Foxway

Report

Giving new life to old smartphones:

Estimating the positive impact of Foxway using the handprint approach

April 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).
WEEE	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. **A disproportionate negative impact to the environment actually comes from smartphones**, as they have a relatively short average useful lifespan of only 2 years. And as the main contributor to the footprint comes from the production phase (85-95%), this constant demand for new devices made **smartphones responsible for 11% of the total ICT impact in 2020** (to compare, notebooks contributed 6% in 2020). (Belkhir et al., 2018)
+ It is argued, that energy efficiency improvements in new products justify replacing old products due to lower energy demand. However, a 2018 report by the European Environmental Bureau showed that a smartphone should be used for a minimum of 25 years in order to compensate for the GHGs linked to their non-use phases.

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

Foxway's asset recovery services give mobile phones a longer life – they buy used or damaged phones; screen, sort, and test them; perform a regulation-compliant full data wipe; and repair as much as possible. Redeemed devices 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 smartphones in the EU would save 2.1 Mt CO2 per year by 2030**, the equivalent of taking over a million 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. International Data Corporation forecasts **worldwide market for used smartphones to grow with a compound annual growth rate of 11.2% from 2019 to 2024** (IDC, 2020).

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 refurbished mobile phones.
+ Foxway's goal is to cover the main product lines that go through refurbishment processes in a similar fashion so the company's asset recovery services total positive impact can be quantified on a yearly or quarterly basis. An assessment of the positive impact of refurbishing phones has been completed.

Purpose of this study

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

+ For this reason, a cradle-to-gate (incl. emissions until the point of sale) **life-cycle assessment** (LCA) was conducted to quantify the GHG avoidance of refurbishing phones, following the **Carbon Handprint methodology** (see next page for more details).

** By typical we mean an average refurbishment scenario for a Foxway phone. 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.*

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 method-ology allows Foxway to clearly communicate the climate benefits of their products and services.

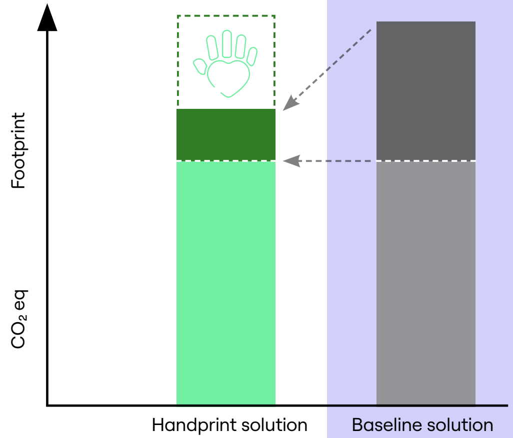


Figure 1. Example: handprint solution has a lower total CO_2-eq footprint compared to baseline solution.

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 phone and its transport to customer
Handprint solution = refurbishing an old phone 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, whereas cradle-to-gate is an assessment of a partial product life cycle until the factory gate (i.e., before it is transported to the consumer).
+ For estimating Foxway's positive handprint, a slightly more comprehensive **cradle-to-gate* life-cycle assessment** was conducted to determine the climate impact of refurbished phones. 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.

** Includes emissions until the point of sale, i.e., including transportation from the factory to the customer.*
*** 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.*

