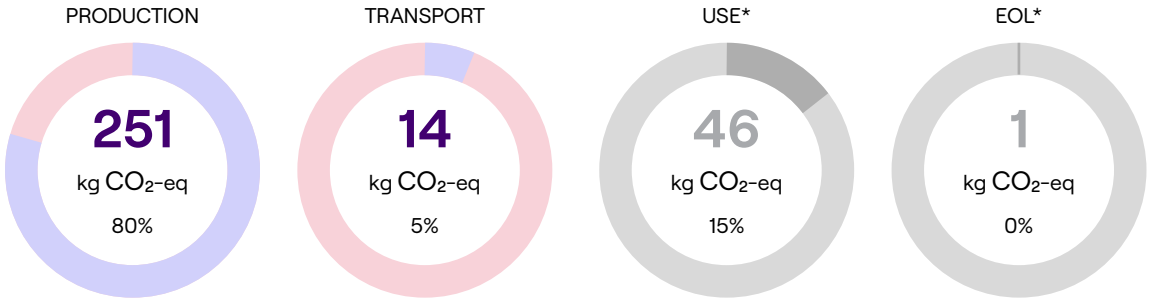
** Bakker et al, 2017; EC, 2017; EEB, 2019; Hennies et al, 2016; Prakash et al, 2020; Thiebaud et al, 2016; Wieser et al, 2015.*

03. Results

Baseline solution's climate impact:

Production of a new laptop and transport to consumer causes ...

+ Carbon footprint (kg CO_2-eq) of the baseline solution is based on 51 laptop models released in 2020. This included laptops from companies such as Apple, Dell, Lenovo and Fujitsu. Data was obtained from respective laptop environmental reports.
+ **An average carbon footprint of a new laptop (released in 2020) was 312 kg CO_2-eq**. The main source of greenhouse gases is the laptop production, as around 80% of the impact derives from this stage. The use phase constitutes on an average 15%, transport to user 5% and EoL 0,3%.
+ Since use phase and EOL are not included in the system boundaries, **baseline carbon footprint equals: 251 kg CO_2-eq + 14 kg CO_2-eq = 265 kg CO_2-eq**



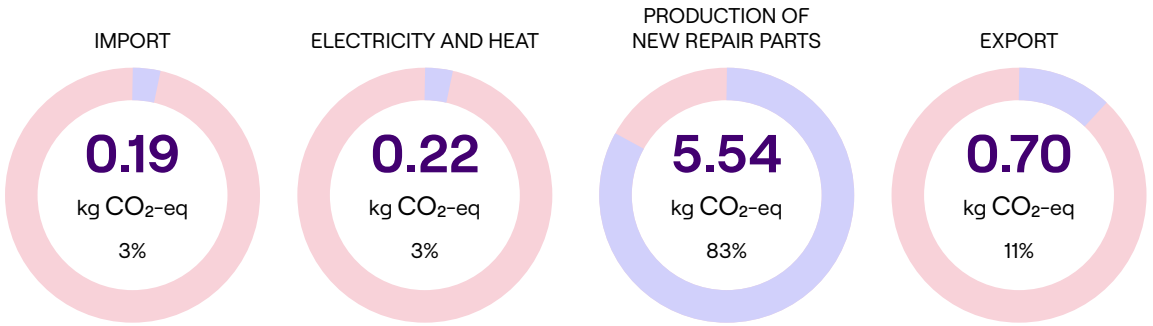
** Use and EOL are out of the system boundaries of this study*

... 265 kg CO_2-eq emissions

Handprint solution's climate impact:

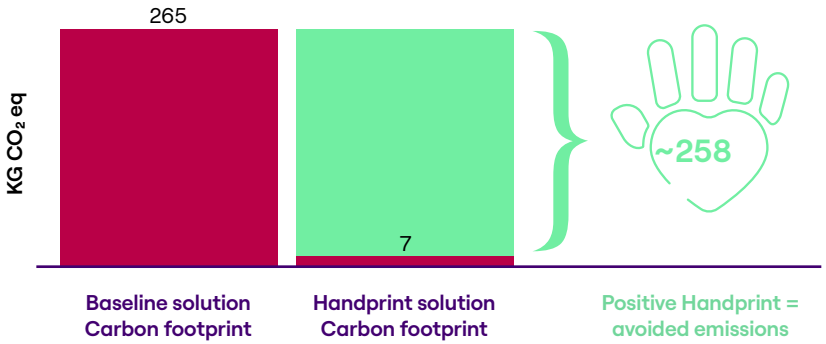
Refurbishment & transport of a Foxway laptop to the customer causes ...

+ A rescued laptop's **transport to Foxway** (import) emits on average roughly **0.19 kg CO_2-eq, energy input to refurbishment processes (electricity and heat use in the factory) 0.22 kg CO_2-eq, repair parts production and transport to Foxway 5.54 kg CO_2-eq and refurbished laptop's transport to customer (export) 0.70 kg CO_2-eq.**
+ All these add up to a total climate impact of **6.65 kg CO_2-eq**.
+ Considering that the rescued laptop is handled as waste, it carries no production legacy. Thus, the main source of emissions for the handprint solutions derives from the production of brand new parts which are used to refurbish the used laptop.



... 6.65 kg CO_2-eq emissions

The Carbon Handprint of one refurbished laptop is 258 kg CO_2-eq



In other words, by buying a refurbished laptop from Foxway instead of purchasing a brand new laptop, a customer will avoid ~258 kg CO_2-eq worth of emissions.

$$\text{Carbon handprint}_{\text{product}} = \text{Carbon footprint}_{\text{Baseline solution}} - \text{Carbon footprint}_{\text{Handprint solution}}$$

$$265 \text{ kg } CO_2\text{-eq} - 6.65 \text{ kg } CO_2\text{-eq} = 258.4 \text{ kg } CO_2\text{-eq}$$

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