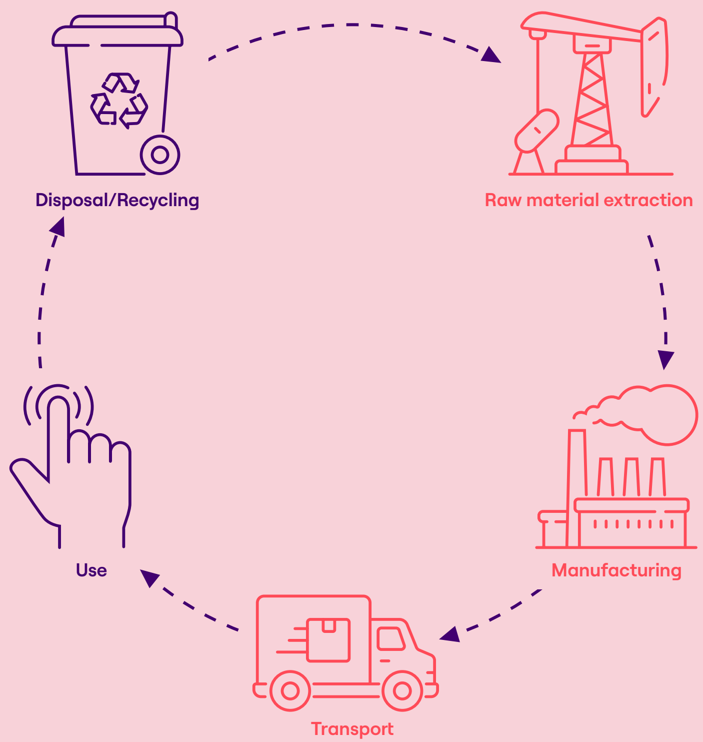


Figure 2. Product's life-cycle. Phases included in the calculations of the current study are depicted in red.

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 smartphone

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 phone are environmentally aware consumers or companies that value sustainability and are concerned about the environmental impact of their purchasing decisions. When buying smartphones, they are interested in the performance of the device and 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 phone.

Defining the baseline

Baseline is an alternative solution to buying a refurbished phone. 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 smartphone.

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 smartphone with expected use phase of 2 years.

The use phase of 2 years has been defined to express the functional equivalence of the refurbished phone's performance to a new phone.

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 cradle-to-gate (incl. emissions until the point of sale) 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 phones 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, phones' 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.

No allocation was used in either of the solutions. 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

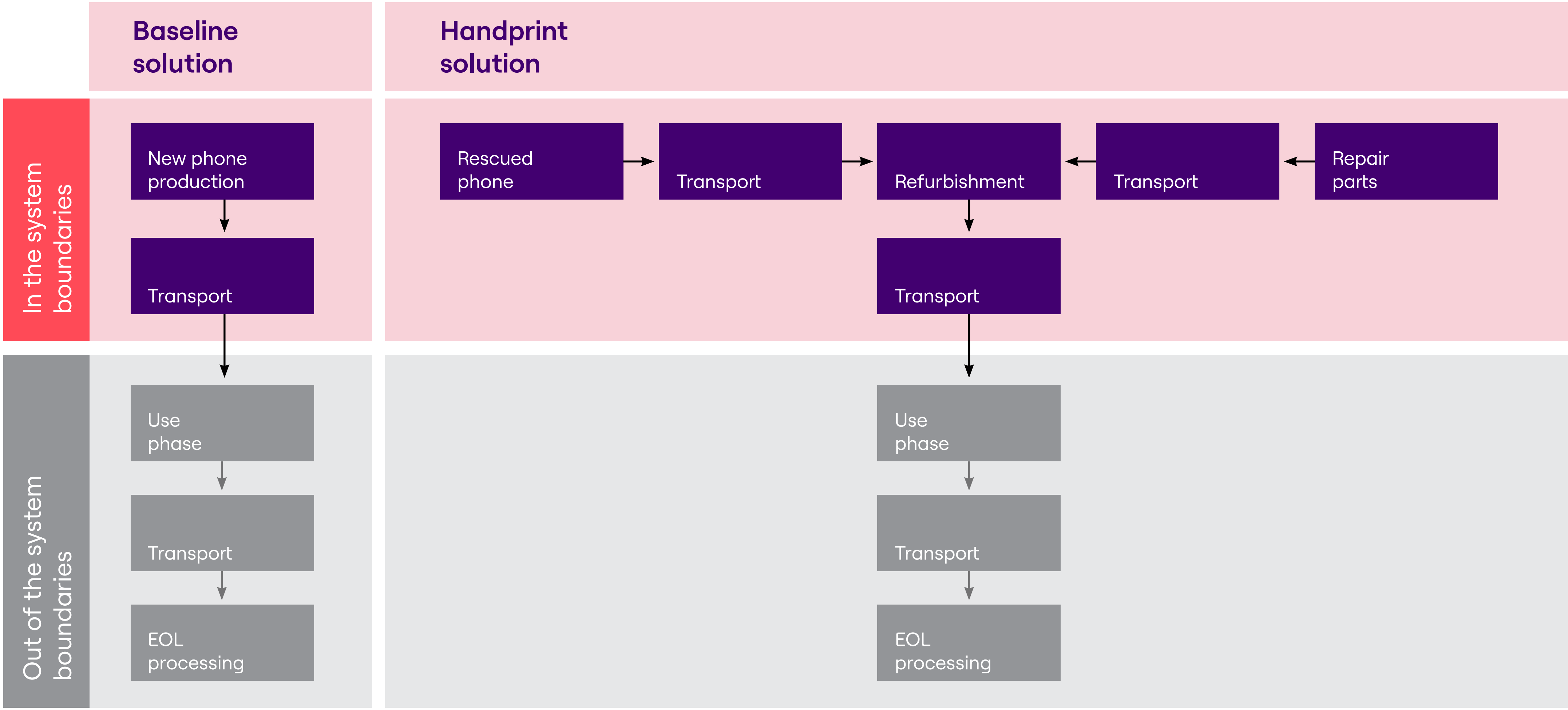


Figure 3. Life-cycle system boundary

Important presumptions behind the calculation

The rescued phone is considered waste, because:

- Nearly all phones that Foxway handles are at least 2 years old (84% are 2 years or older), and since 2 years is considered an average useful lifetime of a smartphone (based on several scientific articles and reports*), the assumption has been made to regard the used phones as saved from disposal.
- During the refurbishment, the phone's performance is enhanced to extend its lifespan. Without the refurbishment, the phone 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 phones, they would reach EOL.

The refurbished phone is assumed to be functionally approximately equivalent to a new smartphone and is assumed to be used for another 2 years.

- Refurbished phone is assumed to be functionally equivalent to a new smartphone. 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 phones can be used for the same purpose 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 smartphones, 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.

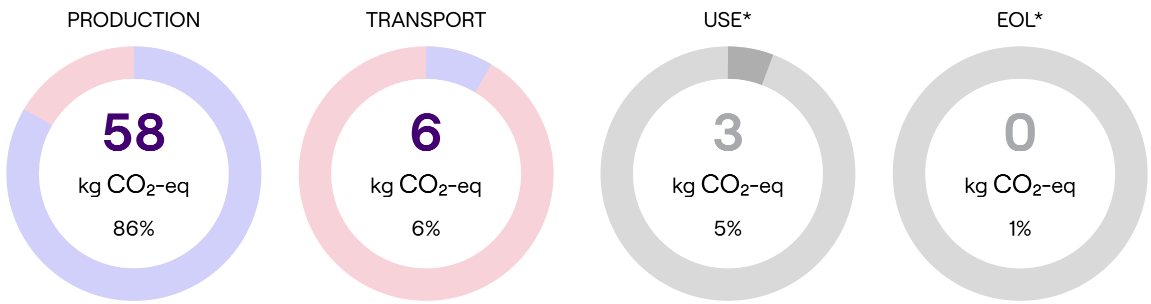
** Bakker et al, 2017; Belkhir et al, 2018; Cordella et al, 2021; EP, 2016; Manhart et al, 2012; Nokia, 2005; Tröger et al, 2017*

03. Results

Baseline solution's climate impact:

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

+ Carbon footprint (kg CO_2-eq) of the baseline solution is based on 11 smartphone models released in 2020 and 2 models released in 2019. Data was obtained from respective environmental reports.
+ **An average carbon footprint of a new smartphone is 67 kg CO_2-eq**. The main source of greenhouse gases is the phone production, as around 86% of the impact derives from this stage. The use phase constitutes on an average 8%, transport to user 5% and EoL 1%.
+ Since use phase and EOL are not included in the system boundaries, **baseline carbon footprint equals: 58 kg CO_2-eq + 6 kg CO_2-eq = 64 kg CO_2-eq**



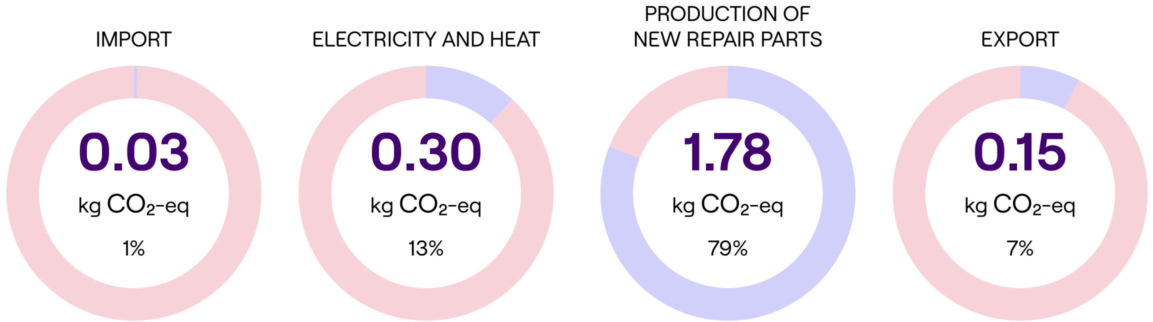
** Use and EOL are out of the system boundaries of this study*

... 64 kg CO_2-eq emissions

Handprint solution's climate impact:

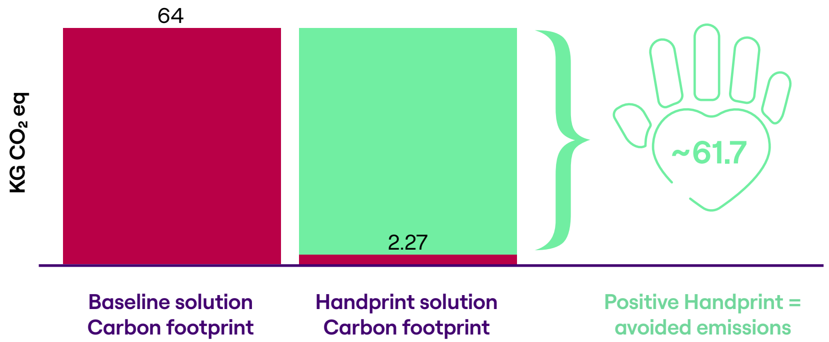
Refurbishment & transport of a Foxway phone to the customer causes ...

- A smartphone's transport to Foxway (import) emits on average roughly **0.03 kg CO_2-eq**, energy input to refurbishment processes (electricity and heat use in the factory) **0.30 kg CO_2-eq**, spare parts production and transport to Foxway **1.78 kg CO_2-eq** and refurbished phone's transport to customer (export) emits **0.15 kg CO_2-eq**.
- All these add up to a total climate impact of **2.27 kg CO_2-eq**.
- Considering that the used phone is handled as waste, it carries no production legacy. Thus, the main source of emissions for the handprint solutions derives from the production of new parts which are used to refurbish the mobile phone.
- Import value is lower than export value, because mainly economy delivery is used for import (99%), whereas express delivery is used 33% of the times for exporting phones.



... 2.27 kg CO_2-eq emissions

The Carbon Handprint of one refurbished phone is 61.7 kg CO_2-eq



In other words, by buying a refurbished phone from Foxway instead of purchasing a brand new phone, a customer will avoid ca 62 kg CO_2-eq worth of emissions.

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

64 kg CO_2-eq - 2.27 kg CO_2-eq = 61.7 kg CO_2-eq

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